ETHOS URBAN

Response to Submissions Report

Sancrox Quarry Expansion (SSD 7293)
Sancrox Road, Sancrox

Submitted to Department of Planning, Industry & Environment
On behalf of Hanson Construction Materials Pty Ltd

20 May 2021 | 2190085

CONTACT

Tim Ward	Director	tward@ethosurban.com	0450 133 453

Reproduction of this document or any part thereof is not permitted without prior written permission of Ethos Urban Pty Ltd.

This document has been prepared by:		This document has been reviewed by:	
Kimberley Bautista	20/5/2021	Tim Ward	20/5/2021

Reproduction of this document or any part thereof is not permitted without written permission of Ethos Urban Pty Ltd. Ethos Urban operates under a Quality Management System. This report has been prepared and reviewed in accordance with that system. If the report is not signed, it is a preliminary draft.

VERSION NO.	DATE OF ISSUE	REVISION BY	APPROVED BY
1	23/3/2021	KB	TW
2	20/5/2021	KB	TW

Ethos Urban Pty Ltd
ABN 13 615 087 931.
www.ethosurban.com
173 Sussex Street, Sydney
NSW 2000 t 61 2 9956 6952

Executive Summary		4
Purpose of this Report		4
Overview of the Originally Exhibited Project		4
Overview of Submissions		4
Proposed Amendments to the Proposal		5
Additional Environmental Assessment		5
Conclusion and Justification		5
1.0	Introduction	6
1.1	Purpose of the Report	6
1.2	Background to the Project	6
1.3	Overview of the Original Proposal	6
1.4	Amendments to the proposal	7
1.5	Site Location and Context	7
1.6	The site and land ownership	8
1.7	Existing Quarry Activities at the Site	9
1.8	Surrounding development and land uses	10
1.9	Objectives of the Project	13
1.10	Structure of this Report	13
2.0	Exhibition and Consultation	14
2.1	Activities prior to EIS exhibition	14
2.2	Public Exhibition	14
2.3	Post Public exhibition	14
3.0	Overview of Submissions	18
3.1	Government agency submissions	18
3.2	Public submissions	18
4.0	Response to Government agency submissions	19
5.0	Response to public submissions	33
5.1	Heritage	33
5.2	Traffic and transport	33
5.3	Hours of Operation	34
5.4	Biodiversity	34
5.5	Vibration – operational and blasting	37
5.6	Noise	37
5.7	Water Management	38
5.8	Air quality	39
5.9	Socio-economic impacts	40
5.10	Other issues	40
6.0	Further Environmental Assessment	42
6.1	Surrounding Residential Areas	42
6.2	Acoustic and vibration Impact	43
6.3	Biodiversity	45
6.4	Water management	47
6.5	Air quality	48
7.0	Revised Mitigation Measures	48
8.0	Conclusion	63

Figures

Figure 1 Locality map 8
Figure 2 The site 8
Figure 3 The site in context of the Fernbank Sancrox Investigation Area 11
Figure 4 The site in context of the Urban Growth Area 12
Figure 5 Future Urban Investigation Areas 43

Tables

Table 1 Current Approved Activities and Hours of Operation 9
Table 2 Response to Agency Submission Issues 19
Table 3 Sancrox Quarry Expansion Mitigation Measures 49

Appendices

A Revised Quarry Extraction Plans
RW Corkery

B Soils, Heritage and Traffic Response
Environmental Resources Management Pty Ltd

C Groundwater Model Peer Review Report
Ren Consulting

D Koala Survey and Report
SLR

E Revised Noise and Vibration Impact Assessment
Environmental Resources Management Pty Ltd

F Revised Air Quality Assessment Report
Environmental Resources Management Pty Ltd

G Supplementary Surface and Groundwater Response
ERM

H Revised Biodiversity Assessment Report
SLR

I Final Landform and Rehabilitation Plan
RW Corkery

J Summary of Public Submissions
Ethos Urban

Executive Summary

Purpose of this Report

This Response to Submissions Report (RTS) is submitted to the Department of Planning, Industry and Environment (DPIE) as part of a State Significant Development Application under Part 4 of the *Environmental Planning and Assessment Act 1979* (EP&A Act). It relates to a proposal for the extension of the existing Sancrox Quarry, which is being assessed as State Significant Development SSD7293.

The proposed Sancrox Quarry extension is identified as a State Significant Development as it is a type of Extractive Industry identified in Clause 7 of Schedule 1 of *State Environmental Planning Policy (State and Regional Development) 2011*.

The Environmental Impact Statement (EIS) for the proposal was publicly exhibited between 3 October 2019 until 11 December 2019, during which time submissions were received from members of the public and government agencies. This RTS provides a response to the issues raised in submissions, either through providing additional assessment or information, or in some cases via an amendment of the proposal.

Overview of the Originally Exhibited Project

The Sancrox Quarry proposal as originally described in the exhibited EIS is to extend the life of the quarry through expanding and increasing the annual extraction limit of hard rock. The hard rock reserve to be quarried is a mixture of various igneous and sedimentary rock formations. The proponent, Hanson Construction Materials Pty Ltd (Hanson), has identified rock formations suited to local and regional construction markets and therefore the project will contribute to satisfying an identified demand for aggregates as a construction material.

The Sancrox Quarry is to facilitate the extraction and distribution of high-quality construction materials for the use primarily in civil infrastructure construction and road projects. The key development parameters of the development proposal for which approval were sought as described in the EIS include:

- Extraction and on-site processing of up to 750,000 tonnes per annum of rock (tpa);
- Construction and operation of a concrete batching plant with an output of 20,000 tpa,
- Construction and operation of a concrete recycling facility to process 20,000 tpa; and
- Construction and operation of an asphalt production plant with an output of 50,000 tpa.
- Employment of up to 25 staff on a full-time basis
- Hours of operation:
  - Quarry operations (including production and maintenance) 24 hours a day, 7 days a week
  - Truck movements and equipment loading 24 hours a day, 7 days a week
  - Blasting operations from 8am – 5pm Monday to Friday.

Overview of Submissions

The EIS was exhibited from Thursday 31 October to 27 November 2019, with a total of 272 submissions. Submissions were received from the following government agencies:

- Heritage Council
- Department of Industry and Environment – Division of Resources and Geoscience
- Environment Protection Authority
- Port Macquarie-Hastings Council
- Department of Planning, Industry and Environment – Diversion of Biodiversity and conservation

A total of 264 submissions were received from individuals, landowners and special interest groups. 259 of these submissions have been classified as objections to the proposal. The main issues identified within these submissions included:

- Traffic and Transport;
- Hours of operation;
- Biodiversity;
- Vibration;
- Water management;
- Air quality; and
- Socio-economic impacts.

Proposed Amendments to the Proposal

As part of the review and response to submissions process, Hanson has reviewed the design and layout of the proposed future quarry. This has resulted in a change to the design and delivery of quarry works over the life of the quarry, as follows:

- Reduction of annual production limit from 750,000tpa to 530,000tpa.
- Whilst the proposed pit expansion is required to be located adjacent and contiguous with the existing pit and associated infrastructure (which are located on the eastern side of the site), the western boundary of the quarry has been rationalised (i.e. straightened) and pulled to the east, reducing the extent of the quarry pit in the south-western section. The pit is still proposed to be excavated to a depth of -40m AHD as previously proposed.
- A total development footprint of 57.55 ha, comprising the proposed pit expansion area and the proposed infrastructure and processing area, requiring the clearing of 39.02 hectares of native vegetation.
- The proposed hours of operation will change to being 5am until 10pm. Hanson will prioritise morning and normal daytime hours operations, with evening hours (i.e. 6pm – 10pm) to be added in response to market demand as required. In addition, Hanson is seeking consent to operate 10pm to 5am 20 nights per year to meet the occasional customer demand (which is generally associated with major infrastructure projects that require construction works to be carried out during the night time).
- Installation of an earth bund on the southern property boundary, approximately 20 metres high and 450 metres long, to provide noise and visual screening.
- The proposed staging will change to being undertaken through four stages.

Additional Environmental Assessment

The amendments made to the quarry layout and design have been the subject of revised impact assessments, which have also responded to issues raised in submissions. The amendments result in a significant reduction in the environmental impact of the proposed development.

Conclusion and Justification

The Proposal, identified as a State Significant Development, has been subject to an EIS and, subsequently to this RTS. The potential environmental, social and economic impacts, both direct and cumulative, have been identified and thoroughly assessed as part of the EIS, and re-assessed where relevant as part of this RTS. No significant adverse environmental, social or economic impacts have been identified by the proposal in preparing the EIS, and potential impacts have been reduced through the amended proposal as described in the RTS.

Any potential environmental and cultural impacts identified during the public exhibition of the EIS have been addressed by design refinements as set out in this RTS. Any residual impacts will be mitigated through the implementation of measures for the construction and operation of the proposal.

The potential impacts of the development are acceptable and are able to be managed as outlined within the safeguard and mitigation measures contained within the EIS and its appended technical reports, and this RTS.

1.0 Introduction

A State Significant Development Application (SSDA) and accompanying Environmental Impact Statement (EIS) was lodged October 2019 and was publicly exhibited for a period of 42 days inclusive between Thursday 31 October and 11 December 2019 in accordance with Section 83 of the *Environmental Planning and Assessment Regulation 2000*. Hanson Construction Materials Pty Ltd (the applicant) is seeking approval for an increase of the annual extraction limit and expansion to the existing boundary of the currently operating hard rock quarry, known as Sancrox Quarry, on Sancrox Road, Sancrox. The proposed development includes the development of a concrete batching plant, recycling facility and asphalt production plant. The proposal is being assessed as State Significant Development SSD7293.

A Secretary's Environmental Assessment Requirement (SEARs) were originally on 19 October 2015 and the SEARs were reissued on 18 September 2017. The exhibited EIS was prepared in accordance with the reissued SEARS and with the Department's guidelines for SSD applications lodged under Part 4 of the *Environmental Planning and Assessment Act 1979* (EP&A Act).

The submissions received from the EIS exhibition form the subject of this report, known as the Response to Submissions Report (RTS).

1.1 Purpose of the Report

The purpose of this RTS is to respond to submissions raised by both community and government stakeholders during the exhibition of the EIS. This RTS has been prepared to satisfy the provisions of Section 89G of the EP&A Act and Section 85A of the *Environmental Planning and Assessment Regulation 2000*. Each of the submissions received has been collated, analysed and relevant issues have been extracted and addressed.

This RTS also provides a description of design amendments made to the proposed development which have been undertaken to address submissions received and also to reduce the overall environmental impact of the proposal. In addition to this amendment description, this RTS provides further environmental assessment to accommodate the change to the proposal and serves as an addendum to the environmental assessment reporting provided within the EIS.

1.2 Background to the Project

1.2.1 Approval pathway

The EP&A Act establishes the assessment framework for development in NSW. Pursuant to Part 4 of the EP&A Act development consent is required for the proposed facility.

The proposed development is defined as an extractive industry and is permissible with consent at the site.

The SRD SEPP identifies development that is declared to be State Significant. Clause 8 of the SRD SEPP states that any development of a type specified in schedule 1 or 2 of the SRD SEPP is declared to be State Significant Development pursuant to Section 89C of the EP&A Act.

Clause 7 of Schedule 1 of the Policy relates to extractive industries. The proposal is for the purposes of extractive industry that will exceed the threshold as it would extract more than 500,000 tonnes of extractive material per year and access greater than 5 million tonnes of reserves.

As such, the proposed development is declared to be State Significant Development. The relevant consent authority for State Significant Development (SSD) where there has been more than 50 submissions by way of objections is the Independent Planning Commission. The Department of Planning, Industry and Environment will assess the SSD Development Application, and ultimately make a recommendation of determination to the Independent Planning Commission.

1.3 Overview of the Original Proposal

The Sancrox Quarry proposal is to extend the life of the existing Sancrox Quarry, by expanding and increasing the annual extraction limit of the hard rock reserve, which comprises a mixture of various igneous and sedimentary rock formations. The Sancrox Quarry is to facilitate the extraction and distribution of high-quality construction materials for the use primarily in civil infrastructure construction and road projects. The key development parameters of the development proposal for which approval was originally sought as described in the EIS include:

- Extraction and on-site processing of up to 750,000 tonnes per annum of rock (tpa);
- Construction and operation of a concrete batching plant with an output of 20,000 tpa,
- Construction and operation of a concrete recycling facility to process 20,000 tpa; and
- Construction and operation of an asphalt production plant with an output of 50,000 tpa.
- Employment of up to 25 staff on a full-time basis
- Hours of operation:
  - Quarry operations (including production and maintenance) 24 hours a day, 7 days a week
  - Truck movements and equipment loading 24 hours a day, 7 days a week
  - Blasting operations from 8am – 5pm Monday to Friday.

Concurrent to the proposed activities is the closing and purchasing of a section of Crown owned land to facilitate the development of the biodiversity offset area to the north of the proposed quarry expansion area.

1.4 Amendments to the proposal

As part of the review and response to submissions process, Hanson has reviewed the design and layout of the proposed quarry. This has resulted in a change to the design and delivery of quarry works over the life of the quarry, as follows:

- Reduction of annual production limit from 750,000tpa to 530,000tpa.
- Whilst the proposed pit expansion is required to be located adjacent and contiguous with the existing pit and associated infrastructure (which are located on the eastern side of the site), the western boundary of the quarry has been rationalised (i.e. straightened) and pulled to the east, reducing the extent of the quarry pit in the south-western section. The pit is still proposed to be excavated to a depth of 40m AHD as previously approved for the existing quarry pit.
- A total development footprint of approximately 57.55 ha, comprising the proposed pit expansion area and the proposed infrastructure and processing area, requiring the clearing of 39.02 hectares of native vegetation.
- The proposed hours of operation will change to being 5am until 10pm. Hanson will prioritise morning and normal daytime hours operations, with evening hours (i.e. 6pm – 10pm) to be added in response to market demand as required. In addition, Hanson is seeking consent to operate 10pm to 5am 20 nights per year to meet the occasional customer demand (which is generally associated with major infrastructure projects that require construction works to be carried out during the night time).
- Installation of an earth bund on the southern property boundary, approximately 20 metres high and 450 metres long, to provide noise and visual screening.
- The proposed staging will change to being undertaken through four stages.

1.5 Site Location and Context

The Sancrox Quarry is located approximately 8km west of Port Macquarie, within the Local Government Area of Port Macquarie-Hastings on the Mid North Coast of NSW. The site is approximately 379km north of Sydney and is considered a major economic resource for regional and state development. The site's location is shown at **Figure 1**.

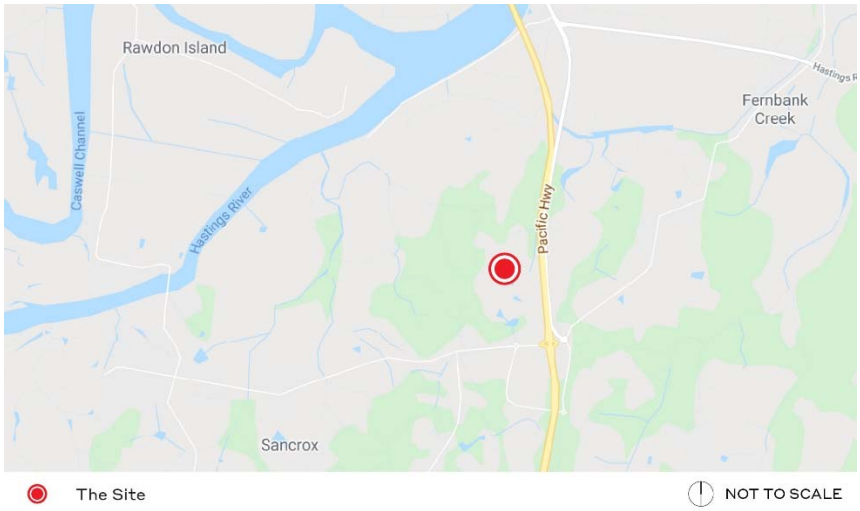


Figure 1 Locality map

Source: Google Maps and Ethos Urban

1.6 The site and land ownership

Sancrox Quarry has been owned and operated by Hanson since 1998. Hanson currently has ownership of approximately 145ha of the site, of which approximately 12ha is currently used in the extraction, processing and storage of high quality aggregate materials. The existing Sancrox Quarry site comprises of Lot 1 in DP 704890, Lot 1 in DP 720807, and Lot 353 in DP 754434 as shown in **Figure 2**.

It is proposed to expand the site through the addition of Lot 2 in DP 574308, which is located west of the existing quarry site. Hanson additionally holds a Crown lands enclosure permit (permit number 49229) for a sliver of Crown land that includes a Crown road reserve, and which traverses Lot 2 in DP 574308. In order to eliminate property fragmentation over the site, Hanson is proposing the closure and purchase of this Crown owned land under the *Land Acquisition (Just Terms Compensation Act) 1991*. Acquisition of this land by Hanson will provide flexibility to expand operations in accordance with best site geology, site morphology, site topography, resource availability and extraction ease.

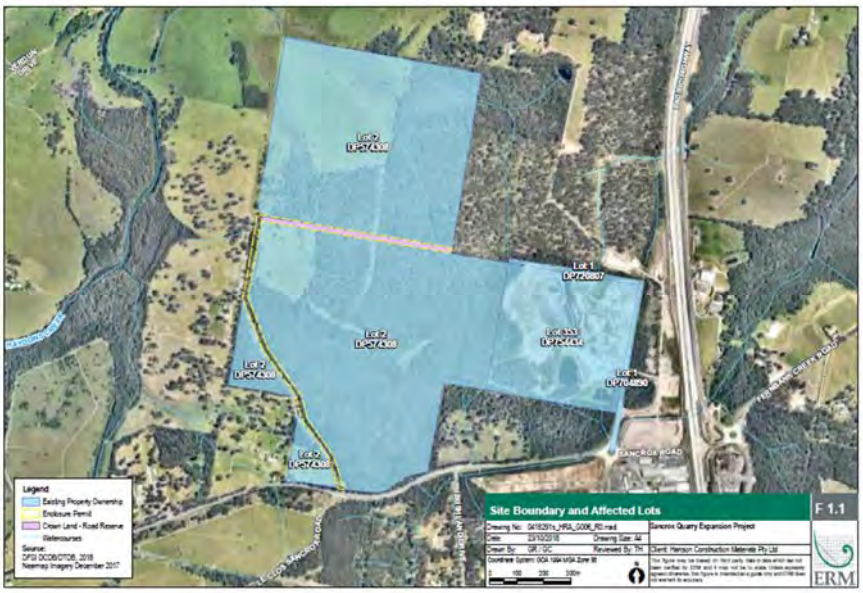


Figure 2 The site

Source: ERM

1.7 Existing Quarry Activities at the Site

The site is currently occupied by the existing quarry pit which is approximately 6.5ha of the total site area. The site also comprises a rock crushing plant of approximately 0.6ha, an administrative area of approximately 0.5ha, three dams occupying approximately 1.8ha and aggregate stockpile areas of approximately 2.2ha. Site management facilities including building, main access road, staff amenities block, site office, workshop, and materials storage shed are also located on the site. All site buildings and infrastructure is currently located near the eastern boundary of the site.

The remaining parts of the site are predominantly native bushland, with some areas near the western boundary that have been previously cleared for agricultural uses.

The quarry currently operates to the approvals as outlined in **Table 1**, an Environmental Management Plan and Environmental Protection Licence (EPL) (EPL 5298) issued by the Environment Protection Authority (EPA) under the *Protection of the Environment Operations Act 1997*. The current Sancrox Quarry operations are approved in accordance with three concurrent development consents under the EP&A Act, and which have been modified at various stages of the quarry development.

The current approval is for extraction of up to 185,000 tonnes per annum (tpa) with a temporary increase of 450,000 tpa via a modification that was approved by Council in March 2014. This temporary increase expired in March 2019, with extraction decreasing back to the original approval limit of 185,000 tpa since that time.

Table 1 Current Approved Activities and Hours of Operation

Hours	Day	Approved Activity
7am – 5pm	Monday – Friday	Normal operations
7am – 1pm	Saturday	Normal operations
7am – 11pm	Monday-Friday	Additional activities, including truck movements into, around and out of the Sancrox Quarry, as well as equipment loading
7am-5pm	Saturday, Sunday and Public Holidays	
11pm – 7am	Up to 20 occasions per year	Additional operations

It is highlighted that Hanson is continually seeking to improve the environmental performance of the existing Sancrox Quarry operational activities, with specific regard to the issues raised by neighbours and the general community through the Community Consultative Committee. In this context, the improvements recently or currently being implemented at the site include the following:

- Installation of new hosing on conveyers.
- New water truck has been commissioned to increase the amount of dust reduction watering being carried out.
- Installation of a new vegetated 3 metre high bund along the eastern and north-eastern edges of the site, and revegetation of the embankment between site and neighbouring property to the east, to the screen the activities from adjacent industrial development.
- Update to blasting methodology with inclusion of electronic detonation to improve geotechnical control and reduce vibration and noise/blast overpressure.
- Applying additives to diesel used on site to reduce diesel emissions.
- Increase in hard stand base in and around plant operations and processing areas, which reduces wind-blown dust from loose surfaces and vehicle tracking.

These improvements will be carried through to the proposed future upgrades, and ongoing opportunities for environmental improvements will continue to be investigated and, where appropriate, implemented throughout the life of the expanded quarry.

1.8 Surrounding development and land uses

The environment surrounding the quarry site includes remnant woodland vegetation immediately adjacent to the north, west and south. The Pacific Highway and Cassegrain Winery are located approximately 175m and 210m to the east, respectively. Sancrox Road is located approximately 230m to the south of the site, with a variety of industrial uses beyond.

1.8.1 Residential Development

The closest residence to the site is located on Sancrox Road approximately 150m to the south-west of the existing quarry pit and processing area. A number of rural residential residences are also located along Bushland Drive further to the south-west of the site, the closest being approximately 650m to the southwest. Further rural residence is located approximately 1km to the west of the existing quarry pit– although it is noted that this residence is located immediately adjacent to the western site boundary of the quarry site.

There are also properties located adjacent to, and north of, the quarry processing area that are currently occupied as rural residences, however these properties were rezoned in 2011 for industrial uses as part of the growing Sancrox Employment Precinct (see **Section 1.8.3** below)..

The *Greater Sancrox Structure Plan 2014-2034* outlines future development options including rural residential development opportunities to the west of the quarry and south of Sancrox Road (see **Section 1.8.4** below).

1.8.2 Sancrox Interchange and Pacific Highway

The road infrastructure directly adjacent to the Sancrox Quarry has recently undergone redevelopment and improvement.

The Sancrox Interchange connects to the Pacific Highway which services northern, southern and eastern movements from the quarry and was opened to the public in 2015. The Interchange was designed to cater for the existing industry and businesses in the area, as well as servicing the area which is planned for development as an industrial precinct.

The Pacific Highway in the vicinity of the quarry has also recently been upgraded, as part of the Oxley Highway to Kempsey Pacific Highway Upgrade Project. The Highway is a dual carriageway, 110km/hr Motorway class road.

1.8.3 Sancrox Employment Precinct

To the east of the quarry, on land between the quarry site and the Pacific Highway, construction has commenced on the development of an estate zoned for light industry. This estate continues to the north, and will include industrial buildings being constructed on land that adjoins the northern boundary of the quarry.

1.8.4 Fernbank Creek and Sancrox Planning Investigation Area

The site is located directly north of the site boundary for the Fernbank Creek and Sancrox Planning Investigation area as shown in **Figure 3**. Port Macquarie Council is investigating the area to cater for the long-term growth of Port Macquarie with protecting areas of high conservation value.

A Draft Structure Plan discussing the key opportunities and constraints of the area was released for public exhibition in September 2020. The discussion paper specifically identifies the Sancrox Quarry as a ‘significant regional resource’, particularly for the supply of aggregates and construction materials to the construction industry. The Draft Structure Plan details the protection of the quarry and proposed expansion as a high priority that will be undertaken during the development of the Structure Plan. This will ensure that any identified urban areas will not sterilise the quarry resource.

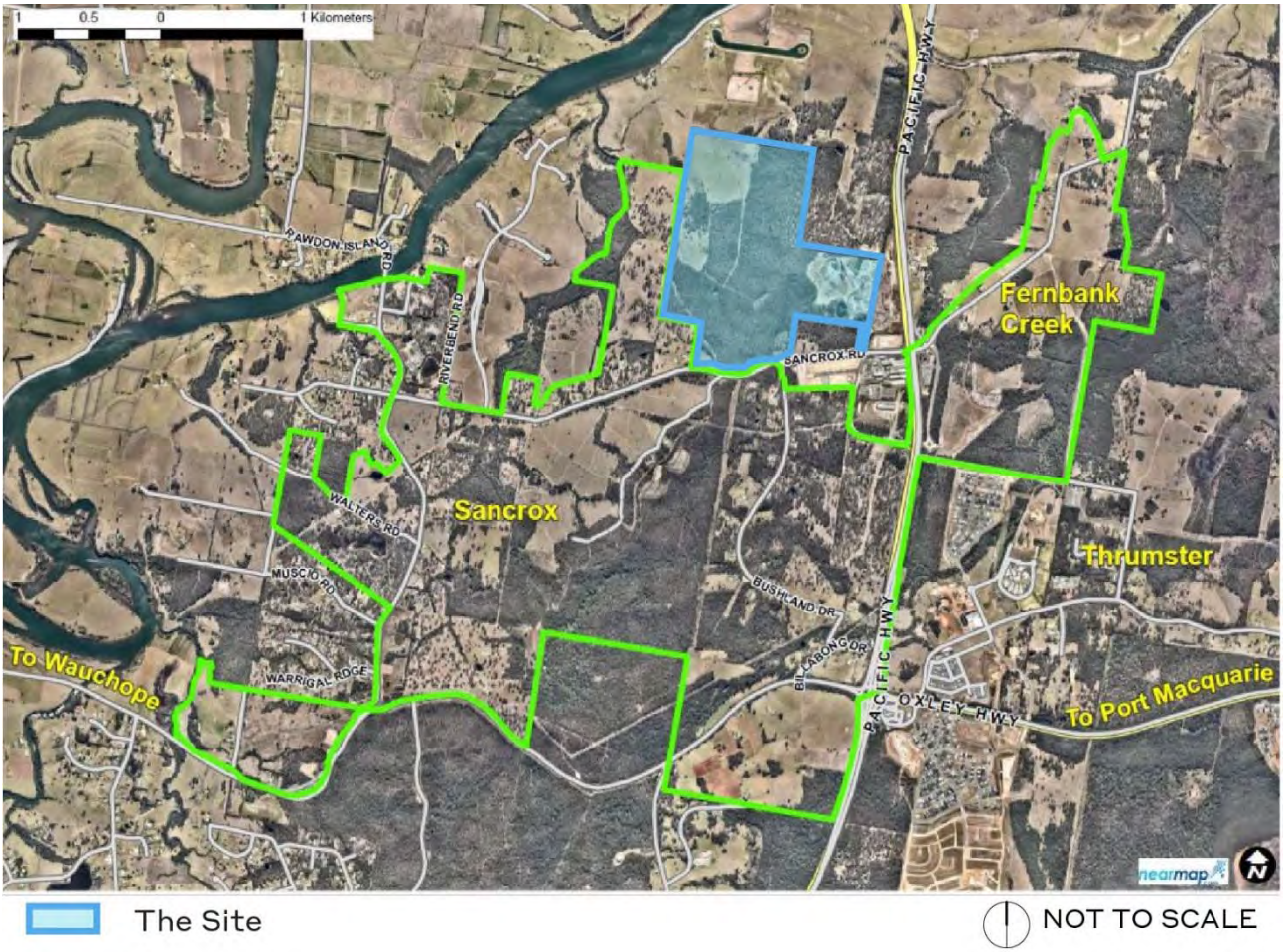


Figure 3 The site in context of the Fernbank Sancrox Investigation Area

It is highlighted that the North Coast Regional Plan 2036 does not identify any land around the Sancrox Quarry as being an Investigation Area – Urban Land (see extract of the North Coast Regional Plan 2036 in **Figure 4** below), and includes Action 13.2 which states:

> *"13.2 Plan for the ongoing productive use of lands with regionally significant construction material resources in locations with established infrastructure and resource accessibility."*

Further, the North Coast Regional Plan 2036 provides principles that must be applied whenever the Urban Growth Area is varied. These principles include:

> *"Land use conflict: The variation must be appropriately separated from incompatible land uses, including agricultural activities, sewage treatment plants, waste facilities and productive resource lands."*

There is therefore a clear obligation on the strategic planning process to address the potential for land use conflicts when new urban residential areas are being considered beyond the current urban area in close proximity to facilities involved in resource extraction.

Importantly, this direction from the North Coast Regional Plan 2036 has been reinforced in the Port Macquarie Draft Regional City Action Plan, which does not identify any of the Sancrox area west of the Pacific Highway as being a current investigation area for urban residential land.

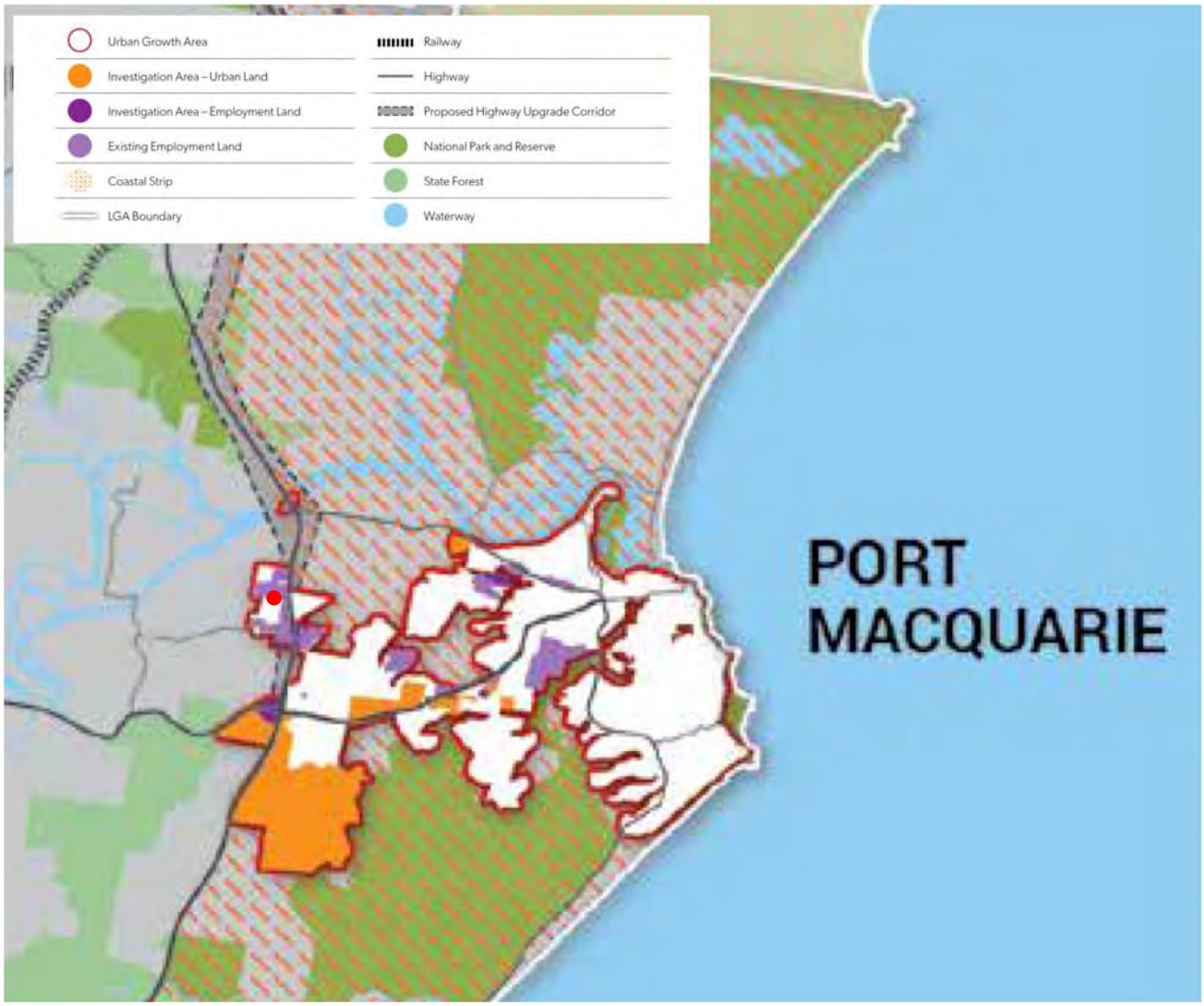


Figure 4 The site in context of the Urban Growth Area

Source: Extract from the North Coast Regional Plan 2036

1.8.5 Le Clos Sancrox Planning Proposal

A Planning Proposal has been prepared by Port Macquarie-Hastings Council for rezoning of land south-west of the Sancrox Quarry site from rural to urban uses – called the Le Clos Sancrox Planning Proposal. The Planning Proposal has obtained a Gateway approval from the Department of Planning, Industry and Environment on 13 May 2021, meaning that it will now proceed to public exhibition. The Le Clos Sancrox Planning Proposal is intended to facilitate the development of approximately 68- residential lots across approximately 75.5 hectares of land to be zoned for residential purposes. The Le Clos Sancrox Planning Proposal specifically identifies the potential land use conflict with the Sancrox Quarry, and provides an additional undeveloped ecological corridor in the north-east corner:

> *"…to provide a larger buffer to the existing quarry and any expansion, should it be approved."*

The future residential properties are located further afield from the quarry site compared to existing rural residences located south-west of the quarry.

1.9 Objectives of the Project

The objectives of the Sancrox Quarry proposal is to cater for the demand of aggregate construction materials of an estimated 12 million tonnes of hard rock in accordance with the *Mid North Coast Regional Strategy 2009.* The proposed expansion will deliver aggregates to contribute to meeting this demand in an efficient and environmentally sensitive manner without generating adverse impacts on the surrounding environment. The project seeks to deliver 25 full time equivalent jobs during the proposed 30 years of the quarry.

1.10 Structure of this Report

The RTS includes the following sections:

- Section 1 Introduction: provide a summary of the proposal
- Section 2 Exhibition and Consultation: Provides a description of the consultation which has been undertaken for the project to date.
- Section 3: Overview of Submission: Provides an analysis of the submissions received during the exhibition of the EIS and identifies key issues raised.
- Section 4: Response to Government Agency Submissions: Provides a response to the key issues received from Government Agencies and responses.
- Section 5: Response to Public Submissions: Provides a summary of the community, community organisation and private organisation submissions received and responses.
- Section 6 Further Assessment: Provides an environmental assessment of the amendment to the design with reference to technical specialist addendums where relevant.
- Section 7: Revised Mitigation Measures: Provides a list of revised recommendations and mitigation measures based on the technical studies undertaken.
- Section 8: Conclusion.

2.0 Exhibition and Consultation

2.1 Activities prior to EIS exhibition

During the preparation of the EIS, a number of consultation activities with key stakeholders took place in order to create an open dialogue. These consultation activities are documented in the EIS and summarised below.

2.1.1 Consultation with key stakeholders

As part of the Secretary's Environmental Assessment Requirements (SEARs) for the EIS, a number of key public authorities provided comment and requested various inputs be provided as part of the EIS documentation. These authorities included:

- Department of Planning, Industry and Environment
- Office of Heritage (OEH)
- Environmental Protection Authority (EPA)
- Department of Primary Industries
- Roads and Maritime Services (RMS)
- Port Macquarie Hastings Council
- NSW Rural Fire Service
- North Coast Local Land services

The requested input by those authorities were incorporated into the EIS.

2.1.2 Public Consultation

Hanson has been proactive in consulting with the community and a summary of the ongoing consultation with the community is provided as **Annex A of the EIS**. In 2018, the Sancrox Quarry Extension project Community Consultative Committee was formed with Lisa Andrews appointed as the independent chairperson in accordance with the SEAR's requirement.

2.2 Public Exhibition

The EIS in support of the State Significant Development Application (SSD 7293) was publicly exhibited for a period of 42 days inclusive between Thursday 31 October and 11 December 2019. Public exhibition occurred in accordance with the requirements of the EP&A Act.

The EIS (and associated supporting technical studies) was made available to the public in electronic format on the DPIE website during this time.

2.3 Post Public exhibition

2.3.1 Community Information Session

Following the receipt of submissions, a community information session hosted by the DPIE was held at the Rydges Bayside Ballroom Port Macquarie on Monday 10 February 2020. A total of 95 people attended including 4 Hanson employees and Councillors Lisa Intemann and Geoff Hawkins of Port Macquarie Hastings Council. The purpose of this consultation was for the DPIE to listen to landholders and interested parties' views about the project and provide advice on the SSD assessment process. Hanson attended that session in order to better understand the concerns of the community, and this has informed the amendments that are now proposed.

2.3.2 Community Consultative Committee

The proposal was also subject of further discussion as part of the Community Consultative Committee meeting held on 11 December 2020 and 26 March 2021. A draft copy of the RTS was issued to the CCC prior to the 26 March 2021 meeting, and comments were raised and discussed at that meeting. Two written submissions were further received from CCC members after the 26 March 3021 meeting. The two submissions raised (or reiterated) some further specific issues which are listed below, and a cross-reference provided to where the issue has been addressed in the RTS:

- Submission 1:
  - *The draft Fernbank Creek and Sancrox Villages Structure Plan and Le Clos Sancrox Planning Proposal should be considered in the assessment of the Sancrox Quarry Expansion Project as applicable*

    The draft Fernbank Creek and Sancrox Villages Structure Plan is addressed in detail in **Table 2** (**Section 4**) and in **Section 6.1**. The Le Clos Sancrox Planning Proposal is addressed in **Section 1.8.5** and **Section 6.1**.
  - *Earth bund should be built in stages to reflect the staging of the quarry.*

    Hanson will ensure the bund is delivered commensurate with the staging of the quarry.
  - *Noise and vibration: Clarify why the selected meteorological conditions were used for noise modelling*

    The process for determining the relevant wind direction is the EPA's noise enhancing wind analysis method (see Section 2.10.1 of the Revised Noise and Vibration Impact Assessment at **Appendix E**).
  - *Noise and vibration: Cumulative construction impacts*

    The Construction Noise Management Plan will take into account other construction projects if relevant at the time of construction. The proposed mitigation measure in **Section 7** has been amended accordingly.
  - *Noise and vibration: Consider relocating plant and equipment to the northern part of the site and/or providing a noise bund to the south west of the quarry*

    The proposed noise bund relates to surface level plant and equipment, whereas quarry operations are generally below ground level and already shielded by the quarry face. Given that noise impacts are predicted to comply with the Project Specific Noise Levels at receptors to the south-west of the site no additional noise bund is considered necessary. See **Section 6.2**.
  - *Noise and vibration: Consider updating the traffic noise assessment with more recent traffic data*

    See **Section 6.2.3** of this RTS. In summary, the background traffic noise is 10dBA or more below the criteria, and the change predicted as a result of the proposed expansion is less than 2dBA. As such, irrespective of the potential for background traffic to have increased in the intervening period, the proposal would remain compliant with the relevant traffic noise criteria.
  - *Noise and vibration: Amendments to the proposed mitigation measures*

    Mitigation measures set out in **Section 7** of this RTS have been amended accordingly.
  - *Air quality: Amendments to the proposed mitigation and management measures*

    Mitigation measures set out in **Section 7** of this RTS have been amended accordingly. Note that the propsoed dust monitoring is real-time, meaning that it is a continuous monitor. Depositional dust monitoring is not currently proposed. It is also noted that the management measures set out in Section 9 of the revised Air Quality Assessment Report at **Appendix F** will be subject to further refinement as part of the preparation of the Air Quality Management Plan, including with consultation with the relevant authorities.
  - *Air quality: revised assessment criteria for odour taking into account potential future residential receptors*

    Whilst a criteria of 6 Odour Units was legitimately established based on the currently low residential density around the site, it is highlighted that the odour emissions would be below the most stringent 2 Odour Units criterion in the case of all sensitive receptors except for a marginal 0.1 exceedance at the closest sensitive receptor to the south west.
  - *Water: Clarify when the recommendations of the groundwater peer review would be implemented*

The REN consulting Groundwater Model Peer Review Report at **Appendix C** sets out recommendations to further develop and improve the confidence-level of the groundwater model during detailed quarry planning and design.

- *Water: Clarify whether reticulated water would be used is site won was insufficient*

  Yes, although the water balance does not predict that the site will be deficient of site won water even in a low rainfall year. Site won water will be suitable for concrete batching.

- *Water: Clarify whether reticulated water would be used is site won was insufficient*

  Yes, although the water balance does not predict that the site will be deficient of site won water even in a low rainfall year. Site won water will be suitable for concrete batching.

- *Biodiversity: Update the Biodiversity Assessment to address inconsistencies and missing sections.*

  The Revised Biodiversity Assessment Report has been updated and is provided at **Appendix H**.

- Submission 2:
  - *Annual production increase remains unjustified*

    A response to this is provided to the Department of Planning, Industry and Environment in **Table 2, Section 4.** Hanson is projecting strong long-term growth in the demand for aggregates, concrete and asphalt on the mid-north coast based on the well documented population increase projections for the Mid-North Coast area. Indeed, the site is currently at capacity for its 2021 annual limit, with future big projects taking precedent, any many new orders being turned away for the remainder of the financial year 2021 – highlighting the level of market demand that Hanson is trying to respond to.

  - *The footprint of the expanded quarry shouldn't extend to the northern boundary in the context of the approved Sancrox Employment Precinct and with consideration of noise and fly rock concerns*

    The existing quarry footprint extends to the northern boundary, noting that apart from the top bench of the northern face, the quarrying will occur away from this boundary and below ground level. Further assessment of noise and fly rock issues are addressed in **Section 6.2** and the Revised Noise and Vibration Impact Assessment at **Appendix E** – which concludes that noise impacts at the future industrial properties to the north (at 40-41 dBA $L_{eq,\ 15\text{-}min}$) would be well below the relevant Project Specific Noise Levels for industrial properties (70 dBA $L_{eq,\ 15\text{-}min}$), and that fly rock can be managed using good blast design in accordance with the Blast Management Plan. Further, for the western half of this boundary the properties are separated by a 20m Crown Road Reserve which forms the defendable space as part of a bushfire Asset Protection Zone for any building in this area, meaning that there will always be a 20m separation distance between any future industrial building in this location and the quarry, even if the quarry extends close to the boundary. No part of the expanded quarry or any of the physical works or activities will encroach across the property boundary. Hanson are confident that all impacts of the proposed Sancrox Quarry can and will be managed within the Sancrox Quarry site, and no blast exclusion zones will be imposed on adjoining properties.

  - *Water management: seepage should be managed to ensure no downstream impacts on neighbours properties*

    Hanson remains committed to working with its neighbours to ensure any water seepage issues around the quarry site are dealt with collaboratively and in a constructive manner.

  - *Visual impacts: Vegetated buffer should be provided along the northern boundary*

    Revegetation plantings along the northern boundary will be provided as part of the rehabilitation of the site. Hanson will investigate opportunities to bring forward the revegetation along the northern boundary of the quarry pit as early as possible in the staging program.

In addition to these further issues, one of the key pieces of feedback received at the CCC meeting 26 March 2021 was that the community wanted to understand what measures Hanson was taking to improve the environmental performance of the Sancrox Quarry, and whether the proposed extension would result in better or worse environmental impacts.

In response to this query, a schedule of recent or current environmental improvements have been listed in **Section 1.7** of this RTS. These improvements will be carried through to the proposed future upgrades, and ongoing opportunities for environmental improvements will continue to be investigated and, where appropriate, implemented throughout the life of the expanded quarry.

In relation to the second part of the query, it is not possible to definitively determine whether any particular environmental impact will improve or worsen as a result of the proposed expansion. However, it is important to note that the critical aspect of assessment and approvals process is to determine whether the quarry as it is proposed to be expanded can comply with current environmental standards. These current environmental standards are in many cases more stringent than the environmental standards that were in place at the time of the original approval for the quarry. Indeed, this is a key objective of enforcing production limits and time frames on quarry consents – to require their further assessment against current standards on a periodic basis. It is also important to note that the capital investment that comes with the expansion also includes investment in implementing modern and more effective environmental controls, including equipment and devices to reduce, manage or monitor emissions. As such, whilst the proposed quarry expansion represents an intensification of the quarry activities, emissions are unlikely to noticeably increase for many issues and receptors, and may well, in some circumstances result in reduced impacts.

2.3.3 Agency Follow Up

In relation to addressing the issues raised in submissions as part of this RTS, Hanson has also carried out further direct consultation with the following agencies:

- Biodiversity and Conservation Branch: The Biodiversity and Conservation Branch of DPIE requested further data and information to support the biodiversity assessment. This mostly revolved around the submission of the underlying data that informed the Biodiversity Assessment Report, which was subsequently provided for review by the Biodiversity and Conservation Branch. After review of the data, the Biodiversity and Conservation Branch clarified its requirements by a letter dated 3 April 2020, which consolidated the key remaining issues as being focussed around reducing the footprint of the impacted area and providing for Koala species credits as part of the biodiversity offsets program. Hanson has acknowledged these key residual issues, and has reduced the extent of the quarry pit to minimise biodiversity impacts. Further, as set out in the revised Biodiversity Assessment Report (see **Appendix H**) extensive further studies have been carried out in relation to the presence of Koala at the site, and Koala species credits have now been incorporated into the biodiversity offsets strategy.
- Department of Industry – Groundwater Assessment: After review of the groundwater model by the Peer Reviewer, Hanson consulted further with the Water Branch of DPIE to clarify the assessment comments made in their original submission. The Department of Industry reiterated its assessment comments of the requesting that a peer review report be prepared and that the model be classified in accordance with the Australian Groundwater Modelling Guidelines. A Peer review report has now been prepared by Ren Consulting and is provided at **Appendix C**.

3.0 Overview of Submissions

A total of two hundred and seventy-two (272) submissions were received in response to the public exhibition of the EIS, including submissions made by government authorities and agencies, and the public, as set out in the following sections.

A response to each of these submissions has been prepared. The key matters raised in the submissions can be grouped into six (6) categories. An overview of the submissions and a summary of the process undertaken to ensure the submissions have been accurately responded to is provided below.

3.1 Government agency submissions

Submissions were received from a total of six (6) government agencies as follows:

- Heritage Council
- Department of Industry and Environment – Division of Resources and Geoscience
- Environment Protection Authority
- Port Macquarie-Hastings Council
- Department of Planning, Industry and Environment – Diversion of Biodiversity and conservation
- NSW Rural Fire Service

As outlined above, a total of six government agencies provided submissions, with the DPIE providing a set of summary comments with the request for an RTS. Each submission varied in terms of the number and types of issues raised, with some agencies raising more issues than others (dependant on their function and responsibility). Each agency submission was reviewed in detail to identify the key issues.

The agency submissions were then provided to the relevant technical specialists of the project team for consideration and preparation of updated or supplementary assessment reports. Where additional information was required to respond to the submission issue raised, it has been provided within this RTS.

A detailed summary of the issues raised by the Government agencies and the response to those issues is provided in **Section 4**.

3.2 Public submissions

A total of two-hundred and sixty-four (264) public submissions was received from individuals, landowners, organisations and special interest groups. Four of these submissions have been classified as comments and one has been classified as in support of the proposal. The remaining 259 submissions have been classified as being an objection to the proposal.

The community submissions were reviewed and summarised into key issues. The main issues identified within these submissions were:

- Traffic and Transport;
- Hours of operation;
- Biodiversity;
- Noise and Vibration;
- Water management;
- Air quality; and
- Socio-economic impacts, including amenity impacts on residents and businesses and property values.

A detailed summary of the issues raised in the public submissions is provided in **Appendix J**, and the response to these issues is provided in **Section 5**.

4.0 Response to Government agency submissions

This section provides a response to the key issues raised in the submissions from Government agencies.

Table 2 Response to Agency Submission Issues

Issue Title	Issues Summary	Hanson's Response
Department of Planning Industry and Environment		
Scope and adequacy of information	Section 3.3.1 of the EIS provides two different total resource volumes. Provide an accurate figure of the total resource that the development application relates.	The reduced quarry pit extent has resulted in a reduced total resource for which the development application relates to approximately 15.9 million tonnes – being 530,000tpa for 30 years.
	Conceptual final landform and rehabilitation figures must be provided.	Final landform and rehabilitation plans are provided at **Appendix I**. The plan illustrates the final landform, including the location of the void and native vegetation re-planting areas around the outside edge of the void, as well the sediment basins and water storage areas that will be retained on-site at the completion of quarrying. The plan should be read in conjunction with the detailed description of quarry rehabilitation set out in Section 17 of the exhibited Environmental Impact Statement. The plan also identifies that parts of the quarry processing area could be utilised for future industrial uses, in-keeping with the immediately surrounding Sancrox Employment Precinct. It also identifies that the Concrete Batching Plant and Concrete Recycling Plant may be able to continue operating in this context.
	Clarify if the bitumen plant is coal fired or gas fired.	The asphalt (bitumen) plant will be totally enclosed and fuelled by natural-gas.
	Provide further details of the availability of hard rock resources in the Port Macquarie area and why Hanson considered the proposed quarry expansion is needed and justified.	Hanson is projecting strong long-term growth in the demand for aggregates, concrete and asphalt on the mid-north coast based on the well documented population increase projections for the Mid-North Coast area – with more than 76,000 new residents and 46,000 new homes projected by the North Coast Regional Plan 2036. These materials will be provided as part of the civil materials supply chain for the construction of, although not limited to; roads, housing, employment & industrial facilities, education facilities and medical facilities. It is also highlighted that the Sancrox Quarry is currently at capacity for its 2021 annual limit. With future big projects taking precedent, many new orders are being turned away for the remainder of financial year 2021 – providing a clear indication of the level of market demand that Hanson is trying to respond to.
Planning and Land Compatibility	Provide details on where the proposed/approved residential areas of Le Clos Verdun, Le Clos Sancrox, Thrumster, Fernbank Road and Riverpark Sancrox would occur in relation to the existing and proposed quarry expansion areas. Provide a figure containing this information.	Further details of the specified proposed / approved residential areas are provided in **Section 6.1**, along with a map illustrating the spatial relationship of these areas with the site.
	Have the proposed/approved residences been considered as residential receivers for noise and air quality assessment purposes.	Any possible new sensitive receptors around the quarry are located further away from the quarry than existing receptors 4, 7, 9, 13, 15, 19 and 20 (as labelled in the revised Noise and Vibration Impact Assessment at Appendix E), and these receptors would remain representative of the nearest and most affected sensitive receptors for both air quality and noise impact assessments.

Issue Title	Issues Summary	Hanson's Response
	Are any noise or air quality mitigation measures proposed for these approved/proposed residences.	As indicated above, compliance with air and noise criteria at the existing and specified residential receptors will ensure compliance of the same criteria at any possible new sensitive receptors located in the vicinity of these receptors.
	Provide details of Hanson's consideration of the strategic planning work associated with Council's Fernbank Creek and Sancrox Planning Investigation Area.	Hanson supports the recently exhibited Draft Structure Plan for Fernbank Creek and Sancrox Planning Investigation Area public exhibition in February 2020, which specifically identifies that the Sancrox Quarry is a 'significant regional resource', that 'protection of the resource is considered to be a high priority', and that the Structure Plan will need to "…ensure any identified urban areas will not sterilise the resource". The Discussion Paper identifies that a key objective that will inform the preparation of the Structure Plan is to "Ensure land use does not restrict or prohibit the development potential of important extractive resources".
	Justify the need to operate 24 hours per day 7 days per week	The proposal has been amended to limit operations to 5am-10pm, and Hanson will prioritise morning and normal daytime hours operations, with evening hours (i.e. 6pm – 10pm) to be added in response to market demand as required. In addition, Hanson is seeking consent to operate 10pm to 5am 20 nights per year to meet the occasional customer demand.
Noise	The EPA has identified departures from the Industrial Noise Policy.	A response to the EPA's issues is provided below.
	The Department supports the EPA's request for details to be provided of how noise mitigation measures will be achieved and implemented, and which items of equipment can meet their sound power level.	A response to the EPA's issues have been provided below. Section 2.10 of the revised Noise and Vibration Impact Assessment (see Appendix E) sets out the noise mitigation measures committed to and confirms that they are feasible. Table 2.4 specifies the sound power level reductions that are committed to, and explains that where a piece of plant or equipment cannot meet the specified power level, then acoustic enclosures or silencers will be used to achieve the specified sound power level.
	Provide an assessment of the noise impacts that will be generated during the construction of the proposed noise mitigation bunds.	Construction of the earth bund has been included as construction noise scenario SCN04, for which details are provided in Table F1, Appendix F of the revised Noise and Vibration Impact Assessment (see Appendix E), and noise modelling of this scenario has been carried out and is presented in Section 6.2 of the revised Noise and Vibration Impact Assessment.
Air Quality	The EPA has identified instances where the Approved methods for Air Quality Impact Assessment have not been followed and where air quality assessment has not been detailed enough.	A response to EPA's issues is provided below. A revised Air Quality Assessment Report has been prepared and is appended at Appendix F providing all of the further details requested by the EPA.
	The EPA has requested revised modelling to be undertaken which incorporates additional control strategies to achieve compliance with the EPA criteria.	A response to EPA's issues is provided below. A revised Air Quality Assessment Report has been prepared and is appended at Appendix F which provides revised air quality modelling and demonstrates compliance the criteria at all sensitive receptors for the 24-hour and annual averaging periods with the quarry operating under typical day operations and maximum day when hours are limited to 5am to 10pm.
	Please address the EPA's issues.	A response to EPA's issues is provided below.
	Please address how the operation of the quarry will be managed to address air quality mitigation measures set out in Council's submission.	The revised Air Quality Assessment Report as appended at Appendix F comprises a list of mitigation measures which will be subject to the development consent conditions and NSW EPA Environment Protection Licence, and Hanson's commitment to implementation of these mitigation and management measures is reiterated by their inclusion in Table 3 (see **Section 7** below).

Issue Title	Issues Summary	Hanson's Response
Biodiversity and Aboriginal Cultural Heritage	Address the Division of Biodiversity and Conservation's recommendations, including to amend the quarry footprint to avoid the scar tree.	A response to the Division of Biodiversity and Conservation's submission is provided below. The footprint of the quarry has been amended to avoid impacts on the scar tree.
	Reassess the likely impacts of the proposal on the sub-regional biodiversity corridor that runs through the site and the biodiversity matters raised in Council's submission.	The ecological surveys have been revised and updated to include all flora and fauna communities. This includes the addition of detailed Koala surveys. See the revised Biodiversity Assessment Report at **Appendix H**. The western side of the quarry pit has been pulled back to reduce the impacts on the north-south biodiversity corridor, which will be retained, although narrower, on the western side of the quarry pit. It is highlighted that the Biodiversity Assessment Report accounts for through site connectivity as part of the credit calculation, and so the impact on connectivity impacts associated with reducing the width of this biodiversity corridor have been accounted for in the biodiversity offset calculation. See also further discussion in **Section 6.3**.
	Respond to Council's concerns that the ecological surveys were not sufficiently comprehensive.	The ecological surveys were carried out in accordance with the Framework for Biodiversity Assessment. Surveys have been supplemented in the revised Biodiversity Assessment Report (see **Appendix H**), including with a supplementary Koala Survey and Assessment report (see **Appendix D**).
	Address the historic grave site identified by the NSW Heritage Council in the Response to Submissions.	A response to the Heritage Council is provided below. In summary, the historic grave site is located over 3km southwest of the Sancrox Quarry and will not be impacted by the proposed development.
Blasting	Provide further consideration of impact zones, road closure procedures, and impacts on local residents, industrial lands the Pacific Highway and the winery.	The revised Noise and Vibration Impact Assessment (see **Appendix E**) includes a detailed assessment of blasting in accordance with Australian and New Zealand Environment Council (ANZEC) – Technical Basis for Guidelines to Minimise Annoyance due to Blasting Overpressure and Ground Vibration, 1990, and demonstrating that blasting can be carried out in accordance with the Australian Standard AS2187.2, which sets out methods for estimating air-blast overpressure and ground-borne vibration levels. Compliance with the Australian Standard will ensure that there are no adverse off-site impacts on any neighbour.
Traffic and Transport	Respond to the EPA's issues in relation to correctly assessing road traffic noise impacts.	A detailed road traffic noise impact assessment is provided in the revised Nosie and Vibration Assessment Report (see **Appendix E**), demonstrating compliance with the Road Noise Policy criteria. The proposed quarry extraction rate has been reduced by almost 30% meaning quarry haulage vehicles will similarly reduce by some 30%. Using the same assumptions as set out in Section 12.3.2 of the EIS, the quarry development will therefore generate approximately 122 new heavy vehicles per day on average, which comprises approximately 90 additional quarried product truck movements on average (being 71% of the amount assessed in the EIS, and which has been reduced due to the lower extraction rate now proposed) and approximately 32 truck movements associated with the other proposed uses at the site that remain as assessed in the EIS. This equates to a combined total (taking into account existing heavy vehicle movements associated) of approximately 164 truck movements per day on average.
	Respond to Council's request for a per tonne monetary contribution for haulage over Council roads.	Noted. Hanson is willing to accept a condition requiring payment of a per tonnage rate per km of Council managed roads at the same rate agreed by other operators, noting that the vast majority of Hanson's trucks would use less than 500 metres of Council managed roads before accessing the Pacific Highway.

Issue Title	Issues Summary	Hanson's Response
Water	Provide further information on the volume of water required to suppress dust on the overburden stockpile in the water balance.	Overburden stockpiles/bunds will be stabilised using site won topsoil and vegetation as part of the erosion and sediment control strategy for the quarry. The need for dust control of stabilised overburden stockpiles/bunds will be minimal and, if necessary, primarily in the establishment phase. Therefore, it is estimated that water demand for dust suppression of overburden stockpiles/bunds will not exceed 1ML per annum. See also the supplementary surface and groundwater water report prepared by ERM at **Appendix G**.
	Respond to the issues raised by Expressway Spares in relation to stormwater drainage.	ERM, on behalf of Hanson, has inspected the flows on several occasions, concluding that the flows are unlikely to be surface water flows from the quarry, but are likely to be sourced from seeps or springs. Notwithstanding this, Hanson commits to working with the neighbouring landowner to develop an agreed approach to manage the seepage flows to ensure they are directed to a stable down-gradient surface water system.
Soil	Respond to the EPA's concerns in relation to impacting the very strongly acidic Euroka Soil Landscape.	A response to the EPA's submission is provided below. Impacts to the Euroka Soil Landscape have been reduced as a result of the amended proposal, and management measures have been set out in **Appendix D** for managing the acidic soils.
Social Impact Assessment	Carefully consider the potential social impacts in accordance with the Social Impact Assessment Guideline.	A Social Impact Assessment was prepared and attached to the EIS at Appendix K. The Social Impact Assessment was prepared in accordance with the Department's *Social Impact Assessment Guideline for state significant mining, petroleum production and extractive industry development*.
Heritage Council		
Impact on historic grave	There is a National Trust listed grave site identified in the Sancrox area. The EIS states a survey was undertaken but no historical heritage items were found during the survey and concludes that there are no historic heritage constraints. However, it is not clear whether the grave site was specifically searched for and given that the grave may not be in good conditions and physical evidence may have been removed since the Trust recorded it and may longer record its location, it is requested that the proponent clarify whether the grave would or would not be affected by the proposed development.	ERM has reviewed the National Trust Listing and identified the grave site located over 3km southwest of the Sancrox Quarry. The single burial site dated 03/05/1901 was surveyed in 1986 and is recorded as an imposing 2m white marble obelisk, erected in memory of Allen Johnston. The monument was reported in good condition with a cast iron surround set in sandstone. Surrounding remnants indicate that additional gravestones may have been in the area yet were not recorded in the survey. The proposed quarry expansion will not result in adverse impact upon the burial site.
Department of Planning, Industry and Environment – Division of Resources & Geoscience		
Provide resource investigation report	The referenced Hanson 2015 resource investigation report should be supplied to the Division.	The referenced Hanson 2015 resource investigation report has been supplied to the DPIE Division of Resources and Geoscience and can be found on the DPIE Major Projects website at https://www.planningportal.nsw.gov.au/major-projects/project/9946
Provide annual production data	The proponent should be required to provide annual production data for the subject site to the Division as a condition of development consent.	Hanson is willing to accept a condition that would require it provides annual production data for the Sancrox Quarry for the DPIE Division of Resources and Geoscience.
Environment Protection Authority		
Noise monitoring	Wind speed data The noise monitoring graphs 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 Noise and Vibration Impact Assessment has been revised to reflect various wind speeds (see **Appendix E**). As described in Section 3.3.2 of the revised Noise and Vibration Impact Assessment, and can be seen in Annex E, noise data recorded

Issue Title	Issues Summary	Hanson's Response
	the day period, and the only measurements removed were when the wind speed at 10m was above 7m/s. Justify including data where wind speeds exceed 5 m/s, or undertake further noise monitoring to record sufficient periods where wind speed is below 5m/s.	during periods of rain or when wind speeds were in excess of 5 m/s at 10m above ground level have been excluded.
	Extraneous noise affects 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.	As set out in Section 3.3 of the revised Noise and Vibration Impact Assessment (see Appendix E), additional short-term operator attended noise measurements were conducted during the evening and night-time periods around the site on Monday 20 July and Tuesday 21 July 2020 to confirm background noise levels. The measurement device was sent to show instantaneous noise levels through each measurement, with noise events noted by the operator. Overall, 15 minute acoustical and statistic parameters were recorded in the device. Site noise was inaudible or barely audible for the majority of measurements as the site was generally not operational during noise logging and attended monitoring.
	Background noise Table 7.2 of the noise report presents existing noise levels in excess of 40 dBA from the existing premises during the day period, which indicates that the existing quarry has potential to influence the background noise levels at the nearest receivers. Demonstrate that the background noise monitoring was not influenced by existing operations at the premises.	Table 7.2 presents noise validation results for the property boundary – not at residential receptors. As set out in Table 3.6 of the revised Noise and Vibration Impact Assessment (see Appendix E) site noise attributable to the site was estimated during operator attended noise monitoring. In most cases the site noise was inaudible by the noise logger operator, and in only two cases on the same day was the site noise estimated at 35-39 dBA. Further, noise form the site was inaudible during the installation and demobilisation of the continuous unattended noise loggers, and during any periods when an operator was in attendance. 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.
Operational noise assessment criteria	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. Provide further 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.	As set out in Section 3.3 of the revised Noise and Vibration Impact Assessment (see **Appendix E**), additional short-term operator attended noise measurements were conducted during the evening and night-time periods around the site on Monday 20 July and Tuesday 21 July 2020 to confirm background noise levels. As set out in Table 4.3, where appropriate the Amenity Noise Level has been used to establish the Project Specific Noise Level, including for residential receptors 33, 34, 35 and 38 during the night-time period.
Noise modelling	Meteorological conditions Some of the meteorological conditions used in the noise report appear to be outside of the meteorological conditions specified in ISO 9613-2. Explain how the specific meteorological conditions have been modelled.	Section 2.10 of the revised Noise and Vibration Impact Assessment (see **Appendix E**) sets out the specific meteorological conditions used for the noise modelling which have been based on the EPA's Noise Enhancing Wind Analysis.

Issue Title	Issues Summary	Hanson's Response
	Model validation 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.	Section 7.2 of the revised Noise and Vibration Impact Assessment (see **Appendix E**) includes details of operational noise model validation, which was carried out by taking noise measurements around the site boundary in July 2020. Noise predictions at the site boundary were within 1 dBA of the measured values.
	Sound power levels Provide a reference or other information to support the use of the assumed sound power level (SWL). The EPA considers that the SPL of the CAT 980H loader (105 dBA) is low when compared to other data available in the public domain for this type of loader.	The sound power level of existing equipment was determined using on-site measurements. Appendix F of the revised Noise and Vibration Impact Assessment (see **Appendix E**) includes details noise modelling data, and Table F.2 in Appendix F presents the spectral data of the CAT980H Loader as measured on-site whilst carrying out stockpiling and loading activities.
Noise modifying factor adjustments	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 should be performed on the total noise emission level at the receiver, not the source or sound power level.	As explained in Section 7.3.3 of the revised Noise and Vibration Impact Assessment (see **Appendix E**), based on the noise source data and model outputs, penalties were not applied. In addition, Hanson commits to ensuring that any activity that has the potential to generate impulsive noise will be avoided at night time and any impulsive or transient noise events expected to exceed the sleep disturbance criteria at residential receptors will be strictly avoided at night.
Noise mitigation measures	Details of how noise mitigation measures will be achieved and implemented, and which items of plant can meet its sound power level requirements.	Section 2.10 of the revised Noise and Vibration Impact Assessment (see **Appendix E**) sets out the noise mitigation measures committed to and confirms that they are feasible. Table 2.4 specifies the sound power level reductions that are committed to, and explains that where piece of plant or equipment cannot meet the specified power level, then acoustic enclosures or silencers will be used to achieve the specified sound power level.
Blasting	Justification of the approach not to use existing blast monitoring data to inform the assessment of blast over-pressure and ground vibration. The quarry is an existing operation that conducts regular blasting and it is expected that existing blasting data would be used in the assessment.	Assessment of blasting is required to be undertaken in accordance with Australian and New Zealand Environment Council (ANZEC) – Technical Basis for Guidelines to Minimise Annoyance due to Blasting Overpressure and Ground Vibration, 1990 and Australian Standard AS2187.2, which sets out methods for estimating air-blast overpressure and ground-borne vibration levels. Long term blasting data from the quarry have been used to inform the site constants relevant to the analysis. Section 2.6.2 and 2.6.2 of the revised Noise and Vibration Impact Assessment (see **Appendix E**) sets out the site constants that have been adopted based on historical blast monitoring data.
Construction assessment	ICNG corrections for annoying noise characteristics 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. Reassess any penalties to predicted noise levels using the ICNG.	As set out in Table 6.2 of the revised Noise and Vibration Impact Assessment (see **Appendix E**) the predicted noise levels for three of the modelled scenarios include a 5 dBA penalty for annoying noise characteristics in accordance with the ICNG.
	Noise bund 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	Construction of the earth bund has been included as construction noise scenario SCN04, for which details are provided in Table F1, Appendix F of the revised Noise and Vibration Impact Assessment (see **Appendix E**), and noise modelling of this scenario has been carried out and is presented in Section 6.2 of the revised Noise and Vibration Impact Assessment.

Issue Title	Issues Summary	Hanson's Response
	for in the construction noise assessment.	
Road traffic noise assessment	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. It is also unclear whether road traffic noise movements during the shoulder or night period have been included in the assessment. Provide further consideration of total traffic noise levels caused by the project, providing justification and evidence for the existing traffic noise levels. This should: • consider both light and heavy vehicle movements generated by the quarry. • provide the calculation method and detail the inputs and assumptions used to calculate the predicted road traffic noise. • identify the roads considered in the assessment and identify which are the closest and most potentially affected receivers adjacent to these roads. • address impacts of vehicle movements on public roads generated by the proposal during the night period.	Section 7.4 of the revised Noise and Vibration Impact Assessment (see **Appendix E**) includes a detailed assessment of road traffic noise, including identifying existing and proposed future road traffic noise levels at the most affected residential property on both the Pacific Highway (as a Freeway standard road) and Frogs Road (a local road). The assessment of noise levels included both daytime and night time periods, and identified that the increase in noise levels is negligible and is below the 2 dBA perceptibility threshold considered acceptable under the Road Noise Policy.
Hours of Operation	Provide justification for the need to operate 24 hours, 7 days a week including measures to reduce adverse impacts to the surrounding rural-residential land users.	The proposal has been refined in relation to hours of operation, with a view to meet the community's expectations whilst providing Hanson the flexibility to meet market requirements. In particular, Hanson in no longer seeking approval for operations to occur 24 hours per day 7 days a week. Instead, Hanson is seeking approval only to operate the quarry on a regular basis during the early morning shoulder, daytime and evening periods – being 5am until 10pm. Hanson will prioritise morning and normal daytime hours operations, with evening hours (i.e. 6pm – 10pm) to be added in response to market demand as required. In addition, Hanson is seeking approval for the operation of the Processing Plant, the Asphalt Plant, and the Concrete Batching/Recycling Plant (and associated transport) during the night time period (i.e. 10 pm to 5 am) for up to 20 nights per year, in order to meet this occasional customer demand (examples of such customer demand occurs when TfNSW is upgrading the Pacific Highway, which requires works to be undertaken at night time when highway traffic is lowest). It is highlighted that, based on the revised proposed operational hours, active quarrying will never occur during the night time period.
Air quality assessment	Modelling of the worst-case scenario The AQIA presented results for one modelling scenario that included quarry activities for the operations of the quarry and all the proposed plant. This modelling scenario was based on	The revised Air Quality Assessment Report as appended at **Appendix F** has been revised to assess two emission scenarios. This includes 'Typical day' and 'Maximum day' operations. The 'Maximum day' operational scenario is based on a production capacity of 2,600 tonnes per day, which reflects

Issue Title	Issues Summary	Hanson's Response
	annual throughputs. Given the predicted additional exceedances based on annual throughput, it is likely that modelling results based on a maximum daily material handling would result in higher project-related increments and extra additional exceedances.	the likely worst-case scenario for a 24-hour period associated with an annual production limit of 530,000 tpa.
	Cumulative assessment • Cumulative results for 24-hour PM10 concentrations indicate predicted additional exceedances at 13 different receptors (R1-R4, R12-R19 and R42) located to the west and south of the project boundary. The AQIA should also state the total number of predicted additional exceedances. These results should be presented in accordance with section 11.2.3 of the Approved Methods. • The Level 2 assessment (contemporaneous assessment) results only present the largest increment and the corresponding background on the day. This analysis needs to include a summary of various days, pairing the highest background concentrations with the corresponding predicted increments, as well as the highest predicted increment concentrations with the corresponding background concentrations on the same day.	Table 7.1 of the revised Air Quality Assessment Report (see **Appendix F**) identifies the total number of predicted exceedances as a result of the cumulative assessment in accordance with the approved methods. The proposed reduction in capacity will result in the cumulative concentrations of PM_{10} below the approved criterion at all sensitive receptors for the 24-hour and annual averaging periods with the quarry operating under typical day operations and maximum day when hours are limited to 5am to 10pm. When operating at 24-hour operations, one receptor (R13) was predicted to exceed the impact assessment criterion using the maximum day scenario and operating for 24 hours a day. The Level 2 contemporaneous analysis (presented at Table 7.2 of **Appendix F**) identifies that there would be three exceedances at this receiver.
	Potential impact on future sensitive receptors The Approved Methods require potential impacts to be assessed at the nearest existing or likely future sensitive receptors. Areas to the south and east of the project are currently under development and the AQIA must assess potential impacts for pollutants at these future sensitive receptors.	The revised Air Quality Assessment Report (see **Appendix F**) has been revised to include the approved methods to address the potential impacts at the nearest existing or likely future sensitive receptors. This includes an investigation into the potential pollutant, particularly located south and east of the project site. Receptor R13 located on the southern boundary of the site has been identified as the closest sensitive receptor with the highest predicted air quality impact. However, the location of R13 is currently subject to IN2 Light Industrial zoning, indicating that it will not likely remain as a sensitive residential receptor into the long term. Land to the east, west and south of the site has been identified for possible future urban development, which would introduce new sensitive receptors around the quarry. However, these receptors are further away from the quarry than existing receptors 4, 7, 9, 13, 15, 18, 19 and 20, and these receptors would remain representative of the nearest and most affected sensitive receptors.
	Revised modelling Provide revised modelling incorporating additional control strategies to achieve compliance with the EPA criterion at all sensitive receptors.	The revised Air Quality Assessment Report as provided at **Appendix F** includes revised modelling incorporating additional control strategies and demonstrates that compliance with the EPA criteria can be met for all sensitive receptors under typical day operations and maximum day operations when hours are limited to 5am to 10pm.

Issue Title	Issues Summary	Hanson's Response
	Source apportionment Modelling predicts large project-only increments. Source apportionment results to better understand what plant operations and/or specific activities are driving the predicted large PM10 increments.	The revised Air Quality Assessment Report as appended at **Appendix F** has been revised to address and justify the large PM_{10} increments for modelling. The proposed extraction rate has been lowered to reduce overall emissions, and source apportionment was completed using iterative modelling process to identify that the most significant contributor to particular matter concentrations, in particular at Receptor R13, were haul road emissions. As such, additional controls in the form of chemical dust suppression to all unsealed haul roads has been applied.
	Mitigation Provide a list of controls that are consistent with best practice control of fugitive emissions to minimise potential impacts.	Section 8 of the revised Air Quality Assessment Report as appended at **Appendix F** includes a list of mitigation controls to minimise potential impacts in accordance with best practice control of fugitive emissions. Table 9.1 of the revised Air Quality Assessment Report provides further management measures that would be implemented through an Environmental Management Plan.
	Annual emissions estimates The assessment needs to segregate estimated annual emissions for the activities carried out at the premises, including providing additional information used to calculation of the emissions inventory to enable replication of the emissions. In particular, please provide: • A table presenting the estimated annual emissions for the activities carried out at the premises in accordance with the Approved Methods. • Further discussion of the assumptions used in the calculation of the emission rates, including a table with all parameters used for their calculation. Further explanation of how the emission estimations for hauling activities accounted for the different stages of the quarry operations. Although, most of the emission rates were calculated based on maximum annual throughputs, the AQIA has not transparently presented the assumptions made regarding distances covered in the modelling scenario or how representative they are of the different stages and future operations.	Appendix A of the revised Air Quality Assessment Report as appended at **Appendix F** includes a detailed table presenting the emission inventory data and associated assumptions and parameters, and a figure illustrating the location of unsealed haulage roads and other modelled sources. Section 5 of the revised Air Quality Assessment Report includes a detailed discussion of how the emission estimations for fugitive emissions were developed. It is also highlighted that the emissions inventory remains a conservative representation of a 'reasonable worst-case', as not every activity will occur at each source location all at the same time (as has been modelled) and the source of emissions has been based on the Stage 4 layout when mobile sources are closest to off-site sensitive receptors.
Soil properties	Revise the need to extend the development and sediment basins into the very strong acidity Euroka Soil Landscape, or provide a more detailed assessment of the potential impacts and mitigation measures addressing the potential risk to water quality.	The revised quarry extraction area has been revised to straighten and move the western quarry boundary to reduce the impact of the acidic Euroka soil landscape. Highly acidic soils that are impacted will be managed through separation and placement in stabilised overburden stockpiles for future reuse and rehabilitation of the quarry. The stockpiles will be located within the disturbed area of the quarry which drain to the site's large capacity dams, and collected runoff will be reused for dust suppression. Any discharges from the dams will be subject to compliance with the pH criteria in the EPA's Environment Protection Licence. Refer to **Appendix B** for further detail.

Issue Title	Issues Summary	Hanson's Response
Water balance	Include the volume of water required to suppress dust on the overburden stockpiles in the site water balance.	Overburden stockpiles will be at planned locations around the quarry for stormwater diversion and acoustic attenuation bunds and stabilised with site won topsoil and vegetation as part of the erosion and sediment control strategy of the quarry. The need for dust control will be minimal and primarily in the establishment phase. Therefore, water demand for dust suppression of overburden stockpiles/bunds will generally not exceed 1ML per annum. Refer to **Appendix G** for further detail.
Port Macquarie-Hastings Council		
Economic benefits	Notes also the potential strong economic development benefits likely to flow to the community and local economy as a consequence of a reasonable expansion of the above quarry.	Noted.
Community concerns	Council notes community concerns with the processing of the application for the current plan to significantly expand the size, operating hours and extraction limits of the existing quarry with respect to: • Lack of interaction and consultation with the Project Consultative Committee; • Lack of transparent consultation with the broader community; • -The adequacy and integrity of the EIS forming part of the application and, as a consequence, requests the Department of Planning to put the project on hold pending further detailed analysis and public scrutiny.	As part of the RTS, Hanson has reviewed and responded to the issues raised in over 200 submissions from the general community. It is therefore considered that all interested parties in the general community have been provided the opportunity to have their say on the proposal. In response to these issues Hanson has: • revised aspects of the proposal to reduce potential environmental impacts, in particular by reducing the extraction rate and limiting the hours of operation • undertaken further environmental impact assessment • made additional commitments to mitigate, manage or offset the predicted residual environmental impacts. We note that, in accordance with the EP&A Act and standard procedure, the Department's assessment of the project has essentially been on hold whilst the RTS has been prepared by Hanson.
Strategic planning: Fernbank Creek and Sancrox	It is requested that Council's strategic planning documents on the Fernbank Creek and Sancrox Planning Investigation Area be considered as part of the assessment process, noting that they refer to the significant regional resource the existing quarry provides and the importance of ensuring that future development in the area does not sterilise this resource, whilst still providing for the long term population growth of the Port Macquarie-Hastings.	A Draft Structure Plan for Fernbank Creek and Sancrox Planning Investigation Area was released for public exhibition in September 2020. Importantly, Section 4.9 of the discussion paper specifically identifies that the Sancrox Quarry is a 'significant regional resource', that 'protection of the resource is considered to be a high priority', and that the Structure Plan will need to "…ensure any identified urban areas will not sterilise the resource". The Discussion Paper identifies that a key objective that will inform the preparation of the Structure Plan is to "Ensure land use does not restrict or prohibit the development potential of important extractive resources. Given the strategic imperative under Ministerial Direction No 1.3 - Mining, Petroleum Production and Extractive Industries, and the way this has been correctly transposed into the Discussions Paper, it is clear that the obligation is on surrounding land owners, developers and Council to justify any future rezoning of and immediately adjacent to the Sancrox Quarry site, rather than there being any obligation on Hanson to unreasonably provide enhanced (costly) mitigation measures in relation to potential future sensitive receptors on immediately surrounding areas in advance of any detailed planning being undertaken to establish the nature and extent of these possible future urban areas. Further, in relation to noise and air quality impacts, it is highlighted that the existing residential receiver locations that are on the western and southern boundary of the site will

Issue Title	Issues Summary	Hanson's Response
		remain representative of the nearest and most affected sensitive receptors, and so compliance with the relevant criteria at these locations will essentially ensure compliance in the possible urban areas around them.
Reliance on reticulated water supply	The EIS has not adequately detailed the proposal development's reliance on reticulated water supply. Further details are required on intended usage.	Potable water will be required from Council mains water supply to support the demand of approximately 1,250 litres per day, or around 0.5ML per year, to maintain the site's amenities. Refer to **Appendix G** for further detail.
	It is requested any approval include the following requirements: • Prior to commencement of works or issue of a construction certificate (whichever occurs first), Payment to Council of developer charges, under the Water Management Act 2000. The contributions are levied in accordance with the provisions of the relevant Section 64 Development Servicing Plan towards the augmentation of the town water supply headworks. The contribution amounts are subject to adjustment in accordance with CPI increases adjusted quarterly and the provisions of the relevant plans. • A Certificate of Compliance under the provisions of Section 307 of the Water Management Act must be obtained prior to the commencement of the use or issue of any occupation certificate (whichever occurs first).	Noted. Hanson is willing to accept Council's standard conditions in relation to servicing contributions.
Haulage	The EIS has not adequately addressed impacts on the haulage route relating to Council managed roads. Council has typically entered into planning agreements with extractive industry proponents, at a per tonnage rate, to adequately compensate for the impact on the local road network attributed to heavy vehicle usage generated by such developments.	Noted. Hanson is willing to accept a condition requiring payment of a per tonnage rate per km of Council managed roads at that same rate agreed by other operators, noting that the vast majority of Hanson's trucks would use less than 500 metres of Council managed roads before accessing the Pacific Highway.
Biodiversity	The ecological surveys are not deemed to be sufficient to assess all ecological impacts on fauna and flora.	The ecological surveys have been revised and updated to include all flora and fauna communities. This includes the addition of detailed Koala surveys. See the revised Biodiversity Assessment Report at **Appendix H**.
	It is also noted that sub-regional habitat corridor runs through the site. This sub-regional corridor is not avoided and will be greatly impacted by the development footprint. This is not adequately addressed in the EIS and it is noted that ecological investigations on surrounding properties have identified the corridor as significant for the local koala population.	A detailed survey and investigation into the local Koala population has been conducted with the support of Koala experts at BioLink Ecological Consultants. The proposed expansion of the Sancrox Quarry will remove approximately 42.6ha of potential Koala habitat. A Koala survey and assessment report has been provided at **Appendix D** and the Biodiversity Assessment Report has been updated (and provided at **Appendix H**) to include species offset credits for the impacts to Koala habitat. The western side of the quarry pit has been pulled back to reduce the impacts on the north-south biodiversity corridor, which will be retained, although narrower, on the western side of the quarry pit. It is highlighted that the Biodiversity Assessment Report accounts for through site connectivity as part of the credit calculation, and so the impact on connectivity

Issue Title	Issues Summary	Hanson's Response
		impacts associated with reducing the width of this biodiversity corridor have been accounted for in the biodiversity offset calculation. See also further discussion in **Section 6.3**.
Air Quality	The list of mitigation measures is quite extensive and will require the imposition of appropriate development consent conditions and probable revision/changes to the NSW EPA Environmental Protection Licence (EPL). Any approval of the proposal should include conditions reflecting both the recommended list of mitigation measures and where appropriate, incorporate relevant assumptions etc made in relation to the mitigation measures, such as: • The dust extraction system for blasting contains 99% of all dust emissions during each bench blast being installed • The asphalt plant is completely enclosed • Bitumen vapour balancing and recovery systems are provided • Sealed haul roads with sweeps when needed • Land clearing/disturbance being kept to a minimum • Site rehabilitation being carried out on a progressive basis • Deliveries are randomised between 6am and 6pm each day • Vehicles travelling onsite at a maximum 30KPH • Limiting the number of loads of materials being delivered to the site each day • Watering and dust suppressions systems being installed and used properly such as Level 2 watering of unsealed roads.	The revised Air Quality Assessment Report as appended at **Appendix F** comprises a list of mitigation measures which will be subject to the development consent conditions and NSW EPA Environment Protection Licence, and Hanson's commitment to implementation of these mitigation and management measures is reiterated by their inclusion in **Table 3** (see **Section 7** below).
Department of Planning, Industry and Environment – Water		
Pre-Approval	Groundwater Assessment, Licencing and Monitoring • Assess and classify the groundwater model against the Australian Groundwater Modelling Guidelines and have the model peer reviewed. • Provide details on acquiring suitable surface/groundwater entitlement to cover estimated take. • Correctly identify potentially impacted water sources and revise its Aquifer Interference Policy (AIP) (DPI 2012) assessment as required.	A groundwater response has been prepared by ERM and is provided in **Appendix G**. In summary: • The groundwater model has been classified under the Australian Groundwater Modelling Guidelines as a 'Class 1' groundwater model. • Entitlements under the Water Sharing Plan for the North Coast Fractured and Porous Rock Groundwater Sources 2016 are available. • The Aquifer Interference Policy assessment remains accurate and does not need to be revised.

Issue Title	Issues Summary	Hanson's Response
Post Approval	Groundwater Licencing and Monitoring • If a Water Access Licence (WAL) is required, it must be obtained prior to the commencement of works. • Develop a groundwater monitoring plan in consultation with DPIE Water including threshold trigger values as well as a contingency strategy if triggers are exceeded. • Develop a water quality monitoring plan for the in-pit sump(s) and existing monitoring bores while they remain accessible.	Hanson would accept conditions of consent consistent with the requirements.
	Surface Water Assessment • Establish a sediment control structure adjacent to the northern aggregate stockpile to the southeast of the Project area.	Hanson would accept conditions of consent consistent with the requirements.
Department of Planning, Industry and Environment – Division of Biodiversity and Conservation		
Biodiversity	A revised Biodiversity Assessment Report should be submitted which addresses all of the requirements of the Framework for Biodiversity Assessment, including: • Providing updated and finalised biodiversity data and information • Further consideration of indirect biodiversity impacts • Further information and justification in relation to koala habitat • Further justification for connectivity impacts • An updated and finalised FBA calculator	A revised Biodiversity Assessment Report is appended as **Appendix H**, which has been prepared in accordance with the Framework for Biodiversity Assessment and to address the Division of Biodiversity and Conservation's issues, in particular in relation to assessment of impacts on Koala. Refer to **Section 6.3** for further information regarding the ecological impact on the existing local koala habitat on the site.
Aboriginal heritage	Further attempts should be made to engage with registered Aboriginal Parties.	As identified in the Aboriginal Cultural Heritage report provided at Annex D of the EIS, four groups registered an interest in being consulted for the project being: • Birpai Traditional Owners; • Birpai Local Aboriginal Land Council (BLALC); • Yanggaay; and • Norm Archibald. Efforts to engage are outlined as follows, and further details are available in **Appendix D**: • On 15-16/11/2017, the project was surveyed by an ERM Heritage Consultant and Jason Holten on behalf of the Birpai Local Aboriginal Land Council and Birpai Traditional Owners Indigenous Corporation. • Consultation was held on 17/10/2017, and each registered Aboriginal stakeholder received an outline of the scope and the proposed survey methodology. No comments were received from any of the Aboriginal Stakeholders. • On 19/1/2018 a draft copy of the ACHAR was provided to all interested Aboriginal parties. Responses received comprised of support from the Burpai Traditional Owners and Birpai Local Aboriginal Land Council, with no responses from the other registered parties.

Issue Title	Issues Summary	Hanson's Response
		• Several efforts and attempts to contact to the Yanggaay and Norm Archibald parties, including during 2020 a part of the preparation of the RTS and in response to the Division of Biodiversity and Conservation's submission, with no additional comments received.
	The development footprint should be amended to preserve the scar tree.	The proposed extraction area has been reduced on its western side, meaning that the potential scar tree is located outside of the quarry pit footprint to the west of the extraction area. Hanson has agreed to a commitment to ensure all revised construction and extraction plans will clearly mark the tree, and consideration will be given to installation of temporary fencing during the final stages of quarrying to ensure there is no accidental damage to the tree.
	The Aboriginal Cultural Heritage induction for workers should be presented by (or involve) a representative of the RAPs, and the content should be formulated by, or reviewed prior to finalisation, by the RAPs to ensure it is culturally appropriate.	Hanson provides a commitment that all employees and subcontractors undergo environment awareness training as part of the site induction. Only information endorsed by RAPs will be included, and a representative of the RAPs will be invited to participate in the induction sessions for major contractors.
	The proposed Chance Finds protocol should be amended to require authorisation from the Department of any proposed salvage of Aboriginal objects discovered during works.	A revised Chance Finds Procedure has been provided in Appendix B and includes authorisation from Heritage NSW.
NSW Rural Fire Service		
Post Approval	NSW Rural Fire Service recommends the following conditions be applied to the development: • A Fire Management Plan be prepared in consultation with the NSW Rural Fire Service. • 20,000L water supply tank to be located adjacent the internal property access road. • A 10m defendable space with unobstructed vehicle access to be provided around the perimeter of the fixed infrastructure.	Hanson is willing to accept the NSW Rural Fire Service's recommended conditions.

5.0 Response to public submissions

This section provides a response to the key issues raised in the submissions from the public, including special interest groups and private organisations.

5.1 Heritage

Issues Raised
Key heritage issues raised in public submissions were in relation to the following:

- The impact upon aboriginal heritage sites including the nearby scar tree and ceremonial site of cultural significance.
- The negative impacts on the rights of Indigenous people to land and resources held collectively.

Response to Issues
In response to these issues:

- A Heritage response has been prepared by ERM as appended as **Appendix B**. This report confirms that the proposed quarry pit expansion has been reduced to ensure it will not result in adverse impact on the nearby scar tree heritage site. The scar tree will be identified on all construction and operational plans to remain protected.
- The ceremonial site is located approximately 3km southwest of the Sancrox Quarry, and thus is not in close proximity to the proposed works.
- Engagement and consultation with interested Aboriginal Parties was conducted. No objections were raised in regard to the methodology and protocol adopted for the proposed works.
- All employees and subcontractors will undergo environmental awareness training as part of the site induction to ensure they understand their obligations and responsibilities. Only information endorsed by Registered Aboriginal Parties will be included, and a representative of the Registered Aboriginal Parties will be invited to participate in the induction sessions for major contractors.

5.2 Traffic and transport

Issues raised
Key traffic issues raised in public submissions include:

- Increased volume of traffic, and associated noise and fumes, will further deteriorate the conditions of Rawdon Island Road / Sancrox Road.
- The traffic impact assessment did not properly account for the growth in traffic from other industrial development and planning proposals in the local area, including rezonings which will increase the population density.
- Increased heavy vehicle traffic will compromise the safety of pedestrian and cyclists on Sancrox Road and Rawdon Island Road.
- Additional heavy vehicle trips on Sancrox Road will result in increased risks for motorists, in particular during night-time hours when there is reduced visibility. This will result in bottlenecks on local roads to avoid heavy vehicle movements.

Response to issues
A Traffic response has been developed by ERM as appended as **Appendix B**. In response to these issues:

- Increased heavy vehicle traffic on the western parts of Sancrox Road and Rawdon Island Road will be limited as vehicles travelling to the site was predominantly use the Sancrox and Oxley Highway interchanges with the pacific Highway, and their associated service roads, as more suitable routes. Heavy vehicles movements west of the site will be limited to supply markets within Sancrox locality, which will be less than 1% of the total annual truck trips.

- The proposed quarry extraction rate has been reduced by almost 30% meaning quarry haulage vehicles will similarly reduce by almost 30%. Using the same assumptions as set out in Section 12.3.2 of the EIS, the quarry development will therefore generate approximately 122 new heavy vehicles per day or a combined total (taking into account existing heavy vehicle movements) of approximately 164 truck movements per day.
- The heavy vehicles will almost exclusively access the site via the Sancrox Road interchange with the Pacific Highway, which was constructed in 2015 to modern highway design standards, and took into account the expansion of the Sancrox Quarry as well as the development of the Sancrox Employment Precinct, and remains sufficient to accommodate the lower levels of additional heavy vehicle traffic rising from the proposed quarry expansion as now proposed. Hanson would expect to pay a per tonnage rate per km travelled on Council-managed roads in order to contribute to the ongoing maintenance of the local road. If further urban or residential development is progressed by Council in the vicinity of Sancrox Road, then the additional traffic on Sancrox Road or though the Pacific Highway interchange would need to be accounted for in the strategic planning stages of the urban development proposals.
- Upgrades to the road network undertaken by RMS in 2016 allow for safe pedestrian and cyclist movements along Sancrox Road and through the Quarry Access Road roundabout.
- Night-time operations have been largely removed, and are now proposed to occur a maximum of 20 days per year which will result in low cumulative road risk during night-time hours.

5.3 Hours of Operation

Issues raised

Issues raised regarding the hours of operation were primarily concerning the level of noise impact for the nearby residential areas caused from the quarry operating 24 hours and 7 days a week. Some of the ways the community has expressed their concern are noted below:

> *I am totally against any further operating hours or days for this current operation. A quarry operating 24/7 will negatively impact on our peaceful lifestyle. There will be no respite from constant noisy plant and equipment. Despite noise mitigation measures, the rural ambience is already reduced and any extra noise generation, especially at night, will only make it worse.*
>
> *I strongly object... As a nearby resident I feel that if this quarry is approved as advertised, my peaceful lifestyle will be significantly impacted by this quarry operating around the clock seven days a week particularly with increased noise, dust, truck movements and blasting.*
>
> *A facility operating 24hrs per day is not an appropriate development to be located right in the middle of the fastest growing residential area in one of the fastest growing regional LGA's in NSW.*

Response to issues

The proposed expansion of the quarry has been revised to operate to restricted hours of 5am until 10pm. Hanson will prioritise morning and daytime hours operations, with evening hours (i.e. 6pm – 10pm) to be added in response to market demand as required. Operation of the Processing Plant, the Asphalt Plant and the Concrete Batching/Recycling Plan and associated transport will be restricted to 20 nights per year to meet the occasional customer demand (which is generally associated with major infrastructure projects that require construction works to be carried out during the night time). As such, noise will only be generated by the site for up to 20 nights per year. Notwithstanding this, noise assessment has been carried out for both on-site operations and traffic noise in the night-time period, which deconstrues that the night-time Project Specific Noise Levels would be complied with for these 20 nights per year when operations may occur.

5.4 Biodiversity

5.4.1 Ecological Assessment and Offsets

Issues raised

Key biodiversity issues raised in submissions include:

- The loss of the biodiversity community corridor which serves a critical link for vegetation connectivity within the Greater Sancrox Structure Plan.

- The clearing of land which will result in habitat fragmentation and significant adverse impacts on existing native vegetation. Impacts on local flora and fauna communities.
- No mention of the existing hollow-bearing and nest box trees as part of the offset area or proposed offset strategy.
- Isolation of fauna that remains in the proposed offset area. The disconnect within the offset area will greatly reduce its ecological viability.
- Insufficient information on the effect of the proposed light and noise pollution on flora and fauna populations.
- The supplementation of "eco-credits" will not replace the loss of the habitat.
- Inadequacy of the fauna surveys which fail to acknowledge the presence of parrots and Regent Honeyeaters.

Response to issues

A revised Biodiversity Assessment Report has been prepared by SLR and is appended at **Appendix H**. The revised Biodiversity Assessment Report has also been supplemented by a Koala Survey and Assessment report prepared in collaboration between SLR and BioLink Ecological Consultants, which is provided at **Appendix D**. In response to these issues:

- The western side of the quarry pit has been pulled back to reduce the impacts on the north-south biodiversity corridor, which will be retained, although narrower, on the western side of the quarry pit. It is highlighted that the Biodiversity Assessment Report accounts for through site connectivity as part of the credit calculation, and so the impact on connectivity impacts associated with reducing the width of this biodiversity corridor have been accounted for in the biodiversity offset calculation.
- The clearing of habitats and native vegetation will be offset through new planting and revegetation of an Offset site of approximately 49 ha, to the northern portion of Lot DP 574308. The proposed revegetation of the northern portion of the site (Lot DP 574308) is designed to support the biodiversity corridor of native vegetation west of the quarry pit, and to maintain the north-south corridor link of canopy trees, in accordance with the sub-regional corridor in the Greater Sancrox Plan.
- The proposed offset area will partially compensate the loss of vegetation and deliver permanent ecological conservation outcomes providing habitat for native wildlife in the local area.
- The post-mitigation measures ensures minimal light and noise impact on flora and fauna species. The revised Biodiversity Assessment Report includes further assessment of edge effects, concluding that edge effects are unlikely to adversely affect local populations of native flora and fauna, and that there are not likely to be any threatened species affected by edge effects, as no such species are likely to be inhabiting the fringes of the proposed pit footprint, or rely on those areas for their breeding or other life cycle processes.
- The Framework for Biodiversity Assessment and the NSW Biodiversity Offsets Policy for Major Projects is an endorsed framework developed and supported by the NSW Government. The purchase and retirement of biobanking offset credits offsets the impacts on biodiversity values arising from clearing associated with development, and ensures the land that is used to offset impacts is secured in-perpetuity, in a way that is designed to ensure that no net loss of biodiversity values are caused as a result of clearing.
- The revised Biodiversity Assessment Report recognises the presence of Regent Honeyeaters which likely use the site for winter forage.

5.4.2 Koala Habitat

Issue raised

The lack of consideration to the existing koala habitat was raised as a significant issue amongst the submissions. The public commented on the importance of preserving the site for the local koala population as a result of the recent bushfire decimating large areas of koala habitats, thus threatening the survival of the species. Submissions also identified the site as a medium to high koala activity corridor with the recent Draft Coastal Koala Plan of Management 2018 produced by PMHC identifying the area core koala habitat. Further, no mention is made of the impact upon the Billabong Wildlife Park and Koala Sanctuary less than 1 km from the pit.

Response to issue

In response to this issue Hanson engaged SLR and BioLink Ecological Consultants to collaboratively carry out a Koala Survey and Assessment, which is provided at **Appendix D**. The results from the Koala Survey and Assessment have identified that the site contains Koala habitat, and have informed the revised Biodiversity Assessment Report. In particular, the proposed development has been modified to reduce impacts on Koala, including to reduce the impact on the north-south corridor on the western side of the quarry pit, and the proposed biodiversity offset strategy has been amended to include the retirement of 1,026 species credits for Koala.

The proposed development will not cause adverse off-site impacts on biodiversity values or the operating environment of facilities of a commercial or community nature, so will not impact on the operations of the Billabong Wildlife Park and Koala Sanctuary.

5.4.3 Endangered Ecological communities

Issues regarding the loss of the following threatened species, endangered ecological communities and biodiversity values were raised:

- Flax Leaved Paperbark
- Pricky-leaved tea tree
- Swamp oak and Mixed Eucalyptus trees
- Hollow bearing trees
- Spotted Gum-Grey Ironbark Open Forest
- 0.55 ha of subtropical coastal floodplain forest
- *Eucalyptus teriticornis*
- Forest Red Gum
- Loss of 27 threatened species identified so far, including 17 birds and 9 mammals, including 7 vulnerable bats.

The community raised significant concern of the impact the loss of these biodiversity values would have on species who nest and reside in the area. This includes the critically endangered Swift parrot, forests owls and glossy Black Cockatoos. Many gliders and possums also live within the area.

Response to issue

A revised Biodiversity Assessment Report has been prepared by SLR and is appended at **Appendix H**. In response to these issues the revised Biodiversity Assessment Report identifies nine threatened ecological communities in accordance with the Wildlife Atlas. Only one of the nine identified threatened ecological communities are identified in the close vicinity of the site – being the Subtropical coastal floodplain forest, which is located in the south western corner of the site, but would no longer be directly impacted by the quarry development footprint as a result of the proposed quarry extent being reduced.

The threatened species and other biodiversity values identified in the submissions are highly unlikely to be adversely impacted by the proposal because:

- There is no suitable breeding habitat for most of the species within the site. For those species that have been recorded within the area of development there are not likely to be local populations present wholly within the site or reliant on the site for their survival in isolation. Any such populations present within the locality will not be rendered locally extinct by the proposed development because of the large ranges of these species and the poor quality and condition of the habitats present within the site.
- The site is not assessed as likely to contain habitat critical to the survival of a species.
- The site is not likely to support an ‘important population’ of any threatened species.
- The proposed mitigation measures are considered sufficient in mitigating and reducing the impact on any threatened species.

5.5 Vibration – operational and blasting

Issues raised

Key vibration issues raised in submissions include:

- Excessive ground vibration impacting nearby residences.
- Impact of increased blasting and crushing for 24/7 operations.
- No risk assessment and impacts of clearing or ripping was conducted as part of the EIS.
- Lack of mitigation measures to manage daily blasting impact on traffic. Consideration of adopting the blast guarding code of conduct prepared by the Australian Explosives Industry and Safety Group.
- Lack of fly rock control and management of post blast gasses that are harmful.
- Lack of response plans in the case of an incident.

Response to issue

In response to these issues:

- A revised Noise and Vibration report has been prepared by ERM and is appended as **Attachment E**. The report sets out the ground-borne vibration and air-blast overpressure limits that the operation must comply with at any time during operations (including blasting activities).
- No vibration or ground-borne noise is expected to be generated during the construction and operation of the quarry (not including blasting), and the combined 100m distance offset to nearby residential receptors will result in minimal impact.
- Blasting will be limited between the hours of 9:00am and 3:00pm Monday to Friday in accordance with the existing EPL. It is predicted that blasting activities will not cause an exceedance of the vibration limits required by the EPA in accordance with the site's EPL. In particular, the airblast overpressure level from blasting operations at the premises must not exceed 120dBZ (L_{Peak}) at any time at any residence or noise sensitive locations, and must not exceed 115dBZ (L_{Peak}) at any residence or noise sensitive locations for more than five per cent of the total number of blasts.
- A Flyrock assessment of Sancrox blasting specifications was undertaken as part of the Buffer Zone Assessment. A Blast Management Plan is currently in use at the site, and will continue to be used to ensure the adequate design and management of blasting activities on site. A number of design management measures will be adopted and applied during quarry operations to minimise the potential fly-rock, and to protect the safety of people, property and livestock. The Blast Management Plan has been informed by blast modelling, setting blast parameters for the site and determining the blast exclusion zone. This minimises the likelihood of fly-rock outside of the exclusion zone, to protect the safety of people, property and livestock.
- Hanson has committed to the preparation of updated Emergency Response Plans for the quarry expansion.

5.6 Noise

Issues Raised

Key noise issues raised in submissions include:

- High noise levels of operations disrupting the sleep of nearby residential receivers.
- The noise of additional truck activities and operations occurring 24 hours and 7 days a week.
- Lack of appropriate noise buffers to prevent noise.
- Request for a noise bund to be installed the eastern boundary adjacent to the Expressway Spares Property, which would also act as a visual screen.
- Explanation of background noise recorded must be provided given the rural setting and various other industrial operations.
- Noise impacts upon native animals breeding and nesting in the area.

- The noise modelling as part of the EIS does not provide contour diagrams and does not clearly identify how neighbouring properties are affected.

Response to issue

A revised Noise and Vibration Assessment Report has been prepared by ERM and is appended as **Appendix E**. In response to these issues Hanson has amended the proposal to limit night-time operations to a maximum of 20 nights per year when market demand requires it (such as for major road construction that must be carried out at night-time), and to reduce the proposed extraction rates. Collectively, these amendments to the proposal will result in a significant reduction in the generation of noise from the site during operational activities. Specific responses to the issues listed above are provided as follows:

- The maximum noise levels of the general quarry operations are not predicted to exceed sleep disturbance criteria for any residential receptors surrounding the site.
- Impacts associated with road traffic noise are not anticipated for night time/morning shoulder periods with the amended proposed hours of operation.
- The proposed mitigation measures are considered appropriate in mitigating noise emissions from the quarry operations. Additionally, the quarry layout is designed with significant separation and will remain wholly within the quarry footprint to prevent excessive noise.
- The noise mitigation measures include the installation of a large earth bund on the southern property boundary, approximately 20 metres high and approximately 450 metres long to shield noise from the closest and most highly affected sensitive receiver.
- Existing background noises were conducted during unattended noise logging and quantified via attended monitoring. Further monitoring was carried out in 2020 as part of the Response to Submissions to validate the background noise levels. Measured background levels vary between 46 and 48 dBA during the day, between 39 and 47 dBA in the evening and between 32 and 47 dBA in the night. Measurements were dominated by Pacific Highway traffic, wind-blown vegetation, some local traffic, birds and insects. Site operational noise was inaudible or barely audible for the majority of measurements.
- Noise impacts as a result of the proposed development will result in a reduction in habitat quality. This will be appropriately managed and mitigated through the proposed mitigation measures.
- The Noise and Vibration report has been updated to reflect noise contours. Neighbouring properties have been identified as nearby sensitive receptors, where they are unlikely to be significantly affected.

5.7 Water Management

Issues Raised

Key water management issues raised in submissions include:

- The use of water for dust suppression in dry periods is inappropriate considering existing water restrictions and drought.
- The EIS does not identify any mitigation measures for the significant loss of volume in water from the groundwater aquifer.
- Impact upon the north and west alluvial flood plains of the Hastings River and Haydons Creek.
- impact on natural water flows, local water supply and groundwater are not adequately addressed in the EIS
- long term viability of Fernbank Creek as a result of surface water loss
- Impact of groundwater drawdown on residential properties
- Lack of scenario modelling for the existing operations and proposed development.

Response to issue

A supplementary water management response has been prepared by ERM and is appended as **Appendix G**. In response to these issues:

- The use of water is required for quarrying operations. Given the concern of drought conditions, demand management and water reuse initiatives will be adopted, with other dust suppression strategies such as surfactants and tackifiers implement.
- Water will be sourced by harvesting accumulating in disturbed areas of the quarry and groundwater seepage into the quarry pit. Any impact to groundwater access or availability will be remedied through modifying the supply bore and the affected location or an alternative water supply.
- The footprint of the proposed expansion is approximately 57 ha and result in a reduction of 24 ha corresponding to approximately 3% in the Haydon Creek Catchment and 10 ha approximately 1% of the Fernbank creek catchment.
- The proposed expansion will result in a lower contribution of flows compared to the existing catchment area as a result of the transformed catchment and significant woodland and vegetation assisting rainfall runoff. The impact of environmental flows, both in terms of frequency and characteristics is deemed to be negligible.
- Although the proposed expansion will affect an addition 10 ha (approximately 1%) of the Fernbank Creek catchment, all discharge from the quarry's water management system will discharge to Fernbank Creek and thence Hastings River. Potential reduction in flow within the Fernbank catchment may be reduced due to the site discharge location lying within the Fernbank catchment area.
- Seepage into neighbouring landowner properties results in minimal entrained sediment and is likely sourced from surface stormwater.
- Groundwater modelling was conducted by ERM and peer reviewed by REN Consulting. The peer review concluded that, whilst ground water model is appropriate in predicting long-term impacts of the proposed development in low value aquifers, the peer review report at **Appendix C** sets out a series of recommendations to further develop and improve the confidence-level of the groundwater model during detailed quarry planning and design.

5.8 Air quality

Issues Raised

The key issues regarding air quality were raised:

- Dust contamination to tank water and excessive fossil fuel emissions including a high level of carcinogenic diesel emissions and bitumen fumes resulting in health impacts.
- Increased volumes of dust diminishing the use of solar panels to power hot water, heating and electricity for nearby residents.
- Western prevailing winds across the quarry will result in dust clouds.
- The EIS fails to address the plumes of dust and fumes which extend beyond the identified receptors with no identified measures for effective real time 24/7 monitoring at multiple locations.
- The EIS has not included any modelling of air quality for the current and proposed quarry and its equipment.
- The construction and operation of the proposed Asphalt Plant will release hazardous pollutants and other agents deleterious to health.
- The EIS fails to include a real time monitoring regime to ensure emissions are detected and alarmed for automatic plant shutdown to prevent plumes affecting the residential area.

Response to issue

An updated Air Quality Assessment has been prepared by ERM to address issues raised as appended at **Appendix F.** In response to these issues:

- The assessment comprises of modelling for ambient air quality impacts and greenhouse gas emissions form construction and operations of the proposed expansion.
- The updated report provides dispersion modelling for 'typical day' operations and 'maximum day' operations. Iterative modelling was also completed to understand key source characteristics and test the effectiveness of dust control strategies.

- The updated modelling demonstrates that the sensitive receptors will result in a reduction in dust deposition compared to the initial proposal with the cumulative annual mean concentrations of PM10 below the EPA's criteria. Further, additional dust mitigation measures are in place for ongoing management of the project. Given the proposed dust dispersion is compliant with the EPA criteria, it is considered that there will be no impact on the operation of solar tanks and no need for remediation for water tanks.
- It is anticipated that an exceedance of the EPA 24-hour average PM_{10} criterion will occur at receptor R13 when operating under maximum daily throughput scenarios over a 24-hour period. Given that the site will be operated on a reduced hours basis (i.e. not over 24 hours), except for up to 20 nights per year, it is considered highly unlikely that night-time operational activities will occur at the same time as the meteorological conditions that would be necessary to result in the exceedance occurring. It is proposed to implement real-time dust monitoring adjacent to the boundary with receptor R13 along with reactive management of the quarry activities to ensure that quarry activities can be modified if night-time activities are required during adverse meteorological conditions.
- The proposed mitigation measures including a range of dust suppression techniques for exposed surfaces, haulage roads and stockpiles, will prevent the formation of dust clouds.
- The Asphalt plant will include one fully enclosed pug mill located on site with a vapour balancing system for the safe delivery of bitumen on site. A vapour recovery system will be employed for transfer of asphalt to trucks to minimise odour and dust emissions. Moreover, the asphalt plant will be totally enclosed to ensure all particulate matter emissions will captured.

5.9 Socio-economic impacts

Issues Raised

The key socio-economic issues raised in public submissions include:

- Loss of amenity for residents and the impact on their physical and mental health
- Negative impacts to property values
- Impact on surrounding businesses

Response to issue

In response to these issues:

- The expansion of the quarry's potential impact on the amenity of nearby residents has been considered, particularly in relation to the dust, noise and visual issues. Hanson will implement a range of mitigation and management measures to minimise residential amenity impacts and ensure that the quarry operates with best practice community engagement and complaints handling procedures to minimise the impacts on the local rural character experienced by the local community.
- Property prices are a complex aggregation of a large number of factors. The residual local amenity impacts have been assessed as minimal, and there are a range of management and mitigation measures that would be implemented to further minimise residual impacts. Conversely the beneficial aspects of the development are significant – including the initial capital investment, temporary construction employment, and ongoing permanent employment, that will support income and employment within the local community. Hanson operates a number of other quarries in NSW that have undergone expansions similar to the expansion proposed at Sancrox. None of these projects have resulted in any evidence that surrounding properties have reduced in value as a result of the quarry's expansion.
- As identified in the Socio-Economic Impact Assessment appended to the EIS, the potential impact to surrounding businesses will be managed in accordance with regulatory requirements to ensure acceptable limits are met at nearest receptors.

5.10 Other issues

Issues Raised

Other issues raised in public submissions include:

- The quality of the EIS and fieldwork conducted was insufficient.

- Visual impact.
- Engagement and consultation prior to the lodgement of the expansion application was insufficient.
- RU1 zoned land approved for subdivisions (some 142 allotments) on adjacent land.
- Estimated 48.4 million tonnes of Carbon Dioxide emissions increasing climate change.
- No principal hazard analysis or principal risk assessment study has been conducted. The EIS does not detail the management of ammonium nitrate, emulsion, detonators and other matters are carried out to prevent a catastrophic explosion that could impact beyond the site.
- Concern of mitigation measures will not be followed through.
- No mention of the East Coast High speed rail corridor runs through the middle of the quarry.
- Hanson's poor operational history and condition for quarry closure in 2005.
- Need of expansion given the several existing quarry resources in the region.

Response to issue
In response to these issues:

- The fieldwork and studies conducted at the time was considered appropriate and supported the EIS. A number of environmental assessments including noise, biodiversity and air quality has been revised to provide the most accurate and likely impacts of the proposed expansion.
- Given the location of the quarry amongst extensive existing vegetation, the surrounding topography and the proposed long-term rehabilitation and revegetation activates, the visual impacts associated with the project are considered negligible.
- Hanson has made genuine efforts to consult with the local community in order to understand their issues and concerns and has made substantive amendments to the proposed quarry in order to avoid, minimise and manage potential impacts.
- The assessment of noise and air quality impacts has been undertaken for the closest residential receivers located adjacent to the site boundary.
- The Air quality assessment prepared with the original EIS details that the projects contribution of greenhouse gas emissions represent approximately 0.0010% of Australia's commitment for annual emissions under the Kyoto Protocol. Appropriate mitigation measures to minimise emissions are provided.
- A risk screening assessment of potential hazards has been carried out in accordance with State Environmental Planning Policy 33 – Hazardous and Offensive Development (SEPP 33), presented at Section 15 of the EIS. The risk screening process concludes that the storage and transportation of hazardous materials would be below the Applying SEPP 33 thresholds, demonstrating that operational inventories of hazardous materials would not pose a significant risk of harm beyond the site boundary, and that risks associated with transportation are similarly unlikely to be significant. Ammonium nitrate, emulsion, detonators and other materials and equipment used for blasting will not be stored at the site. When required they will be brought to the site by specialist blasting contactors for each blast.
- Hanson is committed to complying with all mitigation measures and adhering to all the conditions of consent. Operating under these requirements will ensure the highest level of environmental protection and reduced impact on nearby uses.
- In the event of the east coast high speed rail being delivered, the quarry land will be acquired by the transport authorities. Given the very long lead times likely for the east coast high speed rail, it is likely that Hanson will have completed quarrying before the project is progressed.
- The proposed expansion will contribute to the supply of hard rock and is considered a major economic resource for regional and state development.

6.0 Further Environmental Assessment

6.1 Surrounding Residential Areas

A summary of the proposed and approved residential areas surrounding the site is provided below, and illustrated in **Figure 3** (which overlays the proposed and approved residential areas over the sensitive receptors map from the revised Nosie and Vibration Assessment Report at **Appendix E**):

- Le Clos Verdun (also known as Riverpark Sancrox): An approved rural residential subdivision located approximately 600m west of the site. Rural residential dwellings, once built, will be located significantly further from the site than existing rural residential dwellings identified as sensitive receptors R9, R10, and R11.
- Le Clos Sancrox: An approved rural residential subdivision located southwest of the site. Rural residential dwellings, once built, will be located significantly further from the site than existing rural residential dwellings identified as sensitive receptors R9 and R10. As identified in **Section 1.8.5**, the Le Clos Sancrox Planning Proposal has recently obtained a Gateway approval from the Department of Planning, Industry and Environment, meaning it will now proceed to public exhibition. The Planning Proposal relates to land south-west of the quarry site, south of Sancrox Road in part of the Sancrox B3 Area labelled in **Figure 3** as 'Le Clos Sancrox'. Importantly, any future residential property within the Le Clos Sancrox Planning Proposal area would not be closer to the site than the existing rural residential property at 162 Sancrox Road – meaning compliance with established Project Specific Noise Levels at the existing residential property would ensure compliance at the future residential properties.
- Thrumster: A recently developed urban area (and ongoing) located over 1km to the southeast. Due to the large distance away from the site no sensitive receptors have been identified in Thrumster, noting that receptors R22, R23, R24 and R25 are also located to the southeast of the quarry and are much closer.
- Sancrox Area B1: Identified as investigation area B1 within the Draft Structure Plan for Fernbank Creek and Sancrox Planning Investigation Area. No urban development has been proposed or endorsed in this area and no additional residential dwellings have been approved. Any future residential dwellings in this area will be located close to existing sensitive receptors R34 and R38 which are located on the western edge of this B1 area, and so would remain representative of the worst affected part of the B1 area.
- Sancrox Area B3: Identified as investigation area B3 within the Draft Structure Plan for Fernbank Creek and Sancrox Planning Investigation Area, and containing the Le Clos Sancrox Planning Proposal land south of Sancrox Road (see above). No urban development has been proposed or endorsed in this B3 area north of Sancrox Road and no additional residential dwellings have been approved. R19, R20 and R24 are located in the eastern part of this B3 area, and so would remain representative of the worst affected part of the B3 area.

Importantly, both the Urban Growth Management Strategy (2017) and the recently exhibited Draft Structure Plan for Fernbank Creek and Sancrox Planning Investigation Area (February 2020), specifically identify that the Sancrox Quarry is a significant regional resource, that protection of the resource is considered to be a high priority', and that any future Structure Plan for the expansion of urban development in and around the Sancrox area will need to ensure that any identified urban areas will not sterilise the extractive materials resource. The Discussion Paper specifically identifies that a key objective that will inform the preparation of the Structure Plan is to "Ensure land use does not restrict or prohibit the development potential of important extractive resources" and establishes a Resource Transition Area of approximately 500 metres around the Sancrox Quarry site with the following intention:

> "Protection of the resource is considered to be a high priority and a determination of the likely extent of westward expansion of the quarry and associated buffers (noise, vibration, flyrock) will be undertaken during the development of the Structure Plan. This will ensure any identified urban areas will not sterilise the resource. This assessment will include consultation with the current Quarry operator and the Department of Primary Industries to ensure that constraints associated with this site are adequately considered and addressed."

Further as documented in Section 1.8.4 above, neither the North Coast Regional Plan 2036 nor the Port Macquarie Draft Regional City Action Plan, identify the land around the Sancrox Quarry as being an Investigation Area for Urban Land, and the North Coast Regional Plan 2036 provides a framework for considering variations of the Urban Growth Area which requires the propsoed new urban area to address the potential for land use conflict by being appropriately separated from incompatible land uses, productive resource lands.

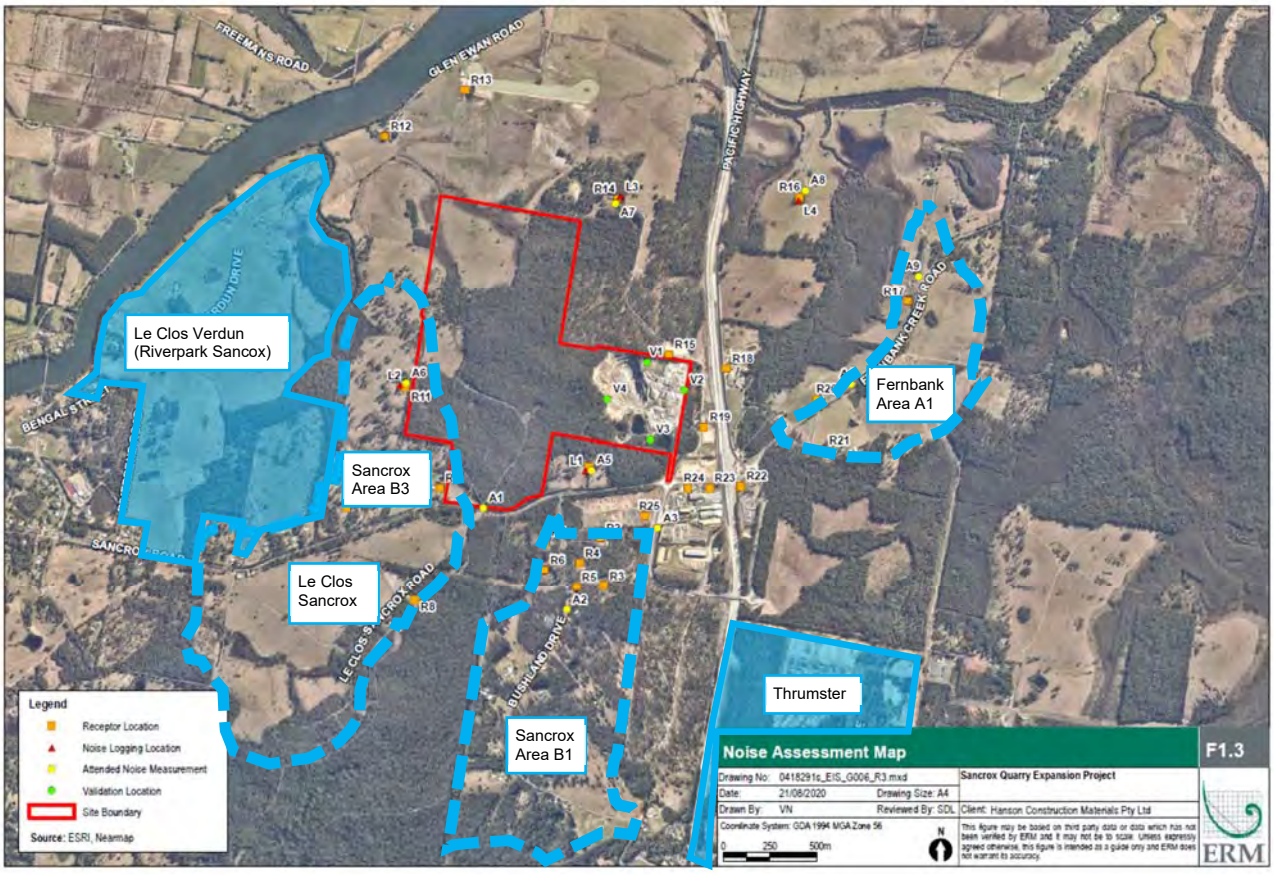


Figure 5 Future Urban Investigation Areas

Source: ERM and modified by Ethos Urban

6.2 Acoustic and vibration Impact

A revised Noise and Vibration Impact Assessment has been prepared by ERM and is provided in **Appendix E.** The revised Noise and Vibration Impact Assessment provides updated noise modelling to assess the reduced proposed extraction limit and reduced operating hours.

6.2.1 Construction Noise

The revised Noise and Vibration Impact Assessment identifies four main construction stages with works that have the potential to generate the most significant noise emissions and that have therefore been the subject of construction noise modelling, as follows:

- Demolition of existing structures.
- Site preparation and establishment.
- General construction of infrastructure.
- Construction of the earth bund.

The revised Noise and Vibration Impact Assessment indicates that the worst-case scenario $L_{Aeq,\ 15\text{-}min}$ noise levels during construction range between 23 and 64 dBA, with the highest noise levels calculated at nearby industrial and commercial premises, as well as adjoining properties that have been rezoned for industrial uses. The worst case predicted levels are identified at potential future industrial receptors 48 and 47, which are located north and east of the project site and closest to the existing processing areas. As these are future industrial receptors, it is unlikely for these receptors to be adversely impacted during the temporary construction stage.

The majority of predicted $L_{Aeq,15\text{-}min}$ noise levels are below the daytime Noise Management Levels applicable at residential and other sensitive receptors for construction works within the recommended standard hours, and all predicted $L_{Aeq,15\text{-}min}$ noise levels are below the Highly Affected Noise Management Levels applicable at residential receptors. Exceedance of the daytime Noise Management Levels by up to 9dBA is predicted for residential receptors located immediately to the south of the site under some construction scenarios.

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 would only be experienced for limited periods of time and will not be experienced over whole daytime, evening or night-time periods. In practical terms, the predicted noise levels will only be for a temporary period and will not result in permanent impact on the community and surrounding environment. These results, however, do identify that general good-practice construction noise management and control techniques will be necessary to maintain acceptable noise levels at all receptors, and that construction works should be limited to the recommended standard construction hours where possible.

6.2.2 Operational Noise

The revised Noise and Vibration Impact Assessment includes revised modelling to predict the noise from four different stages of quarrying, which reflect the changing location of mobile plant and equipment as the quarry pit expands over time. Reasonable and feasible mitigation measures were identified and were incorporated into the modelling, and predicted noise levels compared to the relevant Project Specific Noise Levels calculated for each sensitive receptor.

The assessment found that the predicted $L_{Aeq,\ 15\text{-}min}$ noise levels for the proposed future operations are between 14 and 45 dBA which is within the noise level range associated with the existing quarry operations of between 13 and 50 dBA. The highest noise levels vary depending on meteorological conditions, with the highest levels generally associated with the worst case north-westerly and westerly wind conditions during evening and night-time periods when residential receptors located to the south of the site are the most significantly affected. However, the predicted noise levels will be compliant with the Project Specific Noise Levels for all future operational scenarios if conceptual mitigation as modelled is adopted, thus the proposed quarry expansion is unlikely to generate significant cumulative noise impacts.

6.2.3 Operational Road Traffic Noise

Road traffic noise was assessed based on the estimated traffic accessing the site via the Pacific Highway (motorway standard) and Frogs Road (local road). The assessment demonstrates that:

- Up to 300 quarry related heavy vehicle movements are predicted during the day-time (15 hour assessment period) with approximately 25 movements during the night time period (9 hour assessment period) on sub-arterial roads. An additional 25 quarry related heavy vehicles movements may occur during the day-time with approximately 12 movements during the night (1 hour assessment periods) for local roads. This will not result in a significant risk to the overall road traffic noise level experienced by receptors.
- Operational road traffic on Pacific Highway is predicted to increase daytime noise levels up to 0.5dBa and increase night-time noise levels by 0.2dBA. Predicted noise levels on Frogs Road is expected to increase up to 1.5 dBA during the day and up to 1.8dBA at night. Despite the increase in noise levels as a result of the proposed expansion, the predicted increase is below the 2dBA perceptibility threshold and is not considered substantial. Therefore, road traffic emissions will remain compliant with receptors along Pacific Highway and Frogs Road.

6.2.4 Blasting

Hours for operational blasting will remain in accordance with the existing EPL which specify hours of 9am-3pm Monday to Friday. Blasting operations will comply with the ANZECC 1990 guideline, AS 2187.2 and the approved DA1995/193 criteria.

The assessment identified that blasting overpressure and vibration levels at the closest receptor is predicted to comply with the vibration limits required by the EPA in accordance with the site's EPL. In particular, the airblast overpressure level from blasting operations at the premises must not exceed 120dBZ (L_{Peak}) at any time at any

residence or noise sensitive locations, and must not exceed 115dBZ (L_{Peak}) at any residence or noise sensitive locations for more than five per cent of the total number of blasts, and blasting vibration must not exceed 5 mm/s for more than five per cent of the total number of blasts. It should be noted that individual blast design should be based on meeting the overpressure and vibration criteria rather than restrictions on MIC as the blast design includes a number of variables such as location and whether the blast is located near an open face. As such, the variables of each blast will be managed through good blasting practices and the implementation of a Blast Management Plan to ensure compliance with the EPL limits.

Where flyrock blasting may result in flyrock throws, the burden, stemming height and hole angle parameters can be adjusted to calculate the appropriate clearance zone taking into account the relevant factor of safety for people and equipment. Prior to each blast a fly rock exclusion zone will be established based on blast specific risk assessments.

A Blast Management Plan has been prepared previously and is currently being implemented for existing quarry operations. The Blast Management Plan has been informed by blast modelling, setting blast parameters for the site and determining the blast exclusion zone. This minimises the likelihood of fly-rock outside of the exclusion zone, to protect the safety of people, property and livestock. The Blast Management Plan will continue to be implemented as the quarry expands.

6.3 Biodiversity

6.3.1 Koala Survey and Assessment

A supplementary Koala Survey and Assessment has been prepared by SLR in collaboration with Koala experts from BioLink Ecological Consultants and is provided in **Appendix D**. The Koala Survey and Assessment Report has been prepared to address issues raised in submissions in relation to the ecological importance of the site for the local Koala population.

Field survey assessments were conducted on the 12th and 13th of October 2020. Given the widespread presence of Koala feed trees across the site, all plant community types mapped as occurring on the site are considered to constitute Koala habitat. The survey identified that the proposed expansion of the Sancrox Quarry would result in a loss of approximately 39.02ha of native vegetation that comprises potential habitat, staged over the proposed 30-year life of the quarry.

Historically two populations of less than 10 to 15 individuals have utilised the local area; however, these populations are restricted to the areas by the Pacific Highway to the east and extensively cleared areas to the west and north. The SAT activity results indicate that one or more resident koalas are present within the site, and one Koala was sighted during the Koala Survey, approximately 50m to the west of the existing quarry. Evidence of Koala activity was found most prevalent along the western edge of the existing quarry, as well as a large proportion in the western portion of the site.

The proposed expansion of the Sancrox Quarry will result in a reduction to the availability of foraging and breeding habitat for the local Koala population and will likely increase the barriers to the local movement and dispersal of Koalas in the locality, particularly in a north-south direction. On the basis of the Koala survey, and pursuant to the Framework for Biodiversity Assessment, the Koala Survey and Assessment concludes that a 'species polygon' should be drawn around all Koala habitat within the site and species credits calculated for the purposes of calculating biodiversity offsets.

6.3.2 Biodiversity Assessment

The Biodiversity Assessment Report has been revised to address issues raised in submissions, including those raised by the Division of Biodiversity and Conservation. The revised Biodiversity Assessment Report is provided at **Appendix H**, and:

- Identifies that the direct impacts associated with the amended proposal include the clearing of 39.02 ha of native forest vegetation, compared with 43.1 ha for the originally proposed quarry pit extent. Further, the amended proposal no longer directly impacts on the threatened ecological community Subtropical coastal floodplain forest (NR117).

- Provides a revised assessment of connectivity identifying that the north-south corridor would be narrowed within the site from over 100m to less than 100m, resulting in a BioBanking Credit Calculator score of 2 for connectivity impacts, compared to zero originally as assessed. Combined with other parameters that influence the BioBanking Credit Calculator an overall landscape value score of 17 was established.
- Recalculates that 2,230 ecosystem credits are required to offset the proposed clearing of native vegetation, reduced from 2,449 as originally calculated for the EIS.
- Identifies a total of 24 potential threatened species that are candidate species credit species in the BioBanking Credit Calculator based on relevant geographic and/or habitat features that are present on site. Of these 24 candidate species credit species, four were identified as being located at the site. For three of these species (the Eastern Bentwing-bat, Little Bentwing-bat and Grey-headed Flying-fox) the need for species credits is linked to the presence of breeding habitat, however no breeding habitat was identified at the site. Conversely, Koala is also a species credit species which has been identified on-site.
- Provides updated analysis on the potential impacts on Koala drawing on the supplementary Koala Survey and Assessment described above. Based on the survey results and modelled activity levels, combined with previous Koala survey results, and the widespread occurrence of several Koala feed trees within the forested parts of the site, the site is considered to be habitat for the Koala. As such, a species polygon for the Koala has been prepared in accordance with the Framework for Biodiversity Assessment, which includes all areas of native vegetation within the development footprint totalling 39.02 ha, and results in a requirement for 1,015 species credits.
- Identifies that the western boundary of the quarry has been rationalised (i.e. straightened) and pulled to the east, reducing potential 'edge effects' and ensuring that there is as much vegetation as possible for north-south connectivity for Koala and other fauna to move around the existing and proposed quarry pit edges.
- Includes further assessment of edge effects, concluding that edge effects are unlikely to adversely affect local populations of native flora and fauna, and that there are not likely to be any threatened species affected by edge effects, as no such species are likely to be inhabiting the fringes of the proposed pit footprint, or rely on those areas for their breeding or other life cycle processes.
- Documents further mitigation measures including the preparation of a Biodiversity management plan, pre-clearance surveys and presence of an ecologist during clearing activities, and progressive rehabilitation of the disturbed areas.

The revised Biodiversity Assessment Report sets out a preferred offsetting option for the proposed development as follows:

- Generate available ecosystem credits from the proposed offset site through the creation of a Stewardship Agreement over the offset site in consultation with OEH, which will provide some of the ecosystem credits required.
- Purchase like-for-like ecosystem credits from the Credit Register (or approach potential credit sellers through the Expressions of Interest register) in advance of clearing associated with each stage of the quarry expansion.
- Purchase 'variation credits' by applying the variation rules under the Framework for Biodiversity Assessment, in the scenario that like-for-like credit cannot be found after completing "reasonable steps". In this regard, an Expression of Interest for the required ecosystem credits will be published on the OEH BioBanking 'Credits Wanted' register.
- Purchase species credits for Koala from the Credit Register (or approach potential credit sellers through the Expressions of Interest register) in advance of clearing associated with each stage of the quarry expansion.
- Pay the monetary value of the remaining credit obligation into the NSW Government's Biodiversity Conservation Fund.

In relation to rehabilitation Hanson's broad objective for progressive and final rehabilitation are to create a final landform that is suitable for post-quarrying land uses. This includes the following specific objectives:

- To produce a geotechnically stable, safe and non-polluting landform through progressive shaping of the completed areas of the Quarry.

- To provide a landform that is free-draining and has low maintenance requirements.
- To blend the landform with the surrounding landscape through careful selection of species for revegetation. Only native and endemic species would be used for revegetation.
- To monitor the success of rehabilitation over time to ensure revegetation is not dying back.
- Ensure that the final landform maintains the visual amenity of the locality and, where possible, enhances local biodiversity values.

The revised Biodiversity Assessment Report also sets out a revegetation program indicating that 10 m wide benches will be left every 10 m of depth to provide a horizontal platform on which native flora species will be established, and describes recommended revegetation methods.

6.4 Water management

A supplementary report directly addressing the submissions raised regarding water management has been prepared by ERM and is appended as **Appendix G**. The groundwater model has also been peer reviewed by REN consulting and the peer review report is appended as **Appendix C**.

6.4.1 Groundwater matters

The water report at **Appendix G** has concluded the following:

- Estimated concentrations of total dissolved solids exceed the criteria that would enable the groundwater source to be defined as highly productive;
- The peer review conducted by Ren Consulting concluded that the confidence level of the Sancrox Quarry groundwater model is classified as “Class 1” under the Australian Groundwater Modelling Guidelines and thus may be used for predicting long-term impacts of proposed developments in low-value aquifers;
- Only one of the 13 groundwater users fall within the modelled 2m drawdown contour, increasing to two under the sensitivity run scenario;
- Estimated hydraulic conductivity is low at less than 0.001m/day, which aligns with the observations from the existing pit where groundwater seepage to the pit is reportedly negligible with no active dewatering required. The low hydraulic conductivity will impact the progression of the cone of depression outside of the immediate vicinity of the quarry development and delay observable impacts of the dewatering at more distant locations. The nearest groundwater user, located inside the modelled 2 m drawdown, is approximately 700 m distant from the final quarry perimeter.

The ERM water report also notes that the predicted drawdown is based on steady state drawdown associated with the final stage of pit extension (the maximum drawdown expected over the life of the proposed development), so initial monitoring of water levels can serve as a baseline against which to compare future water level measurements. Monitoring frequency should be adaptable (depending on trends observed and stages of the quarry development) with twice annual monitoring recommended for the first year of monitoring. Water level data will be reported on an annual basis along with the reporting of the water take estimates.

The REN consulting peer review report at **Appendix C** sets out recommendations to further develop and improve the confidence-level of the groundwater model during detailed quarry planning and design.

6.4.2 Water sharing plans

The applicable water sharing plans for the proposed expansion of the Sancrox Quarry include the *Hastings unregulated and alluvial water source 2019* and the *North Coast fractured and Porous Rock Groundwater sources 2016.*

The need for a Water Access Licence for aquifer interference and/or surface water extraction will be determined in consultation with WaterNSW, noting the latter will require purchasing from existing licence shares.

6.5 Air quality

A revised Air Quality Assessment report has been prepared by ERM and is provided at **Appendix F**. The revised Air Quality Assessment provides updated air pollutant dispersion modelling to assess the modifications to the quarry plan, which includes:

- Modelling of 'Typical day' operations and 'Maximum day' operations. An additional scenario where the 'Maximum day' operations are split into operating either with the proposed (20-days per year) at 24 hours a day or by adopting the typical day operational hours of 5am to 10pm.
- Revised modelling incorporating additional control strategies to achieve compliance with the EPA criterion at all sensitive receptors.
- Assessment of potential ambient air quality impacts and greenhouse gas emissions from construction and operation of the project.

The revised modelling indicates that cumulatively, no sensitive receptors are predicted to experience exceedances of the relevant impact assessment criteria for the annual mean concentration of PM_{10} and $PM_{2.5}$.

The assessment identified a minor exceedance for the 24-hour average PM_{10} concentration which predict an exceedance of the approved methods criterion at receptor R13 when operating under maximum daily throughput scenario over a 24-hour period. However, when the amended proposed hours are reduced to operate between 5am and 10pm with the same maximum daily throughput compliance is demonstrated at R13.

It is anticipated that the probability of meteorological conditions conducive to causing an exceedance at receptor R13 occurring during the proposed 20 days of 24-hour operations is low. It is thus considered that this risk can be adequately mitigated by provision of additional dust management planning and controls prior to 24-hour operations as documented within an Air Quality Management Plan.

Notwithstanding, given the proximity of Receptor R13 to the site boundary and moderate occurrence of winds from north-western and north-eastern directions, the revised Air Quality Assessment recommends that a real-time ambient air quality monitoring system is implemented. This will allow staff to identify when additional mitigation measures are to be implemented to minimise impact from the onsite activities. One real-time monitor placed along the southern boundary of the site to monitor conditions when the site is upwind of Receptor R13 is recommended. It is also recommended to place a monitor along the northern boundary to obtain the background PM_{10} concentrations under these conditions.

7.0 Revised Mitigation Measures

The collective measures required to mitigate the impacts associated with the proposed works are detailed in **Table 3** below. These measures have been modified appropriately in response to the amendments to the proposal and concerns raised in submissions, and have been informed by the revised assessments undertaken for Noise and Vibration, Air quality, Groundwater, and Biodiversity.

Table 3 Sancrox Quarry Expansion Mitigation Measures

Overarching Environmental Aspect	Specific Environmental Issue/ timing	Mitigation measure
Biodiversity	Biodiversity offsets	Implement a Biodiversity Offset Strategy that involves the retirement of 2,230 ecosystem credits and 1,015 species credits for Koala, as set out in the revised Biodiversity Assessment Report provided as Appendix H of the RTS. The Biodiversity Offsets Strategy would set out a program for obtaining and retiring credits in a staged a manner to correspond to the clearing of vegetation with each stage of quarry development.
	Pre-construction	Fauna residing with or occupying the expansion are safely and ethically salvaged and relocated. Delineate quarry expansion limit (to ensure no native vegetation outside expansion area is cleared.) Install and maintain erosion and sediment control measures in accordance with the requirements of the 'Blue Book' (Landcom 2004).
	During Construction	Supervision of tree felling to rescue and recover any fauna (as necessary). Management of weeds will be controlled through vehicle wash-down, and the preparation of a site weed control program Rubbish (such as food scraps and building waste) are to be properly managed during construction and must not be stockpiled on areas of native vegetation. Revegetation – re-use topsoil and seeding of pasture grasses and legumes (or as directed in relevant revegetation guidelines or management plans. Design and implement a planting plan for the corridor of native vegetation east and west of the proposed quarry pit. Traffic will be managed during construction through the implementation of: • Speed limits of 40km/hr (or less if lower speed limit imposed in other environmental assessments) to be imposed within site, reducing the likelihood of animal strikes. • Educate workers on possibility of animal strike through construction management program.
	Post-Construction	Speed limits of 40km/hr (or less if lower speed limit imposed in other environmental assessments) are proposed, reducing the likelihood of animal strikes. Limit spread of weeds in accordance with the methods provided throughout the landscape maintenance program and weed control plan. Each luminare will be aimed downwards and only switched on during loading-unloading and servicing activities outside of daylight hours and during heavy fog. Appropriate systems will be implemented to ensure that each waste stream generated by the development is effectively managed and/or disposed of off-site. There will not be any on-site stockpiling or disposal of waste materials. Prepare and implement a Biodiversity and Rehabilitation Management Plan, which will set out a revegetation program to re-establish native tree, shrub and ground cover, and processes that will aim to stabilise reshaped and benched areas. Maintain and monitor plantings within proposed native vegetation corridors east and west of quarry pit.

Overarching Environmental Aspect	Specific Environmental Issue/ timing	Mitigation measure
		An engineered surface water drainage and management strategy is to be prepared and implemented. Techniques currently proposed to manage stormwater including bundling walls, swales, underground water capture systems and dams.
Heritage	Historic Heritage	In the unlikely event that historic heritage items are found during works, the following Unexpected Finds Protocol will be followed. • Where a potential historic heritage item is found during works, all works within the vicinity of the item, or with the potential to impact the item will cease and a temporary exclusion zone established; • An appropriately qualified heritage consultant will examine the item to assess its significance and further archaeological potential; and • Where a relic is found, the NSW Heritage Council will be notified, and approval will likely be required prior to the continuation of works. Other archaeological deposits will be recorded and assessed for significant and potential salvage by an appropriately qualified heritage consultant.
	Aboriginal Heritage	The potential scar tree is located close to the western extent of the proposed extraction area. Whilst it will not be impacted as a direct result of extraction, in order to avoid indirect accidental impacts all site plans will identify the location of the scar tree and temporary fencing will be erected around the tree during the final stages of quarrying. The ceremonial site, although now completely destroyed, is considered to have high cultural significance and recognition of its location within the Sancrox area will be displayed in the quarry site office. The development of any cultural information will be undertaken in consultation with the Birpai Local Aboriginal Land Council. The unexpected Finds Protocol provided at **Appendix B** of the RTS will be followed if further Aboriginal heritage sites, or suspected human skeletal remains are encountered during works. Cultural Awareness Training: In order to comply with the best practice principles, all employees and subcontractors will undergo environmental awareness training as part of the site induction to ensure they understand their obligations and responsibilities. Only information endorsed by RAPs will be included, and a representative of the RAPs will be invited to participate in the induction sessions for major contractors.
Surface water/ Hydrology	Stormwater Diversion	• Stormwater diversion will be required within both clean and dirty catchments throughout the development of the Project; • Diversions in the form of bunds or drains, as fitted to the topography of the specific catchment, will be implemented to allow for the diversion of sediment-laden-run-off to sediment basins and in a few circumstances to divert clean run-off from entering the site; • Diversions with clean catchments are to be stabilised quickly through covering of the diversion channel with geofabric or revegetation • Diversion measures within dirty catchments will incorporate rock check dams to reduce sediment loads within the run-off prior to reaching the basin (to maximise efficiency of the basin and reduce desilting requirements) and where possible have low grade to lower flow velocities.
	Erosion Control	**Mulch** • The mulch will be mixed with topsoil and applied to batters and other locations requiring rehabilitation, acting as both an addition of organic matter to boost the soil quality (along with other ameliorants) and act as an erosion control measure; • Mulch will be used as a replacement to sediment fences, by creating a bund of between 300 and 500mm high; and • Mulch can also be applied as a blanket, of approximately 150mm thick, to cover disturbed areas and prevent erosion.

Overarching Environmental Aspect	Specific Environmental Issue/ timing	Mitigation measure

		Site stabilisation and rehabilitation
		• A progressive site rehabilitation approach will be adopted, whereby stabilisation works (either by revegetation, hard armouring or allowing hard rock finishes to remain where no sediment-laden-run-off will be generated) is undertaken immediately following the completion of the activity. Key principles of progressive rehabilitation include:
		  • Availability of acceptable soil materials;
		  • Correct site preparation and replacement of topsoil;
		  • Selection of the most suitable establishment technique;
		  • Selection of appropriate plant species, fertilisers and ameliorants;
		  • Application of sufficient water germination and to sustain plant growth if rainfall is insufficient;
		  • An adequate maintenance program; and
		  • areas not satisfactorily revegetated will be investigated to determine the reason for failure. Appropriate remedial action will be undertaken, including replacing any lost topsoil and re-sowing the site.

	Sediment Control	**General** • Sediment basins are required for the management of disturbed locations. Conceptual locations are shown in Figure 1.3 of the Hydrology Impact Assessment Chapter, preliminary basin sizes are provided in the Hydrology Assessment (ERM 2018b); • The Proponent must restore the design storage capacity to ensure basin within five days of the cessation of a rainfall event that causes run-off to occur on the site • A basin register will be applied to the Environment Protection License (EPL 5289) to allow for progressive integration of the basins to the licence as each stage of work commences; and • Sediment basins will be established prior to the removal of all vegetation across each stage, where practicable. Essentially, this will require clearing a path to the basin location, removing the vegetation, constructing the basin and the clearing the remainder of the catchment. **Basin Desilting** • All sediment basins will be inspected regularly for accumulated sediment. Graduated makers placed within the basin will assist in measuring sediment depths. Sediment to be removed prior to reaching capacity. **Water treatment and flocculation** • water quality testing will determine compliance, and identity if pH modification (through use of products such as lime or hydrochloric acid) or TSS modification (through the use of gypsum) is required.

Overarching Environmental Aspect	Specific Environmental Issue/ timing	Mitigation measure
	Pollution Control	**General** • Waste receptacles will be provided for the safe and efficient storage of all construction and miscellaneous wastes, as necessary; • recyclable materials should be separated and recycled where possible. Otherwise, disposable wastes should be removed from site regularly and disposed of by approved means; • spent chemical and hydrocarbon drums should be removed from site regularly to limit the potential for spills of the remnant product; • refuelling within active quarry areas should be carried out using a mobile fuel cart fitted with an electronic fuel pump; and • routine maintenance of all plant and machinery should be carried out in the designated maintenance area adjacent to the site office to minimise the potential of accidental contamination of water. **Spill Management** • spill kits should be provided at active work locations, the workshop area, refuelling areas and adjacent to pump locations. Training of site personnel in their use will ensure that in the event of any spills appropriate action can be taken rapidly to prevent and minimise impacts to surface waters; • Material Safety Data Sheets (MSDS) for all chemicals stored on-site are to be collected and maintained by the quarry manager and made available to site personnel. Site personnel should be informed of their location as a part of the site induction; • an impervious bund should be constructed to contain any spills of more than 110% of the volume of the largest container in the bunded area, should none be present in the workshop area. Any spillage should be immediately contained and absorbed with a suitable absorbent material; • storage and transport of Dangerous Goods, Flammable and Combustible Liquids will comply with AS 1940 1993 The Storage and Handling of Flammable and Combustible Liquids and National Code of Practice for the Storage and Handing of Workplace Dangerous Goods [NOHSC: 2017 (2001)].
	Asphalt Production	• clean water diversions around the asphalt production plant site to limit catchment to smallest footprint possible and prevent clean water run-on; • the proposed sediment basin should be contrasted to capture sediment-laden run-off from the plant catchment area; • a triple interceptor or similar pollution control device should be utilised as a “first flush” for the potential hydrocarbon contaminated areas in the plant site;
	Plant Controls	• all oils, fuels, lubricants, liquids and chemicals should be stored in appropriately bunded areas; • bitumen, diesel and other chemicals handling should be undertaken within a contained (bunded) area. Any spillages should be immediately ameliorated; and • the sediment basin servicing the plant catchment should be fitted with a floating hydrocarbon boom as a precautionary measure to contain any potential loss of hydrocarbons from the plant catchment.
	Concrete Batching Plant Controls	• the footprint of the plant should be limited to the smallest extent practicable to reduce the area from which contaminated stormwater can be generated (EPA Victoria, 1998); • all contaminated stormwater and process wastewater should be collected and recycled at the earliest possible opportunity (EPA Victoria, 1998);

<table>
<tr><th>Overarching Environmental Aspect</th><th>Specific Environmental Issue/ timing</th><th>Mitigation measure</th></tr>
<tr><td></td><td></td><td>

a dedicated, paved and bunded washout area should be established for the following locations:

truck washing and agitator drum washout area;
the concrete batching area; and
any other location that will generate stormwater contaminated with cement dust or residues.

the stormwater from these locations should be direct to a first flush system. The OEH (2015) recommended design criteria for first flus containment systems utilised for concrete batching plants must be able to contain 10 mm of rainfall;
a bypass to the first flush system is to be created to allow for run-off from larger storm events (greater than 20mm) to bypass the collection system for when the first flush collection is full;
dry cement should be stored where it cannot generate fugitive dust or be exposed to water and generate run-off;
the sediment collected in the first flush must be regularly cleaned out; and
whenever wet weather discharges occur from the catchment system within the plant, pH and total suspended solid monitoring should be undertaken (EPA Victoria, 1998). EPA Victoria (1998) also states run-off after heavy rainfall (more than 20 mm over 24 hours) contains very small quantities of wastes and is unlikely to pose a significant threat to the environment.

</td></tr>
<tr><td></td><td>Monitoring</td><td>

site inspection of erosion and sediment controls should be undertaken at least monthly and always following rainfall events (greater than 20mm rainfall); and
the EPL 5289, and the surface water monitoring requirements within remain relevant to the Project, the following parameters for the proposed conceptual basins.

<table>
<tr><th>Pollutant</th><th>Unit of measurement</th><th>100%ile Concentration Limit</th><th>Frequency</th><th>Method</th></tr>
<tr><td>Oil and Grease</td><td>Milligrams/Litre</td><td>10 and/or not visible</td><td><24 hours prior to a controlled/scheduled discharge and daily for any continued controlled/scheduled discharge</td><td>Visual (grab sample to be taken if sheen observed)</td></tr>
<tr><td>Ph</td><td>-</td><td>6.5-8.5</td><td><24 hours prior to a controlled/scheduled discharge and daily for any continued controlled/scheduled discharge</td><td>Grab sample/ calibrated field probe</td></tr>
<tr><td>Total Suspended Solids</td><td>Milligrams/litre</td><td>50</td><td><24 hours prior to a controlled/scheduled discharge and daily for any continued controlled/scheduled discharge</td><td>Grab sample</td></tr>
</table>
</td></tr>
<tr><td>Groundwater</td><td>Licensing Requirements</td><td>The NSW Aquifer Interference Policy specifies that all water taken during an activity must be accounted for, and that a water licence is required irrespective of whether the water is taken for consumptive use or whether water is taken incidentally in the course of undertaking the activity.

Depending on specifics of licences currently being held a new licence may need to be applied for.</td></tr>
</table>

Overarching Environmental Aspect	Specific Environmental Issue/ timing	Mitigation measure
	Water Level Drawdown	Mitigation measures for the potential impacts associated with drawdown on bores GW303749 and GW306269 will vary dependant on the extent of the impact, but may include: • lowering the bore pump in the bore casing; • drilling a deeper bore; or • providing an alternative water source as part of “make good” arrangements.
	Groundwater Monitoring Program	It is recommended that a groundwater monitoring plan should be developed that includes specifics of such a monitoring program, including threshold trigger values as well as a contingency strategy if triggers are exceeded. While the development of such a plan falls outside the scope of this assessment, recommendations for monitoring requirements are outlined below. **Water Take** It is recommended that monitoring of inflows should be undertaken to the extent feasible as part of water balance activities. This can be done by metering water being pumped from the in-pit sumps. An estimation of rainfall contribution to water being pumped from the in-pit sumps can then be made on an annual basis by factoring in rainfall data and the pit extent after which the groundwater component can be estimated. Groundwater take should be estimated and reported in this manner on an annual basis. If geological/hydrogeological observations during quarry extension vary significantly from that considered for the groundwater flow model the groundwater flow model should be re-evaluated. The model re-evaluation may include running the existing groundwater model for different stages of pit development and including transient analysis in the modelling to evaluate contributions from aquifer storage (which may require additional pumping tests and observations bore installation). **Water Levels** The groundwater monitoring program should include monitoring of water levels at the potentially affected groundwater bores. In order to be able to identify over or under predictions by the modelling in a reasonable way, it is recommended that all bores showing a > 0.5 m of simulated drawdown should be included in the monitoring program. This would include bores GW303436, GW303749 and GW306269. As the predicted drawdown is based on steady state drawdown associated with the final stage of pit extension (the maximum drawdown expected over the life of the Project), initial monitoring of water levels can serve as a baseline against which to compare future water level measurements. Monitoring frequency should be adaptable (depending on trends observed and stages of the quarry development) with twice annual monitoring recommended for the first year of monitoring. Water level data should be reported on an annual basis along with the reporting of the water take estimates. **Water Quality** Water quality monitoring is recommended at the in-pit sump(s) and existing monitoring bores while they remain accessible. Parameters monitored should include standard field parameters (pH, EC, temperature, ORP and DO) and laboratory analysis of TDS. Monitoring frequency of these sampling locations should be adaptable (depending on trends observed) with twice annual monitoring recommended for the first year of monitoring. Water quality results should be reported on an annual basis along with the reporting of the water take estimates.

Overarching Environmental Aspect	Specific Environmental Issue/ timing	Mitigation measure
		Monitoring water quality of water discharges from the site should continue as per the conditions specified in the site Environmental Protection Licence (EPL). In addition to the current suite of parameters, it is recommended that consideration should be given to including EC and TDS in the EPL related compliance monitoring. ERM (2018c) outlines that pit lake modelling may be required prior to closure of the quarry.
Soil and Land Resource	Soils	The stockpiling of topsoils should ensure that the soils mapped with higher capability (Class 4 and 5 lands) are given preference for storage. These higher capability soils are considered likely to improve the success of rehabilitation. Application of lime is required to address high levels of acidity and aluminium toxicity associated with the Euroka landscape. Amelioratives should be added to other soils to address issues associated with the other landscapes. A soil sampling program should be undertaken prior to topsoil stripping to understand acidity concentrations and receive advice from the laboratory on proposed liming and ameliorative application rates.
	Contamination	No contamination risk is present or will be introduced by the Project that would warrant not undertaking the activity. Chemical and hydrocarbon management, spill prevention and control mitigation measures as outlined in Chapter 7 to be implemented. A site walkover should be undertaken prior to clearing activities taking place to ensure that any refuse is identified and can be removed from site and disposed of at an appropriate licenced location. Should unexpected contamination be identified, works should cease, and an appropriately experienced contamination specialist engaged to develop a strategy to manage the contamination.
	Erosion and Sediment Controls	Erosion and sediment controls outlined in Chapter 7 (Surface Water/Hydrology Assessment) will be implemented to prevent loss of soil and impacts to adjacent watercourses.
	Land Slippage	Standard geotechnical controls will be implemented as required to avoid or minimise impact of land slippage including: • Batter slope trimming - The angle of batter slopes will be reduced to the extent considered safe based on localised geology and hazardous blocks of rock removed. • Bunds - installed as necessary at batter bases to control falling rocks • Future bunds and material stockpiles - will be located away from top of benches where they may be subject to instability. • Void progression - will progress along a ridgeline such that any potential inflow of surface water runoff over batter faces will be minimal. Benching will also be implemented during quarry progression.

Overarching Environmental Aspect	Specific Environmental Issue/ timing	Mitigation measure
Noise and Vibration	Construction	To ensure noise emissions associated with construction works and activities are kept to acceptable levels, the following noise mitigation and management measures will be implemented: • Noise generating work and activities should 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 potentially affected sensitive receptors 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 should 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 should 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 should 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 should 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 any validated noise complaints are received, operator attended noise measurements should 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 Noise Management Levels presented in the Revised Noise and Vibration Assessment (see **Appendix E** of this Response to Submissions Report). • All site noise levels should be measured in the absence of any influential source not associated with the site. If the measured site noise levels are below the predicted values and comply with the Noise Management Levels, no further mitigation or management measures are required. If the measured site noise levels are above the predicted noise levels or Noise Management Levels, 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 the Revised Noise and Vibration Assessment Report (**Appendix E** of the Response to Submissions Report) including those addressed in Chapter 5 and Chapter 6 of that report. 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. The CNMP will also take into consideration any nearby construction projects in relation potential cumulative impacts.

Overarching Environmental Aspect	Specific Environmental Issue/ timing	Mitigation measure
	Operation	**Boundary Mitigation:** • Earth Bunding (approximately 20 m in height and 450 m in length) is required at the southern boundary to provide 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 or impulsiveness. • The key items of plant/equipment are presented in Section 2.10.2 of the Revised Noise and Vibration Assessment Report (Appendix E of the Response to Submissions Report). The required Lw reductions for these specific items of equipment/plant and the Lw required to meet the 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 the Revised Noise and Vibration Assessment Report (**Appendix E** of the Response to Submissions Report). Detailed noise modelling data (including Lw references and spectral data) are provided in Appendix F of the Revised Noise and Vibration Assessment Report. **At Source Mitigation:** • Where Lw values for plant/equipment outlined in Table 2.3 of the Revised Noise and Vibration Impact Assessment (**Appendix E** of the Response to Submissions Report) are not reasonable or feasible, or where it is otherwise reasonable and feasible to do so, the operational design should incorporate acoustic enclosures / barriers to assist in reducing the noise emission of identified plant/equipment. Design of acoustic enclosures / barriers should also consider offensive noise characteristics such as tonality and low frequency noise. **General Operational Mitigation Measures:** • 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 should 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 should 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 should 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 should be located as far as possible from noise sensitive areas. • The location of activities, plant and equipment should optimise attenuation effects through measures such as topography, natural and purpose built barriers.

Overarching Environmental Aspect	Specific Environmental Issue/ timing	Mitigation measure
		• If any validated noise complaints are received, operator attended noise measurements should be undertaken within 24 hours to measure and compare the site noise level contributions ($L_{eq,\ 15\ minute}$ and L_{max} in dBA) to the predicted values; and the Project Specific Noise Levels. • All site noise levels should be measured in the absence of any influential source not associated with the site. If the measured site noise levels are below the predicted values and comply with the Project Specific Noise Levels 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 Project Specific Noise Levels presented in the Revised Noise and Vibration Impact Assessment (Appendix E of the Response to Submissions Report), further mitigation and/or management measures should be considered. • A Detailed Design Noise Impact Assessment should be undertaken during the final stages of the Project design to ensure that noise emissions from the Processing Plant and Asphalt Production Plant can be effectively reduced to compliant levels through plant / equipment procurement and construction of acoustic enclosures / barriers. • An Operational Noise Management Plan (ONMP) should be also prepared based on the detailed design, and should consider all potential acoustical factors identified in this report including those addressed in Chapter 5 and Chapter 7 of the Revised Noise and Vibration Assessment Report (Appendix E of the Response to Submissions Report). The ONMP should 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.
Air Quality and Greenhouse Gas	General	The Air Quality and GHG Assessment considered all reasonable and feasible mitigation measures to minimise the emissions from the proposed activities at the site, including: • Roads, which are likely to remain unchanged throughout the Project stages and to be frequently used by machinery, will be sealed using asphalt and swept daily (or on an as needs basis) to minimise wheel-generated dust emissions; • Full dust extraction system for drilling; • Utilisation of water sprays during truck rear dumping; • The use of mobile sprinkler systems during the operation of Front End Loaders; • Dust suppression measures such as water sprays in place at the crushers and screeners; • Water sprays used on all conveyor transfer points; • The conveyor loading to be enclosed by a shroud; • A dust suppressant will be applied to unsealed haul roads; • Water sprays to be utilised to minimise the wind erosion from stockpiles, as required. Hanson will also investigate use of additional stabilisation techniques to be applied progressively such as revegetation and use of soil binder on stockpiles and disturbed areas; • The dry product delivered to the concrete batching and recycling plant and asphalt plant to be stored in aggregate storage bins enclosed on three sides. The aggregate storage bins to be fitted with water sprays. • Cement and cement supplement to be delivered to the concrete batching plant in the agitator trucks and pneumatically fed. • Concrete batching loading point to be totally enclosed with all particulate matter emissions generated by the facility captured by one bag filter located above the pan mixer;

Overarching Environmental Aspect	Specific Environmental Issue/ timing	Mitigation measure
		• Concrete recycling facility out-loading to be directly to processed material storage bins enclosed on three sides. The recycled concrete storage bins to be fitted with water sprays; • Vapour balancing system to be installed for the delivery of bitumen at the asphalt plant; • Asphalt plant loading point will be totally enclosed. All particulate matter emissions generated at the loading point will be captured by one fabric filter associated with the natural-gas fired dryer; and • Vapour recovery system to be employed for transfer of asphalt to trucks.
	Real-time ambient air quality monitoring system with reactive management	Implement a real-time ambient air quality monitoring system that includes one real-time monitor placed along the southern boundary of the site to monitor conditions when the site is upwind of Receptor R13 and one monitor along the northern boundary to obtain the background PM_{10} concentrations under these conditions. Implement a reactive management process that will allow staff to implement additional mitigation measures to minimise impact from the onsite activities when identified as required by the real-time ambient air quality monitoring system.
	Air Quality Management Plan	Prepare and implement an Air Quality Management Plan taking into account the recommendations set out in Table 9.1 of the revised Air Quality Assessment report at **Appendix F** of the response to Submissions Report.
Traffic and Access	General	The following mitigation measures are proposed to minimise impacts to road users and infrastructure: • movements to the west of the Quarry Access Road on Sancrox Road will be strictly limited to supplying markets in the Sancrox area only. Access to Wauchope and other locations to the west will be provided by utilising the Oxley Highway Interchange. Sancrox Road to the west of the quarry will not be used as a regular product transport route; • movements to the east of the Sancrox Interchange along Fernbank Creek Road will be strictly limited to supplying local residents/markets in the area. The road will not be used as a regular product transport route. • limit compression braking; • avoid bunching of quarry vehicles along product transport routes; • cover loads entering and leaving the site; • induct all drivers to the Hanson code of conduct and carry out regular tool box talks discussing road safety issues; and • all loaded vehicles leaving the site are to be cleaned of materials on tail guards and body edges that may fall on the road. • Adhere to Vehicle Operator Code of Conduct outlined in Section 12.4.1 of the Traffic Assessment.
Visual Amenity	General	The following mitigation measures are recommended to minimise visual amenity impacts: • Retain the vegetative buffer along the north western edge of the quarry pit to screen views from nearby private land. • Light spill will be minimised through detailed design and standard measures to contain lighting.
Socio-economic	General	The construction and operation of the Project is anticipated to have minimal negative socio-economic impacts and as such no additional socioeconomic specific mitigation measures have been provided, other than those provided throughout each technical assessment contained throughout this EIS.

Overarching Environmental Aspect	Specific Environmental Issue/ timing	Mitigation measure
		Community and stakeholder engagement has been outlined in Chapter 4, providing the local community with access to project information and the opportunity to raise any concerns with regard to the Project.

Hazards and Risks	Hazardous Material Storage and Transportation	**Storage**
		The following mitigation measures should be implemented for the storage of hazardous materials to ensure compliance with the application of SEPP 33, including but not limited to:
		• All hazardous substances that may be required for construction and operation would be stored and managed in accordance with the Storage and Handling of Dangerous Goods Code of Practice (WorkCover NSW, 2005) and Hazardous and Offensive Development Application Guidelines: Applying SEPP 33 (Department of Planning, 2011), including but not limited to the following:
		  • diesel should not be stored with Class 3 materials;
		  • lubricating and hydraulic oils and grease should not be stored with Class 3 materials;
		  • maximum stored inventories (250 kg) should be located more than 25 metres (m) away from the nearest site boundary, so as to not trigger the Applying SEPP 33 thresholds if considered in aggregate.
		• As bitumen and bitumen emulsions will be present in volumes greater than 10,000kg, SafeworkNSW are to be notified and manifests and emergency plans developed.
		Transportation
		Mitigation measures relating to the transport of potentially hazardous materials include:
		• the method for delivery of explosives would be developed prior to the commencement of blasting in consultation with the DP&E and be timed to avoid the need for on-site storage. No explosive storage on site is proposed.
		• transportation routes outlined in the Traffic and Access Assessment (refer to Chapter 12) will be followed to ensure impacts to road system will be minimised where practicable.

	Bushfire Prevention and Control	**Prevention**
		For a bushfire to occur there are three factors to which must be present, namely oxygen, fuel and an ignition source, along with several other factors which affect the probability and intensity of a bushfire. While exclusion of oxygen is not feasible, each of the remaining issues will be managed as follows.
		• Fuel loads within the site will be managed through:
		  • The maintenance of Asset Protection Zones (APZ) in accordance with the Planning for Bushfire Protection Guidelines (RFS, 2006) will be established and maintained around all administration buildings and the workshop areas, as outlined in Figure 15.2 of the EIS
		  • Trees and shrubs will be maintained to prevent the spread of a fire towards the buildings, taking into account the requirement of an effective visual screen.
		• Company-controlled ignition sources and the associated management measures that will be implemented include the following:

Overarching Environmental Aspect	Specific Environmental Issue/ timing	Mitigation measure
		• All project-related activities will be undertaken, where practicable, in cleared areas; • All mobile equipment will be maintained in good working order with appropriate exhaust and fire suppression systems; • All mobile equipment working in vegetated areas will be inspected to ensure that they do not pose a risk of starting a bushfire. This will include inspection of exhaust and electrical systems, including, in the case of vehicles using unleaded petrol, catalytic converters; and • Mobile equipment working in vegetated areas will not be left unattended with the engine running. • Personnel, contractors and their employees will undergo site-specific training incorporating bush fire management awareness as part of the Project's induction program ensuring the following is outlined • Obligations toward prevention and notification; • All mobile equipment will be equipped with appropriate communication equipment, including two-way radios and/or mobile telephones • Restrictions of activities during period of very high (or higher) bushfire danger rating; • Emergency response procedures; • Locations of fire-fighting equipment l • Adopt appropriate controls during re-fuelling; and • Ensure fire extinguishers are fitted to all site vehicles. • Welding or other hot works activities will, as far as practicable, be conducted and confined to the main workshop area • Fuel loads within the Project site will be managed in conjunction with Hanson's obligations in relation to rehabilitation of the Project site and biodiversity offset requirements. **Control** The ability to control a bushfire depends upon available fuel, control of ignition sources and good access and water supplies. The following fire management procedures will be adopted to assist with the control of any bushfire on or adjacent to the Project site: • Provision of access to strategic areas on the site; • A static water supply is provided for firefighting purposes in areas where reticulated water is not available, this includes all weather access to the sedimentation dams; • Stockpiling of cleared vegetation with a minimum 10m cleared buffer zone and • Creating suitable all weather access tracks (with suitable signage and turning circles if not a through road) and if required during a bushfire event, strategically located fire breaks. Hanson will also incorporate bushfire management procedures in the overall Emergency Response Plan for the Project. A copy of the procedures, including a map of all fire-fighting equipment, access roads, communications protocol, emergency evacuation plans, and any locked gates will be provided to the local RFS.
Emergency Response	Emergency Response Plans	Site Emergency Response Plans will be updated for the quarry expansion.

Overarching Environmental Aspect	Specific Environmental Issue/ timing	Mitigation measure
Waste	General	Mitigation measures to be implemented to minimise wastes generated by the Project include: • Separation of recyclable and non-recyclable materials will take place where possible and be stored in designated receptacles; • Waste receptacles will be collected on a regular basis by licensed contractors or Council collection service and transported for off-site disposal at an appropriately licensed landfill or recycling facility; • Beneficial reuse of suitable resources will be undertaken where practicable in accordance with relevant requirements of the relevant resource recovery order and exemption; • All waste disposal will be in accordance with POEO Act and Waste Classification Guidelines 9 (EPA 2014); • Waste tracking will occur for any types and quantities of waste that trigger the requirement for tracking; and • Waste management measures will be incorporated into the site Construction and Operation Environment Management Plan (or form its own separate sub-plan if requested by the DP&E) which will outline measures to avoid waste generation and promote reuse, recycling and reprocessing of waste where possible.

8.0 Conclusion

This proposal for the expansion of the Sancrox Quarry has been amended and now seeks approval for the following:

- Extraction and on-site processing of up to 530,000 tonnes per annum of rock (tpa);
- A total development footprint of approximately 57.55 ha, comprising the proposed pit expansion area and the proposed infrastructure and processing area, requiring the clearing of 39.02 hectares of native vegetation. Development of the quarry pit to a depth of 40m AHD over four stages;
- Construction and operation of a concrete batching plant with an output of 20,000 tpa;
- Construction and operation of a concrete recycling facility to process 20,000 tpa;
- Construction and operation of an asphalt production plant with an output of 50,000 tpa;
- Employment of up to 25 staff on a full-time basis;
- Hours of operation:
  - Quarry operations (including production and maintenance), truck movements and equipment loading 5am – 10pm. Hanson will prioritise morning and normal daytime hours operations, with evening hours (i.e. 6pm – 10pm) to be added in response to market demand as required. In addition, Hanson is seeking consent to operate the processing and loading activities 10pm to 5am for up to 20 nights per year to meet the occasional customer demand (which is generally associated with major infrastructure projects that require construction works to be carried out during the night time).
  - Blasting operations from 9am – 3pm Monday to Friday.
- Installation of an earth bund on the southern property boundary, approximately 20 metres high and 450 metres long, to provide noise and visual screening.

This RTS has been prepared to satisfy the provisions of Section 89G of the EP&A Act and Section 85A of the *Environmental Planning and Assessment Regulation 2000*. Each of the submissions received during the public exhibition period has been collated, analysed and addressed.

This RTS has described and assessed changes that include reducing the extent of the quarry extraction pit, reducing the annual extraction limit down to 530,000 tpa, and reducing the proposed operating hours to 5am to 10pm. The amendments made to the quarry extent and operational parameters have been the subject of revised impact assessments, which have also responded to issues raised in submissions. The amendments made to the proposal result in a significant reduction in the environmental impact of the proposed development, compared to the original proposal described in the EIS.

The mitigation measures provided within the EIS have been updated where necessary to respond to the submissions received, and these updated measures will further reduce the overall environmental impacts during both the construction and operation of the proposal. In addition, Hanson is now proposing to provide species credits to offset the potential impacts to Koala habitat.

No residual significant adverse environmental, social or economic impacts have been identified. Residual environmental impacts identified will be mitigated through the implementation of management measures for the construction and operation of the proposal.

Having regard to biophysical, economic and social considerations, including the principles of ecologically sustainable development, the carrying out of the project is considered to be justified.

Appendix A

Quarry Extraction Plans – Stage 1 to Stage 4

Y:\Jobs 1001+\1045\Reports\104501_RTS Site Layout 2021\CAD\1045Base56.dwg_Layout1-14.05.2021-5:08 PM

TN
MN

Tree Screening (under construction)
Silt Retention Dam
Existing Plant
Sump
Existing Precoat Plant
Weighbridge
New Precoat Plant
Dam 1
Dam 2
Noise Bund
Asphalt Plant
New Quarry Processing Plant
Pipe (under road)
Diversion Bund
Quarry Access Road
Sancrox Road

Stage 1

Concrete Batching Plant and Concrete Recycling Plant
Tree Screening
Silt Retention Dam
Weighbridge
Precoat Plant
Dam 1
Dam 2
Noise Bund
Quarry Processing Plant
Asphalt Plant
Pipe (under road)
Diversion Bund
Quarry Access Road
Sancrox Road

Stage 2

REFERENCE

- Site Boundary
- Cadastral Boundary
- Limit of Disturbance
- Limit of Extraction
- Processing and Stockpiling Area
- Civil Works Area
- Office and Weighbridge Area
- Noise Bund
- Tree Screening
- Quarry Access Road
- Internal Road
- 40 Contour (mAHD) (Interval = 1m)
- Watercourse/Drainage Line
- Diversion Bund
- Diversion Drain
- Existing Dam/Water Storage
- Sediment Basin
- Sump (Size and location to vary)

SCALE 1:5 000 (A3)

50 0 50 100 150 200 250 m

Note: Some boundaries are coincident & are offset for clarity

Figure 1
QUARRY LAYOUT STAGE 1 AND 2

Y:\Jobs 1001+\1045\Reports\104501_RTS Site Layout 2021\CAD\1045Base56.dwg_Layout1-14.05.2021-5:08 PM

TN
MN

Concrete Batching Plant and Concrete Recycling Plant
Tree Screening
Silt Retention Dam
Weighbridge
Precoat Plant
Dam 1
Dam 2
Noise Bund
Quarry Processing Plant
Asphalt Plant
Pipe (under road)
Diversion Bund
Quarry Access Road
Sancrox Road

Stage 3

Concrete Batching Plant and Concrete Recycling Plant
Tree Screening
Silt Retention Dam
Weighbridge
Precoat Plant
Dam 1
Dam 2
Noise Bund
Quarry Processing Plant
Asphalt Plant
Pipe (under road)
Diversion Bund
Quarry Access Road
Sancrox Road

Stage 4

REFERENCE

- Site Boundary
- Cadastral Boundary
- Limit of Disturbance
- Limit of Extraction
- Processing and Stockpiling Area
- Civil Works Area
- Office and Weighbridge Area
- Noise Bund
- Tree Screening
- Quarry Access Road
- Internal Road
- 40 Contour (mAHD) (Interval = 1m)
- Watercourse/Drainage Line
- Diversion Bund
- Diversion Drain
- Existing Dam/Water Storage
- Sediment Basin
- Sump (Size and location to vary)

SCALE 1:5 000 (A3)

50 0 50 100 150 200 250 m

Note: Some boundaries are coincident & are offset for clarity

Figure 2
QUARRY LAYOUT STAGE 3 AND 4

Appendix B

Soils, Heritage and Traffic Response

ERM

Level 1 45 Watt Street
Newcastle NSW 2300
PO Box 803
Newcastle NSW 2300

Telephone: +61 2 4903 5500
Fax: +61 2 4929 5363

www.erm.com

Belinda Pignone
Hanson
Environmental Planning and Compliance Coordinator

belinda.pignone@hanson.com.au

23 October 2020

Reference: 0418291

Dear Belinda,

Subject: Sancrox Quarry Response to Submissions

Environmental Resources Management Australia Pty Ltd (ERM) provides this response to specific agency and community submissions made following the exhibition of the Sancrox Quarry Environmental Impact Statement (EIS). Responses are provided with respect to:

- Soils and Water:
  - NSW Environment Protection Authority (EPA) comments relating to soil properties and water balance;
  - Port Macquarie Hastings Council (PMHC) relating to reticulated water supply;
  - Department Planning, Industry and Environment (DPIE) relating to soil properties, water balance (consistent with EPA comments) and stormwater drainage;
- Heritage:
  - DPIE Biodiversity and Conservation Division (BCD) comments relating to further engagement with Registered Aboriginal Parties (RAPs), chance finds protocol, protection of a scar tree, and Aboriginal Cultural Heritage induction
  - Heritage Council of NSW relating to location of a National Trust grave site relative to the quarry; and
- Traffic
  - Community comments relating to traffic movements, safety and road conditions of Rawdon Island Road and Sancrox Road.

Responses to these comments are provided in Table 1. Further responses on stormwater drainage will be provided with the more detailed surface and groundwater assessments currently under investigation and response preparation.

Registered office
Environmental Resources Management Australia Pty Ltd
Level 15, 309 Kent Street
Sydney NSW 2000 Australia

ABN: 12 002 773 248
ACN: 002 773 248

Offices worldwide

A member of the
ERM Group

Table 1: Soils and Water, Heritage and Traffic Responses

Submission Reference No.	Submission	Response
Soils and Water		
EPA #24	**Soil Properties** Revision of the need to extend the development and sediment basins into the very strong acidity Euroka Soil Landscape. Alternatively, provide a more detailed assessment of the potential impacts and mitigation measures addressing the potential risk to water quality.	The site is mapped as comprising three soil landscapes; Kundabung, Cooperabung and Euroka. The quarry extension is predominately across the Cooperabung soil landscape. The revised quarry plan provided with this RtS has straightened and moved the western quarry boundary eastward out of the Kundabung soil landscape and slightly reducing the impact on the Euroka soil landscape. The Euroka soil landscape is mapped across extensive areas from north of Kempsey to south of Wauchope and generally west of the Pacific Highway. The EIS at Section 9.3.2 provides a general description and limitations of the Euroka soil landscape including having very strong acidity. Atkinson (1999) confirms that the very strong acid soils are in the range pH 4.5-5.5 in the B and C subsoil horizons to a depth of approximately 100-120 cm depending on depth of the topsoil. The acidity limitation relates to agricultural use in which liming to increase pH to above 5.5 is recommended to improve agricultural productivity. Interrogation of the eSPADE data for NSW (OEH, 2012), provides a soil profile report at a location on Sancrox Road approximately 500 m south west of the revised quarry footprint. The soil profile report confirms the soils in this locality have A-horizon to a depth of 35 cm and B-horizon to 120 cm. The report confirms a field pH of the A horizon at pH 6.0 and subsoils at pH 5.0-5.5, a higher pH range than noted in the general description and limitations of the Euroka soil landscapes. The quarry void is not self-draining and runoff is collected in a sump which is pumped to the onsite dams for reuse for product moisture, dust control and rehabilitation works or eventual discharge offsite within pH criteria under an existing Environment Protection Licence (EPL). Runoff from surrounding disturbed areas including the office and processing areas drain to the onsite dams. This process will continue for the proposed quarry expansion. Overburden including topsoil with be separated and stockpiled for future reuse. The stockpiles will be stabilised and located within the disturbance footprint such that runoff will be directed to the onsite dams. The overburden stockpiles will constitute a minor portion of the total catchment areas for the onsite dams. Given the quarry is subject to water discharge limits under the EPL, and it is expected that these limits will remain for future quarry activity, management of pH in discharge water is through monitoring and pH adjustment as required. Given the strong acidity of the Euroka Soil Landscape, soil sampling will determine if required adjustment of pH using a determined lime application rate during stockpiling. Water quality testing of the most downstream onsite dam will determine compliance, and identify if pH modification (through use of products such as lime or hydrochloric acid) or total suspended soils modification (through the use of gypsum) is required prior to discharge. In summary management of highly acid soils will be through separation and placement in stabilised overburden stockpiles for future reuse and rehabilitation of the quarry. The stockpiles will be located within disturbed areas of the quarry which drain to the site's large capacity dams. Collected runoff is prioritised for onsite reuse and any discharges offsite are subject to EPL conditions including pH criteria. Therefore, the potential impacts will be managed through the implementation of appropriate mitigation and management which will be outlined in a Soil and Water Management Plan (SWMP).

Registered office
Environmental Resources Management Australia Pty Ltd
Level 15, 309 Kent Street
Sydney NSW 2000 Australia

ABN: 12 002 773 248
ACN: 002 773 248

Offices worldwide

A member of the
ERM Group

Submission Reference No.	Submission	Response
PMHC #1	The Environmental Impact Statement (EIS) has not adequately detailed the proposal development's reliance on reticulated water supply. Further details are required on intended usage.	As mentioned in Section 7.4.1 of the EIS, potable water will be required and will be source from council supply mains. This demand is for site amenity purposes as the quarry site water management system is predicted to provide sufficient supply to meet quarry demands as the quarry expands (refer EIS Section 7.4.3). Section 7.3.4 of the EIS provides an estimation of wastewater generation from site amenities at 1,250 litres per day. Given this constitutes the primary demand for potable water it is estimated with an allowance for other minor uses that the Project will require approximately 0.5 ML per year for potable water use onsite.
DPIE #24	**Soil Properties** Please respond to the EPA's concern over the proposal to undertake development activities within the very strongly acidic Euroka Soil Landscape.	Please refer to response to EPA #24 comment.
Heritage		
DPIE Biodiversity and Conservation Division (BCD) #7	Further attempts should be made to engage with Registered Aboriginal Parties.	As outlined within the Aboriginal Cultural Heritage Report (ERM 2019), four groups registered an interest in being consulted for the project being: ■ Birpai Traditional Owners; ■ Birpai Local Aboriginal Land Council (BLALC); ■ Yanggaay; and ■ Norm Archibald. On 17 October 2017, each registered Aboriginal stakeholder group was provided an outline of the scope and a proposed survey methodology. No comments were received on the proposed methodology from any of the Aboriginal stakeholders. The Project area was surveyed by an ERM Heritage Consultant and Jason Holten (representing both Birpai Local Aboriginal Land Council and Birpai Traditional Owners Indigenous Corporation) on Wednesday 15 November and Thursday 16 November 2017. A draft copy of the ACHAR was provided to all four registered Aboriginal parties on 19 January 2018. A response was received on 14 March 2018 from the Birpai Local Aboriginal Land Council confirming that they were satisfied with the assessment, methodology and the protocols and do not wish to make any further comments. The remaining two RAPs, Yanggaay and Norm Archibald, registered an interest but did not respond to any other consultation. In response to BCD comments on the ACHAR, ERM have again attempted to contact both Yanggaay and Norm Archibald. On Monday 20th July ERM phoned Norm Archibald to discuss the Project and provide additional opportunities for input. Norm confirmed that he remembered the Project but he did not have any additional comments to make at this stage. ERM advised that they would be available to discuss further towards the end of the week in case anything came to mind. Norm made no efforts to contact ERM again and no further comments were received. During initial consultation, ERM tried to contact Yanggaay by phone, only to receive a notification that the number had been disconnected. No alternative contact numbers were provided during consultation. On 20th July 2020, ERM sent an email to the contact address provided by Yanggaay during initial consultation. The email advised that ERM had been trying to contact the group, and that we were seeking confirmation of receipt of the email. In addition to the email, ERM made efforts to search for a contact phone number via the internet, to

Submission Reference No.	Submission	Response
		no avail. No further correspondence has been received from Yanggaay. An updated consultation log and copies of the sent emails and text messages has been provided in Attachment A.
BCD #8	The development footprint should be amended to preserve the scar tree.	As confirmed within Figure 1 below, the potential scar tree has been avoided and is located to the west of the proposed extraction area. The location of the tree should be clearly marked on all construction/extraction plans. Consideration should also be given to further protecting the tree with temporary fencing during the final stages of the proposed works to ensure no accidental damage the site. **Figure 1 – Location of potential scar tree**
BCD #9	The ACH induction for workers should be presented by a representative of the Registered Aboriginal Parties (RAPs), or at a minimum, have a representative of the RAPs participate in the presentation and the context should be formulated by, or reviewed prior to finalisation, by the RAPs to ensure it is culturally appropriate.	As outlined within Section 9.2.2 of the ACHAR (ERM 2019), Hanson provide a commitment that all employees and subcontractors will undergo environmental awareness training as part of the site induction to ensure they understand their obligations and responsibilities. This training will include basic Aboriginal heritage awareness across the following topics: ■ legal responsibilities and statutory obligations for heritage under the National Parks and Wildlife Act 1974 and the Heritage Act 1977; ■ outline the location and type of archaeological sites within the Project Area and give instructions not to disturb these sites; ■ provide the detailed locations of all known Aboriginal objects within the Project Area to all relevant personnel; ■ outline the procedures for the discovery of previously unrecorded Aboriginal objects; and ■ provide training on how to identify stone artefacts and other Aboriginal heritage sites. It is important to note that only information endorsed for sharing by the RAPs would be included within the induction package. A representative of the RAPs will also be invited to participate in the induction sessions for major contractors prior to works commencing.

Submission Reference No.	Submission	Response
BCD #10	The proposed chance finds procedure should be amended to require authorisation from the Department of Planning, Industry and Environment of any proposed salvage of Aboriginal objects discovered during works associated with the project.	An updated unexpected (chance) finds procedure is provided in Attachment B and includes authorisation from Heritage NSW (noting that the management of Aboriginal Cultural Heritage was transferred from Department of Planning, Industry and Environment to Heritage NSW on 1 July 2020).
Heritage Council of NSW	The supporting EIS prepared for the Sancrox Quarry Expansion, by ERM dated October 2019 has been reviewed and does not discuss the location of the National Trust grave site in relation to the development…..Whilst it is acknowledged that a survey was undertaken, a lone grave, if that is what this National Trust reference relates to, may not be in good condition and physical evidence may have been removed. It would be appropriate for the DPIE to request the Proponent to clarify this outstanding question at the response to submissions stage.	ERM have reviewed the National Heritage Trust Listing and confirm that the site is located over 3km to the southwest of the Sancrox Quarry. It's recorded as a single burial dated 3/5/1901. The site was surveyed in 1986 and is recorded as an imposing 2m white marble obelisk, erected in memory of Allen Johnston. The monument which faces east was reported to be in good condition with a cast iron surround set in sandstone. Two small surrounds of natural stone immediately north and south of the monument suggest that there may be other burials in the vicinity although no other monuments were recorded. The proposed quarry expansion will not impact on this record, and the heritage site is not required to be further assessed within the EIS or the RtS.

Submission Reference No.	Submission	Response
Traffic		
Community	A few community submissions raised that Rawdon Island Road is currently in poor shape and increased volume of heavy vehicles will further its deterioration. Some added that both Sancrox Road and Rawdon Island Road are unsuitable roads to cater for trucks and heavy traffic flow as these roads are designed for light rural traffic. Some also felt that is currently dangerous to walk, or ride a bike or a horse safely, as roads such as Sancrox Road and Rawdon Island Road are too narrow.	Trips to the west of the Quarry Access Road on Sancrox Road and Rawdon Island Road are not required due to the more suitable access options provided by the Sancrox and Oxley Highway interchanges and service roads. Hence, western movements on the Sancrox Road from the Quarry Access Road would be strictly limited to supplying markets within the Sancrox locality, considered to be less than 1% of the total annual trucks trips. To address safety concerns for pedestrians and cyclists, Figure 2 to Figure 5 illustrates upgrades to the road network undertaken by RMS in 2016 which allow for safe passage of pedestrians and cyclists along the Sancrox Road / Quarry Access roundabout **Figure 2 – Photograph taken on Frogs Road looking North towards Quarry Access roundabout depicting pedestrian and cycle access** **Figure 3 – Photograph taken on Quarry Access roundabout looking North along Quarry Access Road depicting pedestrian and cycle access**

Submission Reference No.	Submission	Response
		Figure 4 – Photograph taken on Quarry Access roundabout looking East along Sancrox Road depicting pedestrian and cycle access **Figure 5 – Photograph taken on Quarry Access roundabout look west along Sancrox Road depicted pedestrian and cycle access**

Yours sincerely,

Amanda Antcliff
Principal Consultant

Murray Curtis
Partner

ATTACHMENT A UPDATED CONSULTATION LOG, JULY 2020

Table A1 – Updated Consultation Log, July 2020

Date	RAP/Contact Name	Contact Made By:	Form of Contact:	Evidence of Consultation	Details	Response/Follow up?
4 September 2017	-	-	Newspaper Advertisement	Yes	Port News	
30 August 2017	Birpai Local Aboriginal Land Council	ERM	Stage 1 Notification letter sent via email.	Yes	Letters were sent to the relevant government agencies to determine the relevant stakeholder groups for contact. Response requested by Friday 15 September 2017.	05/9/2017 - Response received via email to register an interest and confirming the proposed work is wholly located within the boundary of the Birpai Local Aboriginal Land Council. It was also suggested that Birpai Traditional Owners group would be interested.
30 August 2017	the Registrar	ERM	Stage 1 Notification letter sent via email and post.	Yes	Letters were sent to the relevant government agencies to determine the relevant stakeholder groups for contact. Response requested by Friday 15 September 2017.	6/09/2017 – Email response confirming that the project area described does not have Registered Aboriginal Owners pursuant to Division 3 of the Aboriginal Land Rights Act 1983 (ALRA).
30 August 2017	OEH Port Macquarie	ERM	Stage 1 Notification letter sent via email and post.	Yes	Letters were sent to the relevant government agencies to determine the relevant stakeholder groups for contact. Response requested by Friday 15 September 2017.	17/09/2017 – Letter providing a list of potential interested parties.
30 August 2017	NTSCorp	ERM	Stage 1 Notification letter sent via email and post.	Yes	Letters were sent to the relevant government agencies to determine the relevant stakeholder groups for contact. Response requested by Friday 15 September 2017.	
30 August 2017	NNTT	ERM	Stage 1 Notification letter sent via email and post.	Yes	Letters were sent to the relevant government agencies to determine the relevant stakeholder groups for contact. Response requested by Friday 15 September 2017.	20/06/17 – Response email from NNTT which stated that there are no Native Title Determination Applications, Determinations of Native Title, or Indigenous Land Use Agreements over the identified area.
30 August 2017	Port Mac Hastings Council	ERM	Stage 1 Notification letter sent via email and post.	Yes	Letters were sent to the relevant government agencies to determine the relevant stakeholder groups for contact. Response requested by Friday 15 September 2017.	
30 August 2017	North Coast LLS	ERM	Stage 1 Notification letter sent via email and post.	Yes	Letters were sent to the relevant government agencies to determine the relevant stakeholder groups for contact. Response requested by Friday 15 September 2017.	
5 September 2017	Birpai Local Aboriginal Land Council	David Carroll	Email	Yes	David Carroll sent an email registering BLALC in the project and confirming that the proposed work is wholly located within the boundary of the Birpai Local Aboriginal Land Council. David also suggested contact with Birpai Traditional owners group.	5/09/2017 - ERM replied thanking David for his response and confirming that we will be in contact soon.
11 September 2017	Jason Holten Birpai Traditional Owners	Jason Holten Birpai Traditional Owners	Phone	Consultation log	Jason Holten called KD ERM to register Birpai Traditional Owners as RAP for project. Received letter from NTS.	
4 October 2017	Saltwater Tribal Council	ERM KD	Mail	Yes	Letter was sent to groups identified from Stage 1.1 letter to government agencies to determine the relevant stakeholder groups for contact, letter requested registration of interest to be consulted. Response requested by 13 October 2017.	
4 October 2017	Ghinni Ghinni Youth and Culture	ERM KD	Email & Mail	Yes	Letter was sent to groups identified from Stage 1.1 letter to government agencies to determine the relevant stakeholder groups for contact, letter requested registration of interest to be consulted. Response requested by 13 October 2017.	

Date	RAP/Contact Name	Contact Made By:	Form of Contact:	Evidence of Consultation	Details	Response/Follow up?
	Aboriginal Corporation					
4 October 2017	Bindi Aboriginal Heritage & Cultural Centre Inc.	ERM KD	Mail	Yes	Letter was sent to groups identified from Stage 1.1 letter to government agencies to determine the relevant stakeholder groups for contact, letter requested registration of interest to be consulted. Response requested by 13 October 2017.	
4 October 2017	Jason Holten Birpai Traditional Owners	ERM KD	Email	Yes	Letter was sent to groups identified from Stage 1.1 letter to government agencies to determine the relevant stakeholder groups for contact, letter requested registration of interest to be consulted. BTO have already registered interest however letter sent to ensure that all groups have the same information.	
4 October 2017	Lakkari NTCG Mick Leon	ERM KD	Email & mail	Yes	Letter was sent to groups identified from Stage 1.1 letter to government agencies to determine the relevant stakeholder groups for contact, letter requested registration of interest to be consulted. Response requested by 13 October 2017.	
4 October 2017	Birpai Local Aboriginal Land Council Steve Miles	E RM KD	Email & Mail	Yes	Letter was sent to groups identified from Stage 1.1 letter to government agencies to determine the relevant stakeholder groups for contact, letter requested registration of interest to be consulted. Response requested by 13 October 2017.	
4 October 2017	Norm Archibald	ERM KD	Email & Mail	Yes	Letter was sent to groups identified from Stage 1.1 letter to government agencies to determine the relevant stakeholder groups for contact, letter requested registration of interest to be consulted. Response requested by 13 October 2017.	
4 October 2017	Yanggaay Danial Carriage	ERM KD	Mail	Yes	Letter was sent to groups identified from Stage 1.1 letter to government agencies to determine the relevant stakeholder groups for contact, letter requested registration of interest to be consulted. Response requested by 13 October 2017.	
13 October 2017	Yanggaay Danial Carriage	Yanggaay	email	Yes	Danial Carriage sent an email registering an interest in the project.	13/10/2017 ERM replied to confirm the registration and that ERM will be in contact with additional information..
17 October 2017	Jason Holten Birpai Traditional Owners	ERM KD	Email	Yes	Letter was sent to RAPs providing project information and invitation to fieldwork on 15 and 16 November. Requesting response by 13 November.	
17 October 2017	Birpai Local Aboriginal Land Council David Carroll	ERM KD	Email	Yes	Letter was sent to RAPs providing project information and invitation to fieldwork on 15 and 16 November. Requesting response by 13 November.	
17 October 2017	Yanggaay Danial Carriage	ERM KD	Email	Yes	Letter was sent to RAPs providing project information and invitation to fieldwork on 15 and 16 November. Requesting response by 13 November.	
21 October 2017	Norm Archibald	Norm Archibald	Email	Yes	Norm Archibald sent an email registering an interest in the project. Norm apologised for delayed registration as there were issues with the mail.	27/10/2017 ERM replied to confirm the registration.
27 October 2017	Norm Archibald	ERM KD	Email	Yes	Email was sent to advise that ERM had included Norm Archibald as a Registered Aboriginal Party and extended invitation to fieldwork in form of below letter. Letter was sent to RAPs providing project information and invitation to fieldwork on 15 and 16 November. Requesting response by 13 November.	

Date	RAP/Contact Name	Contact Made By:	Form of Contact:	Evidence of Consultation	Details	Response/Follow up?
8 November 2017	Birpai Local Aboriginal Land Council cc. OEH	ERM	Email	Yes	Letter was sent to the LALC in accordance with the consultation guidelines advising them that the Registered Aboriginal Parties for the Sancrox Quarry Project are: Birpai Local Aboriginal Land Council; Birpai Traditional Owners; Yanggaay; and Norm Archibald.	
9 November 2017	Jason Holten Birpai Traditional Owners	ERM KD	Phone	Consult log	Call to advise that fieldwork still going ahead on 15 and16 November. Jason Holten advised that he would be conducting the fieldwork on behalf of Birpai Traditional Owners and Birpai Local Aboriginal Land Council.	
9 November 2017	Birpai Local Aboriginal Land Council	ERM KD	Phone	Consult log	Call to advise that ERM had spoken to Jason Holten who had advised he would be conducting the fieldwork on behalf of Birpai Traditional Owners and Birpai Local Aboriginal Land Council. Requested insurance information be sent on Jason's behalf.	
9 November 2017	Yanggaay Danial Carriage	ERM KD	Phone	Consult log	Call to advise that fieldwork still going ahead on 15 and 16 November. Message that phone number was disconnected.	
19 January 2018	Jason Holten Birpai Traditional Owners	ERM KD	Email	Yes	Draft heritage assessment provided to all Registered Aboriginal Parties for their review and comment. Comments requested by COB Friday 16 February 2018.	
19 January 2018	Birpai Local Aboriginal Land Council David Carroll	ERM KD	Email	Yes	Draft heritage assessment provided to all Registered Aboriginal Parties for their review and comment. Comments requested by COB Friday 16 February 2018.	
19 January 2018	Yanggaay Danial Carriage	ERM KD	Email	Yes	Draft heritage assessment provided to all Registered Aboriginal Parties for their review and comment. Comments requested by COB Friday 16 February 2018.	
19 January 2018	Norm Archibald	ERM KD	Email	Yes	Draft heritage assessment provided to all Registered Aboriginal Parties for their review and comment. Comments requested by COB Friday 16 February 2018.	
14 March 2018	Birpai Local Aboriginal Land Council	LALC	Email	Yes	Response received on the draft report. The Birpai Local Aboriginal Land Council viewed the draft heritage assessment dated January 2018 and were satisfied with the assessment, methodology and the protocols and did not wish to make any further comments.	No further action required.
20 July 2020	Norm Archibald	ERM SM	Email	Yes	Call to Norm Archibald to ask if he had any comments on the draft report. Norm had no comments. SM advised that we would be available for follow up later in the week in case comments later came to mind.	SM sent a text message after the phone call with the appropriate contact information to provide any comments.
20 July 2020	Yanggaay Danial Carriage	ERM SM	Email	Yes	Email to Danial to follow up on consultation. Advised that we had previously made several attempts to contact with no response. Provided contact details and asked Danial to call or email to confirm receipt of the correspondence.	Find a current phone number for Danial.

ATTACHMENT B UNEXPECTED FINDS PROTOCOL

UNEXPECTED FINDS PROTOCOL, July 2020

An unexpected (chance) finds procedure will be implemented for any locations subject to soil disturbance activities, including vegetation clearing. In the event that site workers identify any potential Aboriginal heritage sites, the unexpected finds procedure shall be implemented in compliance with s89 of *National Parks and Wildlife Act 1974*. The procedure is as follows:

STOP WORK IMMEDIATELY. Any person that observes or uncovers potential Aboriginal heritage objects during the works must notify machinery operators immediately. All activities and/or works in the immediate area must cease (DO NOT collect samples to show someone).

NOTIFY. Notify the site supervisor immediately. The site supervisor will contact, notify and consult with Registered Aboriginal Parties (RAPs), Heritage NSW and an appropriately qualified heritage professional (archaeologist).

AVOID DISTURBANCE of the area at and adjacent to the cultural finds.

PROTECT THE SITE. Any sand/soils removed must be identified and set aside for assessment. The disturbed area needs to be cordoned off as an exclusion zone so that no further disturbance occurs (include an adequate buffer area).

ASSESS THE FIND. The RAPs and archaeologist will investigate the nature; extent and location of the find.

RECORD/SALVAGE THE FIND. The RAPs and archaeologist will, in consultation with the site supervisor, arrange recording of the objects and if required salvage. Note that any proposed salavge methodology must be approved in writing by Heritage NSW prior to undertaking any works on site.

RESUME WORK. Subject to the archaeologist's assessment, work may be able to recommence once the site is assessed and appropriately salvaged in accordance with any specitic requirements from Heritage NSW. Alternatively, where possible, work methods or location may be altered to minimise further harm to the find, or objects associated with the find.

Note: In the event of the discovery of human skeletal material (or suspected human skeletal material) during Project activities, a separate protocol is provided in Section 9.2.1 of the ACHAR (ERM 2019). NSW Police and the Coroner will determine the nature of the suspected remains and advise on further actions.

Appendix C

Groundwater Model Peer Review

HANSON CONSTRUCTION MATERIALS

SANCROX QUARRY EXPANSION

INDEPENDENT PEER REVIEW OF SANCROX QUARRY EXPANSION GROUNDWATER MODEL

GW-HANSON-20-02-REP-001

Hanson HEIDELBERGCEMENT Group

REN Consulting Pty Ltd

HANSON CONSTRUCTION MATERIALS

SANCROX QUARRY EXPANSION

Document Title	:	INDEPENDENT PEER REVIEW OF SANCROX QUARRY EXPANSION GROUNDWATER MODEL
Document No.	:	GW-HANSON-20-02-REP-001
Revision No.	:	A
Date	:	07 SEPTEMBER 2020

Rev	Description	Originator	Reviewer	Approver	Date
A	Issued for Client Review	JA	TA	JA	07 SEP '20

Contents

1 INTRODUCTION 1
1.1 Background 1
1.2 Scope of work 2
1.3 Modelling guidelines 2
1.4 NSW Planning Industry & Environment 2
2 PEER REVIEW 3
2.1 Model objectives 3
2.2 Model confidence level classification 3
2.3 Data analysis 5
2.4 Hydrogeological conceptualisation 6
2.5 Model design 8
2.6 Boundary conditions 9
2.7 Model calibration 9
2.8 Sensitivity analysis and verification 10
3 SUMMARY AND CONCLUSION 12
Appendix A – Review Checklist 14
Appendix B – Department of Planning Industry & Environment Review 20

List of Tables

Table 2-1 Performance measures and targets 9

List of Figures

Figure 1-1 Locality map 1
Figure 2-1 Groundwater monitoring bores 4
Figure 2-2 Topography of study area 7
Figure 2-3 Regional surface geology 7
Figure 2-4 Plot of residual and monthly rainfall 11

1 INTRODUCTION

This report provides a review of the groundwater model that has been developed to address the impact assessment requirements of the NSW Aquifer Interference Policy. The groundwater model was developed by Environmental Resources Management Australia Pty Ltd (ERM) and the modelling components are described in the Sancrox Quarry Expansion Environmental Impact Statement (EIS) - Annex F: Groundwater Assessment[1].

1.1 Background

The site is an operational hard rock quarry, located in Sancrox approximately 8 km to the west of Port Macquarie. The quarry has been owned and operated by Hanson since 1998. Hanson owns approximately 145 ha of land, of which approximately 12 ha has been in use for the extraction, processing, and storage of aggregates. Infrastructure associated with the existing quarry includes the processing plant, offices, weighbridge, and workshop.

The Study Area includes the existing quarry site, the area identified for the quarry expansion and a 2 km radius from the perimeter of the final pit to identify groundwater users that may be impacted by the proposed activity. The eastern portion of the Study Area has been disturbed by active quarrying activities while the west and northwest portions of the Study Area are largely undisturbed and predominantly covered with remnant woodland vegetation. Some smaller sections of ground are covered with pasture. **Figure 1-1** shows the location of the existing quarry site.

Figure 1-1 Locality map

[1] ERM, 2019 Sancrox Quarry Expansion, Groundwater Assessment, Hanson Construction Materials Pty Ltd, 0418291_Final, August 2019

1.2 Scope of work

The key tasks for this review were as follows:

- Review the development and calibration of the groundwater model and comment on:
  - Adequacy of the modelling approach for the intended purpose; and
  - Appropriateness of the assumptions used in the model.

1.3 Modelling guidelines

The peer review has been structured according to the following guidelines:

- Australian groundwater modelling guidelines, June 2012[2]; and,
- The Standard Guide for Conceptualization and Characterization of Ground-Water Systems (ASTM 5979-96).

The modelling has been assessed according to the Model Review checklist in the Australian Modelling Guidelines. This checklist has questions on (1) The Report; (2) Data Analysis; (3) Conceptualisation; (4) Model Design; (5) Calibration; (6) Verification; (7) Prediction; (8) Sensitivity Analysis; and (9) Uncertainty Analysis. Not all questions are pertinent to a site-specific model. Appendix A includes a checklist for a groundwater model review.

The effort put into a modelling study is dependent on timing and budgetary constraints that are generally not known to a reviewer. Hence, reduced performance in one aspect of the modelling effort could be the result of a conscious decision by the modelling team to get the model finished on budget and/or on time, or to apply extra focus on specific issues arising during modelling.

1.4 NSW Planning Industry & Environment

The DPIE review on the EIS – "Annex F: Groundwater Assessment" is provided in Appendix B. This review mainly questioned whether a model review has been undertaken, as stated in the Australian Groundwater Modelling Guidelines, to ascertain model's applicability for the impact assessment. It examined the model verification, impact on third party bores and available historical data on groundwater level and quality.

The DPIE pointed out that the proponent has misidentified the applicable Water Sharing Plans and Water Sources potentially affected by this development and has failed to identify the New England Fold Belt Coast Groundwater Source of the Water Sharing Plan for the North Coast Fractured and Porous Rock Groundwater Sources 2016 as the impacted water source. (The Hastings Alluvium sits adjacent to the quarry extent but partly within the project boundary.)

[2] Barnett et al, 2012, Australian groundwater modelling guidelines, Waterlines report, National Water Commission, Canberra

2 PEER REVIEW

2.1 Model objectives

The modelling guidelines are specific about defining the modelling objectives. These objectives should explain in detail the purpose or 'desired end' or 'outcome' of a groundwater model. Section 1.2 of Annex F discusses that the objective of the Groundwater Assessment is to meet the requirement of the Secretary's Environmental Assessment Requirements (SEARs):

- Identification of any licensing requirements or other approvals under the Water Act 1912 and/or Water Management Act 2000.
- An assessment of the likely impacts on the quality and quantity of existing surface and groundwater resources, including a detailed assessment of proposed water discharge quantities and quality against receiving water quality and flow objectives.
- An assessment of the likely impacts of the development on aquifers, watercourses, riparian land, water-related infrastructure, and other water users.
- A detailed description of the proposed water management system (including sewage), water monitoring program and other measures to mitigate surface and groundwater impacts.

The modelling objectives are to evaluate groundwater inflow rates into the expanded quarry as well as potential groundwater drawdown proximal to the quarry and the potential magnitude of drawdown at identified groundwater users.

The modelling objectives were stated in specific and measurable terms, along with the resource management objectives. However, it can be enhanced by discussing questions to be answered by the model and scenarios to be modelled.

2.2 Model confidence level classification

Models are used to produce predictions and the majority of models inherently have some degree of uncertainty associated with them. Hence, their predictions are imperfect. The potential for imperfection in predictions or the "wrongness" of model predictions arises from:

- Insufficient available data for unique estimation of parameterization detail; and
- Errors in its conceptual basis.

It is important to identify these constraints and how they affected the modelling process, especially in the development of a groundwater model of high complexity. This a schematic drawing or tabular form, showing all the hydrological stresses acting on the groundwater system and the reliability of the components obtained and input to the groundwater model.

Some of the hydrological stresses acting on the system are as follows:

- Rainfall recharge
- Evapotranspiration
- Groundwater extraction
- Groundwater seepage (quarry)

- Base flow discharge (gully catchment areas)

It is critical to provide a clear statement on how these hydrological input stresses were collated or simulated using the availablehistorical monitoring data. Three 50 mm dia. monitoring bores (SA1501 – SA1503) were drilled in 2015 for hydrogeological investigation and to record groundwater level fluctuations **Figure 2-1**.

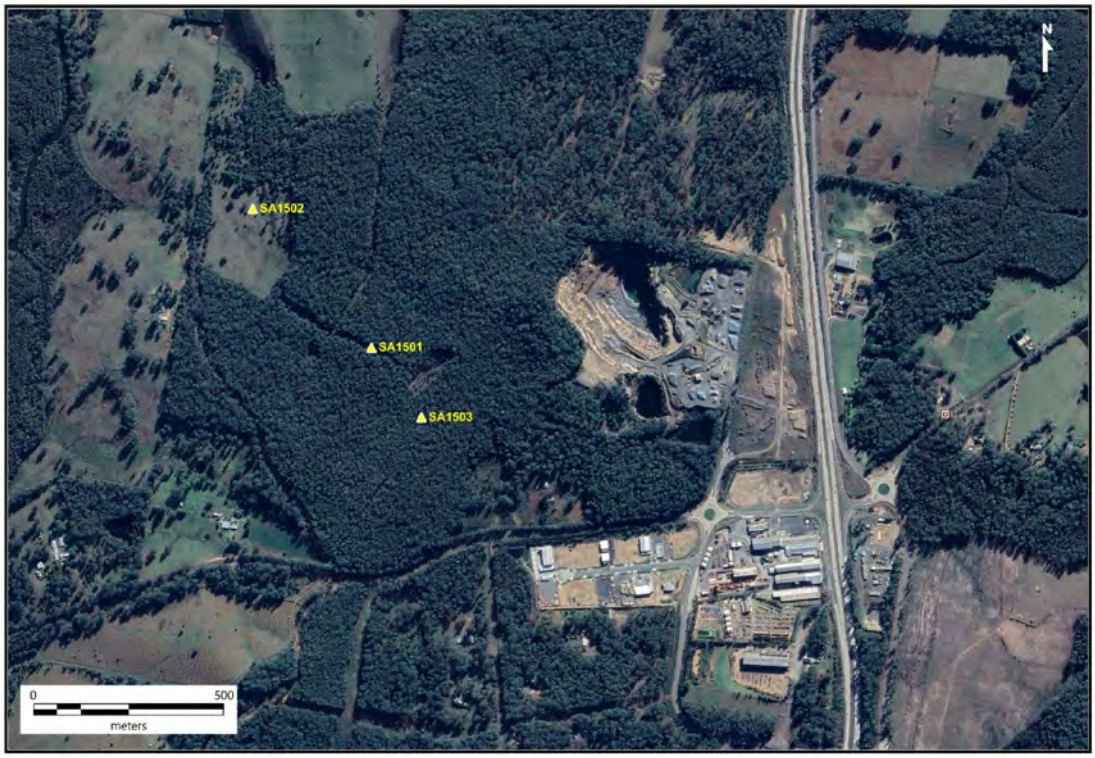


Figure 2-1 Groundwater monitoring bores

These bores are located in a near straight line which is not ideal for inferring groundwater flow directions spatially within the study area. Historical water levels that were collected from these bores were neither provided nor analysed to understand the hydrological stresses. It is also noted that no hydrogeological information from the surrounding groundwater bores, GW060512, GW060513, GW300120, GW301263, GW302376, GW303436, GW303749 and GW306269, has been included in the groundwater model development.

The model confidence-level classification (Class 1, Class 2, or Class 3 in order of increasing confidence) has been proposed in the Australian Groundwater Modelling Guidelines in order to assess whether or not the model has met this target. The confidence-level classification is mainly based on the available data (and the accuracy of that data) for conceptualisation, design, and construction.

The following limitations to the model are presented in the modelling report:

- The measured hydraulic conductivities were extrapolated throughout the model domain with the assumption that there are no structural or other geological features present with hydraulic characteristics significantly different to the pumping test results.

- Hydraulic conductivity of weathered rock and quarrying impacted rock and its effect on recharge rates are unknown.
- The rate of recharge was determined during model calibration and has significant uncertainty.
- A topographic high occurs in the southern portion of the domain which may present a groundwater flow divide, creating flow to the southwest as well as towards the Hastings River. There is no groundwater elevation information in this portion of the model to establish model outflows boundaries. This may result in overly elevated heads in the southwest portion of the Model.
- This model does not include a transient analysis (groundwater level and flow estimates varying over time). Therefore, the model-calculated pit inflows are stabilized long-term values that do not include groundwater in storage effects. These storage effects, although temporary, could increase the current estimates significantly within the initial stages of the quarry expansion where large amounts may be released from aquifer storage.
- Similarly, the drawdown estimates are stabilized long-term estimates that represent the largest cone to be formed by the quarry dewatering. In reality, the cone of depression will expand gradually over time.
- Pit inflow estimates are based on groundwater seepage only, and do not include directly precipitated waters or surface water runoff into pit, with direct precipitation through rainfall likely being the major component of pit dewatering requirements.
- The current model is not sufficiently detailed to identify pit wall-groundwater issues and does not include additional estimates for pit slope pore pressure reduction. Should such systems (e.g. horizontal pit wall wells) be required, groundwater flows would be higher than current estimates. A more detailed analysis including transient flows and more detailed pit geometry configurations would be required to assess such issues.

The confidence level of the Sancrox Quarry groundwater model may be classified as “Class 1”, as defined by the Australian Groundwater Modelling Guidelines, as three poorly distributed monitoring bores were relied upon to obtain groundwater and geological information. As such, the groundwater model may be used for predicting long-term impacts of proposed developments in low-value aquifers. The model results should be used to plan additional data gathering to improve the confidence-level of the groundwater model.

2.3 Data analysis

It is reported that water level loggers were deployed in all three monitoring bores, SA1501 (Oct’15 – Sep’17), SA1502 (Dec’16 – Sep’17) and SA1503 (Dec’16 – Jul’17), and the loggers were programmed to collect water level measurements at 12 hour intervals. A summary of the water level measurements has been included in the report. However, comparison of the recorded logger data with the residual rainfall might help to understand the hydrological stresses for the model calibration and verifications.

Two short-term pumping tests were carried out at monitoring bores SA1501 and SA1502 over the period 28/29 November 2017. The pre-pumping test standing water levels were 10.72 and 1.53 mbGL in Bores SA1501 and SA1502, respectively. The standing water level was 11.43 mbGL in Bore SA1503, however this bore was not included in the pumping test program due a blockage within the bore.

The field records suggest that variable discharge pumping tests were carried out at these bores. Pumping rates at SA1502 were increased from 1 L/min to 3 L/min and at SA1501 from 3 L/min to 6 L/min.Water level recovery was observed in both bores. As such, these pumping tests should be analysed using the variable discharge flow equations.

The investigation / quantification of the following matters has not been sufficiently documented in the modelling report.

- Comparison of historical groundwater levels with the residual rainfall
- Existing groundwater bore survey
- Seepage discharge and evapotranspiration processes

Investigation / quantification of the matters listed above may provide some insight into the quantification of errors in the derivation of hydrological stresses.

2.4 Hydrogeological conceptualisation

Gravity is the main driving force for groundwater flow, while topography and geology define the effects on groundwater flow. The topography of the Study Area can be characterised by low lying hilly terrain (**Figure 2-2**) of relatively low hydraulic conductivity metasedimentary rocks. In these areas, the groundwater flow field is controlled by the topography and the groundwater table closely follows the landscape topography.

The eastern portion of the Study Area has been disturbed by active quarrying activities. while the west and northwest portions of the Study Area are largely undisturbed. A conceptual model diagram that conveys the essential features of the hydrological system, denoting all recharge/discharge processes. would be a useful addition to the documentation. Such a diagram could serve a dual purpose of displaying the water balance components derived from data sources and the uncertainty associated with the derivation of the water balance components.

ASTM 5979-96 provides a stepwise method for the qualitative conceptualisation and quantitative characterisation of groundwater flow systems, including the unsaturated zone, for natural or human-induced behaviour or changes.

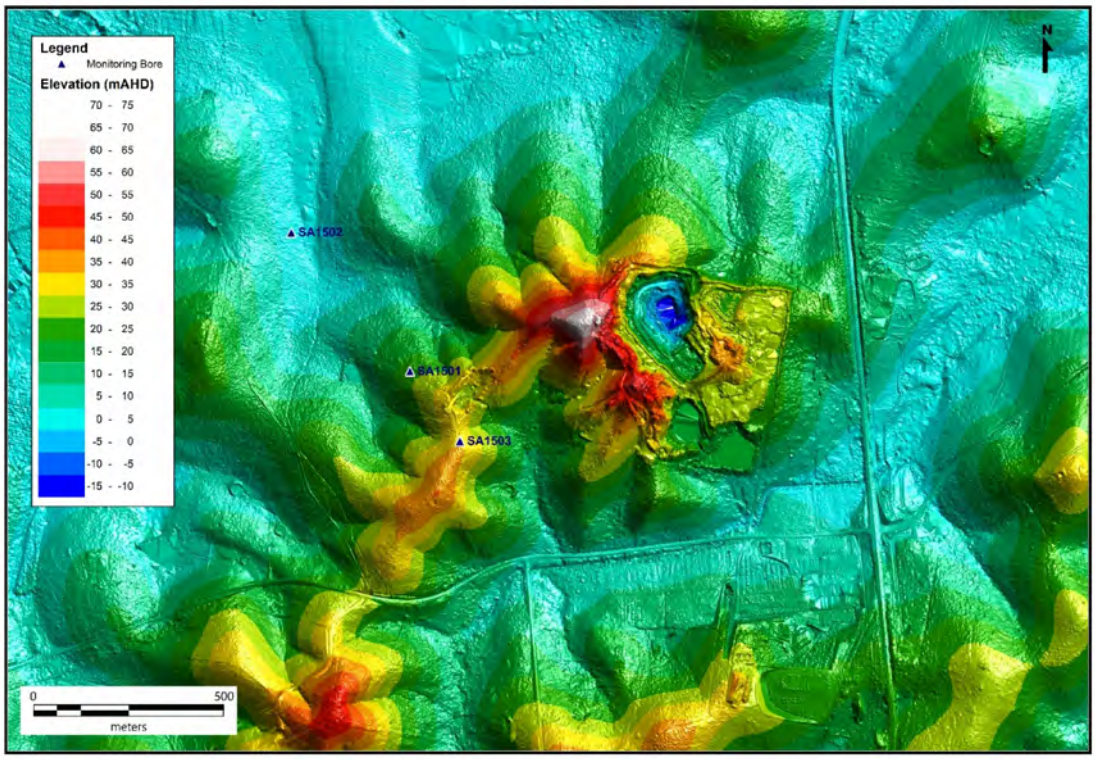


Figure 2-2 Topography of study area

Figure 2-3 Regional surface geology

The regional surface geology map (***Figure 2-3***) indicates that the Study Area is underlain by the Byabbara Beds of the Carboniferous Period. The Byabbara Beds' geology has been inferred to comprise conglomerate, sandstone, and siltstone to the north of the fault line and predominantly shale to the south of the fault line. The meta-sediments of the Byabbara Beds underlying the Study Area are considered to present a fractured rock aquifer, with groundwater storage and flow largely controlled by secondary porosity.

Three monitoring bores (SA1501 – SA1503) have been installed at the Study Area and the aquifer thickness values presented for SA1501 and SA1502 were 70 m and 36 m, respectively. It is recommended that a hydrogeological cross-section across SA1501 – SA1503 be provided showing hydro-stratigraphic units andstructural discontinuities to illustrate the key groundwater flow processes in the Study Area. In the absence of specific documentation relating to the bulk water movements between the layers of the model, the construction of a 4-layered model is potentially fraught with significant uncertainties.

The quantification of groundwater system water balance components was not documented in the modelling report for conceptual model development. The quantification of water balance components provides insight into potential deficiencies in the data collection.

2.5 Model design

A numerical groundwater flow model for the Study Area was developed using MODFLOW-NWT[3], a Newton formulation of MODFLOW-2005[4]. MODFLOW is a block-centred finite difference code and it views the three-dimensional system as a sequence of layers of porous material, though transmissivity within a layer may vary due to spatial variations in aquifer thickness and/or hydraulic conductivity. Finite difference grids are made of square or rectangular cells described as uniform or rectilinear grids, respectively.

The groundwater model is a four-layered MODFLOW based model. The model grid comprises 220 rows and 220 columns and is aligned with the primary groundwater flow direction across the Site towards the Hastings River. The model area was discretized with a uniform finite difference grid of 20 m x 20 m and covers an area of 19.36 km^2. Layer 1 was set to a constant 10 m thickness to represent quaternary alluvium and weathered meta-sediments. Layers 2 and 3 are a combined 100 m to represent the fractured meta-sediments and the full depth of the monitoring bores. Layer 4 is a constant 20 m thickness to allow for interaction of deeper metasedimentary rocks.

During normal MODFLOW operation, when the water levels in some model cells fall below the base of those cells, these cells are declared as "dry" and rendered inactive. Even though they can be "re-wet" at a later stage of the simulation process if necessary, numerical solution convergence difficulties are experienced due to the use of certain thresholds in the re-wetting process. Because of the limited implementation of drying-re-wetting functionality in MODFLOW, MODFLOW-NWT, which does not set dewatered cells as no-flow or inactive, was selected to overcome numerical instabilities during de-saturation. It is considered that MODFLOW-NWT code is an appropriate choice to achieve the objectives of the study. However, questions on the adequacy of field data for the spatially distributed MODFLOW

[3] Niswonger, R.G., Panday, Sorab, and Ibaraki, Motomu, 2011: MODFLOWNWT, A Newton formulation for MODFLOW-2005: U.S. Geological Survey Techniques and Methods, Book 6, Chapter A37.
[4] Harbaugh, A.W., 2005, MODFLOW-2005: the U.S. Geological Survey modular groundwater model – the Groundwater Flow Process: U.S. Geological Survey Techniques and Methods 6-A16, variously paginated.

model has to be resolved. In order to address this deficiency, it is recommended that additional field investigations at key locations be carried out in order to gather data and to allow subsequent improvement of model performance.

2.6 Boundary conditions

The following four types of boundary conditions have been assigned to the groundwater model:

- No-flow boundaries were set as the bottom of Layer 4 and the northwest, southwest and southeast boarders.
- A constant head boundary (CHB) was set in Layer 1 as the domain outflow on the northwest boundary of the model to represent discharge to the Hastings River and the southwest corner to represent discharge to quaternary materials.
- Recharge rates of 2.7 and 40 mm/year were determined during model calibration over the meta-sedimentary rocks and quaternary alluvial units, respectively.
- Drainage package was used to model seepage into the quarry pit.

The modelling report Figure 5.1 does not clearly show the limits constant, no-flow boundaries at the northwest and southwest boundaries and the assigned constant head. The modelling report also does not provide supporting data nor discusses the basis for the above boundary conditions.

2.7 Model calibration

A number of performance measures have been prescribed in Australian Groundwater Modelling Guidelines to demonstrate that a model is robust, simulates the water balance as required and is consistent with the conceptual model on which it is based (***Table 2-1***).

Table 2-1 Performance measures and targets

Performance measure	Criterion
Model convergence The model must converge in the sense that the maximum change in heads between iterations is acceptably small.	The iteration convergence criterion should be one or two orders of magnitude smaller than the level of accuracy required in head predictions. Typically, of the order of centimetres or millimetres.
Water balance The model must demonstrate an accurate water balance, at all times and in steady state. The water balance error is the difference between total predicted inflow and total predicted outflow, including changes in storage, divided by either total inflow or outflow and expressed as a percentage.	A value less than 1% should be achieved and reported at all times and cumulatively over the whole simulation. Ideally the error should be much less. An error of >5% would be unacceptable, and usually indicates some kind of error in the way the model has been set up.

Performance measure	Criterion
Qualitative measures The model results must make sense and be consistent with the conceptual model. Contours of heads, hydrographs and flow patterns must be reasonable, and similar to those anticipated, based either on measurements or intuition. Estimated parameters must make sense and be consistent with the conceptual model and with expectations based on similar hydrogeological systems.	Qualitative measures apply during calibration, when comparisons can be made with historical measurements, but also during predictions, when there is still a need for consistency with expectations. There is no specific measure of success. A subjective assessment is required as to the reasonableness of model results, relative to observations and expectations. The modeller should report on relevant qualitative measures and discuss the reasons for consistency and inconsistency with expectations.
Quantitative measures The goodness of fit between the model and historical measurements can be quantified, using statistics such as RMS, SRMS, MSR and SMSR for trial-and-error calibration and the objective function in automated calibration.	Quantitative measures only apply during calibration. Statistics of goodness of fit are useful descriptors but should not necessarily be used to define targets. Goodness of fit of heads is only one part of a regularised objective function—the other relates to agreement between parameter estimates and prior estimates, so in this situation, the two components of the objective function should both be reported. Targets such as SRMS < 5% or SRMS < 10% may be useful if a model is similar to other existing models and there is good reason to believe that the target is achievable. Even if a formal target is not set, these measures may provide useful guides.

Model calibration was carried out for a steady state condition in which groundwater elevation data was collected from three monitoring bores (SA1501, SA1502 and SA1503) prior to the start of the pumping tests conducted on 28 November 2017. It appears that no other data such as water levels in the surrounding groundwater bores, hand-drawn groundwater level contours based on the topography for pre-mining and current conditions, etc. have been considered to demonstrate robustness to the calibration process.

The goodness of fit of the three target data points presented in the modelling report cannot be considered as a useful information on the model calibration. This is because target data does not adequately represent the groundwater flow processes within the Study Area. Furthermore, the simulated groundwater equipotential surface presented in the modelling report (Figure 5.4) may not agree with the topography of the Study Area (i.e. ground surface is appeared to be lower than the simulated groundwater equipotential surface). No modelling results were presented to show the effect of the existing quarry surface on the groundwater equipotential surface.

It is concluded that model calibration does not systematically address the performance measures and targets (***Table 2-1***) and the uncertainty and lack of data has to be resolved.

2.8 Sensitivity analysis and verification

Sensitivity analysis is a procedure for quantifying the impact on an aquifer's simulated response due to an incremental variation in a model parameter or a model stress. Its purpose is to identify those

parameters which are most important in determining aquifer behaviour. A sensitivity scenario in which combined higher hydraulic conductivities in the metasedimentary unit and expanded locations of the southwest and southeast boundaries by 1,000 m has been documented in the report. The sensitivity analysis shows that the modelled drawdown at groundwater boreGW303749 increased from 2.90 m (base case) to 7.23 m and modelled drawdown in groundwater boresGW303436 and GW306260 increased by 0.90 m and 1.72 m, respectively. This indicates that the assignment of no flow boundary conditions at the southwest and southeast boundaries has to be reviewed and water levels at the groundwater bores GW060512, GW060513, GW300120, GW301263, GW302376, GW303436, GW303749 and GW306269 have to be included in the model calibration.

No verification of the model performance was reported. Verification is a test of whether the model can be used as a predictive tool by demonstrating that the calibrated model is an adequate representation of the physical system. The steady state model has been calibrated based on the groundwater elevation data collected on 28 November 2017 and the rainfall data available for the site from the DataDrill[5] climate repository (**Figure 2-4**) indicates that the Study Area experienced more than average rainfall in the latter part of 2017.

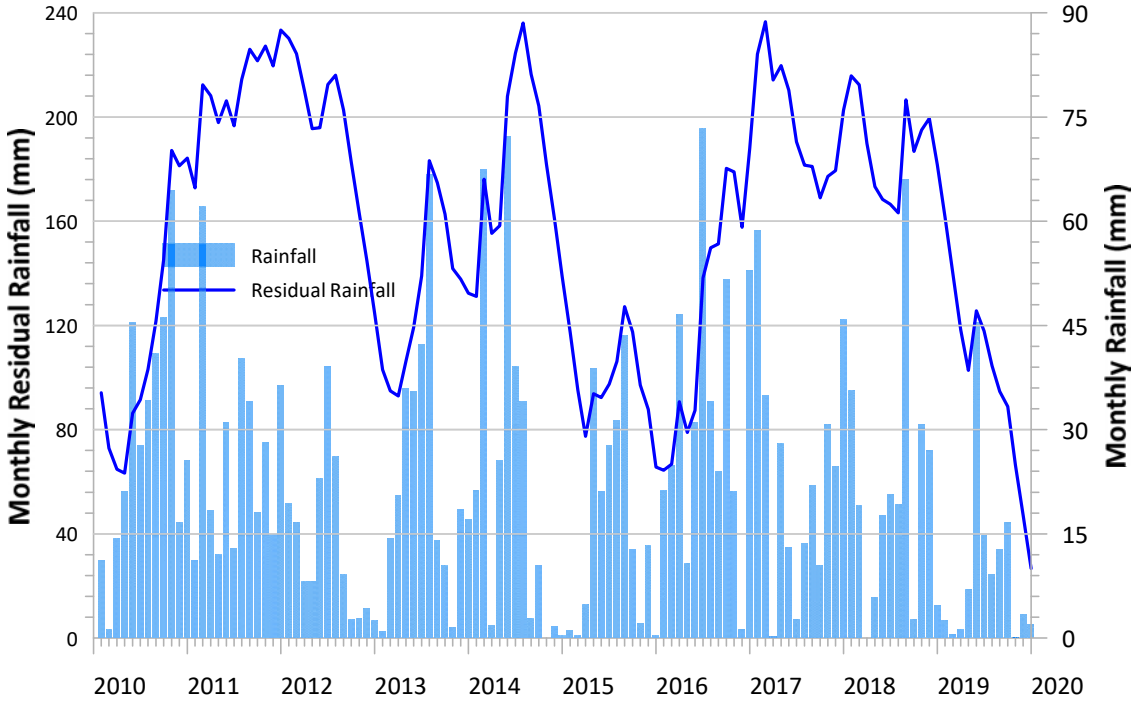


Figure 2-4 Plot of residual and monthly rainfall

Consideration should be given to verification of the model using the logger data to assess if the model is a reliable tool for the prediction of groundwater level fluctuation with varying climate data.

[5] https://www.longpaddock.qld.gov.au/silo/point-data/

3 SUMMARY AND CONCLUSION

The information provided in the Sancrox Quarry Expansion Environmental Impact Statement (EIS) – Annex F: Groundwater Assessment relating to groundwater modelling was reviewed based on the Australian Groundwater Modelling Guideline checklist. The groundwater model data files were not reviewed by REN.

The following conclusions were made:

- The statement of modelling objectives in the report could be enhanced by discussing questions to be answered by the model and scenarios to be modelled.
- A set of static groundwater elevation data collected at only three monitoring bores, SA1501, SA1502 and SA1503, prior to the pumping test has been included in the model development. Water level data that was collected from these bores was neither provided nor analysed to understand the hydrological stresses in the Study Area.
- No hydrogeological information from the surrounding groundwater bores, GW060512, GW060513, GW300120, GW301263, GW302376, GW303436, GW303749 and GW306269, has been included in the groundwater model development.
- The investigation / quantification of the following matters has to be analysed to provide some insight into the quantification of errors in the derivation of hydrological stresses:
    - Comparison of historical groundwater levels with the residual rainfall
    - Existing groundwater bore survey
    - Seepage discharge and evapotranspiration processes.
- The hydrogeological cross-section across the monitoring bores: SA1501, SA1502 and SA1503, should be presented to support the adopted model layer configuration.
- The quantification of groundwater system water balance components has to be provided in order to gain insight into potential deficiencies in the data collection.
- The modelling report neither provides supporting data nor discusses the basis for the adopted boundary conditions.
- Estimated pre-quarrying and current groundwater level contours have to be presented to verify the modelled groundwater level contours.
- The modelled groundwater equipotential surface presented in the modelling report may not agree with the topography of the study area (i.e. ground surface appears to be lower than the modelled groundwater equipotential surface).
- The model calibration does not systematically address the performance measures and targets as outlined in the Groundwater Modelling Guidelines and the uncertainty and lack of data have to be resolved.
- Sensitivity analysis of the assignment of no flow boundary conditions at the southwest and southeast boundaries has to be reviewed and water levels at the groundwater bores, GW060512, GW060513,

GW300120, GW301263, GW302376, GW303436, GW303749 and GW306269, have to be included in the model calibration.

- No verification of the model performance was reported. Verification of the model using the logger data is needed to assess if the model is a reliable tool for the prediction of groundwater level fluctuation with varying climate data.

The confidence level of the Sancrox Quarry groundwater model may be classified as "Class 1", as defined by the Australian Groundwater Modelling Guidelines, as three poorly distributed monitoring bores were relied upon to obtain groundwater and geological information. As such, the groundwater model may be used for predicting long-term impacts of proposed developments in low-value aquifers. The model results should be used to plan additional data gathering to improve the confidence-level of the groundwater model.

Appendix A – Review Checklist

Review questions	Yes/No	Comment
1. Planning		
1.1 Are the project objectives stated?	Yes	
1.2 Are the model objectives stated?	Yes	
1.3 Is it clear how the model will contribute to meeting the project objectives?	Yes	
1.4 Is a groundwater model the best option to address the project and model objectives?	Yes	
1.5 Is the target model confidence-level classification stated and justified?	No	
1.6 Are the planned limitations and exclusions of the model stated?	Yes	
2. Conceptualisation		
2.1 Has a literature review been completed, including examination of prior investigations?	No	
2.2 Is the aquifer system adequately described?	No	
2.2.1 hydrostratigraphy including aquifer type (porous, fractured rock ...)	No	
2.2.2 lateral extent, boundaries and significant internal features such as faults and regional folds	No	
2.2.3 aquifer geometry including layer elevations and thicknesses	No	
2.2.4 confined or unconfined flow and the variation of these conditions in space and time?	No	
2.3 Have data on groundwater stresses been collected and analysed?	No	
2.3.1 recharge from rainfall, irrigation, floods, lakes	No	
2.3.2 river or lake stage heights	n/a	
2.3.3 groundwater usage (pumping, returns etc)	No	
2.3.4 evapotranspiration	No	
2.3.5 other?		
2.4 Have groundwater level observations been collected and analysed?	No	
2.4.1 selection of representative bore hydrographs	No	
2.4.2 comparison of hydrographs	No	
2.4.3 effect of stresses on hydrographs	No	
2.4.4 water-table maps/piezometric surfaces?	No	
2.4.5 If relevant, are density and barometric effects taken into account in the interpretation of groundwater head and flow data?	n/a	
2.5 Have flow observations been collected and analysed?	No	
2.5.1 baseflow in rivers	No	
2.5.2 discharge in springs	n/a	
2.5.3 location of diffuse discharge areas?	n/a	
2.6 Is the measurement error or data uncertainty reported?	No	

Review questions	Yes/No	Comment
2.6.1 measurement error for directly measured quantities (e.g. piezometric level, concentration, flows)	No	
2.6.2 spatial variability/heterogeneity of parameters	No	
2.6.3 interpolation algorithm(s) and uncertainty of gridded data?	No	
2.7 Have consistent data units and geometric datum been used?	Yes	
2.8 Is there a clear description of the conceptual model?	No	
2.8.1 Is there a graphical representation of the conceptual model?	No	
2.8.2 Is the conceptual model based on all available, relevant data?	No	
2.9 Is the conceptual model consistent with the model objectives and target model confidence level classification?	No	
2.9.1 Are the relevant processes identified?	No	
2.9.2 Is justification provided for omission or simplification of processes?	No	
2.10 Have alternative conceptual models been investigated?	No	
3. Design and construction		
3.1 Is the design consistent with the conceptual model?	No	
3.2 Is the choice of numerical method and software appropriate (**Error! Reference source not found.**)?	Yes	
3.2.1 Are the numerical and discretisation methods appropriate?	Yes	
3.2.2 Is the software reputable?	Yes	
3.2.3 Is the software included in the archive or are references to the software provided?	Yes	
3.3 Are the spatial domain and discretisation appropriate?		
3.3.1 1D/2D/3D	Yes	
3.3.2 lateral extent	No	
3.3.3 layer geometry?	No	
3.3.4 Is the horizontal discretisation appropriate for the objectives, problem setting, conceptual model and target confidence level classification?	No	
3.3.5 Is the vertical discretisation appropriate? Are aquitards divided in multiple layers to model time lags of propagation of responses in the vertical direction?	No	
3.4 Are the temporal domain and discretisation appropriate?		
3.4.1 steady state or transient	No	
3.4.2 stress periods	n/a	
3.4.3 time steps?	n/a	
3.5 Are the boundary conditions plausible and sufficiently unrestrictive?		
3.5.1 Is the implementation of boundary conditions consistent with the conceptual model?	No	
3.5.2 Are the boundary conditions chosen to have a minimal impact on key model outcomes? How is this ascertained?	No	

Review questions	Yes/No	Comment
3.5.3 Is the calculation of diffuse recharge consistent with model objectives and confidence level?	No	
3.5.4 Are lateral boundaries time-invariant?	No	
3.6 Are the initial conditions appropriate?	n/a	
3.6.1 Are the initial heads based on interpolation or on groundwater modelling?	n/a	
3.6.2 Is the effect of initial conditions on key model outcomes assessed?	n/a	
3.6.3 How is the initial concentration of solutes obtained (when relevant)?	n/a	
3.7 Is the numerical solution of the model adequate?		
3.7.1 Solution method/solver		
3.7.2 Convergence criteria		
3.7.3 Numerical precision		
4. Calibration and sensitivity		
4.1 Are all available types of observations used for calibration?		
4.1.1 Groundwater head data	No	
4.1.2 Flux observations	No	
4.1.3 Other: environmental tracers, gradients, age, temperature, concentrations etc.	n/a	
4.2 Does the calibration methodology conform to best practice?		
4.2.1 Parameterisation	No	
4.2.2 Objective function	No	
4.2.3 Identifiability of parameters	No	
4.2.4 Which methodology is used for model calibration?		
4.3 Is a sensitivity of key model outcomes assessed against?		
4.3.1 parameters	Yes	
4.3.2 boundary conditions	Yes	
4.3.3 initial conditions	n/a	
4.3.4 stresses	n/a	
4.4 Have the calibration results been adequately reported?	No	
4.4.1 Are there graphs showing modelled and observed hydrographs at an appropriate scale?	No	
4.4.2 Is it clear whether observed or assumed vertical head gradients have been replicated by the model?	No	
4.4.3 Are calibration statistics reported and illustrated in a reasonable manner?	Yes	
4.5 Are multiple methods of plotting calibration results used to highlight goodness of fit robustly? Is the model sufficiently calibrated?		
4.5.1 spatially	No	
4.5.2 temporally	No	
4.6 Are the calibrated parameters plausible?	Yes	

Review questions	Yes/No	Comment
4.7 Are the water volumes and fluxes in the water balance realistic?	No	
4.8 has the model been verified?	No	
5. Prediction		
5.1 Are the model predictions designed in a manner that meets the model objectives?	Yes	
5.2 Is predictive uncertainty acknowledged and addressed?	No	
5.3 Are the assumed climatic stresses appropriate?	No	
5.4 Is a null scenario defined?	n/a	
5.5 Are the scenarios defined in accordance with the model objectives and confidence level classification?	No	
5.5.1 Are the pumping stresses similar in magnitude to those of the calibrated model? If not, is there reference to the associated reduction in model confidence?	No	
5.5.2 Are well losses accounted for when estimating maximum pumping rates per well?	No	
5.5.3 Is the temporal scale of the predictions commensurate with the calibrated model? If not, is there reference to the associated reduction in model confidence?	No	
5.5.4 Are the assumed stresses and timescale appropriate for the stated objectives?	No	
5.6 Do the prediction results meet the stated objectives?	No	
5.7 Are the components of the predicted mass balance realistic?	No	
5.7.1 Are the pumping rates assigned in the input files equal to the modelled pumping rates?	n/a	
5.7.2 Does predicted seepage to or from a river exceed measured or expected river flow?	n/a	
5.7.3 Are there any anomalous boundary fluxes due to superposition of head dependent sinks (e.g. evapotranspiration) on head-dependent boundary cells (Type 1 or 3 boundary conditions)?	n/a	
5.7.4 Is diffuse recharge from rainfall smaller than rainfall?	Yes	
5.7.5 Are model storage changes dominated by anomalous head increases in isolated cells that receive recharge?	n/a	
5.8 Has particle tracking been considered as an alternative to solute transport modelling?	n/a	
6. Uncertainty		
6.1 Is some qualitative or quantitative measure of uncertainty associated with the prediction reported together with the prediction?	n/a	
6.2 Is the model with minimum prediction-error variance chosen for each prediction?	n/a	
6.3 Are the sources of uncertainty discussed?		
6.3.1 measurement of uncertainty of observations and parameters	No	
6.3.2 structural or model uncertainty	Yes	
6.4 Is the approach to estimation of uncertainty described and appropriate?	n/a	

Review questions	Yes/No	Comment
6.5 Are there useful depictions of uncertainty?	n/a	
7. Solute transport		
7.1 Has all available data on the solute distributions, sources and transport processes been collected and analysed?	n/a	
7.2 Has the appropriate extent of the model domain been delineated and are the adopted solute concentration boundaries defensible?	n/a	
7.3 Is the choice of numerical method and software appropriate?	n/a	
7.4 Is the grid design and resolution adequate, and has the effect of the discretisation on the model outcomes been systematically evaluated?	n/a	
7.5 Is there sufficient basis for the description and parameterisation of the solute transport processes?	n/a	
7.6 Are the solver and its parameters appropriate for the problem under consideration?	n/a	
7.7 Has the relative importance of advection, dispersion and diffusion been assessed?	n/a	
7.8 Has an assessment been made of the need to consider variable density conditions?	n/a	
7.9 Is the initial solute concentration distribution sufficiently well-known for transient problems and consistent with the initial conditions for head/pressure?	n/a	
7.10 Is the initial solute concentration distribution stable and in equilibrium with the solute boundary conditions and stresses?	n/a	
7.11 Is the calibration based on meaningful metrics?	n/a	
7.12 Has the effect of spatial and temporal discretisation and solution method taken into account in the sensitivity analysis?	n/a	
7.13 Has the effect of flow parameters on solute concentration predictions been evaluated, or have solute concentrations been used to constrain flow parameters?	n/a	
7.14 Does the uncertainty analysis consider the effect of solute transport parameter uncertainty, grid design and solver selection/settings?	n/a	
7.15 Does the report address the role of geologic heterogeneity on solute concentration distributions?	n/a	
8. Surface water–groundwater interaction		
8.1 Is the conceptualisation of surface water–groundwater interaction in accordance with the model objectives?	n/a	
8.2 Is the implementation of surface water–groundwater interaction appropriate?	n/a	
8.3 Is the groundwater model coupled with a surface water model?	n/a	
8.3.1 Is the adopted approach appropriate?	n/a	
8.3.2 Have appropriate time steps and stress periods been adopted?	n/a	
8.3.3 Are the interface fluxes consistent between the groundwater and surface water models?	n/a	

Appendix B – Department of Planning Industry & Environment Review

OUT19/14564

Melissa Anderson
Environmental Assessment Officer
Planning & Assessments
NSW Department of Planning and Environment

melissa.anderson@planning.nsw.gov.au

Dear Ms Anderson

Sancrox Quarry Expansion Project (SSD-7293)
EIS Exhibition

I refer to your email of 25 October 2019 to the Department of Planning, Industry and Environment (DPIE) Water and the Natural Resources Access Regulator (NRAR) about the above matter.

The following recommendations for you to consider are provided from DPIE Water and NRAR. Please note Crown Lands, the Department of Primary Industries (DPI) – Fisheries and DPI - Agriculture all now provide a separate response directly to you. Please note more detail is provided in **Attachment A**.

Pre-Approval

Groundwater Assessment, Licencing and Monitoring

- Assess and classify the groundwater model against the Australian Groundwater Modelling Guidelines and have the model peer reviewed.
- Provide details on acquiring suitable surface/groundwater entitlement to cover estimated take.
- Correctly identify potentially impacted water sources and revise its Aquifer Interference Policy (AIP) (DPI 2012) assessment as required.

Post Approval

Groundwater Licencing and Monitoring

- If a Water Access Licence (WAL) is required it must be obtained prior to the commencement of works.
- Develop a groundwater monitoring plan in consultation with DPIE Water including threshold trigger values as well as a contingency strategy if triggers are exceeded.
- Develop a water quality monitoring plan for the in-pit sump(s) and existing monitoring bores while they remain accessible.

Surface Water Assessment

- Establish a sediment control structure adjacent to the northern aggregate stockpile to the southeast of the Project area.

Any further referrals to DPIE – Water and NRAR can be sent by email to: landuse.enquiries@dpi.nsw.gov.au.

Any further referrals to (a) Crown Lands; (b) DPI – Fisheries; and (c) DPI – Agriculture can be sent by email to: (a) lands.ministerials@industry.nsw.gov.au; (b) ahp.central@dpi.nsw.gov.au; and (c) landuse.ag@dpi.nsw.gov.au respectively.

Yours sincerely

Simon Francis
Senior Project Officer, Assessments
Water – Strategic Relations
10 February 2020

Sancrox Quarry Expansion Project (SSD-7293)
EIS Exhibition

Groundwater Assessment, Licencing and Monitoring

The numerical groundwater model (herein the model) reported in the EIS was calibrated in steady state only and with no transient verification. The proponent has not referenced the Australian Groundwater Modelling Guidelines (2012) in the EIS or in Appendix F. No report is given of a peer review and no classification is made under the Guidelines. However, the model is appropriately constructed and well calibrated.

The model does not incorporate surface water harvesting and enhanced pit inflows, nor does it take into account harvested surface water storages close to the pit. These have the potential to alter the model final iterations in its current form.

The proponent has misidentified the applicable Water Sharing Plans and Water Sources potentially affected by this development, possibly misguided by the possibility that the Water Sharing Plan for the Hastings Unregulated and Alluvial Water Sources (2019) was yet to be gazetted at the time of the groundwater assessment.

In any event, the proponent has failed to identify the New England Fold Belt Coast Groundwater Source of the Water Sharing Plan for the North Coast Fractured and Porous Rock Groundwater Sources 2016 as the impacted water source. (The Hastings Alluvium sits adjacent to the quarry extent but partly within the project boundary.)

Despite this, the minimum impact considerations of the AIP are correctly made for a less productive porous rock aquifer, but should be reassessed by the proponent in view of the other errors made and the shortcomings identified with the numerical model.

The bulk of the water demands are to be supplied from harvesting overland flows on site, with an estimated peak operational demand of at 131 ML/year. The groundwater seepage into the pit void is modelled at between 15 to 22 ML/year – representing the full volume of groundwater take.

The proponent has not provided details on acquiring suitable surface/groundwater entitlement for the predicted water take within the WSP. The predicted 100-year 2 m drawdown contour is not entirely within lands owned by the proponent (and quarry lease). The proponent has modelled drawdown impacts on two neighbouring third-party bores that breach the 2 m limit required under the AIP. The proponent will need to implement monitoring of these sites in the WMP and provide triggers for make good provisions on impacted bores.

There are currently three groundwater monitoring bores within the proponents lease area and a further 13 bores within a 2 km radius of the pit. Two years of water level data were collected in the three monitoring bores at 12 hr intervals between October 2015 and July 2017. Water quality monitoring was completed only once during the pump test completed in November 2017 – this is insufficient to represent baseline conditions.

A water monitoring plan will need to be developed in consultation with DPIE Water.

Surface Water Assessment

Surface water runoff flows into the main pit and is pumped into water holding dams in the southeast corner of the site. There is a sediment basin in the north east of the quarry that captures water from the crushing plant and stock pile. The northern aggregate stockpile area drains to the southeast and has minimal sediment control. The proponent has committed to reviewing sediment control on site. The quarry is surrounded by a bund at its extents.

The quarry sites represent a challenge for erosion control deemed “high risk”, due to the large areas of exposed soil surface (which is often unavoidable), and erosion control will only ever be partially effective. To protect receiving waters against pollution, sediment controls such as large sediment basins near final discharge locations and smaller sediment traps targeting problem areas, will be an important element of the Soil and Water Management Plan.

Appendix D

Koala Survey and Report

SANCROX QUARRY EXPANSION PROJECT (SSD 7293)

Koala Survey and Assessment

Prepared for:

Hanson Heidelberg Cement Group
Level 8, 2-12 Macquarie Street PARRAMATTA NSW 2150

SLR Ref: 630.11478-R01
Version No: -v2.2
December 2020

PREPARED BY

SLR Consulting Australia Pty Ltd
ABN 29 001 584 612
10 Kings Road
New Lambton NSW 2305 Australia
(PO Box 447 New Lambton NSW 2305)
T: +61 2 4037 3200
E: newcastleau@slrconsulting.com www.slrconsulting.com

BASIS OF REPORT

This report has been prepared by SLR Consulting Australia Pty Ltd (SLR) with all reasonable skill, care and diligence, and taking account of the timescale and resources allocated to it by agreement with Hanson Heidelberg Cement Group (the Client). Information reported herein is based on the interpretation of data collected, which has been accepted in good faith as being accurate and valid.

This report is for the exclusive use of the Client. No warranties or guarantees are expressed or should be inferred by any third parties. This report may not be relied upon by other parties without written consent from SLR.

SLR disclaims any responsibility to the Client and others in respect of any matters outside the agreed scope of the work.

DOCUMENT CONTROL

Reference	Date	Prepared	Checked	Authorised
630.11478-R01-v2.2	30 December 2020	Caitlin Cross and Amanda Lane (Biolink)	J Pepper	J Pepper

EXECUTIVE SUMMARY

Project Description and Background

Hanson Heidelberg Cement Group Pty Ltd (Hanson) is seeking project approval for the expansion of the existing Sancrox hard rock quarry. The Sancrox Quarry Expansion Project (SSD-7293) will involve extending the life of the quarry to 30 years and increasing approved extraction limits of 175, 00m^3. In their updated submission on the EIS, the Department of Planning, Industry and Environment requested the Biodiversity Assessment Report (BAR) should be amended to calculate required species credits for the Koala.

As part of the response to submissions on the EIS, Hanson has engaged SLR and Biolink to conduct supplementary surveys across the Sancrox project site to determine current Koala utilisation of the site and to update the assessment of impacts on the Koala. The aim of these surveys is to address the BCD concerns regarding impacts on the Koala and revaluate the ecological importance of the site for the local population of Koala.

Field Survey and results

Field surveys were conducted by SLR Consulting and Biolink on the 12-13 October 2020. These surveys included using RGb-SAT and nocturnal (spotlighting) surveys. Koala faecal pellets were recorded at eight of the 15 sampled field sites, and of the eight sites, four returned significant activity levels of 'medium' or 'high' use. One Koala was sighted during nocturnal spotlighting transects approximately 50 m west of the existing quarry wall. This is indicated the presence of one or more resident Koalas within the site.

Discussion

Ecological analysis of Koala activity levels identified two Koala activity cells adjoining the western edge of the quarry, reaching both the northern and southern boundary of the site, as well as another cell in the western portion of the site. Survey data implies the site as a high use area, with one or more resident Koalas within the study area.

Based on the current survey results and modelled activity levels, combined with previous Koala survey results, and the widespread occurrence of several Koala feed trees within the forested parts of the site, the site is considered to be habitat for the Koala, as a species credit species under the Framework for Biodiversity Assessment. The total area of Koala habitat within the site is estimated to be around 42.6 hectares.

The removal of Koala habitat associated with the proposed expansion of the Sancrox Quarry will reduce the availability of foraging and breeding habitat for the local Koala population and will increase barriers to local movement and dispersal of Koalas in the locality, particularly in a north-south direction.

Conclusion

On the basis of the current findings, and with reference to the procedures for calculating impacts on species credit species in the Framework for Biodiversity Assessment, a species polygon should be drawn for all areas of Koala habitat removal on the site and the associated species credits for the Koala calculated.

CONTENTS

1 INTRODUCTION 1
1.1 Background 1
1.2 Site Location and Description 1
1.3 Koala ecology and Habitat 3

2 KOALA ASSESSMENT METHODOLOGY 4
2.1 Overall assessment methodology 4
2.2 SAT survey 4
2.3 Nocturnal (spotlighting) surveys 6
2.4 Spatial modelling 6

3 SURVEY RESULTS 7
3.1 Previous Surveys 7
3.2 Koala Habitat 7
3.3 Koala Activity 9
3.4 Koala Sightings 11

4 DISCUSSION AND CONCLUSION 14

5 REFERENCES 15

CONTENTS

DOCUMENT REFERENCES

TABLES

Table 1 Categorisations of Koala activity# 6
Table 2 Tree species recorded as part of the SAT surveys within Sancrox Quarry 7
Table 3 Plant Community Types (PCTs) mapped within the study area 8
Table 4 Koala activity level amongst SAT sites 11

FIGURES

Figure 1 Study area and regional location 2
Figure 2 Koala Survey Locations 5
Figure 3 Koala habitat within Sancrox Quarry 10
Figure 4 Locations of positive SAT sites and Koala sighting 12
Figure 5 Koala Activity Contours 13

APPENDICES

Appendix A Koala SAT Field Sheets
Appendix B Koala Feed Trees for the North Coast Area

1 Introduction

1.1 Background

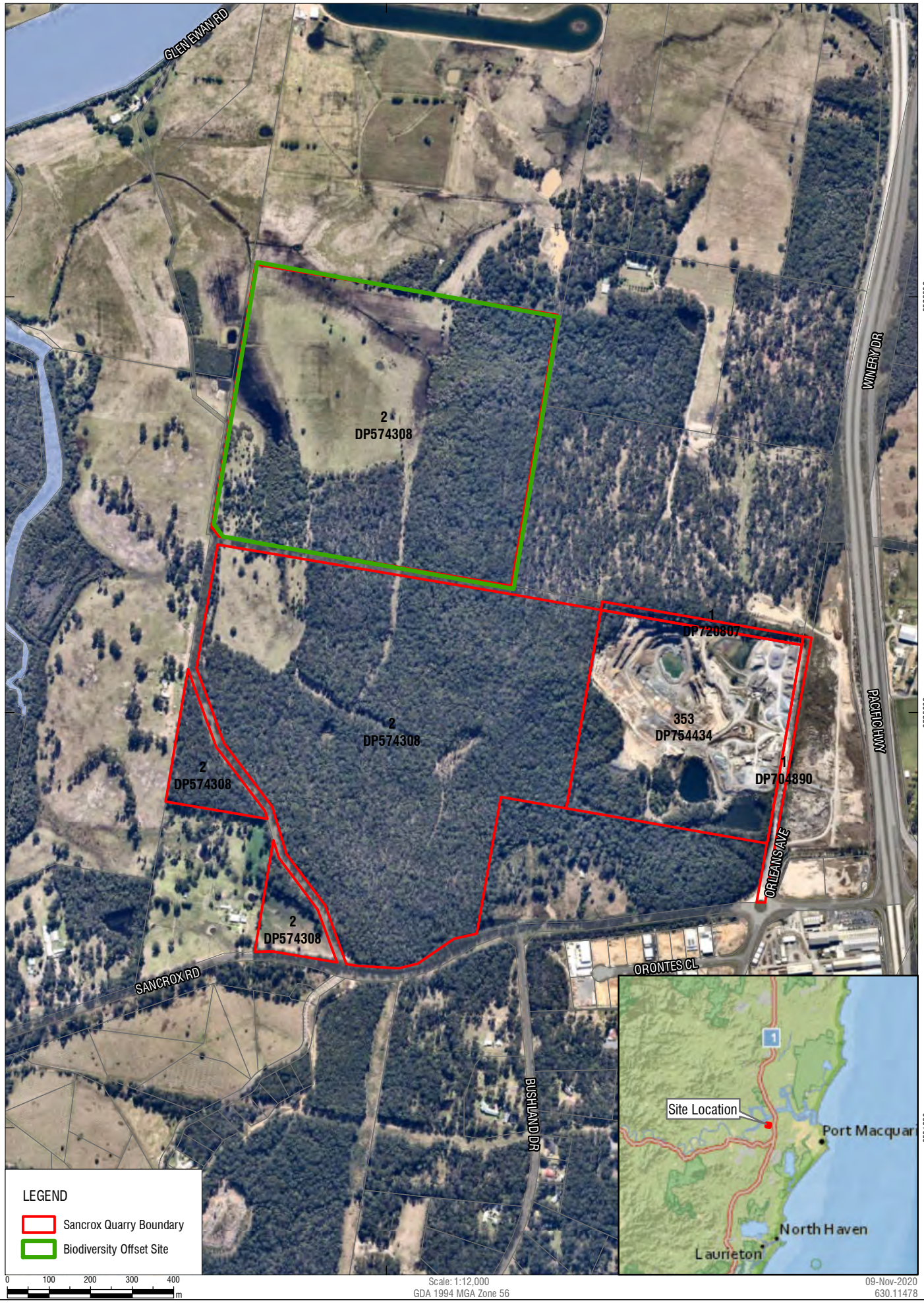
Hanson Heidelberg Cement Group Pty Ltd (Hanson) is seeking project approval for the expansion of the existing Sancrox hard rock quarry. The Sancrox Quarry Expansion Project will involve extending the life of the quarry to 30 years and increasing approved extraction limits by 175, 000 m^3. The Sancrox Quarry Expansion Project (SSD-7293) is a State Significant Development (SSD) as defined under *State Environmental Planning Policy (State and Regional Development) 2011* (SRD SEPP) and will require development consent under Part 4, Division 4.1 of the *NSW Environmental Planning and Assessment Act 1979* (EP&A Act). Hanson has prepared an environmental impact statement (EIS) according to the requirements for SSD projects and the EIS has been submitted and exhibited. As part of the preparation of the EIS, SLR prepared a Biodiversity Assessment Report in accordance with the *Framework for Biodiversity Assessment* (FBA, OEH 2014a).

In the updated submission on the EIS (see letter DOC20/211538, dated 3 April 2020), the Department of Planning, Industry and Environment (DPIE), Biodiversity Conservation Division (BCD) commented, *inter alia*, as follows: "As evidence of the koala has been previously recorded on site, the BAR should be amended to calculate the required species credits". In response to the BCD submission, Hanson has engaged SLR and Biolink to conduct supplementary surveys across the Sancrox project site ('the site') to determine current Koala utilisation of the site. The aim of these surveys is to address the BCD concerns regarding impacts and revaluate the ecological importance of the site for the local population of Koala. Subsequently, a determination can be made on whether the impacts of the project on Koala habitat will necessitate the generation and purchase of Koala species credits according to the FBA. The results and conclusions of the report are based on field surveys and data provided by Biolink in combination with the assistance of SLR ecology staff.

Several surveys targeting the Koala have been completed on the Sancrox site and within the wider Port Macquarie Hastings local government area over recent years (see **Section 3.1**). Most recently, Koala surveys were conducted by SLR in late 2015 as part of the Biodiversity Assessment Report (BAR) for the SSD application (see SLR 2019). The results of those surveys indicated that Koala activity levels were 'Low' according to the Spot Assessment Technique (SAT) criteria. On this basis, species credits for the Koala were not calculated (in accordance with the FBA) to address impacts on Koala habitat as a result of the proposed development.

1.2 Site Location and Description

Sancrox Quarry (the Study Area) is located on Lot 353 DP754434 and on Lot 2 DP574308, north-east of the Sancrox Road and Frogs Road intersection approximately 8 km west of Port Macquarie, in the Port Macquarie-Hastings Local Government Area (**Figure 1**). The majority of the study area is covered with natural forest vegetation that has been modified by past logging and grazing, with some cleared areas at the extremities of the study area. The proposed expansion of the quarry will result in the removal of approximately 42.6 ha of native vegetation.



Sheet Size : A4

SLR

www.slrconsultingaustralia.com.au

Study Area and Regional Location

FIGURE 1

1.3 Koala ecology and Habitat

The Koala (*Phascolarctos cinereus*) is listed as Vulnerable on both the NSW *Biodiversity Conservation Act 2016* (BC Act) and on the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). The Koala has a fragmented distribution throughout eastern Australia from the inhabiting a range of eucalypt forest and woodland communities usually where preferred browse species of eucalypt occur, from north-eastern Queensland to south-eastern South Australia and to the west of the Great Dividing Range. Port Macquarie is considered one of the important population centres for Koalas (Ecotone 2013).

Koalas are fundamentally solitary animals that occupy a small home range that may overlap with other individuals. In preferred habitat female Koalas have a home range of approximately 1 hectare, whereas males have approximately 1 to 1.5 hectares, depending on their age and size. Koala home ranges will vary in size depending on the quality of the habitat and suitability, with home range size varying from less than two hectares, to several hundred hectares during breeding season (DPIE 2019). The breeding season for the Koala peaks between September and February. The young spend the first six months in the pouch and are then carried on the mothers back. At 12 months of age the young are independent, but do not reach sexual maturity until they are two years of age (DPIE 2019).

Koalas are known to use a variety of eucalyptus and non-eucalyptus species throughout NSW (DPIE 2020). A review of Koala tree use identified approximately 137 tree species in 2018, but following consultation with Koala experts, the list was refined to 123 species in the *Koala Habitat Information Base Technical Guide* (DPIE 2020). These 123 tree species were categorised into nine distinct regions, according to feed tree preferences in each region. Port Macquarie (and the subject site at Sancrox) is located within the North Coast region and contains a total of 42 Koala use tree species (DPIE 2020).

.

2 Koala assessment methodology

2.1 Overall assessment methodology

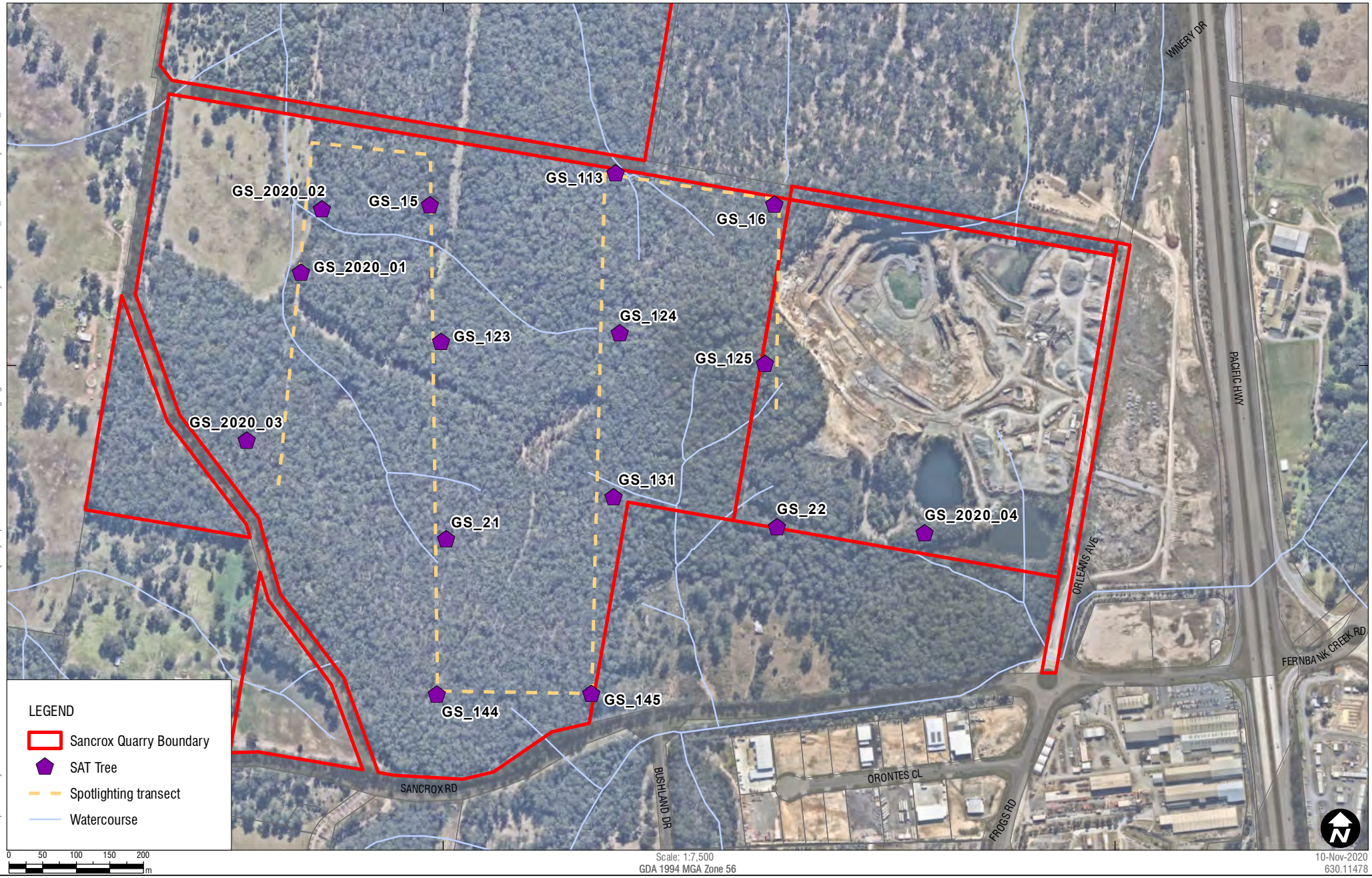
Field assessments were undertaken using RGb-SAT (Regularised Grid-based Spot Assessment Technique) underpinned by the protocols of Phillips and Callaghan (2011) and two consecutive nights of spotlight searches along a walking transect. Field transects were carried out by Biolink ecologists Dr. Amanda Lane and Kristen Wallis and SLR Ecologist Caitlin Cross.

Field survey assessments were undertaken across the study area on the 12-13 October 2020, during which time 15 SAT sites were assessed and a 3 km walking spotlight transect was undertaken on two consecutive nights.

2.2 SAT survey

The study area was initially overlain with a 250 m grid and aerial imagery to identify potential sampling points that are spatially independent and occur within an area of mapped eucalypt woodland/forest. Eleven of these 15 sites were previously surveyed by Biolink (2011). Coordinates (UTM) were determined for each corresponding sampling point and uploaded into a hand-held GPS to enable location in the field. Once a sampling point was located, Koala activity was measured using the SAT protocols of Phillips and Callaghan (2011). Koala activity (measured as a percentage, %) was determined based on the number of trees with Koala faecal pellets within a prescribed search area of 1 m around the base of a tree that has a stem diameter greater than 100 mm at breast height (DBH), accounting for the total number of trees sampled, up to a maximum of 30. By way of example, three positive trees (ie trees with scats present within 1 m of the base) out of 30 would yield a Koala activity score of 10 %.

The distribution of surveyed field sites (ie SAT sites) is illustrated in **Figure 2** and scanned copies of survey data sheets are provided in **Appendix A**.



\\AU\Corporate\Projects-SLR\630-Sty\NTL\630-NTL\630.11478 Sancrox Quarry Expansion\06 SLR Data\06 Drafting\Figures\ArcGIS\Koala Survey\SLR630114 78_F02_KoalaSurveyMethods_01.mxd

Sheet Size : A4

SLR

www.slrconsultingaustralia.com.au

Koala Survey Locations

FIGURE 2

2.3 Nocturnal (spotlighting) surveys

Spotlighting was undertaken from 7:30 pm to 10:30 pm on 12 and 13 October 2020. Nocturnal surveys consisted of spotlighting transects that were designed to sample the variety of vegetation types and hence Koala habitat types across the site. A series of walked traverses was completed across the site over two nights, with the same transect alignment repeated on the second night. The transect alignment is shown in **Figure 2.** The length of the transect totalled approximately 3 km; the precise location of the centreline of the transect was subject to minor variations based on local topography.

2.4 Spatial modelling

Habitat utilisation / naïve occupancy was calculated by Biolink according to the number of active sites (ie SAT sites) divided by the total number of sites. This value is reported with a standard error (SE).

Koala activity data from all SAT sites were interpolated using regularised, thin-plate splining techniques using the spatial analyst extension in ArcGIS 10.5, performed by Biolink. Output from the splining process was used to produce an activity contour model to delineate areas occupied by resident Koala populations by identifying contours greater than 10 % indicating significant activity thresholds of Phillips and Callaghan (2011) as detailed in **Table 1**. Lower activity contours were included in the activity model to assist with interpretation of connectivity. This process produces a meta-population model (or contour map) that delineates important 'source' areas supporting established resident Koala populations. These modelled areas of significant Koala activity tend to encapsulate most contemporary Koala records including 100 % of breeding families (Biolink 2007).

Given the occurrence of Preferred Koala Food Trees (PKFTs) such as grey gum across the study area, Koala activity was interpreted in the terms of the East Coast (low) population density level of utilisation as defined by Phillips and Callaghan (2011).

Table 1 Categorisations of Koala activity#

Activity category	Low use	Medium (normal) use	High use
East Coast (low)	<9.97%	≥ 9.97% but ≤ 12.59%	>12.59%

Based on use of mean activity level ± 99% confidence intervals. Activity levels in the medium (normal) and High use range for East Coast (low) activity categories indicates occupancy by resident koala populations

3 Survey Results

3.1 Previous Surveys

Several surveys targeting the Koala have been completed on the Sancrox site and also within the wider Port Macquarie Hastings local government area over the last 10 years. The ecological assessment completed for the *Greater Sancrox Structure Plan* (Biolink 2011) identified two small areas of significant Koala activity, of which both are located within the site. Although no Koalas were recorded on the site, the recording of scats provided enough data to model the distribution of core Koala habitat. Two populations of less than 10 to 15 individuals were predicted to utilise the bushland within and around the site and were considered to be restricted to these areas by the Pacific Highway to the east and extensive clearing to the west and north. Accordingly, the Sancrox area was identified and mapped as an area of 'generational persistence', meaning that records extend beyond the lifespan of individual animals (Biolink, 2011).

Koala habitat mapping conducted by Biolink in 2013 identified the Port Macquarie-Hastings local government area in which the Sancrox Quarry is located as an area of high generational persistence and a high likelihood of Koalas occurring within the area (OEH 2014).

In a previous survey for Koalas on the Sancrox Quarry site, Ecotone (2013) recorded evidence of Koala activity in the form of scats and scratches on tree bark. However, no Koalas were sighted and no males were heard calling. Ecotone (2013) state that the evidence for the presence of Koalas (ie scratches on bark and scats) was not recent and was likely to be several months old. On this basis, Ecotone conclude that Koalas still utilise the habitats within the site for dispersal between other areas of habitat in the locality.

Similarly, SLR recorded evidence of Koala activity during field surveys in November 2015, being a small number of older scats and possible tree scratches (see SLR 2019). However, despite comprehensive searches for Koalas using visual inspection of feed trees, listening for male calls, spotlighting and the Spot Assessment Technique (10 SAT sites in total), no evidence via sightings or calls was recorded. The results of the SAT assessment indicated that Koala activity on the site at the time was 'Low'.

3.2 Koala Habitat

Fir the current survey, SAT surveys were conducted at 15 sites comprising of a total of 16 tree species during the surveys (**Table 2**). Of these, 15 species are listed as Koala feed trees (DPIE 2020). The full list of Koala feed trees for the North Coast Management Area, which incorporates the Sancrox locality, is listed in **Appendix B**.

Table 2 Tree species recorded as part of the SAT surveys within Sancrox Quarry

Scientific name	Common name	Koala use trees#
Allocasuarina torulosa	Forest Oak	Yes
Corymbia intermedia	Pink Bloodwood	Yes
Corymbia maculata	Spotted Gum	Yes
Eucalyptus sp.		Yes
Eucalyptus acmenoides	White Mahogany	Yes
Eucalyptus carnea	Thick-leaved Mahogany	Yes
Eucalyptus crebra	Narrow-leaved Ironbark	Yes

Scientific name	Common name	Koala use trees#
Eucalyptus glaucina	Slaty Red Gum	Yes
Eucalyptus globoidea	White Stringybark	Yes
Eucalyptus microcorys	Tallowwood	Yes
Eucalyptus pilularis	Blackbutt	Yes
Eucalyptus propinqua	Small-fruited Grey Gum	Yes
Eucalyptus robusta	Swamp Mahogany	Yes
Eucalyptus tereticornis	Forest Red Gum	Yes
Lophostemon confertus	Brush box	No
Melaleuca sp.		Yes

Koala use trees as defined by DPIE (2020)

Vegetation mapping conducted as part of the BAR indicates that the forested parts of the site are classified into three plant community types (PCTs), as listed in **Table 3**.

Table 3 Plant Community Types (PCTs) mapped within the study area

PCT Code	PCT Name	TEC	Area (ha)
686	Blackbutt - Pink Bloodwood shrubby open forest of the coastal lowlands of the NSW North Coast Bioregion	Yes	0.6
1215	Spotted Gum - Grey Ironbark open forest of the Macleay Valley lowlands of the NSW North Coast Bioregion	No	11.0
1262	Tallowwood - Small-fruited Grey Gum dry grassy open forest of the foothills of the NSW North Coast	No	31.0
	Total Native Vegetation		**42.6**

Koala feed trees are present in all three PCTs and are distributed widely across the site. According to DPIE (2020), and based on the results of the BAR surveys and the current Koala survey, the site contains 13 Koala feed trees, as follows:

- Spotted Gum *Corymbia maculata*;
- Pink Bloodwood *Corymbia intermedia*;
- Small-fruited Grey Gum *Eucalyptus propinqua*;
- Blackbutt *Eucalyptus pilularis*;
- Tallowwood *Eucalyptus microcorys*;
- Thick-leaved Mahogany *Eucalyptus carnea;*
- White Stringybark *Eucalyptus globoidea*;
- Grey Ironbark *Eucalyptus siderophloia*;
- Flooded Gum *Eucalyptus grandis* (in offset site);
- Broad-leaved Paperbark *Melaleuca quinquenervia*;
- Forest Red Gum *Eucalyptus tereticornis* (in offset site);

- Narrow-leaved Red Gum *Eucalyptus seeana* (in offset site); and
- Forest Oak *Allocasuarina torulosa*.

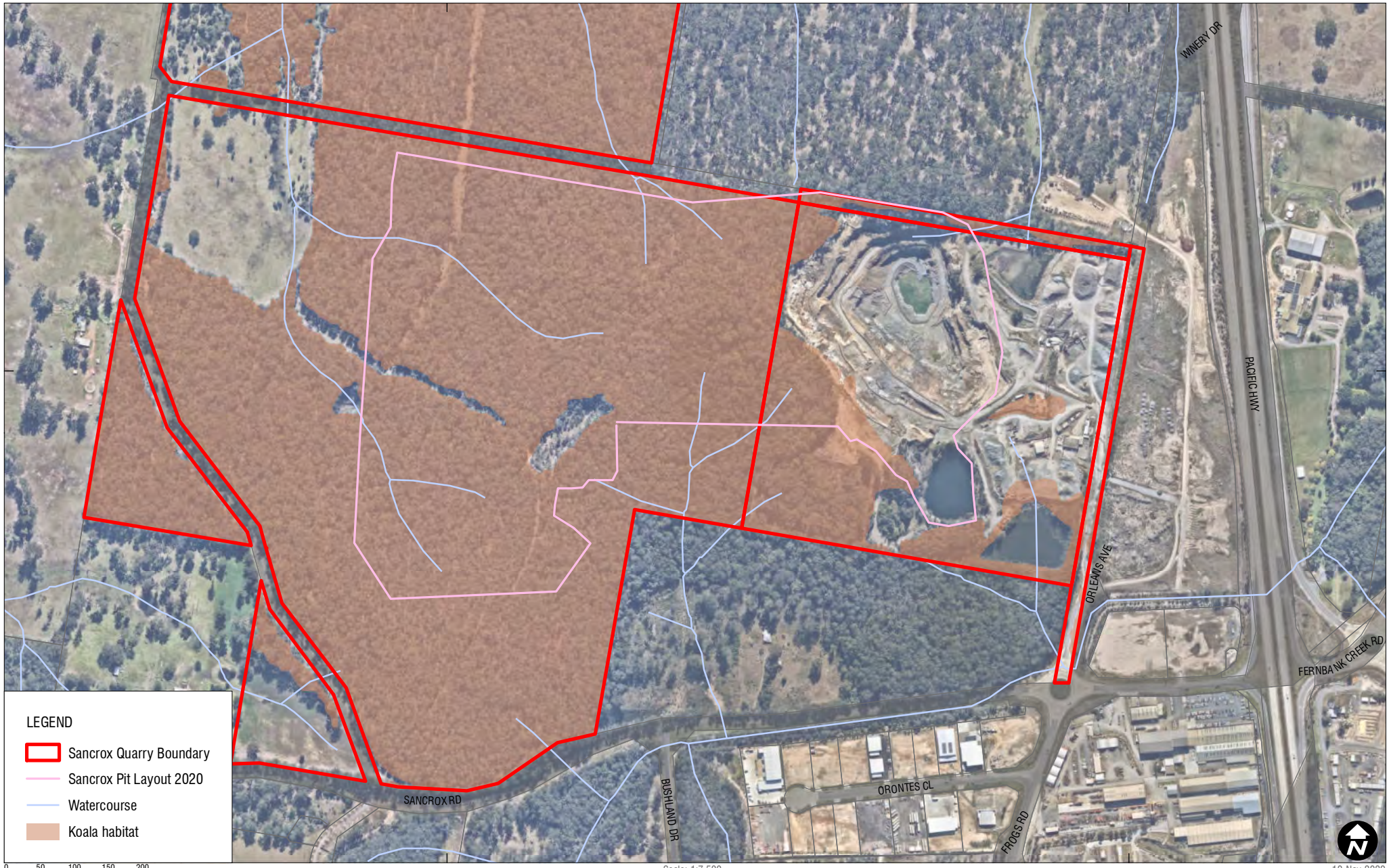
It is also noted that Koalas have been recorded feeding on Swamp Oak *Casuarina glauca* (which is more common in the offset site) at Bonville (G Leonard *pers. comm.* 2016), although Swamp Oak is not generally recognised as a Koala feed tree.

Given the widespread presence of Koala feed trees across the site, all PCTs mapped (in the BAR) as occurring on the site, comprising a total area of 42.6 hectares, are considered to constitute Koala habitat, in accordance with the methods for identification of species credits in the FBA. Consequently, a map of Koala habitat has been prepared by combining the PCTs mapped across the site, as shown **Figure 3**.

3.3 Koala Activity

Evidence of Koalas in the form of diagnostic faecal pellets was recorded at eight of the 15 sampled SAT sites (**Figure 4**) resulting in a habitat utilisation / naïve occupancy estimate of 53 % ± 13 % (SE) of the available habitat. Eight SAT sites yielded evidence of Koalas with activity levels ranging from 3.33% - 33.33% (**Table 4**). Three sites returned 'high' activity levels (13.33% - 33.33%) and one site returned 'medium' activity level (10.00%) in accordance with Phillips and Callaghan (2011) (**Table 1**). Four sites yielded 'low' activity levels (3.33% - 6.67%) and the remaining sites returned no activity levels.

Koala activity data collected from the current field survey was modelled by Biolink to produce a set of activity contours, which are displayed on **Figure 5**. The Koala activity contours show an activity cell adjoining the western edge of the quarry, reaching both the northern and southern boundary of the site, as well as another cell in the western portion of the site, centred around sampling point GS_2021 (see **Figure 2**). These cells indicate high use areas within Koala home ranges, which may extend beyond the bounds of the study area.



\\AU\Corporate\Projects-SLR\630-SYNTL\630-NTL\630.11478 Sancrox Quarry Expansion\06 SLR Data\06 Drafting\Figures\ArcGIS\Koala Survey\SLR630114478_F03_KoalaHabitat_01.mxd

Sheet Size : A4

SLR

www.slrconsultingaustralia.com.au

Koala Habitat within Sancrox Quarry

FIGURE 3

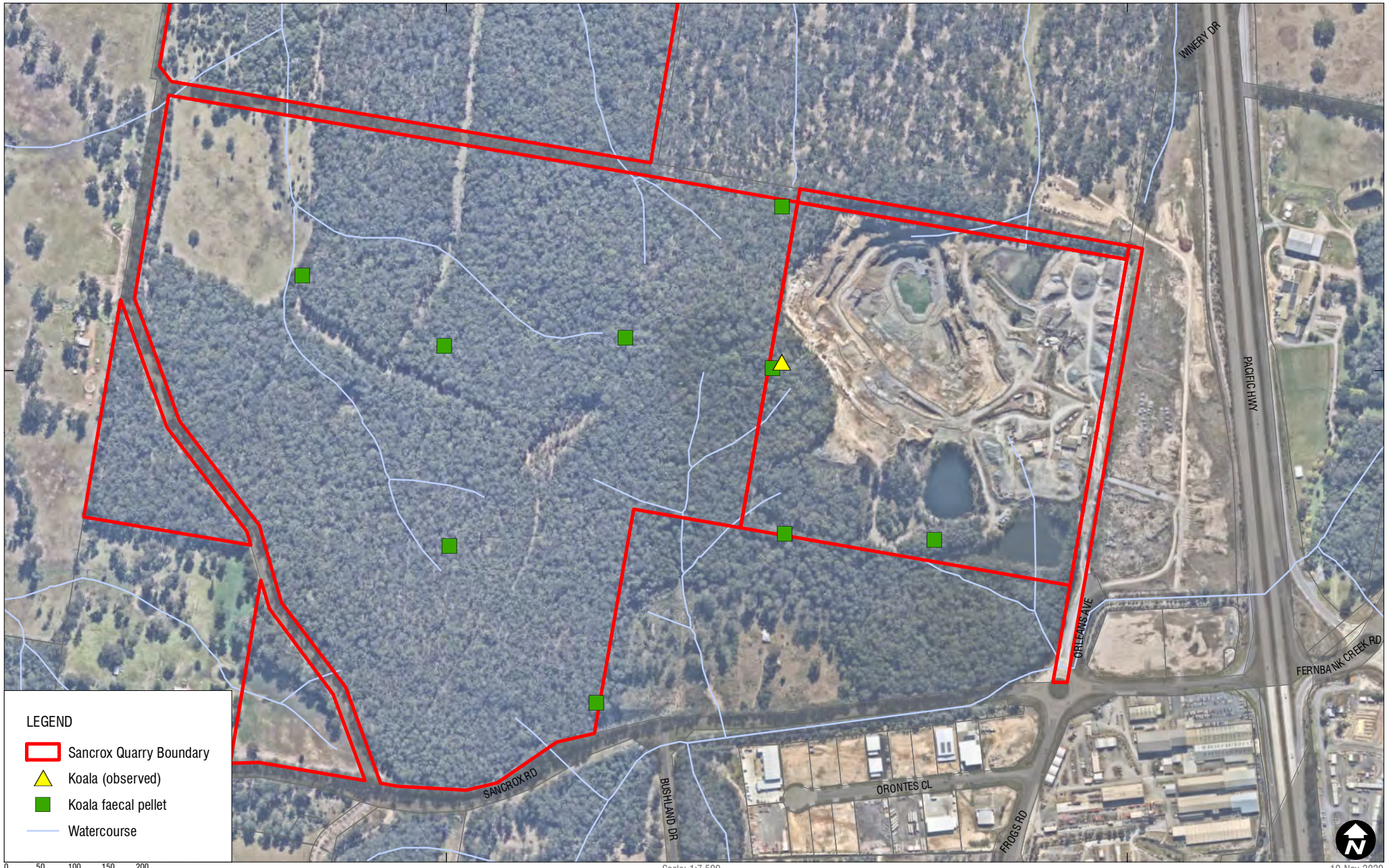
Table 4 Koala activity level amongst SAT sites

Site code	Total number of trees	Activity (as %)	Activity level	Easting	Northing
GS_113	30	0.00	Nil	482257	6522287
GS_123	30	10.00	Medium	481997	6522036
GS_124	31	6.45	Low	482263	6522048
GS_125	30	33.33	High	482479	6522003
GS_131	30	0.00	Nil	482254	6521805
GS_144	30	0.00	Nil	481991	6521511
GS_145	30	3.33	Low	482221	6521512
GS_15	30	0.00	Nil	481981	6522239
GS_16	30	13.33	High	482493	6522240
GS_2020_01	30	26.67	High	481789	6522139
GS_2020_02	30	0.00	Nil	481820	6522233
GS_2020_03	30	0.00	Nil	481708	6521889
GS_2020_04	30	3.33	Low	482717	6521751
GS_21	30	0.00	Nil	482005	6521742
GS_22	30	6.67	Low	482497	6521760

3.4 Koala Sightings

One Koala was sighted during nocturnal (spotlighting) surveys and the location of the sighting is shown in **Figure 4**. The young adult Koala sighted was found in a Spotted Gum *Corymbia maculata* approximately 50 m west of the existing pit wall.

No Koalas were sighted in previous surveys conducted by SLR in 2015 or by Ecotone in 2013.



Sheet Size : A4

SLR

www.slrconsultingaustralia.com.au

Locations of positive SAT sites and Koala sighting

FIGURE 4

\\AU\Corporate\Projects-SLR\630-SYVNTL\630-NTL\630.11478 Sancrox Quarry Expansion\06 SLR Data\06 Drafting\Figures\ArcGIS\Koala Survey\SLR630114 78_F05_KoalaActivityContours_01.mxd

Sheet Size : A4

SLR

www.slrconsultingaustralia.com.au

Koala activity contours

FIGURE 5

4 Discussion and Conclusion

The proposed expansion of the Sancrox quarry will remove approximately 42.6 ha of Koala habitat of the lands comprising of the Sancrox Quarry. Previous survey data conducted by SLR in 2015 and Ecotone in 2013 indicated that Koala activity levels on site were 'Low'. The ecological analysis of Koala activity levels during the current survey identified two Koala activity cells adjoining the western edge of the quarry, reaching both the northern and southern boundary of the site, as well as another cell in the western portion of the site.

Survey data of direct and indirect evidence of the site as defined by Phillips and Callaghan (2011) identified medium and high use SAT sites within the activity cells indicating the presence of one or more resident Koalas within the Sancrox quarry. Additionally, the site has previously been mapped as an area of 'generational persistence' by Port Macquarie Council (OEH 2014). Historical modelling indicates that two populations of less than 10 to 15 individuals have utilised the Sancrox locality; however, these populations are restricted to these areas by the Pacific Highway to the east and extensive clearing to the west and north (PMHC 2015). The current survey results combined with areas of modelled high Koala activity and widespread presence of several Koala feed trees across the site indicates that the forested parts of the site all qualify as Koala habitat within the meaning of the FBA.

The proposed expansion of the Sancrox quarry will require the removal of around 42 ha of Koala habitat and may have the potential to negatively impact on local Koala movements and the home ranges of resident Koalas within the Sancrox study area. The site is considered to provide habitat for Koalas, with the presence of one or more resident Koalas within the study area. On the basis of the current findings and following Section 6 of the FBA, a 'species polygon' is required to be drawn around all Koala habitat within the site and species credits calculated.

5 References

Biolink. (2007). *Koala Habitat and Population Assessment for the City of the Gold Coast*. Final Report to Gold Coast City Council. Biolink Ecological Consultants, Uki, NSW.

Biolink. (2011). *Greater Sancrox Ecological Assessment.* Final Report to Port Macquarie-Hastings Council. Biolink Ecological Consultants, Uki, NSW.

Biolink. (2020). *Proposed Expansion of the Brandy Hill Quarry: Habitat Utilisation by Koalas.* Final report to Department of Agriculture, Water and the Environment

Department of Planning, Industry and Environment (DPIE) (2019). *Koala*. Retrieved from https://www.environment.nsw.gov.au/topics/animals-and-plants/native-animals/native-animal-facts/koala

DPIE (2020) *Koala Habitat Information Base Technical Guide*. Department of Planning, Industry and Environment Sydney NSW 2000.

Department of Planning, Industry and Environment (DIPE) (2020). *Koala Habitat Protection Guideline: Implementing State Environmental Planning Policy (Koala Habitat Protection) 2019*. Ecotone (2013) *Preliminary Koala assessment for the proposed expansion of the Sancrox gravel quarry near Port Macquarie*. Ecotone Ecological Consultants Pty Ltd, Waratah NSW.

Phillips, S. and Callaghan, J. (2011). *The Spot Assessment Technique: a tool for determining localised levels of koala habitat use by koalas Phascolarctos cinereus*. Australian Zoologist, 35: 774-7890.

PMHC. (2015). *Greater Sancrox Structure Plan 2014-2034*. Port Macquarie-Hastings Council, Port Macquarie.

Office of Environment and Heritage (OEH) (2014). *A Preliminary Map of the Likelihood of Koala Occurrence in NSW*.

OEH (2014a) *Framework for Biodiversity Assessment*. Office of Environment and Heritage for the NSW Government, Sydney.

SLR Consulting (SLR) (2019) *Sancrox Quarry Extension Project; State Significant Development (SSD 7293) Biodiversity Assessment Report.* Prepared for Hanson Heidelberg Cement Group.

APPENDIX A

Koala SAT Field Sheets

PROJECT: Sancrox Quarry Koala Surveys 2020 **FULL SAT DATA SHEET**

SAT No: __GS 145__ **Staff:** Caitlin (SLR) Amanda Kirsty **Date:** 12 / 10/2020

SITE DATA

Datum	Zone		Easting						Northing							±
GDA 94	5	6	4	8	2	2	2	1	6	5	2	1	5	1	2	3
Elevation	Aspect								Slope							
18	N	NE	E	SE	S	SW	W	NW	0 - 10		10 - 30		>30			

SAT DATA

	Tree sp	DBH (mm)	K	FP
1 (CT)	E. Pro	288	—	
2	E. Pro	244	—	
3	E Cor	407	—	
4	E Pro	261	—	
5	E Pro	232	—	
6	E. Cor	522	—	
7	E. Pro	346	—	
8	E. Cor	124	—	
9	Allo. cos	128	—	
10	Ironbark	460	—	
11	E. Cor	271	—	
12	E. Cor	244	—	
13	E. Inc	194	—	
14	E. Glo	348	—	
15	E. Glo	263	—	
16	E. Mic	133	—	
17	E. Mic	~~150~~ 550		X
18	E. Glo	400	—	
19	E. Glo	281	—	
20	E. Pro	330	—	
21	E. Glo	375	—	
22	E. Mic	255	—	
23	Ironbark	256	—	
24	E. Prop	330	—	
25	E. Pro	403	—	
26	E. Inc	218	—	
27	E. Glo	185	—	
28	E. Mic	295	—	
29	E Glo	468	—	
30	E. Mic	410	—	

1. Soil Landscape: _____

2. SAT Criteria: 1 2 (3)

3. Age of pellets: (Old) Mixed Fresh

4. A/Level: __1__ / __30__ = __3.3__ %

5. Mean % groundcover in search area:

< 30% (30 – 70%) >70%

6. Comments:

_____

_____

_____

_____

_____

7. No Koalas within 25m of CT: N/A

Checked by: Kirsty **Date:** 19/10/20 **Entered by:** Kirsty **Date:** 19/10/20

DATA Checklist: Database ☑ Scanned ☑ Filed ☐

PROJECT: Sancrox Quarry Koala Surveys 2020 **FULL SAT DATA SHEET**

SAT No: GS 144 **Staff:** Caitlin (SLR), Amanda, Kirsty **Date:** 12 / 10 /2020

SITE DATA

Datum	Zone		Easting						Northing							±
GDA 94	5	6	4	8	1	9	9	1	6	5	2	1	5	1	1	3
Elevation	Aspect								Slope							
35	N	NE	E	SE	S	SW	W	NW	0 - 10		10 - 30		>30			

SAT DATA

	Tree sp	DBH (mm)	K	FP
1 (CT)	E. Glo	290	–	
2	E. Glo	275	–	
3	E. Glo	193	–	
4	E. Mic	145	–	
5	E. Glo	490	–	
6	E. Glo	321	–	
7	E. Glo	385	–	
8	E. Glo	175	–	
9	E. Glo	290	–	
10	E. Pro	298	–	
11	E. Glo	369	–	
12	E. Pro	255	–	
13	Ironbark	300	–	
14	E. Glo	513	–	
15	E. Glo	280	–	
16	E. Glo	436	–	
17	E. Intermedia	435	–	
18	E. Glo	267	–	
19	E. car	290	–	
20	E. mic	217	–	
21	E. Pro	275	–	
22	Ironbark	243	–	
23	E. Glo	360	–	
24	E. Glo	273	–	
25	E. Glo	169	–	
26	E. Pro	360	–	
27	E. car	117	–	
28	E. Glo	338	–	
29	E. Intermed	347	–	
30	E. Int	165	–	

1. Soil Landscape: _____

2. SAT Criteria: 1 2 (3)

3. Age of pellets: Old Mixed Fresh

4. A/Level: 0 / 30 = 0.0 %

5. Mean % groundcover in search area:

< 30% (30 – 70%) >70%

6. Comments:

- Possum scats present
- Large Macropod scats present

7. No Koalas within 25m of CT: N/A

Checked by: Kirsty **Date:** 19/10/20 **Entered by:** Kirsty **Date:** 12/10/20

DATA Checklist: Database ☑ Scanned ☑ Filed ☐

PROJECT: Sancrox Quarry Koala Surveys 2020 **FULL SAT DATA SHEET**

SAT No: __GS 21__ **Staff:** Caitlin (SLR) Amanda Kirsty **Date:** 12/ 10/2020

SITE DATA

Datum	Zone		Easting						Northing							±
GDA 94	5	6	4	8	2	0	0	5	6	5	2	1	7	4	2	3

Elevation	Aspect								Slope		
28	(N)	NE	E	SE	S	SW	W	NW	0 - 10	(10 - 30)	>30

SAT DATA

	Tree sp	DBH (mm)	K	FP
1 (CT)	E.Glo	330		X
2	E.Glo	245	—	
3	E.car	350	—	
4	E Glo	328	—	
5	Ironbark	410	—	
6	Ironbark	508	—	
7	White Mahog	523	—	
8	White Mahogy	417	—	
9	E.Glo	228	—	
10	E.Glo	220	—	
11	~~C.Inc~~ Cint	218	—	
12	E.Glo	192	—	
13	E.Glo	505	—	
14	~~C.Inc~~ Cint	317	—	
15	E.Glo	430	—	
16	Grey Gum	350		X
17	E.Pro	427	—	
18	E Pro	190	—	
19	E.car	487	—	
20	~~C.Inc~~ Cint	343	—	
21	Ironbark	500	—	
22	E.Pro	223	—	
23	E.Glo	135	—	
24	E.Glo	108	—	
25	~~E.Intermedia~~ Cint	122.	—	
26	~~E.Intermedia~~ Cint	138	—	
27	Ironbark	405	—	
28	E.Glo	200	—	
29	White Mahogan	304	—	
30	~~E.Intermedia~~ Cint	113	—	
	E.Pro	280	—	

1. Soil Landscape: _____

2. SAT Criteria: 1 2 (3)

3. Age of pellets: (Old) Mixed Fresh

4. A/Level: 2 / 30 = 6.67%

5. Mean % groundcover in search area:

(< 30%) 30 – 70% >70%

6. Comments:

Large Maropod Scats

7. No Koalas within 25m of CT: N/A

Checked by: Kirsty **Date:** 19/10/20 **Entered by:** Kirsty **Date:** 12/10/20.

DATA Checklist: Database ☑ Scanned ☑ Filed ☐

PROJECT: Sancrox Quarry Koala Surveys 2020 **FULL SAT DATA SHEET**

SAT No: __GS__15__ **Staff:** Caitlin (SLR) Amanda Kirsty **Date:** 12/10 /2020

SITE DATA

Datum	Zone		Easting						Northing							±
GDA 94	5	6	4	8	1	9	8	1	6	5	2	2	2	3	9	3
Elevation	Aspect								Slope							
11	N	NE	E	SE	S	SW	W	NW	0 - 10		10 - 30		>30			

SAT DATA

	Tree sp	DBH (mm)	K	FP
1 (CT)	Grey Gum	226	—	
2	E. Glo	283	—	
3	E. Glo	380	—	
4	Swamp Mahog	600	—	
5	E. Glo	398	—	
6	C. Inc	240	—	
7	E. Mic	604	—	
8	E. Car	400	—	
9	E. Car	180	—	
10	E. ~~Pop~~ Pro	310	—	
11	E. Pro	1011 (2)	—	
12	Mel. Spp	165	—	
13	Mel. Spp	161	—	
14	E. Int	229	—	
15	E. Int	303	—	
16	E. Mic	520	—	
17	E. Mic	312	—	
18	Ironbark	495	—	
19	E. Mic	152	—	
20	E. Mic	390	—	
21	E. Pro	286	—	
22	White Mahog	470	—	
23	Ironbark	174	—	
24	~~E. Inc~~ Cint	147	—	
25	~~E. Intermedia~~ Cint	205	—	
26	E. Mic	245	—	
27	White Mahog	326	—	
28	C. Inc	126	—	
29	White Mahog	442	—	
30	Ironbark	605	—	

1. Soil Landscape: _____

2. SAT Criteria: 1 2 3

3. Age of pellets: Old Mixed Fresh

4. A/Level: 0 / 30 = 0 %

5. Mean % groundcover in search area:

< 30% 30 – 70% >70%

6. Comments:

Brushtail Possum Scat

7. No Koalas within 25m of CT: N/A

Checked by: Kirsty **Date:** 19/10/20 **Entered by:** Kirsty **Date:** 12/10/20

DATA Checklist: Database ☑ Scanned ☑ Filed ☐

PROJECT: Sancrox Quarry Koala Surveys 2020 **FULL SAT DATA SHEET**

SAT No: GS 123 **Staff:** Caitlin (SLR), Amanda, Kirsty **Date:** 12 10 /2020

SITE DATA

Datum	Zone		Easting						Northing							±
GDA 94	5	6	4	8	1	9	9	7	6	5	2	2	0	3	6	3

Elevation	Aspect								Slope		
18	N	NE	E	SE	S	SW	W	NW	0 - 10	10 - 30	>30

SAT DATA

	Tree sp	DBH (mm)	K	FP
1 (CT)	E. Glo	217	—	
2	E. cor	349	—	
3	Ironbark	384		X
4	E Glo	290	—	
5	E. Pro	260	—	
6	E. Glo	352 (2)	—	
7	E cor	390	—	
8	E Glo	198	—	
9	E cor	722 (2)		X
10	E Pro	337	—	
11	E. Pro	339	—	
12	C Int	560		X
13	E. Glo	224	—	
14	E Glo	356	—	
15	E Glo	202	—	
16	E Pro	294	—	
17	E Pro	220	—	
18	E. Pro	345 (2)	—	
19	E Pro	435	—	
20	E. Pro	403	—	
21	E. Glo	355	—	
22	E Pro	243	—	
23	C Int	227	—	
24	E Pro	182	—	
25	E Glo	241	—	
26	Ironbark	357	—	
27	E Glo	234	—	
28	E cor	410	—	
29	E. Pro	373	—	
30	E. Pro	447	—	

1. Soil Landscape: _____

2. SAT Criteria: 1 2 3

3. Age of pellets: Old Mixed Fresh

4. A/Level: 3 / 30 = 10 . _ %

5. Mean % groundcover in search area:

< 30% 30 – 70% >70%

6. Comments:

7. No Koalas within 25m of CT: N/A

Checked by: Kirsty **Date:** 19/10/20 **Entered by:** Kirsty **Date:** 12/10/20

DATA Checklist: Database ☑ Scanned ☑ Filed ☐

PROJECT: Sancrox Quarry Koala Surveys 2020 **FULL SAT DATA SHEET**

SAT No: __GS_2020_02 **Staff:** Caitlin (SLR) Amanda Kirsty **Date:** 12 /10 /2020

SITE DATA

Datum	Zone		Easting						Northing							±
GDA 94	5	6	4	8	1	8	2	0	6	5	2	2	3	3	1	3
Elevation	Aspect								Slope							
8	N	NE	E	SE	S	SW	W	NW	0 - 10		10 - 30		>30			

SAT DATA

	Tree sp	DBH (mm)	K	FP
1 (CT)	E.Mic	530	—	
2	Ironbark	188	—	
3	Ironbark	191	—	
4	E.mic	249	—	
5	E.Mic	335	—	
6	Grey Gum	232	—	
7	C Gla	128	—	
8	C Int	162	—	
9	E.Car?	592	—	
10	~~C.Inc~~ Cint	167	—	
11	E. Car	444	—	
12	Grey Gum	175	—	
13	Grey Gum	471	—	
14	C.Int	186	—	
15	~~E.thro~~ Eglo	420	—	
16	E.Mic	207	—	
17	E.mic	177	—	
18	E.Car	255	—	
19	~~E.thro~~ Eglo	234	—	
20	~~E.thro~~ Eglo	198	—	
21	Grey Gum	441	—	
22	E.mic	312	—	
23	~~E.thro~~ Eglo	406	—	
24	~~C.Inc~~ Cint	163	—	
25	Ironbark	339	—	
26	E.Mic	339	—	
27	Grey Gum	430		
28	Grey Gum	343	—	
29	Ironbark	167	—	
30	~~E.Pop~~ Epro	540 (2)	—	

1. Soil Landscape: _____

2. SAT Criteria: 1 2 3

3. Age of pellets: Old Mixed Fresh

4. A/Level: 0 / 30 = 0 . _ %

5. Mean % groundcover in search area:

< 30% 30 – 70% >70%

6. Comments:

_____

_____

_____

_____

_____

7. No Koalas within 25m of CT: N/A

Checked by: Kirsty **Date:** 19/10/20 **Entered by:** Kirsty **Date:** 12/10/20

DATA Checklist: Database ☑ Scanned ☑ Filed ☐

PROJECT: Sancrox Quarry Koala Surveys 2020 **FULL SAT DATA SHEET**

SAT No: __GS__2020-01 **Staff:** Caitlin (SLR) Amanda Kirsty **Date:** 12 / 10 /2020

SITE DATA

Datum	Zone		Easting						Northing							±
GDA 94	5	6	4	8	1	7	8	9	6	5	2	2	1	3	9	3
Elevation	Aspect								Slope							
8	N	NE	E	SE	S	SW	(W)	NW	(0 - 10)		10 - 30		>30			

SAT DATA

	Tree sp	DBH (mm)	K	FP
1 (CT)	E. ter	481	✓	
2	Ironbark	635		x
3	C. int	591 (3)	✓	
4	Ironbark	552	✓	
5	C. int	265	✓	
6	C. int	479	✓	
7	E. Mic	240	✓	
8	C int	271	✓	
9	Mel. Spp	317 (2)	✓	
10	E. cor	378	✓	
11	C. int	442	✓	
12	Ironbark	130		x
13	~~C. Gla~~ Allo	239		x
14	~~C. Gla~~ Allo	125		x
15	Grey Gum	129		x
16	Ironbark	571	✓	
17	E. Mic	400 (3)		x
18	E. Mic	154	✓	
19	E. ter	428		x
20	Ironbark	169	✓	
21	C. int	485		x
22	E. Mic	511	✓	
23	Ironbark	460	✓	
24	Mel. Spp.	124	✓	
25	Mel Spp	134	✓	
26	Mel Spp.	118	✓	
27	~~Cas. tit~~ Allit	174	✓	
28	~~Cas. tit~~ Allit	280	✓	
29	Grey Gum	220	✓	
30	C int	345	✓	
	C. Gla	119		

1. **Soil Landscape:** _____

2. **SAT Criteria:** 1 2 (3)

3. **Age of pellets:** (Old) Mixed Fresh

4. **A/Level:** __8 / 30 = 26.67%

5. **Mean % groundcover in search area:**
(< 30%) 30 – 70% >70%

6. **Comments:**
Collected Scats Bag 2020_01

7. **No Koalas within 25m of CT:** N/A

Checked by: Kirsty **Date:** 19/10/20 **Entered by:** Kirsty **Date:** 12/10/20

DATA Checklist: Database ☑ Scanned ☑ Filed ☐

PROJECT: Sancrox Quarry Koala Surveys 2020 **FULL SAT DATA SHEET**

SAT No: __GS 2020_3 **Staff:** Amanda Caitlin (SLR) Jade, Steve Kirsty **Date:** 12/10/2020

SITE DATA

Datum	Zone		Easting						Northing							±
GDA 94	5	6	4	8	1	7	0	8	6	5	2	1	8	8	9	3

Elevation	Aspect								Slope		
14	N	NE	E	SE	S	SW	W	NW	0 - 10	10 - 30	>30

SAT DATA

	Tree sp	DBH (mm)	K	FP
1 (CT)	410	E. mic	x	x
2	385	E. glo	x	x
3	170	ironbark	x	x
4	292	E. mic	x	x
5	388	ironbark	x	x
6	271	grey gum	x	x
7	610	E. glo	x	x
8	185	C. int	x	x
9	505(2)	E. car	x	x
10	135	C. lit	x	x
11	515	E. glo	x	x
12	330	C. int	x	x
13	295	E. mic	x	x
14	637	E. glo	x	x
15	331	ironbark	x	x
16	640	E. glo	x	x
17	720	E. glo	x	x
18	343	E. glo	x	x
19	690	E. glo	x	x
20	180	greygum	x	x
21	428	E. mic	x	x
22	188	E. mic	x	x
23	328	C. int	x	x
24	400	C. int	x	x
25	450	E. mic	x	x
26	175	C. int	x	x
27	178	C. int	x	x
28	232	C. int	x	x
29	557	E. mic	x	x
30	234	E. glo	x	x

1. Soil Landscape: _____

2. SAT Criteria: 1 2 3

3. Age of pellets: Old Mixed Fresh

4. A/Level: 0/30 = 0.0 %

5. Mean % groundcover in search area:

< 30% 30 – 70% >70%

6. Comments:

7. No Koalas within 25m of CT: N/A

Checked by: Kirsty **Date:** 19/10/20 **Entered by:** Kirsty **Date:** 15/10/20

DATA Checklist: Database ☑ Scanned ☑ Filed ☐

PROJECT: ~~BRANDY HILL QUARRY~~ SANCROIX QUARRY

FULL SAT DATA SHEET

SAT No: ~~BHQ~~ GS 131

Recorder: Caitlin (SLR) Amanda Kirsty

Date: 13 / 10 /2020

SITE DATA

Datum	Zone		Easting						Northing							±
GDA	~~9~~ 56	~~47~~ 6	4	8	2	2	5	4	6	5	2	1	8	0	5	3

Elevation	Aspect								Slope		
29	N	NE	E	SE	S	SW	W	NW	0 - 10	10 - 30	>30

SAT DATA

	Tspp	DBH (mm)	K	FP
1 (CT)	E Mic	366		✓
2	Ironbark	234		—
3	Allocas	110		—
4	L. Con	560 (2)		—
5	L. Con	497 (2)		—
6	E. Glo	310		—
7	E Glo	212		—
8	Ironbark	362		—
9	E. Mic	334		—
10	E. Glo.	679		—
11	E. Mic	244		—
12	Ironbark	596		—
13	L. Con	153		—
14	E Glo	260		—
15	E Glo	224		—
16	E Glo	185		—
17	E. Glo	673		—
18	Ironbark	358		—
19	E Mic	387		—
20	L. Con	326		—
21	E. Mic	426		—
22	E Mic	468		—
23	E. Int	288		—
24	E. Mic	283		—
25	Ironbark	490		—
26	E. Glo	243		—
27	E Glo	115		—
28	E. Glo	242		—
29	E. Int	163		—
30	E Mic	479		—

1. Soil Landscape: _____

2. SAT Criteria: 1 2 3

3. Age of pellets: Old Mixed Fresh

4. A/Level: 0 / 30 = 0. %

5. Mean % groundcover in search area:

(< 30%) 30 – 70% >70%

6. Comments:

7. No Koalas within 25m of CT: N/A

Checked by: Kirsty Date: 19/10/20 Entered by: Kirsty Date: 15/10/20

DATA Checklist: Entered ☑ Scanned ☑ Filed ☐

PROJECT: ~~BRANDY HILL QUARRY~~ SAN CROOK QUARRY

FULL SAT DATA SHEET

SAT No: ~~BHQ~~ GS 124

Recorder: Caitlin (SLR) Amanda Kirsty

Date: 13 / 10 /2020

SITE DATA

Datum	Zone		Easting						Northing							±
GDA	~~3~~ 5	~~4~~ 6	4	8	2	2	6	3	6	5	2	2	0	4	8	3
Elevation	Aspect								Slope							
43	N	NE	E	SE	S	SW	W	NW	0 - 10		10 - 30		>30			

SAT DATA

	Tspp	DBH (mm)	K	FP
1 (CT)	E. Pro	342		X
2	Allo.cas	160	—	
3	E.Glo	530	—	
4	Allocas	135	—	
5	E. pro	332		X
6	Allocas	140	—	
7	Allocas	110	—	
8	C.Int	510	—	
9	C.Int	235	—	
10	E Glo	219	—	
11	E. Glo	183	—	
12	Allocas	135	—	
13	C.Cit	244	—	
14	E.Pro	358	—	
15	E Pro	323	—	
16	C.Cit	197	—	
17	C.Cit	466		
18	C.Int	255	—	
19	Allocas	167	—	
20	Allocas	214	—	
21	Allocas	177	—	
22	E.Pro	422	—	
23	C.Cit	395	—	
24	E.Glo	271	—	
25	E.Glo	520	—	
26	E. Pro	464	—	
27	Allocas	140	—	
28	C.cit	256	—	
29	Allocas	140	—	
30	Allocas	200	—	

1. Soil Landscape: _____

2. SAT Criteria: 1 2 3

3. Age of pellets: Old Mixed Fresh

4. A/Level: 2 / 30 = 6.6 %

5. Mean % groundcover in search area:

< 30% 30 – 70% >70%

6. Comments:

7. No Koalas within 25m of CT: N/A

Checked by: Kirsty Date: 19/10/20 Entered by: Kirsty Date: 15/10/20

DATA Checklist: Entered ☑ Scanned ☑ Filed ☐

PROJECT: Sancrox Quarry Koala Surveys 2020 **FULL SAT DATA SHEET**

SAT No: GS 113 **Staff:** Caitlin (SLR) Amanda Kirsty **Date:** 13 / 10 /2020

SITE DATA

Datum	Zone		Easting						Northing							±
GDA 94	5	6	4	8	2	2	5	7	6	5	2	2	2	8	7	3

Elevation	Aspect								Slope		
26	N	NE	E	SE	S	SW	(W)	NW	(0 - 10)	10 - 30	>30

SAT DATA

	Tree sp	DBH (mm)	K	FP
1 (CT)	E. Pro	274	✓	
2	E. Glo	316	—	
3	E. Glo	776	—	
4	L. con	101	—	
5	E. Glo	530	✓	
6	E. Mic	303	—	
7	C. int	263	—	
8	E. Mic	554	—	
9	E. Glo	575	—	
10	L. con	176	—	
11	E. Glo	445	—	
12	C. int	243	—	
13	Ironbark	600 (2)	—	
14	E. Glo	239	—	
15	C. int	235	—	
16	E. Glo	180	—	
17	E. Glo	895	—	
18	E. Glo	340	—	
19	E. Mic	388	—	
20	E. Pro	417	—	
21	E. Pro	417	—	
22	E. Glo	620	—	
23	Ironbark	385	✓	
24	E. Glo	522	—	
25	Ironbark	444	✓	
26	E. Mic	270	—	
27	E. Mic	380	—	
28	Allo. cas	100	—	
29	Mel. sp	165	✓	
30	E. Mic	291	—	

1. Soil Landscape: _____

2. SAT Criteria: 1 2 (3)

3. Age of pellets: Old Mixed Fresh

4. A/Level: 0 / 30 = 0. _ %

5. Mean % groundcover in search area:

< 30% (30 – 70%) >70%

6. Comments:

_____

7. No Koalas within 25m of CT: N/A

Checked by: Kirsty **Date:** 19/10/20 **Entered by:** Kirsty **Date:** 15/10/20.

DATA Checklist: Database ☑ Scanned ☑ Filed ☐

PROJECT: Sancrox Quarry Koala Surveys 2020 **FULL SAT DATA SHEET**

SAT No: __GS 2020_04 **Staff:** Kirsty. W Caitlin (SLR) Amanda. **Date:** 13 / 10 /2020

SITE DATA

Datum	Zone		Easting						Northing							±
GDA 94	5	6	4	8	2	7	1	7	6	5	2	1	7	5	1	3
Elevation	Aspect								Slope							
26	N	NE	(E)	SE	S	SW	W	NW	(0 - 10)		10 - 30		>30			

SAT DATA

	Tree sp	DBH (mm)	K	FP
1 (CT)	C. Int	299	—	
2	C Int	199	—	
3	E. Glo	160	—	
4	C Int	259	—	
5	Allo. cos	136	—	
6	E. Pro	279	—	
7	C. Int	308	—	
8	E. Mic	349	—	
9	C Int	363	—	
10	E. Glo	231	—	
11	C Pro	182	—	
12	Allo (co)	239	—	
13	E Glo	260	—	
14	Allo. cos	160	—	
15	E. Glo	205		X
16	E. Mic	190	—	
17	E Car	344	—	
18	Ironbark	303	—	
19	E. Glo	558 (2)	—	
20	Allo. cos	280	—	
21	E Glo	393	—	
22	E. Glo	602 (2)	—	
23	E. Glo	356	—	
24	Ironbark	517	—	
25	E. Glo	130	—	
26	E. Glo	316	—	
27	C. Int	218	—	
28	E. Glo	175	—	
29	C Int	475 (2)	—	
30	C Int	143	—	

1. Soil Landscape: _____

2. SAT Criteria: 1 2 (3)

3. Age of pellets: (Old) Mixed Fresh

4. A/Level: 1 / 30 = 3.33%

5. Mean % groundcover in search area:

(< 30%) 30 – 70% >70%

6. Comments:

7. No Koalas within 25m of CT: N/A

Checked by: Kirsty **Date:** 19/10/20 **Entered by:** Jade. K **Date:** 15/10/20

DATA Checklist: Database ☑ Scanned ☑ Filed ☐

PROJECT: Sancrox Quarry Koala Surveys 2020 **FULL SAT DATA SHEET**

SAT No: __GS 22__ **Staff:** Kirsty. W, Amanda, Caitlin (SLR) **Date:** 13 / 10 /2020

SITE DATA

Datum	Zone		Easting						Northing							±
GDA 94	5	6	4	8	2	4	9	7	6	5	2	1	7	6	0	3
Elevation	Aspect								Slope							
31	N	NE	E	SE	S	SW	W	NW	0 - 10		10 - 30		>30			

SAT DATA

	Tree sp	DBH (mm)	K	FP
1 (CT)	E.Glo	278	—	
2	Allo.cas	126	—	
3	E Glo	373	—	
4	C Int	215	—	
5	E Glo	690	—	
6	E.Glo	305	—	
7	C.Glo	216	—	
8	E Glo	351	—	
9	C.Int	400	—	
10	E.Cer	242	—	
11	E Mic	127	—	
12	E.Glo	353	—	
13	E Glo	206	—	
14	E Pro	382	—	
15	E Glo	306	—	
16	Allo.cas	158	—	
17	E.Glo	563		x
18	C.Int	787		x
19	Ironbark	324	—	
20	E.Glo	294	—	
21	Grey Gum	465	—	
22	E.Car	562	—	
23	C.Cit	219	—	
24	E.Glo	105	—	
25	E Glo	271	—	
26	E Glo	431	—	
27	E.Mic	124	—	
28	Ironbark	339	—	
29	E.Glo	623	—	
30	E.Mic	368		

1. Soil Landscape: _____

2. SAT Criteria: 1 2 3

3. Age of pellets: Old Mixed Fresh

4. A/Level: 2 / 30 = 6.67%

5. Mean % groundcover in search area:

< 30% 30 – 70% >70%

6. Comments:

7. No Koalas within 25m of CT: N/A

Checked by: Kirsty **Date:** 19/10/20 **Entered by:** Jade.K **Date:** 15/10/20

DATA Checklist: Database ☑ Scanned ☑ Filed ☐

PROJECT: Sancrox Quarry Koala Surveys 2020 **FULL SAT DATA SHEET**

SAT No: __GS 125__ **Staff:** Kirsty . W, Amanda, Caitlin (SLR) **Date:** 13 /10 /2020

SITE DATA

Datum	Zone		Easting						Northing							±
GDA 94	5	6	4	8	2	4	7	9	6	5	2	2	0	0	3	3
Elevation	Aspect								Slope							
52	N	NE	E	SE	S	SW	W	NW	0 - 10		10 - 30		>30			

SAT DATA

	Tree sp	DBH (mm)	K	FP
1 (CT)	C. Cit	532	—	
2	Allo. con	132	—	
3	C. Cit	278	—	
4	E. Glo	246	—	
5	C. Cit	283	—	
6	L. con	387		X
7	E. Mic	399		X
8	C. Cit	352		X
9	C. Cit	255		X
10	E. Mic	462		X
11	E. Glo	240	—	
12	Ironbark	393		X
13	Ironbark	205	—	
14	E. Glo	277	—	
15	C. Cit	271	—	
16	E. Glo	233	—	
17	C. Cit	370	—	
18	E. Glo	167	—	
19	C. Cit	321	—	
20	C. Cit	220		X
21	C. Cit	222	—	
22	E. Glo	190	—	
23	C. Cit	284	—	
24	E. Pil	593		X
25	C. Cit	235	—	
26	E. Glo	339		X
27	Ironbark	423		X
28	C. Cit	142	—	
29	E. Pil	526	—	
30	E. mel	389	—	

1. Soil Landscape: _____

2. SAT Criteria: 1 2 (3)

3. Age of pellets: Old Mixed (Fresh)

4. A/Level: 10 / 30 = 33.33%

5. Mean % groundcover in search area:

< 30% 30 – 70% >70%

6. Comments:

Next to Quarry walls
& Scats still Glossy

7. No Koalas within 25m of CT: N/A

Checked by: _____ **Date:** _____ **Entered by:** Jade. K **Date:** 15/10/20

DATA Checklist: Database ☐ Scanned ☐ Filed ☐

NB Koala found near here in spotlighting transect!

PROJECT: Sancrox Quarry Koala Surveys 2020

FULL SAT DATA SHEET

SAT No: GS16

Staff: Kirsty W, Amanda, Caitlin (SLR)

Date: 13/10/2020

SITE DATA

Datum	Zone		Easting						Northing							±
GDA 94	5	6	4	8	2	4	9	3	6	5	2	2	2	4	0	3

Elevation	Aspect								Slope		
32	N	NE	E	SE	S	SW	W	NW	0 - 10	10 - 30	>30

SAT DATA

	Tree sp	DBH (mm)	K	FP
1 (CT)	E. Pro	393		–
2	Allo cas	194		–
3	E. Pro	385		–
4	E Pro	288		–
5	C. Int	147		–
6	Allo cas	143		–
7	E Glo	820		–
8	E Glo	454		–
9	Ironbark	220		–
10	E Pil	757		–
11	Allo cas	175		X
12	Allo cas	195		–
13	E. Pil	500		–
14	Allo cas	177		–
15	E. Mac	570		X
16	E. Pil	720		–
17	C. int	268		X
18	Allo. cas	218		–
19	Allo. cas	115		–
20	All cas	145		–
21	Grey Gum	367		–
22	E. Glo	185		–
23	E. Pro	331		–
24	E. Pro	516		–
25	E Pil	600		–
26	E. Pro	381		–
27	E. Pil	1402 (3)		X
28	E. Pil	518		
29	Ironbark	352		–
30	Allo cas	135		–

1. Soil Landscape: _____

2. SAT Criteria: 1 2 3

3. Age of pellets: Old Mixed Fresh

4. A/Level: 4 / 30 = 13.33%

5. Mean % groundcover in search area:

< 30% 30 – 70% >70%

6. Comments:

7. No Koalas within 25m of CT: N/A

Checked by: Kirsty Date: 19/10/20

Entered by: Jade K Date: 15/10/20

DATA Checklist: Database ✓ Scanned ✓ Filed ☐

APPENDIX B

Koala Feed Trees for the North Coast Area

Species Name	Common Name
Allocasuarina torulosa	Forest Oak
Angophora floribunda	Rough-barked Apple
Corymbia gummifera	Red Bloodwood
Corymbia henryi	Large-leaved Spotted Gum
Corymbia intermedia	Pink Bloodwood
Corymbia maculata	Spotted Gum
Eucalyptus acmenoides	White Mahogany
Eucalyptus amplifolia	Cabbage Gum
Eucalyptus bancroftii	Orange Gum
Eucalyptus biturbinata	Grey Gum
Eucalyptus campanulata	New England Blackbutt
Eucalyptus canaliculata	Large-fruited Grey Gum
Eucalyptus carnea	Thick-leaved Mahogany
Eucalyptus crebra	Narrow-leaved Ironbark
Eucalyptus eugenioides	Narrow-leaved Stringybark
Eucalyptus fibrosa	Board-leaved Red Ironbark
Eucalyptus glaucina	Slaty Red Gum
Eucalyptus globoidea	White Stringybark
Eucalyptus grandis	Flooded Gum
Eucalyptus laevopinea	Silver-top Stringybark
Eucalyptus largeana	Craven Grey Box
Eucalyptus microcorys	Tallowwood
Eucalyptus moluccana	Grey Box
Eucalyptus nobilis	Forest Ribbon Gum
Eucalyptus pilularis	Blackbutt
Eucalyptus placita	Grey Ironbark
Eucalyptus planchoniana	Bastard Tallowwood
Eucalyptus propinqua	Small-fruited Grey Gum
Eucalyptus psammitica	Bastard White Mahogany
Eucalyptus punctata	Grey Gum
Eucalyptus resinifera	Red Mahogany
Eucalyptus robusta	Swamp Mahogany
Eucalyptus rummeryi	Steel Box
Eucalyptus saligna	Sydney Blue Gum
Eucalyptus scias	Large-fruited Red Mahogany
Eucalyptus seeana	Narrow-leaved Red Gum
Eucalyptus siderophloia	Grey ironbark
Eucalyptus signata/ Eucalyptus racemose	Scribbly gum/ Narrow-leaved Scribbly Gum

Species Name	Common Name
Eucalyptus tereticornis	Forest Red Gum
Eucalyptus tindaliae	Stringybark
Eucalyptus umbra	Bastard White Mahogany
Melaleuca quinquenervia	Board-leaved paperbark

ASIA PACIFIC OFFICES

BRISBANE
Level 2, 15 Astor Terrace
Spring Hill QLD 4000
Australia
T: +61 7 3858 4800
F: +61 7 3858 4801

CANBERRA
GPO 410
Canberra ACT 2600
Australia
T: +61 2 6287 0800
F: +61 2 9427 8200

DARWIN
Unit 5, 21 Parap Road
Parap NT 0820
Australia
T: +61 8 8998 0100
F: +61 8 9370 0101

GOLD COAST
Level 2, 194 Varsity Parade
Varsity Lakes QLD 4227
Australia
M: +61 438 763 516

MACKAY
21 River Street
Mackay QLD 4740
Australia
T: +61 7 3181 3300

MELBOURNE
Level 11, 176 Wellington Parade
East Melbourne VIC 3002
Australia
T: +61 3 9249 9400
F: +61 3 9249 9499

NEWCASTLE
10 Kings Road
New Lambton NSW 2305
Australia
T: +61 2 4037 3200
F: +61 2 4037 3201

PERTH
Ground Floor, 503 Murray Street
Perth WA 6000
Australia
T: +61 8 9422 5900
F: +61 8 9422 5901

SYDNEY
Tenancy 202 Submarine School
Sub Base Platypus
120 High Street
North Sydney NSW 2060
Australia
T: +61 2 9427 8100
F: +61 2 9427 8200

TOWNSVILLE
12 Cannan Street
South Townsville QLD 4810
Australia
T: +61 7 4722 8000
F: +61 7 4722 8001

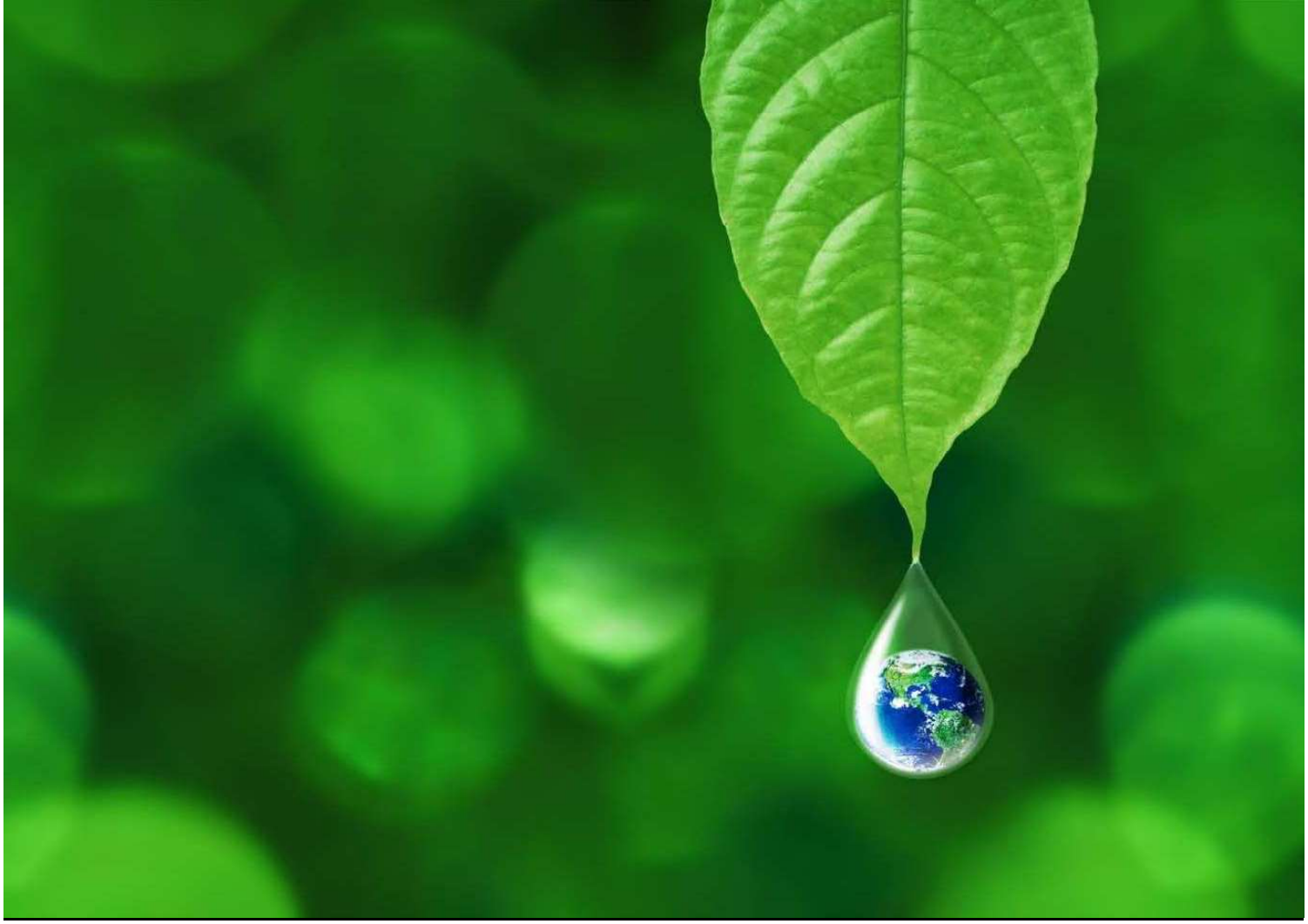
WOLLONGONG
Level 1, The Central Building
UoW Innovation Campus
North Wollongong NSW 2500
Australia
T: +61 2 4249 1000

AUCKLAND
68 Beach Road
Auckland 1010
New Zealand
T: 0800 757 695

NELSON
6/A Cambridge Street
Richmond, Nelson 7020
New Zealand
T: +64 274 898 628

Appendix E

Revised Noise and Vibration Impact Assessment



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

ERM

Document details	
Document title	Sancrox Quarry Expansion Response to Submissions
Document title	Updated Noise and Vibration Impact Assessment
Document subtitle	0418291
Date	27 November 2020
Version	10
Author	Steven De Luzuriaga (SD)
Client Name	Hanson Construction Materials Pty Ltd

Document history

				ERM approval to issue		
Version	Revision	Author	Reviewed by	Name	Date	Comments
Draft	09	SD	Aaron McKenzie	Murray Curtis	26.08.2020	Response to Submissions Updates – For Hanson Review
Final	10	SD	Damon Roddis	Murray Curtis	27.11.2020	Response to Submissions Updates – Final for Issue

Signature Page

27 November 2020

Sancrox Quarry Expansion Response to Submissions

Updated Noise and Vibration Impact Assessment

Steven De Luzuriaga
Senior Acoustics Consultant

Damon Roddis
Partner

Murray Curtis
Partner

Environmental Resources Management Australia Pty Ltd

Level 15, 309 Kent Street

Sydney NSW 2000

Australia

© Copyright 2020 by ERM Worldwide Group Ltd and / or its affiliates ("ERM").
All rights reserved. No part of this work may be reproduced or transmitted in any form,
or by any means, without the prior written permission of ERM

CONTENTS

1. INTRODUCTION 1
1.1 Background 1
1.2 Project Description 1
1.3 Project Locality 2

2. ASSESSMENT METHODOLOGY 6
2.1 Objectives and Scope of Work 6
2.2 Policy Setting 7
2.3 Relevant Policy, Guidelines and Standards 8
2.4 NSW Industrial Noise Policy 8
2.5 NSW Interim Construction Noise Guideline 9
2.6 Blasting 10
2.6.1 Estimated Charge Values 10
2.6.2 Air-Blast Overpressure 10
2.6.3 Ground-Borne Vibration 10
2.6.4 Flyrock 11
2.7 NSW Road Noise Policy 11
2.8 Vibration Guidelines and Standards 11
2.9 Requirements for Land Acquisition 12
2.9.1 Voluntary Mitigation Rights 14
2.9.2 Voluntary Land Acquisition Rights 15
2.10 Noise Modelling 15
2.10.1 Noise Enhancing Meteorological Conditions 18
2.10.2 Conceptual Mitigation Measures 18
2.11 Cumulative Impacts 19
2.11.1 Noise 19
2.11.2 Vibration 20
2.12 Consultation 20

3. EXISTING CONDITIONS 22
3.1 Existing Noise Environment 22
3.2 Potentially Sensitive Receptors 23
3.3 Existing Background Noise Levels 25
3.3.1 Monitoring Methodology 25
3.3.2 Unattended Noise Logging Results 26
3.3.3 Operator Attended Noise Measurement Results 29
3.3.4 Rating Background Noise Levels 30

4. NOISE MANAGEMENT LEVELS AND CRITERIA 32
4.1 Construction Noise Management Levels 32
4.2 Construction and Operational Road Traffic Noise Criteria 34
4.3 Operational Noise Criteria 35
4.3.1 Operational (Quarry) Emissions 35
4.3.2 Quarry Blasting Emissions 37

5. QUALITATIVE ASSESSMENTS 39
5.1 Road Traffic Noise – Construction 39
5.2 Vibration – Construction and Operation 39
5.3 Ground-Borne Noise – Construction and Operation 40

6. CONSTRUCTION NOISE ASSESSMENT 41
6.1 Assessment Scenarios 41
6.2 Predicted Construction Noise Levels 42

6.2.2 Summary of Results 44
6.2.3 Discussion of Findings 44
6.2.4 Sleep Disturbance 45
6.2.5 Potential Cumulative Impacts 45
6.3 Assessment Outcomes 45
7. OPERATIONAL NOISE ASSESSMENT 46
7.1 Assessment Scenarios 46
7.2 Validation of Existing Operations 47
7.3 Predicted Operational Noise Levels 47
7.3.2 Summary of Results 53
7.3.3 Discussion of Findings 53
7.3.4 Potential Cumulative impacts 53
7.4 Road Traffic – Operation 54
7.4.2 Summary of Results 56
7.4.3 Discussion of Findings 56
7.5 Sleep Disturbance 56
7.6 Blasting 57
7.6.1 Overpressure and Vibration 57
7.6.2 Flyrock 57
7.6.3 Assessment Outcomes 58
8. RECOMMENDATIONS 59
8.1 Construction Noise 59
8.2 Operational (Quarry) Noise 60
8.3 Operational (Blasting) Overpressure and Vibration 61
8.3.1 Flyrock 62
8.4 Potential Monitoring Options 62
9. CONCLUSION 64
10. REFERENCES 65

APPENDIX A STAGING AND LAYOUT
APPENDIX B ACOUSTICS GLOSSARY
APPENDIX C INP METHODOLOGY
APPENDIX D ICNG METHODOLOGY
APPENDIX E UNATTENDED NOISE LOGGING CHARTS
APPENDIX F DETAILED NOISE MODELLING DATA

List of Tables

Table 2.1 Secretary's Environmental Assessment Requirements (SEARs) 6
Table 2.2 Characterisation of Noise Impacts & Potential Treatments.....14
Table 2.3 Noise Modelling Features, Inputs and Assumptions.....16
Table 2.4 LW mitigation required to meet most stringent PSNL.....19
Table 2.5 Stakeholder Consultation.....20
Table 3.1 Potentially Sensitive Receptors.....24
Table 3.2 Unattended Environmental Noise Logging (L1).....27
Table 3.3 Unattended Environmental Noise Logging (L2).....27
Table 3.4 Unattended Environmental Noise Logging (L3).....28
Table 3.5 Unattended Environmental Noise Logging (L4).....28
Table 3.6 Operator Attended Noise Measurements.....29
Table 3.7 Rating Background Noise Levels.....31
Table 4.1 Construction Noise Management Levels (NML).....33
Table 4.2 Road Traffic Noise Criteria.....34
Table 4.3 Project-Specific Noise Levels (PSNL).....36
Table 4.4 Allowable Air Blast Overpressure Levels.....37
Table 4.5 Allowable Vibration Levels.....37
Table 4.6 Allowable Limits with Regards to Commercial and Industrial Receivers 37
Table 6.1 Construction Noise Assessment Scenarios.....41
Table 6.2 Predicted Construction Noise Levels – All Scenarios (SCN01 to SCN04, Lmax).....43
Table 7.1 Operational Noise Assessment Scenarios 46
Table 7.2 Existing Operations Validation Data.....47
Table 7.3 Predicted Operational Noise Levels – All Scenarios (Standard Meteorological Conditions) including conceptual mitigation.....49
Table 7.4 Predicted Operational Noise Levels – All Scenarios (Evening - Prevailing W Wind) including conceptual mitigation.....50
Table 7.5 Predicted Operational Noise Levels – All Scenarios (Night - Prevailing NW Wind) including conceptual mitigation.....51
Table 7.6 Predicted Operational Noise Levels – All Scenarios (Night - Prevailing W Wind) including conceptual mitigation.....52
Table 7.7 Traffic Data Inputs.....54
Table 7.8 Predicted Operational Road Traffic Noise Levels: Compliance/Change (Highway).....55
Table 7.9 Predicted Operational Road Traffic Noise Levels: Compliance/Change (Local Roads)55
Table 7.10 Flyrock Throw and Clearance Distances for Current Practice.....57
Table 7.11 Maximum Throw and Minimum recommended clearance distances behind a blast.....58
Table 7.12 Stemming height requirements to contain flyrock within the.....58
Table D.10.1 Residential Receptors (NML).....87
Table D.10.2 Other Sensitive Receptors (NML).....88

List of Figures

Figure 1.1 Site Location..... 3
Figure 1.2 Zoning Map..... 4
Figure 1.3 Noise Assessment Map 5
Figure 2.1 Process for Decision-Making on Noise Impacts (VLAMP).....13

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.

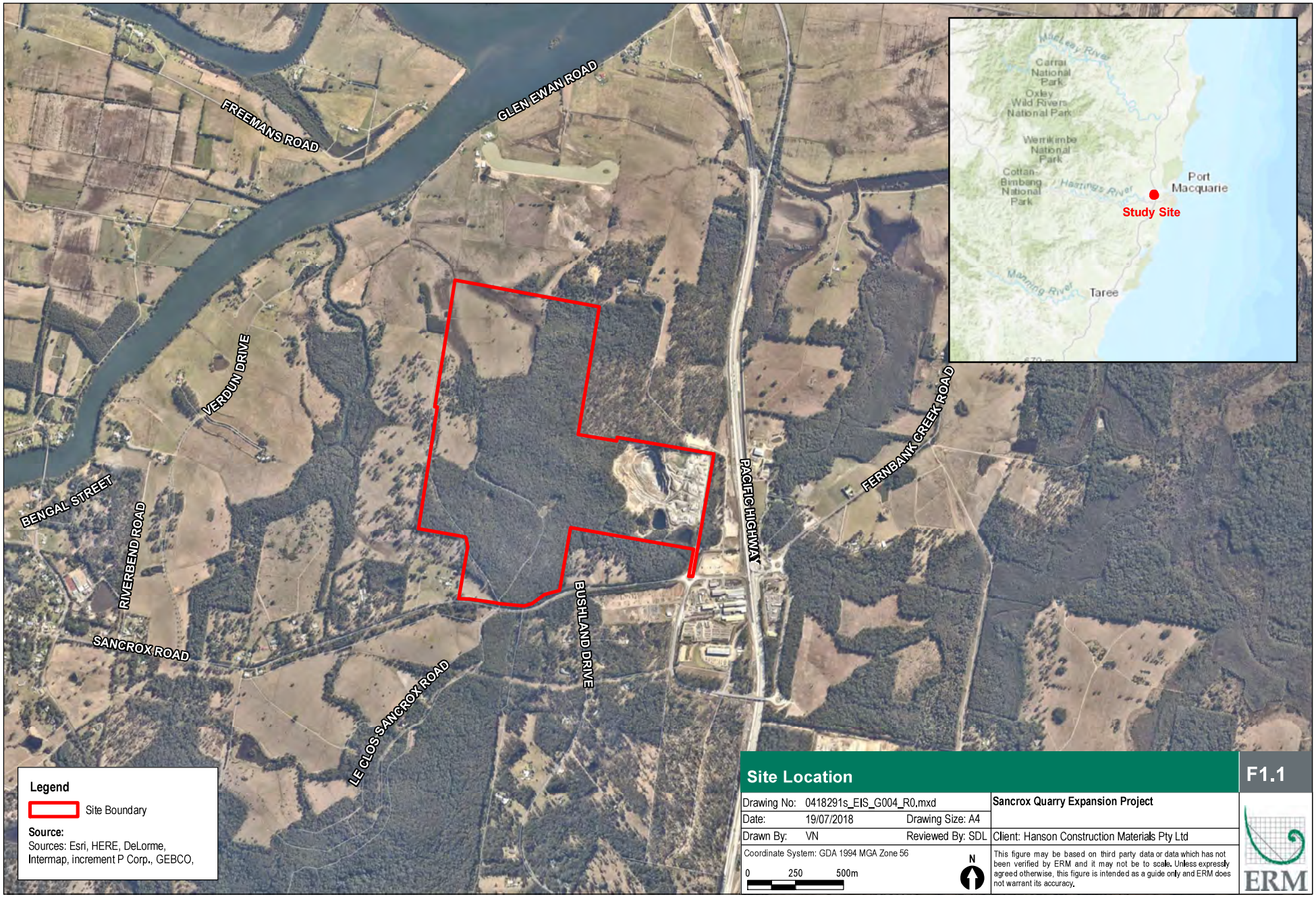
1.3 Project Locality

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

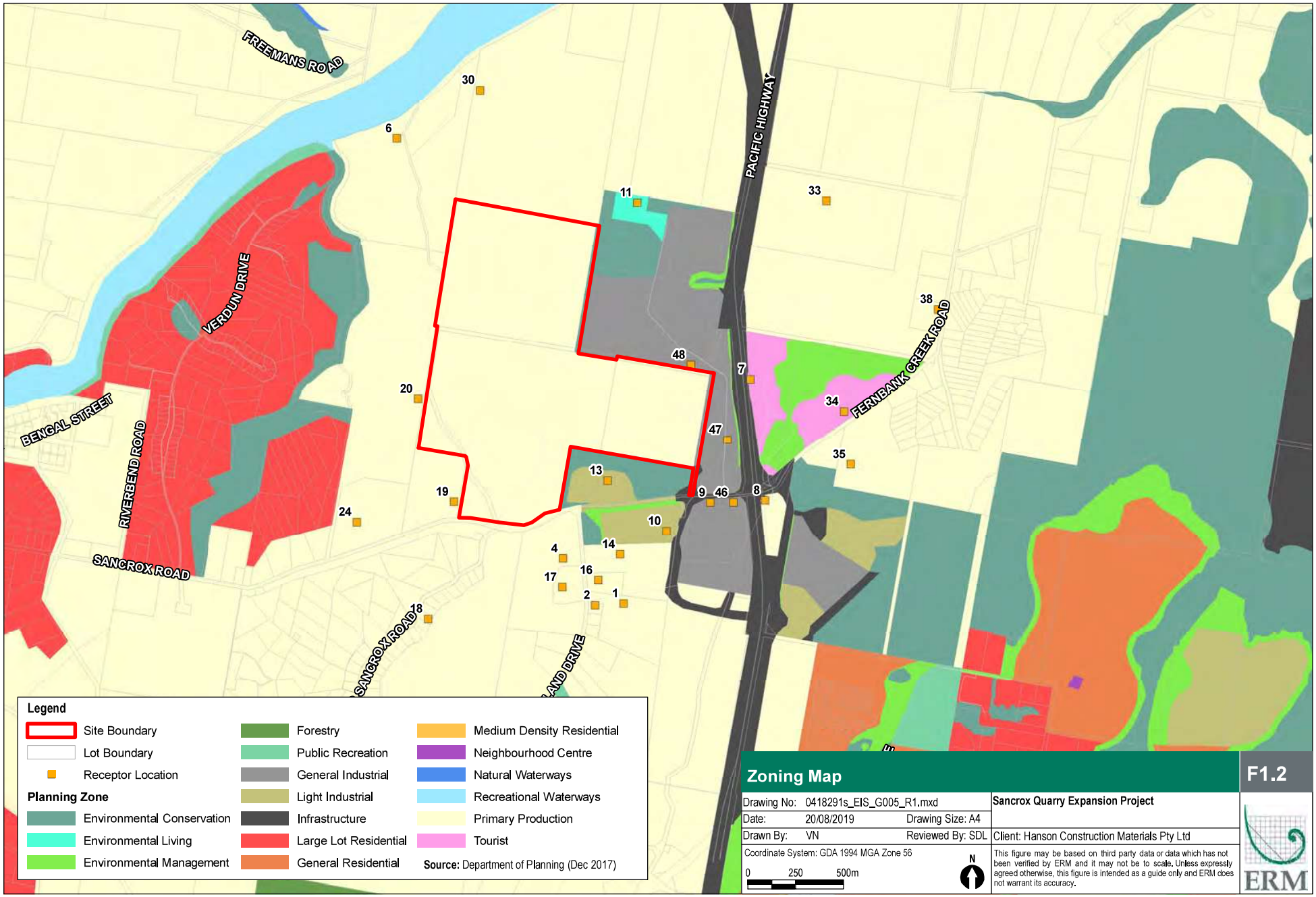
F1.1

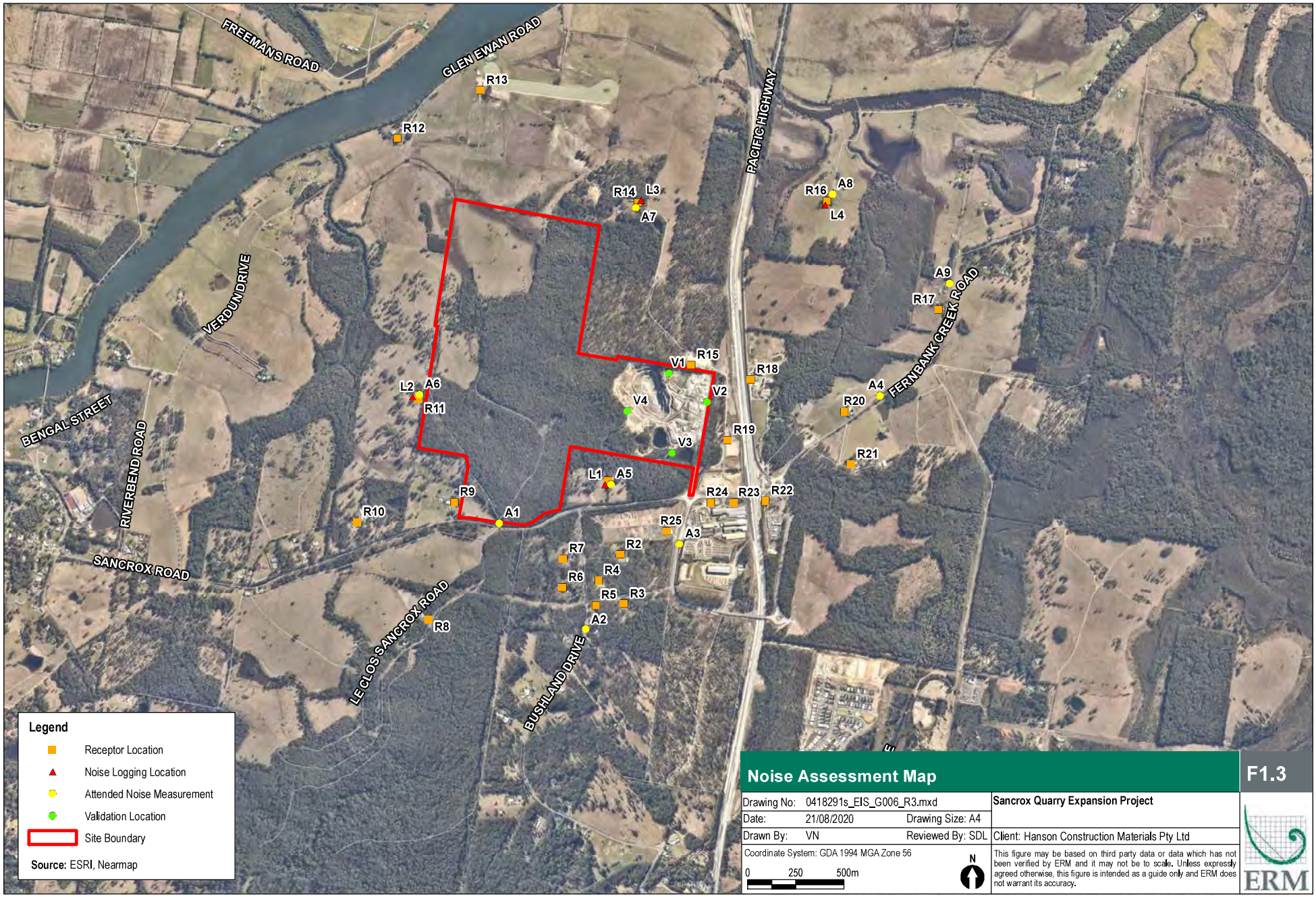
Drawing No: 0418291s_EIS_G004_R0.mxd		Sancrox Quarry Expansion Project
Date: 19/07/2018	Drawing Size: A4	
Drawn By: VN	Reviewed By: SDL	Client: Hanson Construction Materials Pty Ltd
Coordinate System: GDA 1994 MGA Zone 56		This figure may be based on third party data or data which has not been verified 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.

0 250 500m

N

ERM


FREEMANS ROAD
PACIFIC HIGHWAY
VERDUN DRIVE
BENGAL STREET
RIVERBEND ROAD
SANCROX ROAD
FERNBANK CREEK ROAD
30
6
11
33
38
48
7
20
34
47
35
13
19
9
46
8
24
10
14
4
16
17
2
1
18
Legend
Site Boundary
Lot Boundary
Receptor Location
Planning Zone
Environmental Conservation
Environmental Living
Environmental Management
Forestry
Public Recreation
General Industrial
Light Industrial
Infrastructure
Large Lot Residential
General Residential
Medium Density Residential
Neighbourhood Centre
Natural Waterways
Recreational Waterways
Primary Production
Tourist
Source: Department of Planning (Dec 2017)
Zoning Map
F1.2
Drawing No: 0418291s_EIS_G005_R1.mxd
Date: 20/08/2019
Drawing Size: A4
Drawn By: VN
Reviewed By: SDL
Coordinate System: GDA 1994 MGA Zone 56
0 250 500m
N
Sancrox Quarry Expansion Project
Client: Hanson Construction Materials Pty Ltd
This figure may be based on third party data or data which has not been verified by ERM and it may not be to scale. Unless expressly agreed otherwise, this figure is intended as a guide only and ERM does not warrant its accuracy.
ERM



Noise Assessment Map

F1.3

Drawing No: 0418291s_EIS_G006_R3.mxd		Sancrox Quarry Expansion Project
Date: 21/08/2020	Drawing Size: A4	
Drawn By: VN	Reviewed By: SDL	Client: Hanson Construction Materials Pty Ltd
Coordinate System: GDA 1994 MGA Zone 56		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.

0 250 500m

N

ERM

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

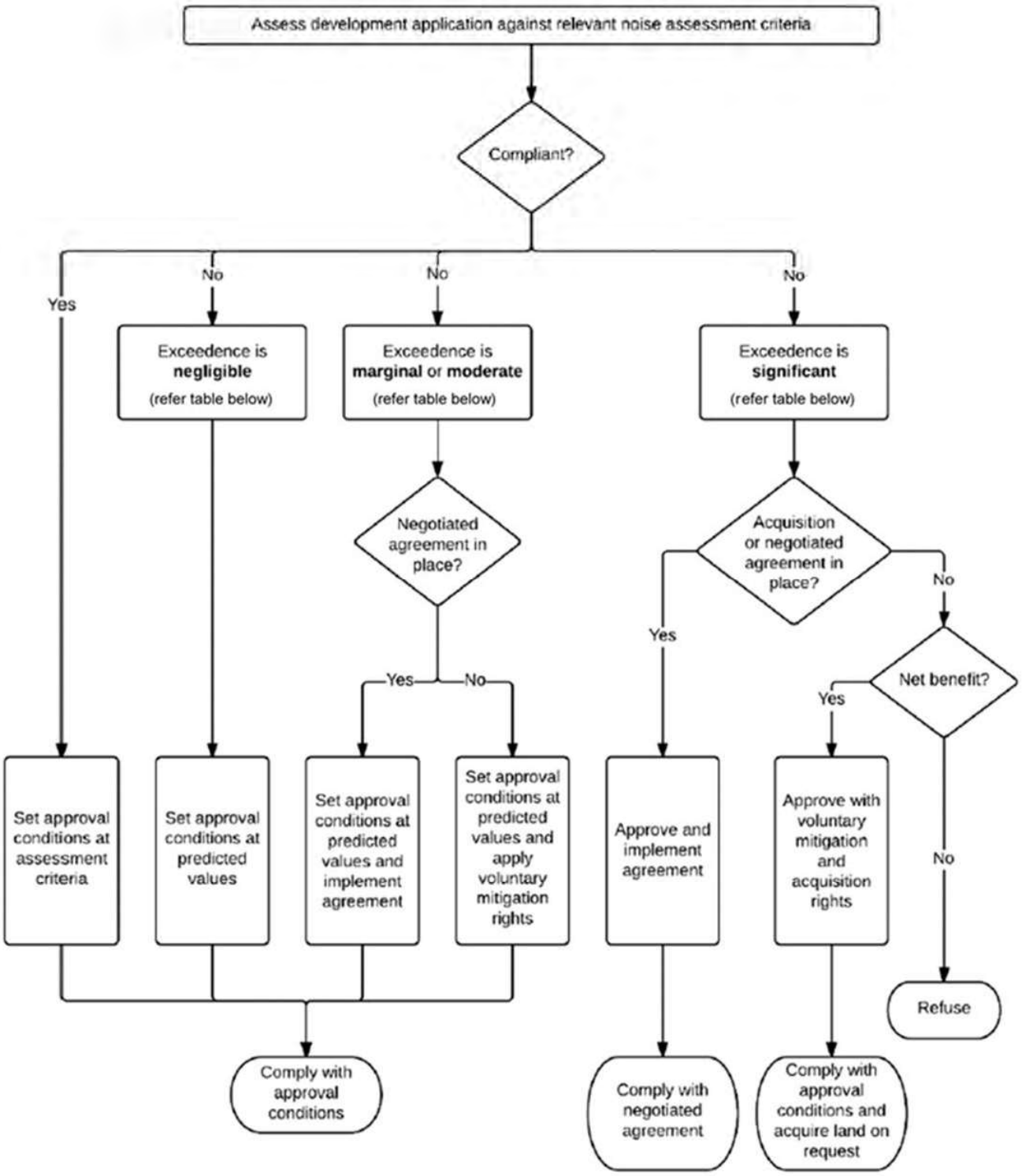
The *Voluntary Land Acquisition and Mitigation Policy For State Significant Mining, Petroleum And Extractive Industry Developments* (VLAMP) is to be applied by consent authorities when assessing and determining development applications and modification applications for mining, petroleum and extractive 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.



Process for Decision-Making on Noise Impacts (VLAMP)			F2.1
Drawing No: 0418291s_NVIA_C001_R0.cdr			**Noise and Vibration Impact Assessment Sancrox Quarry Expansion**
Date: 25/02/2019	Drawing size: A4		
Drawn by: GC	Reviewed by: SD		Client: Hanson Construction Materials Pty Ltd
			This figure may be based on third party data or data which has not been verified by ERM and it may not be to scale. Unless expressly agreed otherwise, this figure is intended as a guide only and ERM does not warrant its accuracy.

ERM

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 LW references and spectral data) are provided in *Appendix F.*

6.2 Predicted Construction Noise Levels

Based on the construction assessment scenarios and LW 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.

10. REFERENCES

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

Department of Planning and Environment (DPE) - **Voluntary Land Acquisition and Mitigation Policy (VLAMP)** for State Significant Mining, Petroleum and Extractive Industry Developments, September 2018.

CONCAWE – 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

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 – **NSW Environmental Noise Management – Industrial Noise Policy** (INP), January 2000 and relevant application notes.

NSW Environment Protection Authority – **Implementation and transitional arrangements for the Noise Policy for Industry (2017)**, October 2017.

NSW Environment Protection Authority – **Noise Policy for Industry** (NPI, 2017), October 2017

NSW Department of Environment and Climate Change – **NSW Interim Construction Noise Guideline** (ICNG), July 2009.

NSW Department of Environment, Climate Change and Water – **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.

Sinclair Knight Merz (SKM) - **Sancrox Employment Precinct Buffer Zone Assessment – Air Quality, Noise and Flyrock**, dated April 2009.

SLR Consulting Australia (SLR) – **Operational Noise Management** – **IFC Design Documentation, Pacific Highway Upgrade Oxley Highway to Kundabung**. Prepared for Lendlease, dated February 2016.

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

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

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

APPENDIX A STAGING AND LAYOUT

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

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

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

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

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

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

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

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:

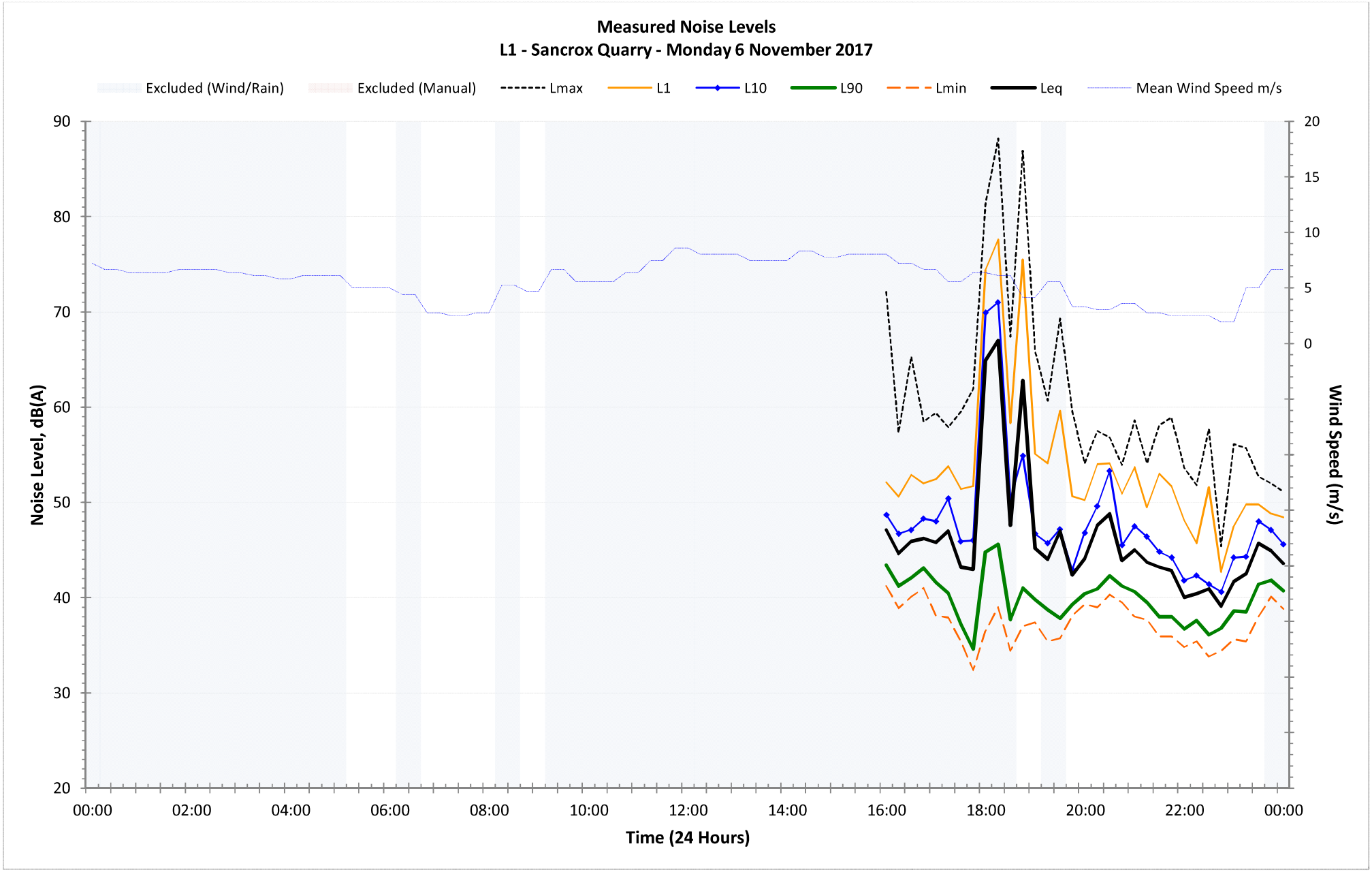
- Industrial premises: external $L_{eq,\ 15\ minute} \leq 75$ dBA.
- Offices, retail outlets: external $L_{eq,\ 15\ minute} \leq 70$ dBA.

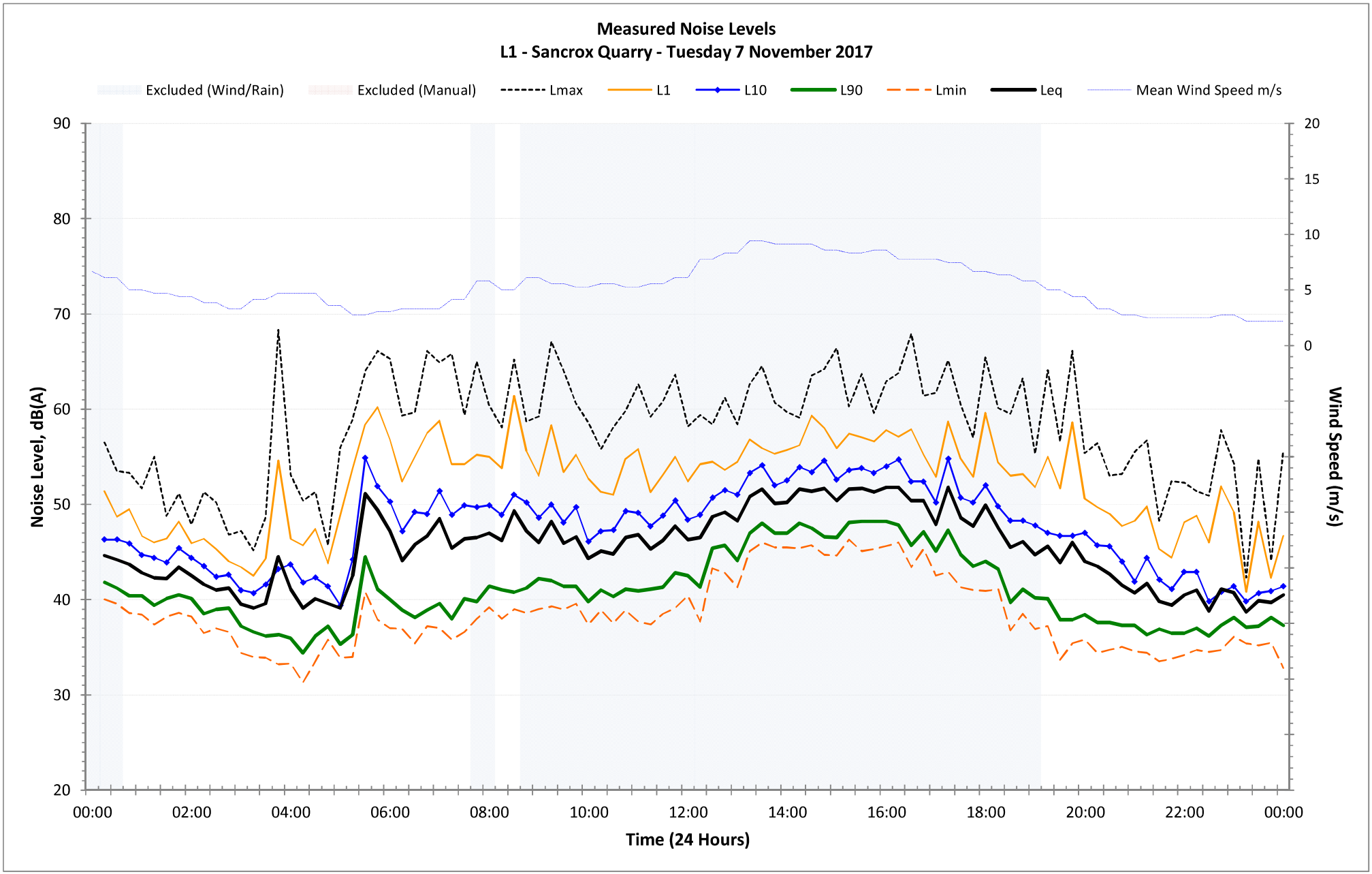
Other businesses that may be very sensitive to noise, where the noise level is project specific as discussed in the ICNG.

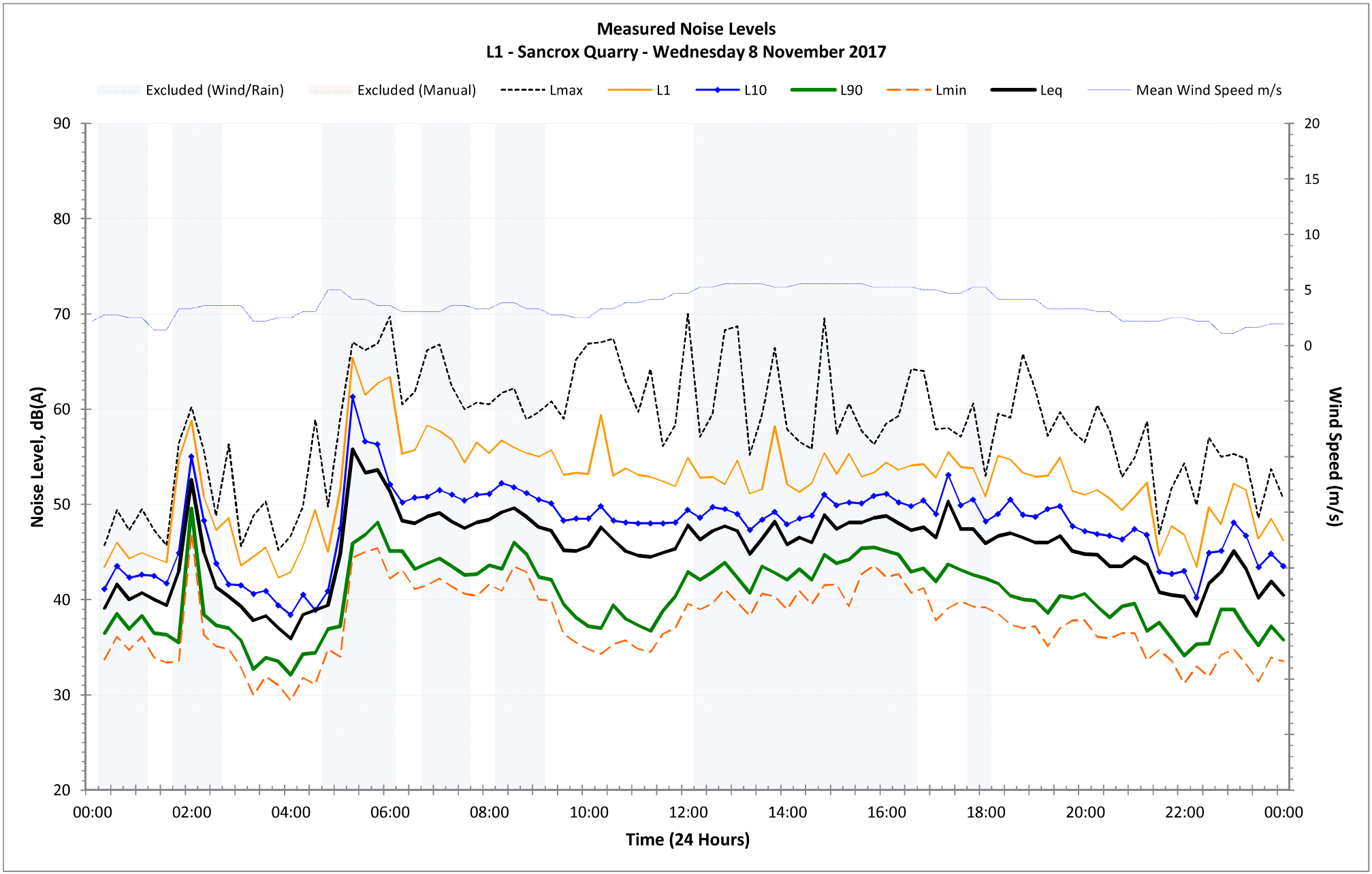
Other Features

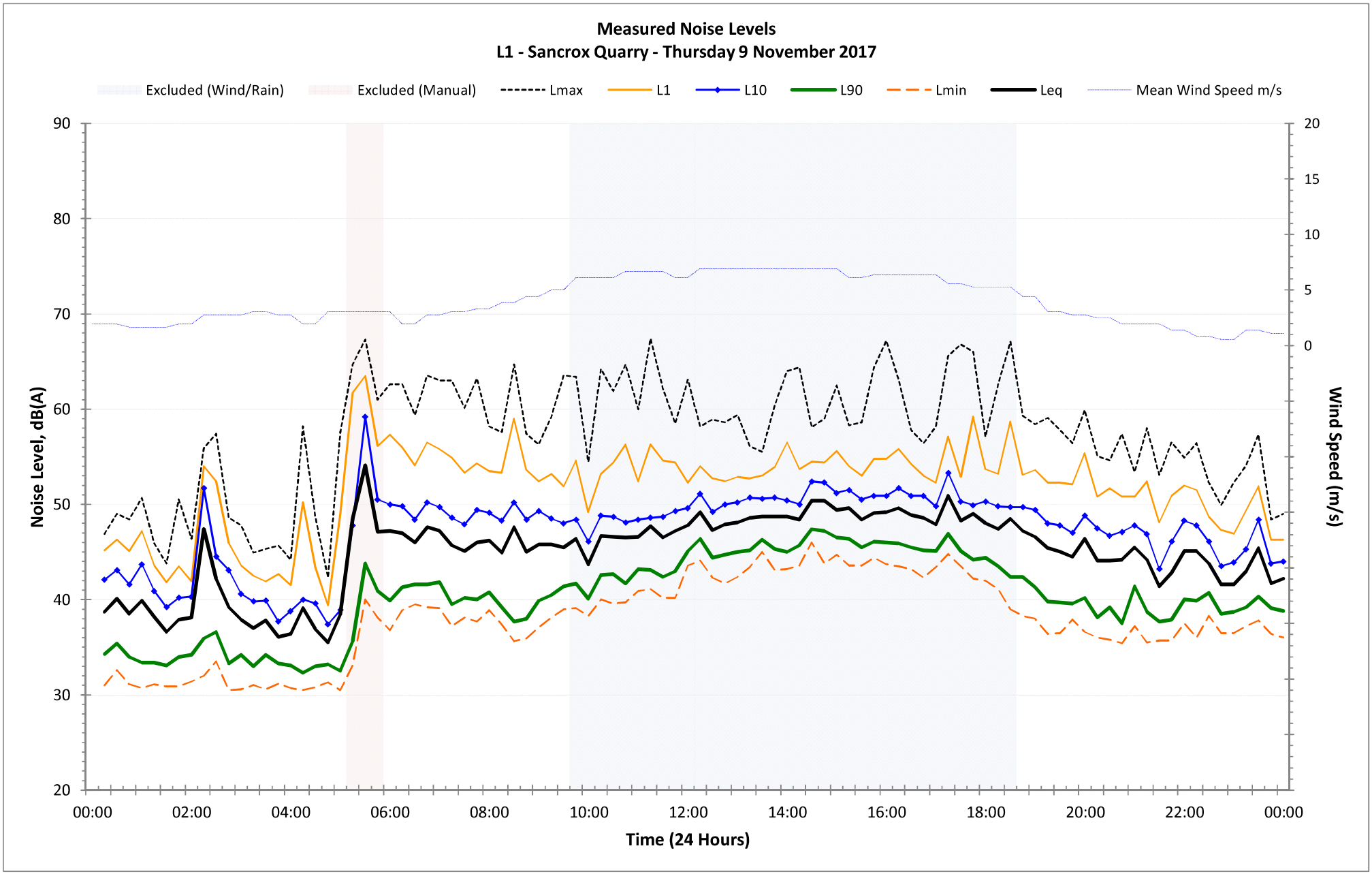
The ICNG goes on to describe criteria for ground-borne noise but these values are not relevant to this assessment. The ICNG also references vibration standards however these are addressed separately by applicable guidelines.

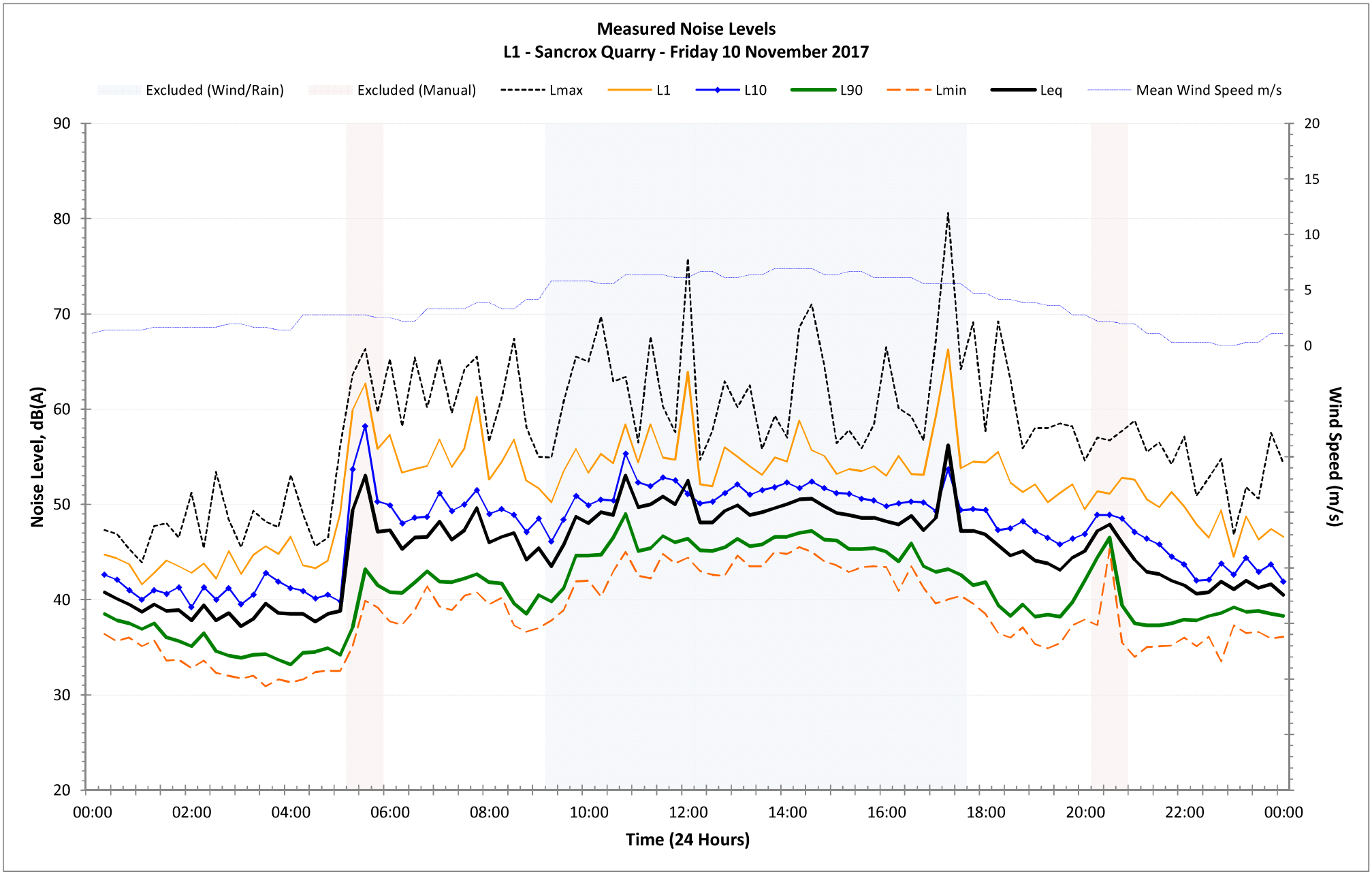
APPENDIX E UNATTENDED NOISE LOGGING CHARTS

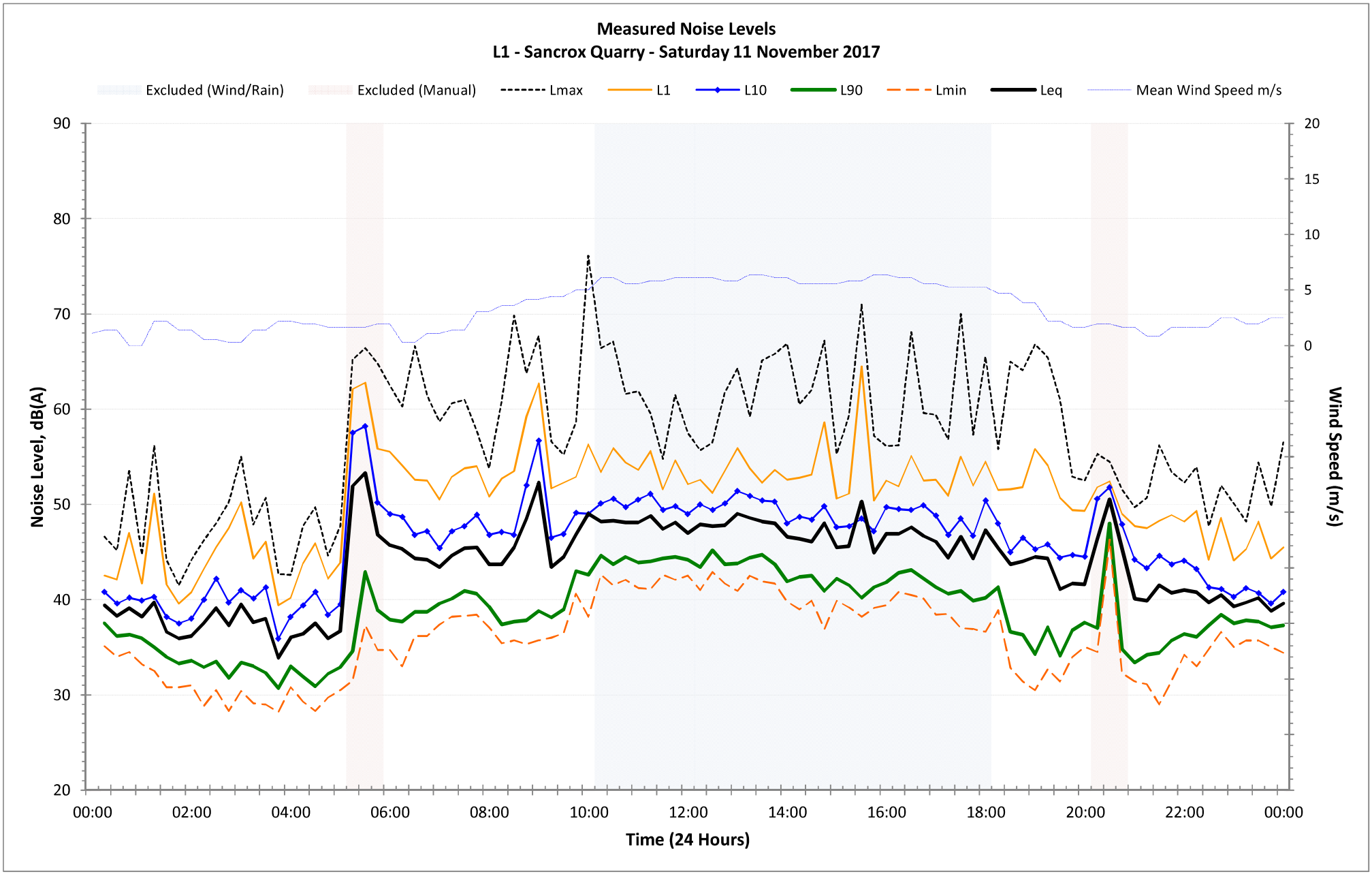

Measured Noise Levels
L1 - Sancrox Quarry - Monday 6 November 2017
Excluded (Wind/Rain)
Excluded (Manual)
Lmax
L1
L10
L90
Lmin
Leq
Mean Wind Speed m/s
Noise Level, dB(A)
Wind Speed (m/s)
Time (24 Hours)
90
80
70
60
50
40
30
20
20
15
10
5
0
00:00
02:00
04:00
06:00
08:00
10:00
12:00
14:00
16:00
18:00
20:00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

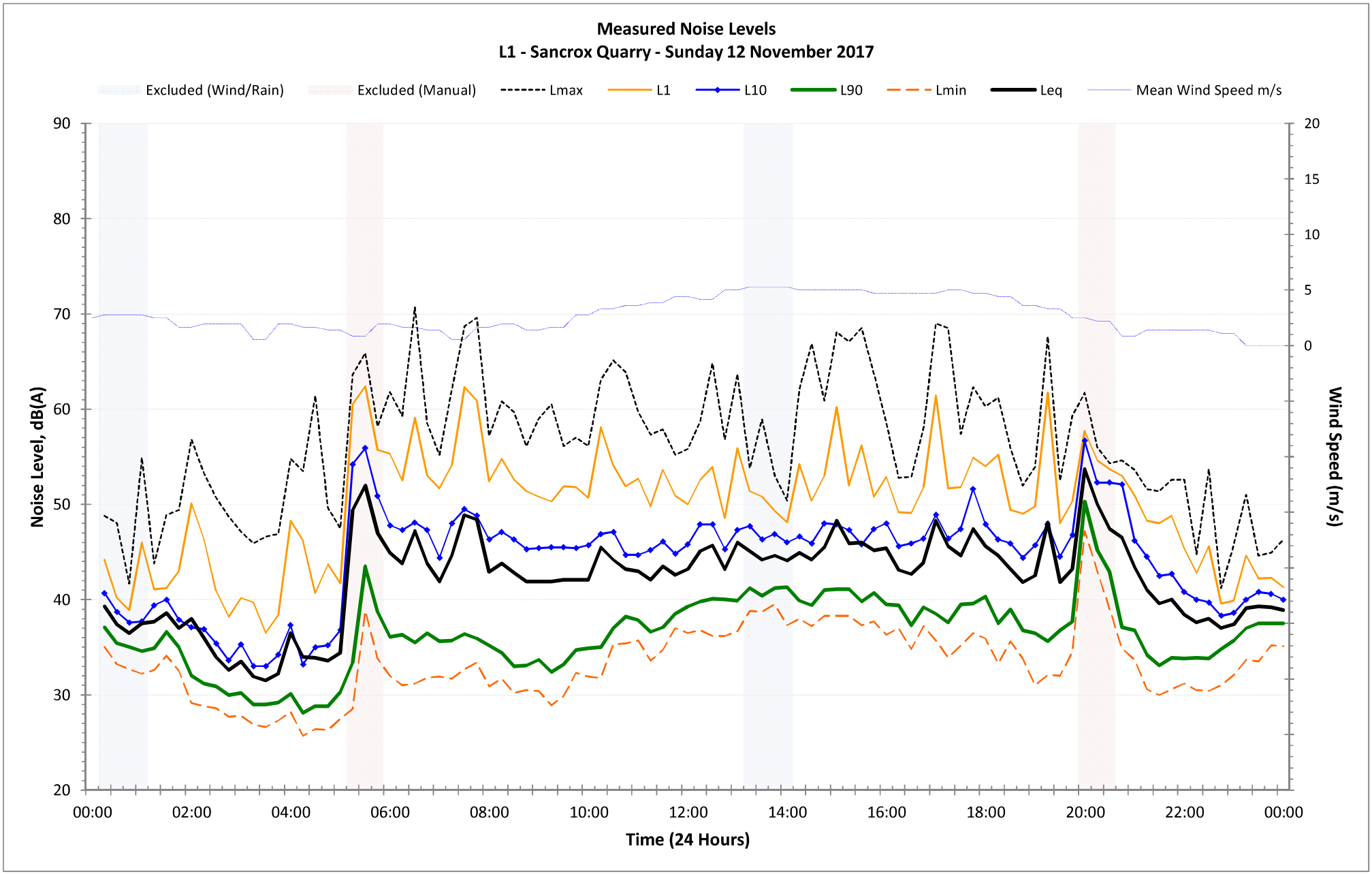

Measured Noise Levels
L1 - Sancrox Quarry - Tuesday 7 November 2017
Excluded (Wind/Rain)
Excluded (Manual)
Lmax
L1
L10
L90
Lmin
Leq
Mean Wind Speed m/s
Noise Level, dB(A)
Wind Speed (m/s)
Time (24 Hours)
90
80
70
60
50
40
30
20
20
15
10
5
0
00:00
02:00
04:00
06:00
08:00
10:00
12:00
14:00
16:00
18:00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

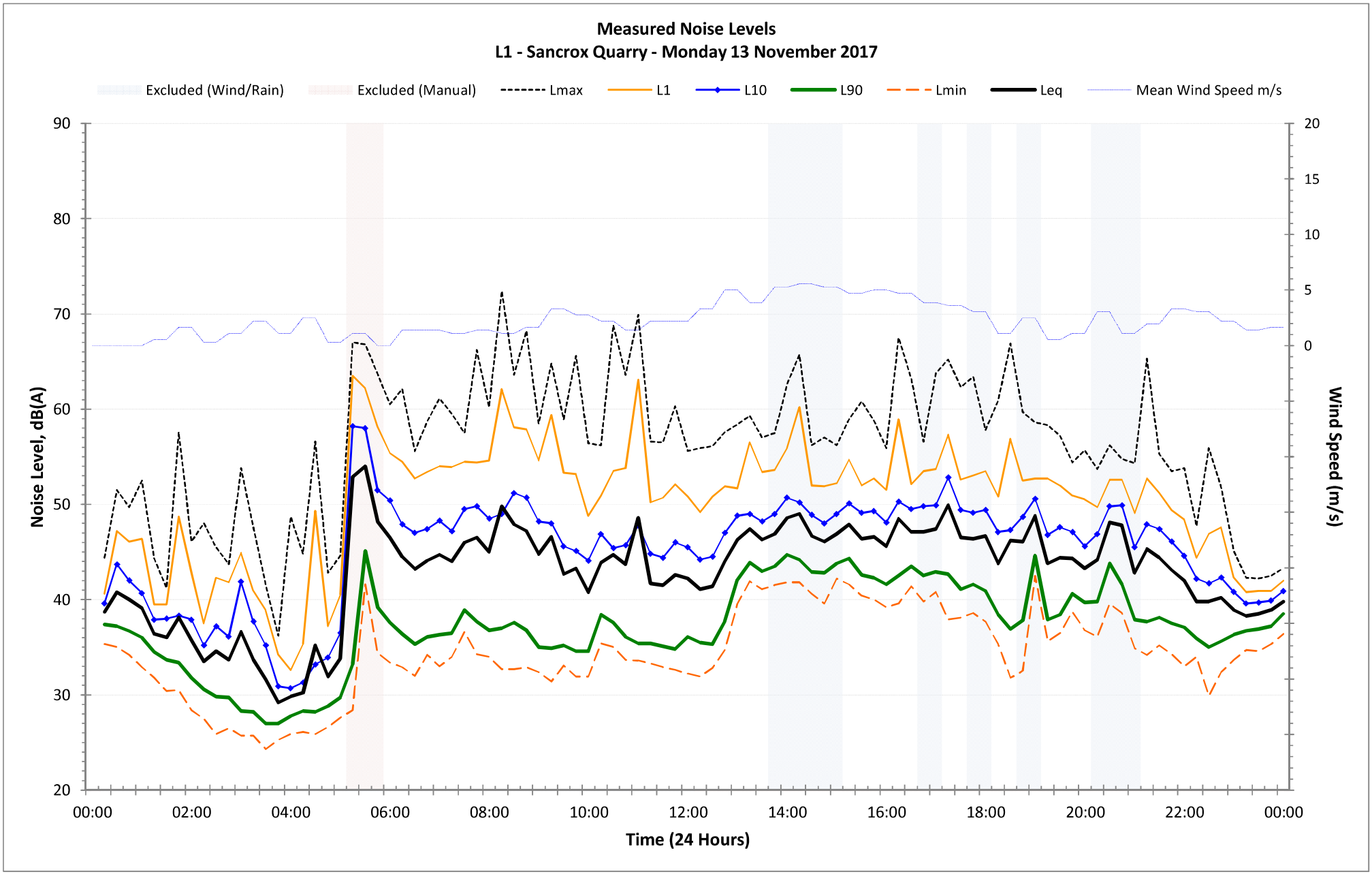

Measured Noise Levels
L1 - Sancrox Quarry - Wednesday 8 November 2017
Excluded (Wind/Rain)
Excluded (Manual)
Lmax
L1
L10
L90
Lmin
Leq
Mean Wind Speed m/s
Noise Level, dB(A)
Wind Speed (m/s)
Time (24 Hours)
90
80
70
60
50
40
30
20
20
15
10
5
0
00:00
02:00
04:00
06:00
08:00
10:00
12:00
14:00
16:00
18:00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

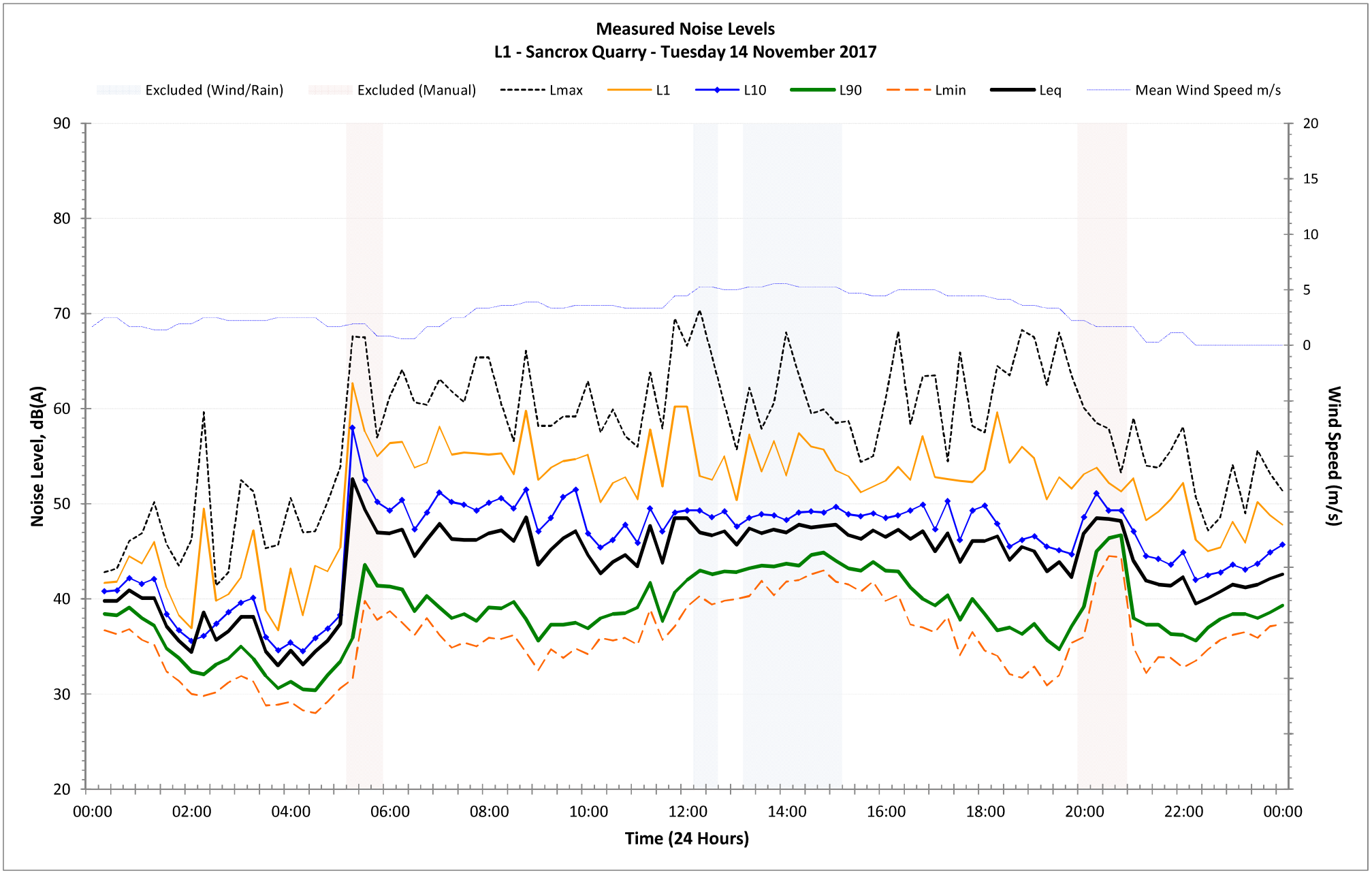

Measured Noise Levels
L1 - Sancrox Quarry - Thursday 9 November 2017
Excluded (Wind/Rain)
Excluded (Manual)
Lmax
L1
L10
L90
Lmin
Leq
Mean Wind Speed m/s
Noise Level, dB(A)
Wind Speed (m/s)
Time (24 Hours)
90
80
70
60
50
40
30
20
20
15
10
5
0
00:00
02:00
04:00
06:00
08:00
10:00
12:00
14:00
16:00
18:00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

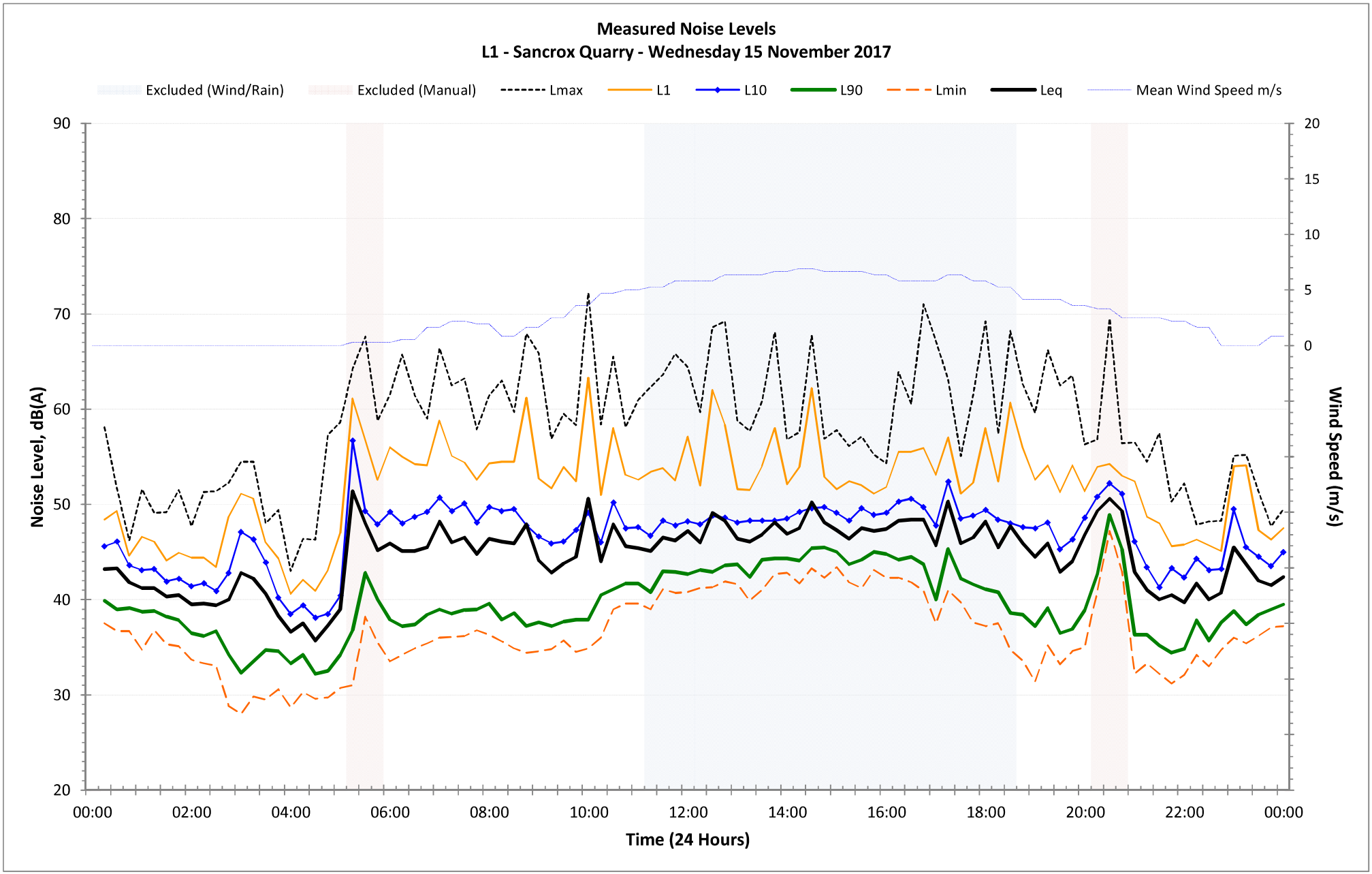

Measured Noise Levels
L1 - Sancrox Quarry - Friday 10 November 2017
Excluded (Wind/Rain)
Excluded (Manual)
Lmax
L1
L10
L90
Lmin
Leq
Mean Wind Speed m/s
Noise Level, dB(A)
Wind Speed (m/s)
Time (24 Hours)
90
80
70
60
50
40
30
20
20
15
10
5
0
00:00
02:00
04:00
06:00
08:00
10:00
12:00
14:00
16:00
18:00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

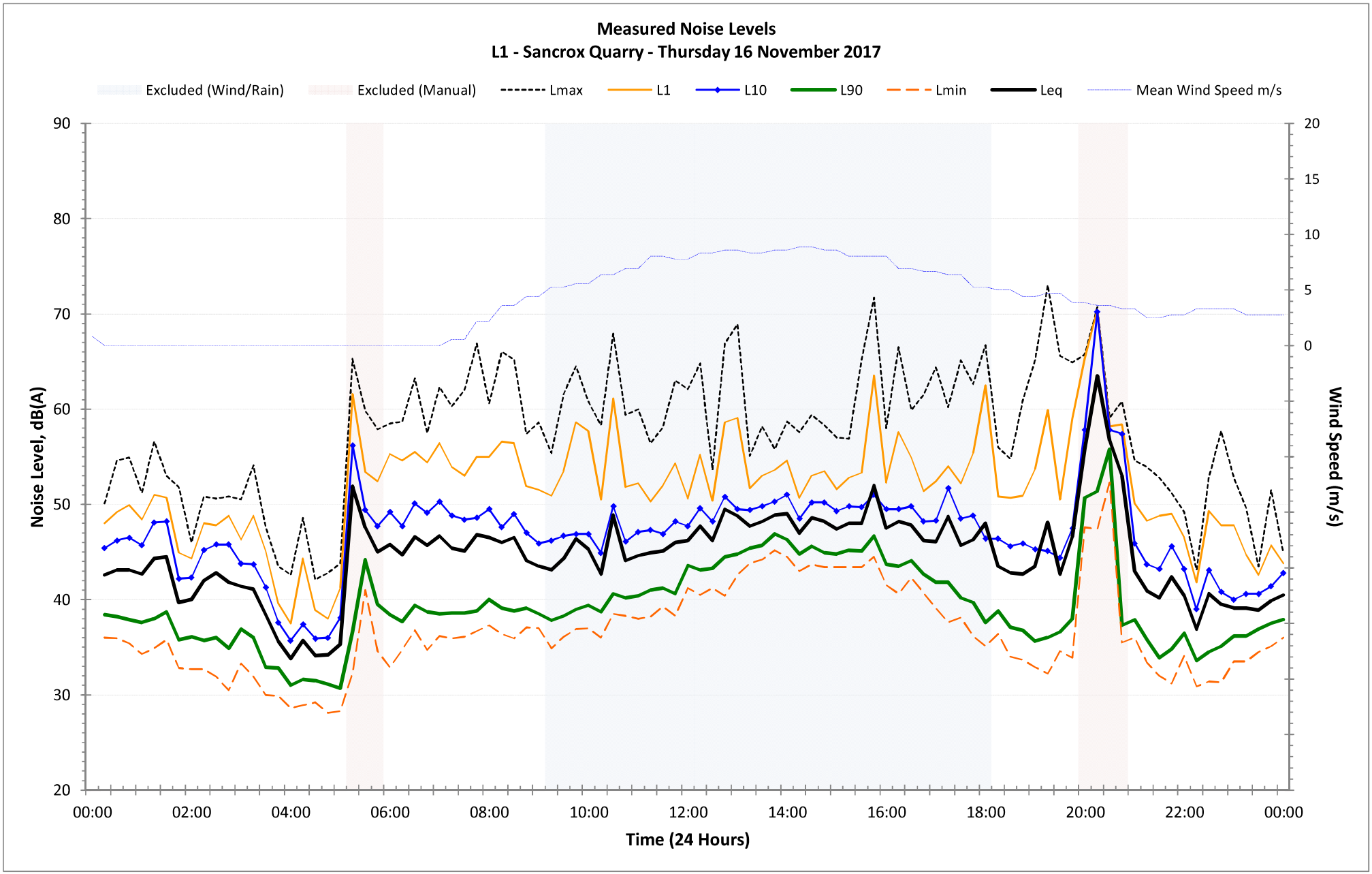

Measured Noise Levels
L1 - Sancrox Quarry - Saturday 11 November 2017
Excluded (Wind/Rain)
Excluded (Manual)
Lmax
L1
L10
L90
Lmin
Leq
Mean Wind Speed m/s
Noise Level, dB(A)
Wind Speed (m/s)
Time (24 Hours)
90
80
70
60
50
40
30
20
20
15
10
5
0
00:00
02:00
04:00
06:00
08:00
10:00
12:00
14:00
16:00
18:00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

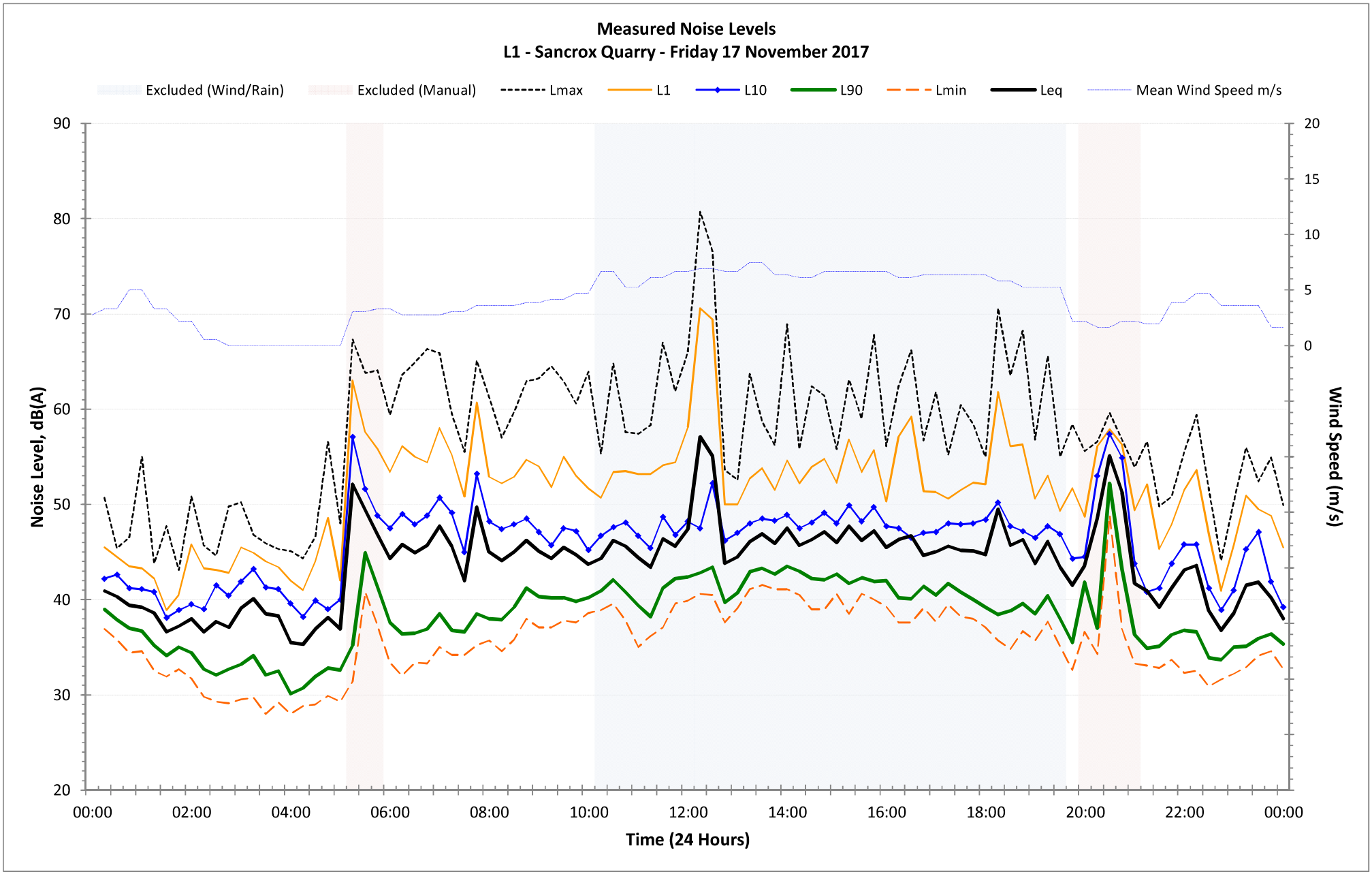

Measured Noise Levels
L1 - Sancrox Quarry - Sunday 12 November 2017
Excluded (Wind/Rain)
Excluded (Manual)
Lmax
L1
L10
L90
Lmin
Leq
Mean Wind Speed m/s
Noise Level, dB(A)
Wind Speed (m/s)
Time (24 Hours)
90
80
70
60
50
40
30
20
20
15
10
5
0
00:00
02:00
04:00
06:00
08:00
10:00
12:00
14:00
16:00
18:00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

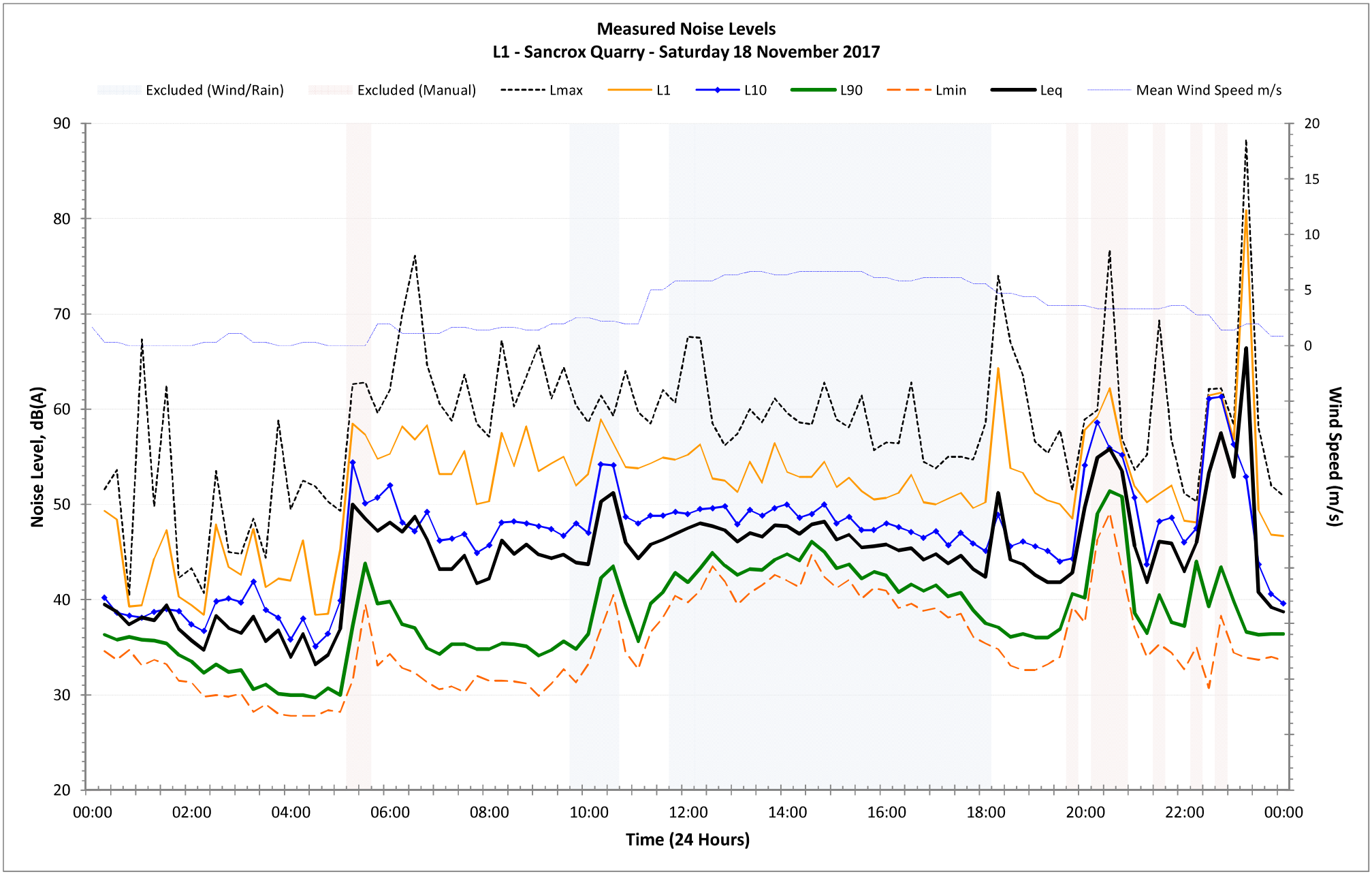

Measured Noise Levels
L1 - Sancrox Quarry - Monday 13 November 2017
Excluded (Wind/Rain)
Excluded (Manual)
Lmax
L1
L10
L90
Lmin
Leq
Mean Wind Speed m/s
Noise Level, dB(A)
Wind Speed (m/s)
Time (24 Hours)
90
80
70
60
50
40
30
20
20
15
10
5
0
00:00
02:00
04:00
06:00
08:00
10:00
12:00
14:00
16:00
18:00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

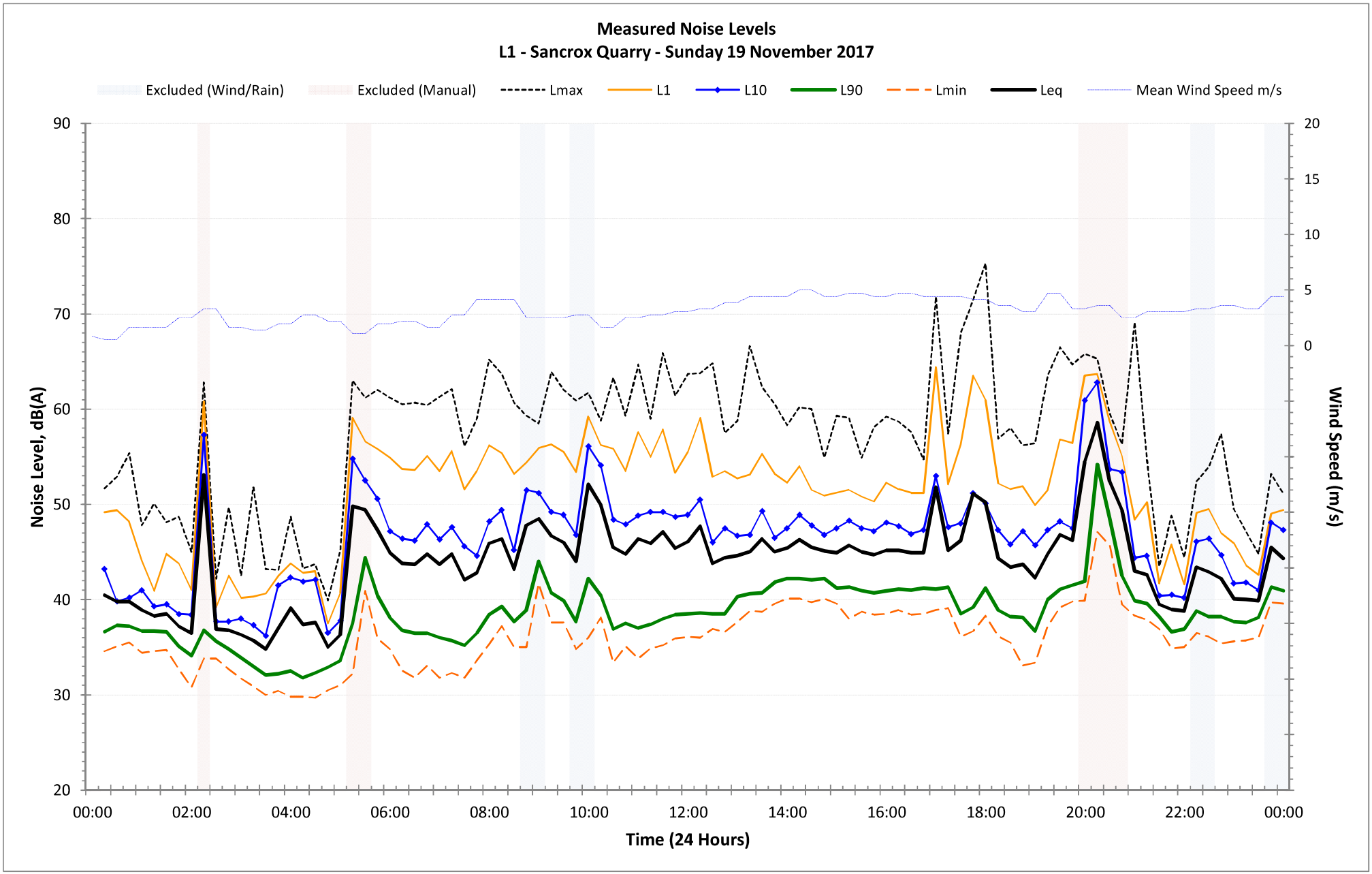

Measured Noise Levels
L1 - Sancrox Quarry - Tuesday 14 November 2017
Excluded (Wind/Rain)
Excluded (Manual)
Lmax
L1
L10
L90
Lmin
Leq
Mean Wind Speed m/s
Noise Level, dB(A)
Wind Speed (m/s)
Time (24 Hours)
90
80
70
60
50
40
30
20
20
15
10
5
0
00:00
02:00
04:00
06:00
08:00
10:00
12:00
14:00
16:00
18:00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

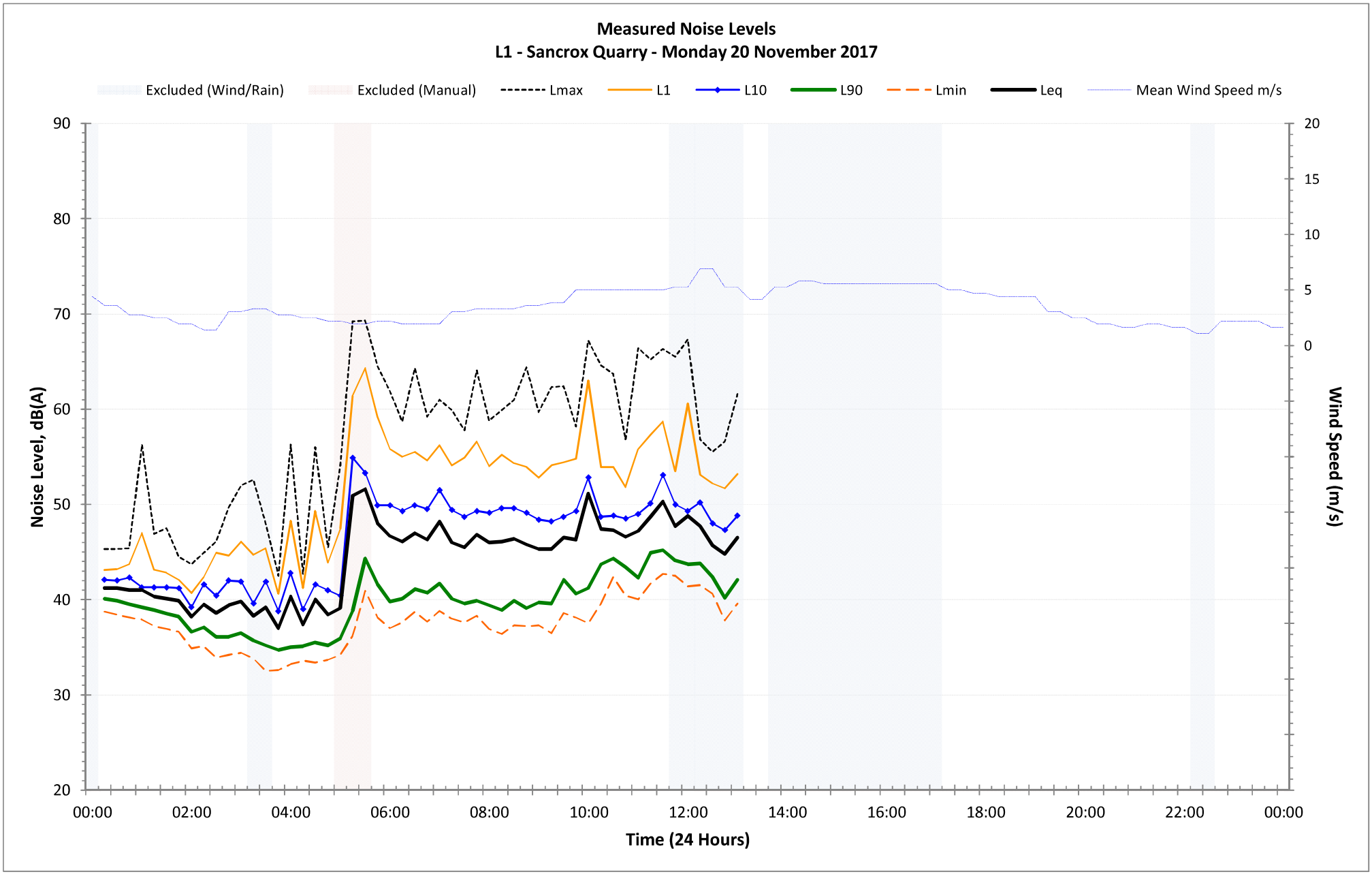

Measured Noise Levels
L1 - Sancrox Quarry - Wednesday 15 November 2017
Excluded (Wind/Rain)
Excluded (Manual)
Lmax
L1
L10
L90
Lmin
Leq
Mean Wind Speed m/s
Noise Level, dB(A)
Wind Speed (m/s)
Time (24 Hours)
90
80
70
60
50
40
30
20
20
15
10
5
0
00:00
02:00
04:00
06:00
08:00
10:00
12:00
14:00
16:00
18:00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

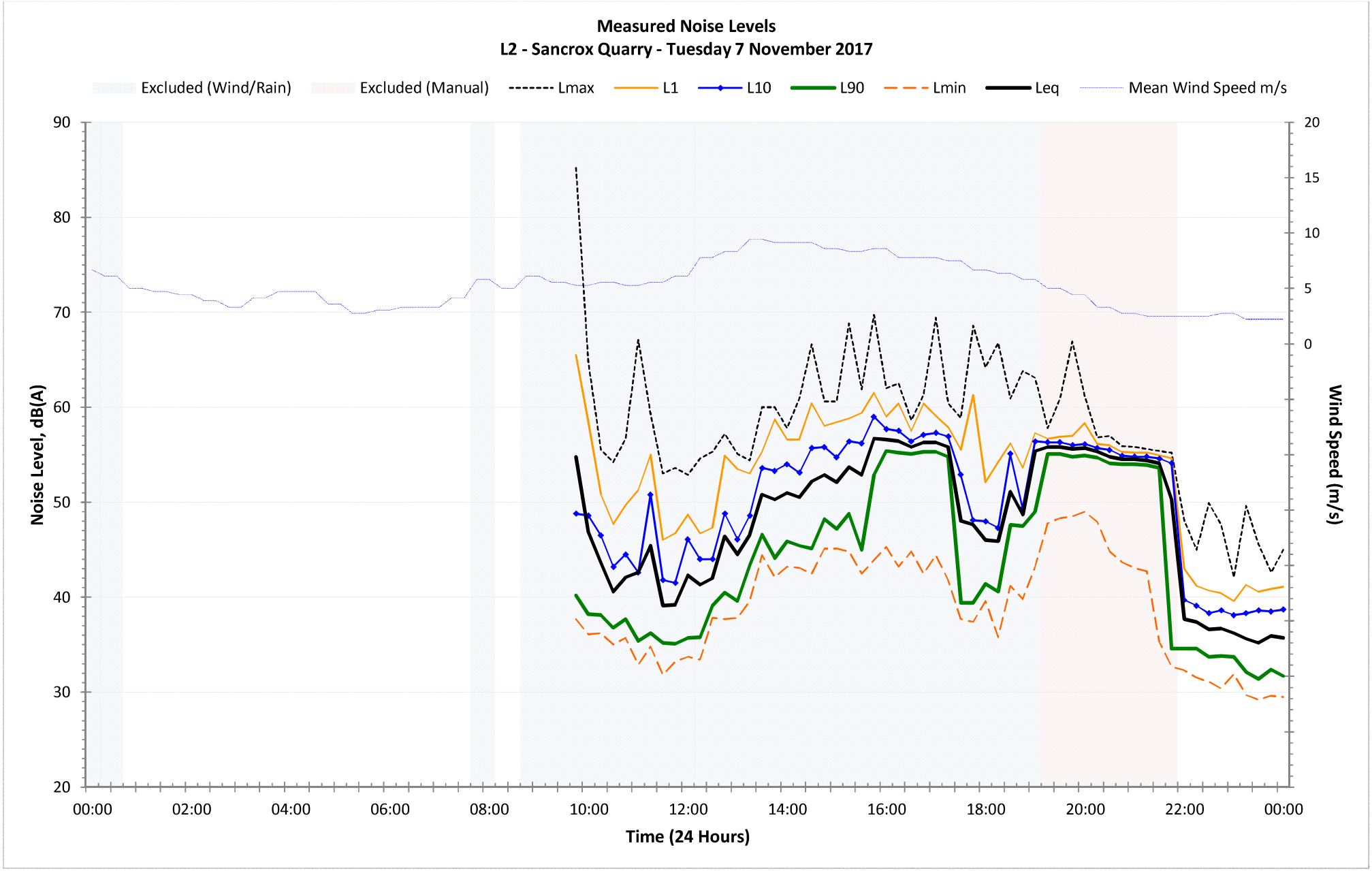

Measured Noise Levels
L1 - Sancrox Quarry - Thursday 16 November 2017
Excluded (Wind/Rain)
Excluded (Manual)
Lmax
L1
L10
L90
Lmin
Leq
Mean Wind Speed m/s
Noise Level, dB(A)
Wind Speed (m/s)
Time (24 Hours)
90
80
70
60
50
40
30
20
20
15
10
5
0
00:00
02:00
04:00
06:00
08:00
10:00
12:00
14:00
16:00
18:00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

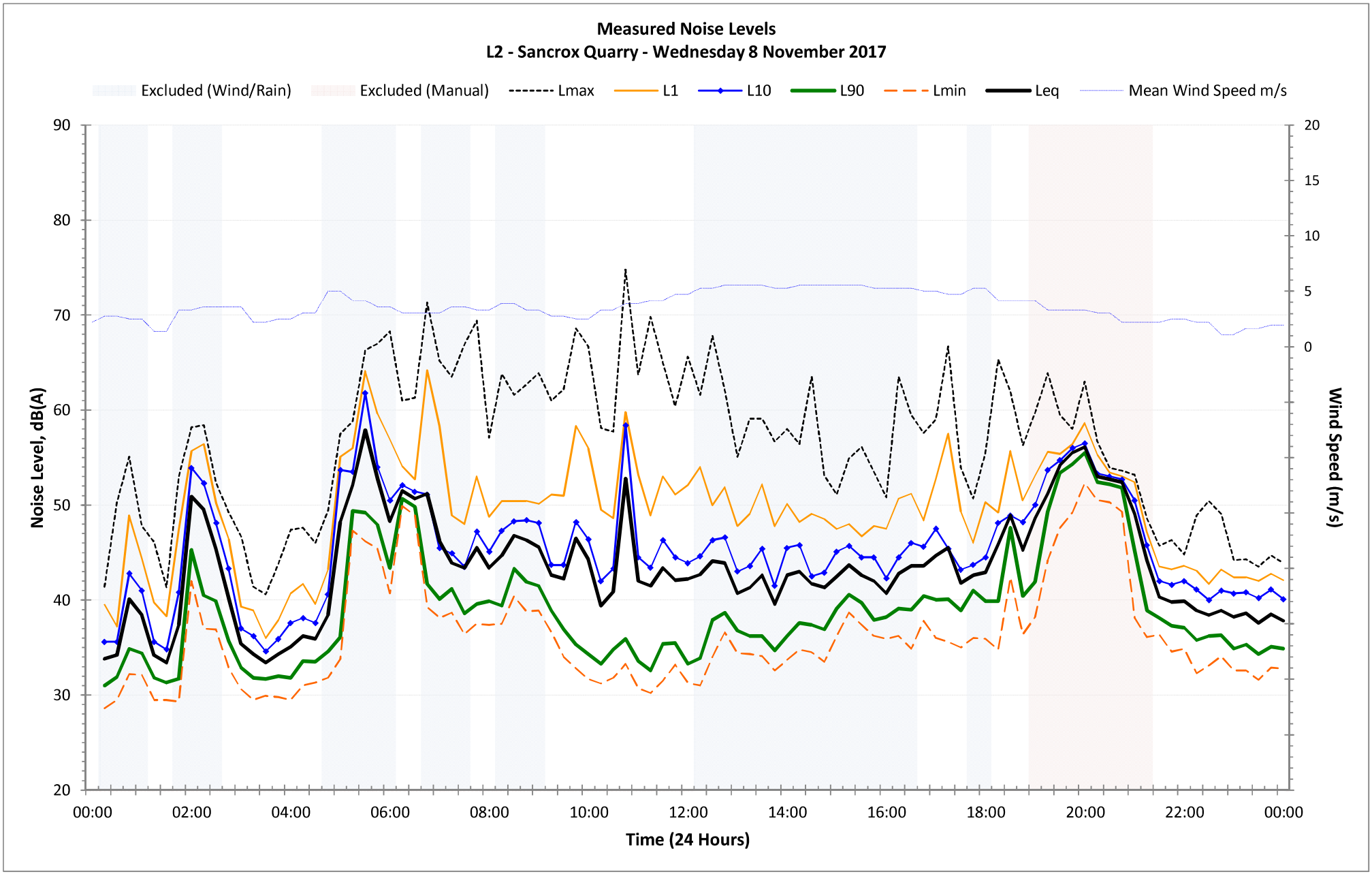

Measured Noise Levels
L1 - Sancrox Quarry - Friday 17 November 2017
Excluded (Wind/Rain)
Excluded (Manual)
Lmax
L1
L10
L90
Lmin
Leq
Mean Wind Speed m/s
Noise Level, dB(A)
Wind Speed (m/s)
Time (24 Hours)
90
80
70
60
50
40
30
20
20
15
10
5
0
00:00
02:00
04:00
06:00
08:00
10:00
12:00
14:00
16:00
18:00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

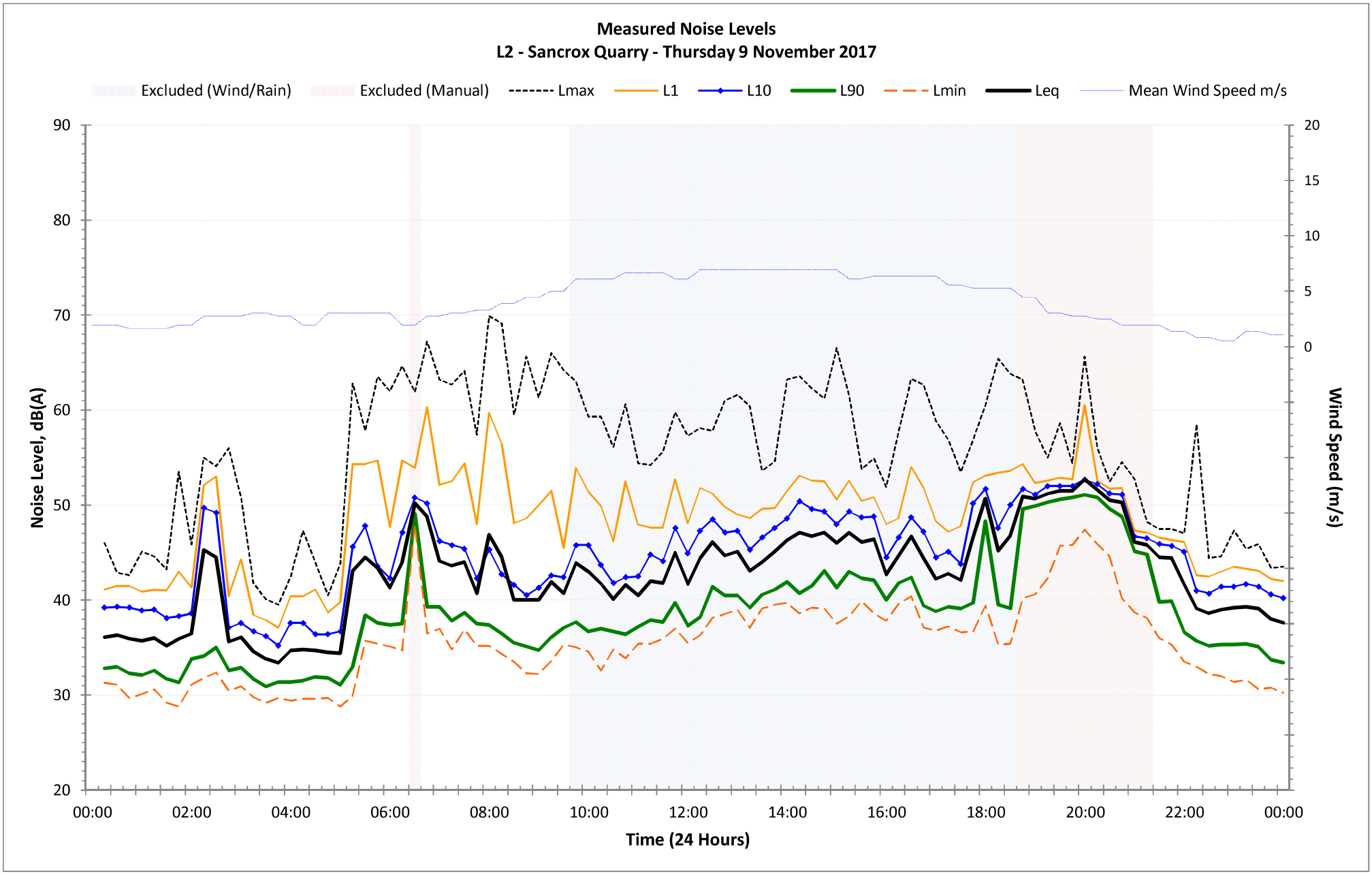

Measured Noise Levels
L1 - Sancrox Quarry - Saturday 18 November 2017
Excluded (Wind/Rain)
Excluded (Manual)
Lmax
L1
L10
L90
Lmin
Leq
Mean Wind Speed m/s
Noise Level, dB(A)
Wind Speed (m/s)
Time (24 Hours)
90
80
70
60
50
40
30
20
20
15
10
5
0
00:00
02:00
04:00
06:00
08:00
10:00
12:00
14:00
16:00
18:00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

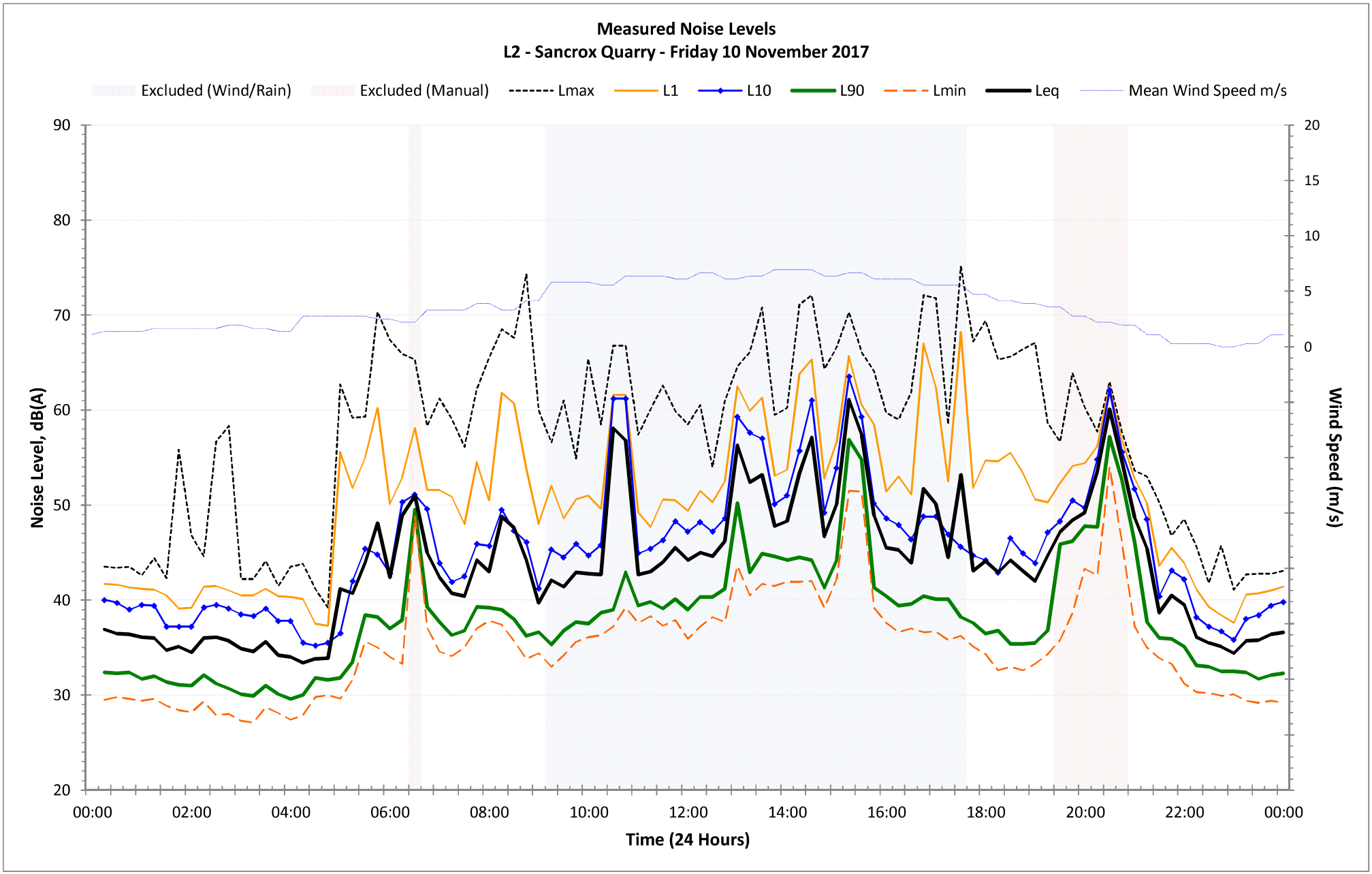

Measured Noise Levels
L1 - Sancrox Quarry - Sunday 19 November 2017
Excluded (Wind/Rain)
Excluded (Manual)
Lmax
L1
L10
L90
Lmin
Leq
Mean Wind Speed m/s
Noise Level, dB(A)
Wind Speed (m/s)
Time (24 Hours)
90
80
70
60
50
40
30
20
20
15
10
5
0
00:00
02:00
04:00
06:00
08:00
10:00
12:00
14:00
16:00
18:00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

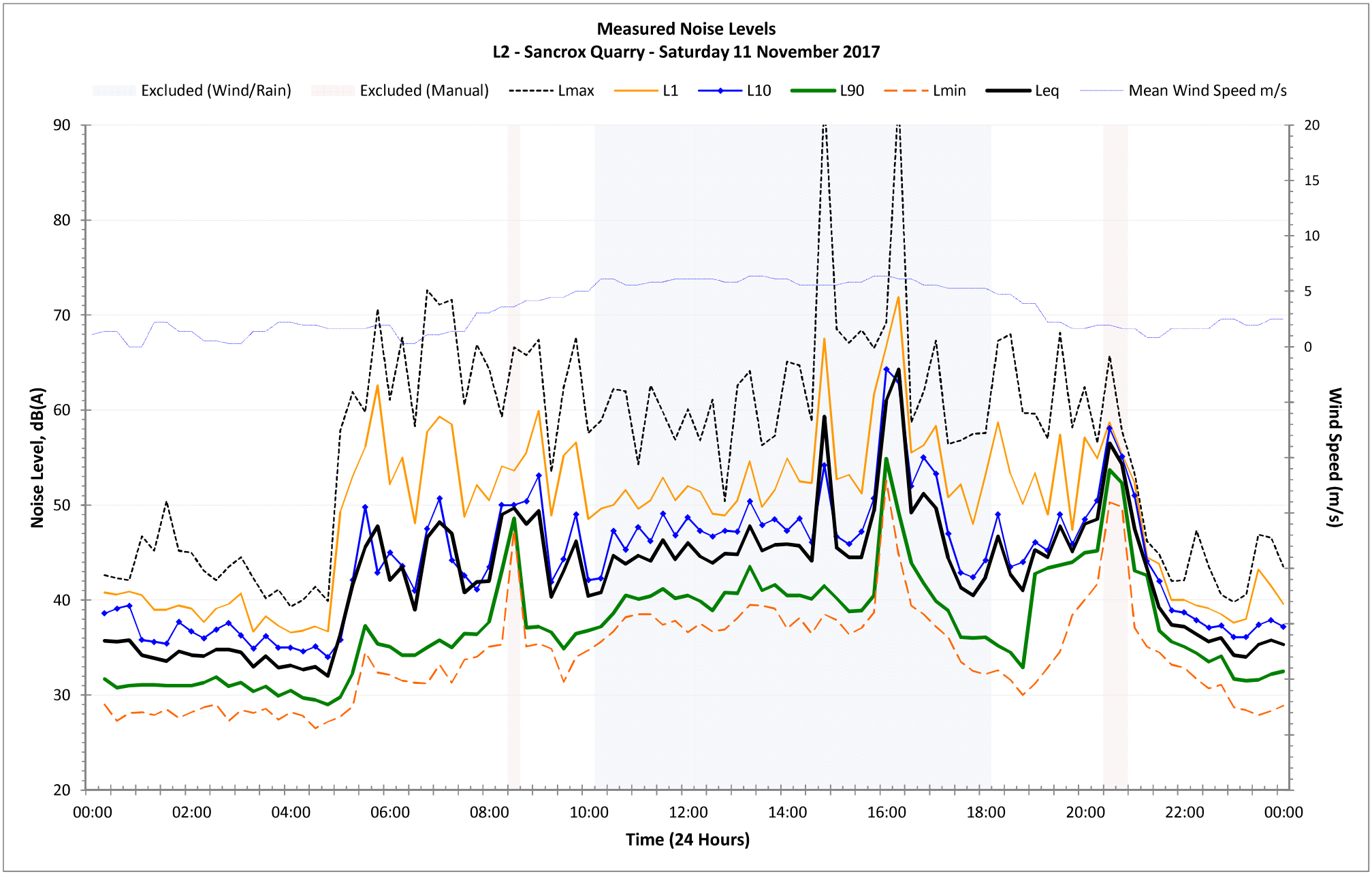

Measured Noise Levels
L1 - Sancrox Quarry - Monday 20 November 2017
Excluded (Wind/Rain)
Excluded (Manual)
Lmax
L1
L10
L90
Lmin
Leq
Mean Wind Speed m/s
Noise Level, dB(A)
Wind Speed (m/s)
Time (24 Hours)
90
80
70
60
50
40
30
20
20
15
10
5
0
00:00
02:00
04:00
06:00
08:00
10:00
12:00
14:00
16:00
18:00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

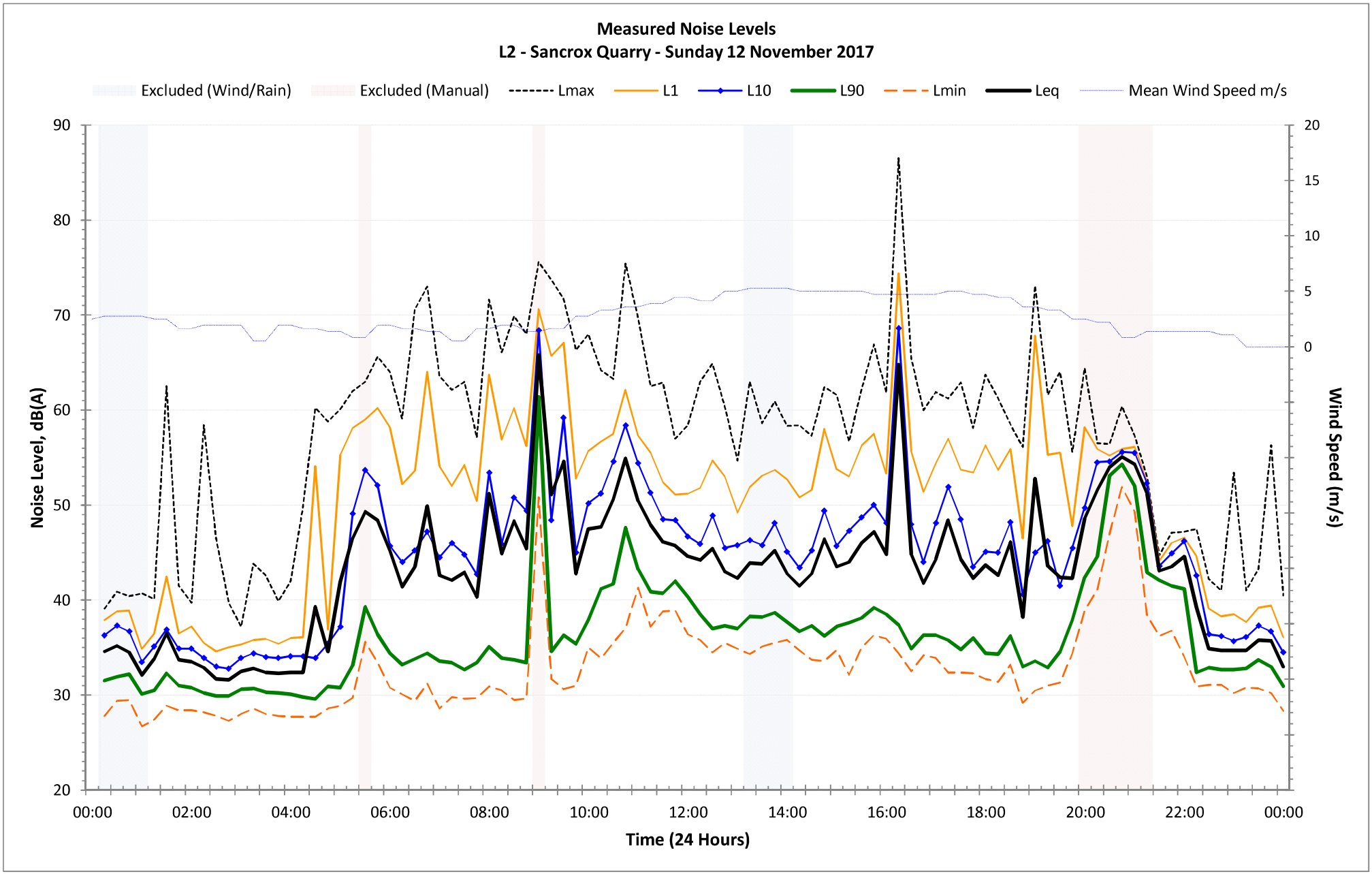

Measured Noise Levels
L2 - Sancrox Quarry - Tuesday 7 November 2017
Excluded (Wind/Rain)
Excluded (Manual)
Lmax
L1
L10
L90
Lmin
Leq
Mean Wind Speed m/s
Noise Level, dB(A)
Wind Speed (m/s)
Time (24 Hours)
90
80
70
60
50
40
30
20
20
15
10
5
0
00:00
02:00
04:00
06:00
08:00
10:00
12:00
14:00
16:00
18:00
20:00
22:00
00:00

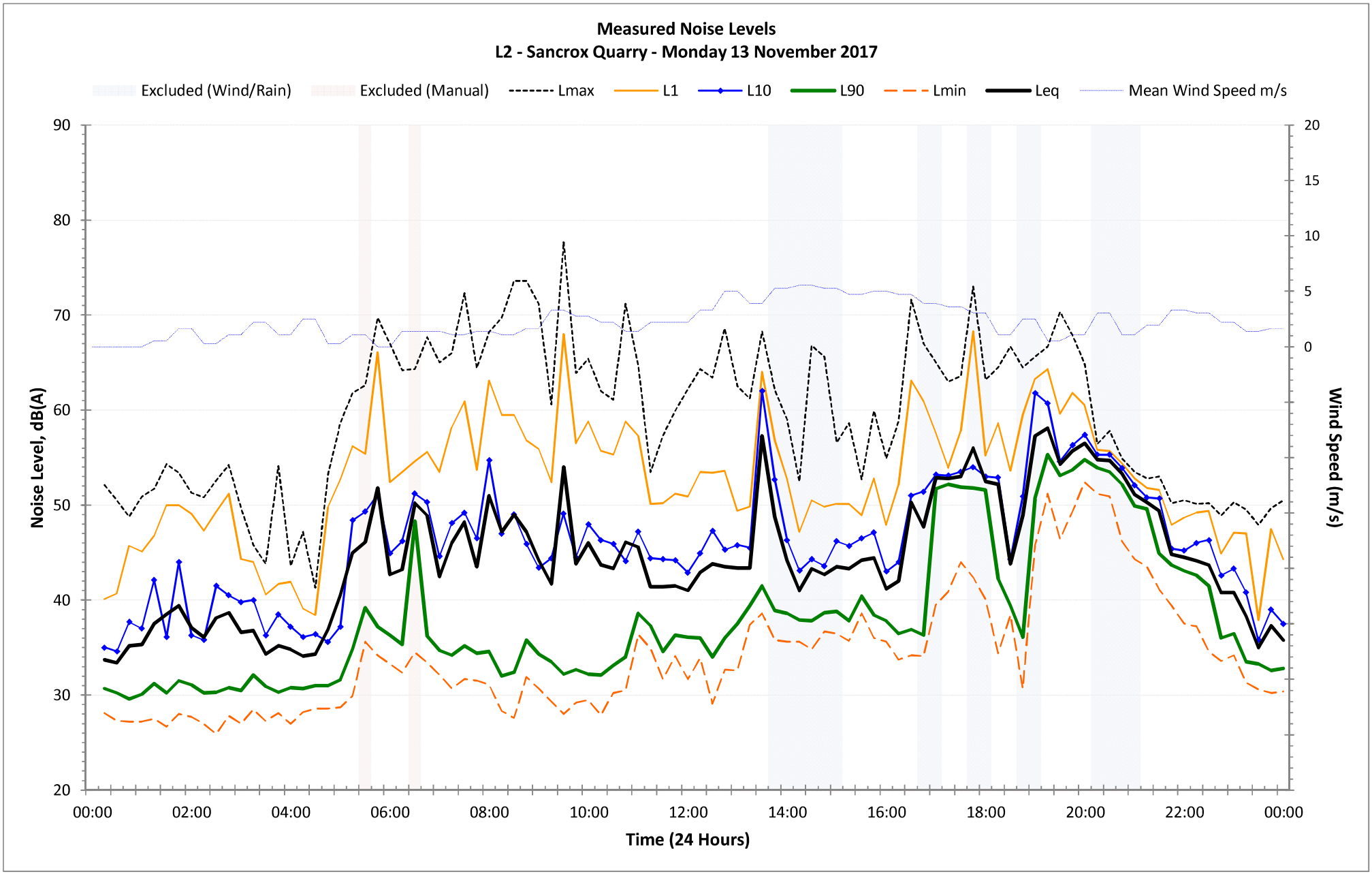

Measured Noise Levels
L2 - Sancrox Quarry - Wednesday 8 November 2017
Excluded (Wind/Rain)
Excluded (Manual)
Lmax
L1
L10
L90
Lmin
Leq
Mean Wind Speed m/s
Noise Level, dB(A)
Wind Speed (m/s)
Time (24 Hours)
90
80
70
60
50
40
30
20
20
15
10
5
0
00:00
02:00
04:00
06:00
08:00
10:00
12:00
14:00
16:00
18:00
20:00
22:00
00:00

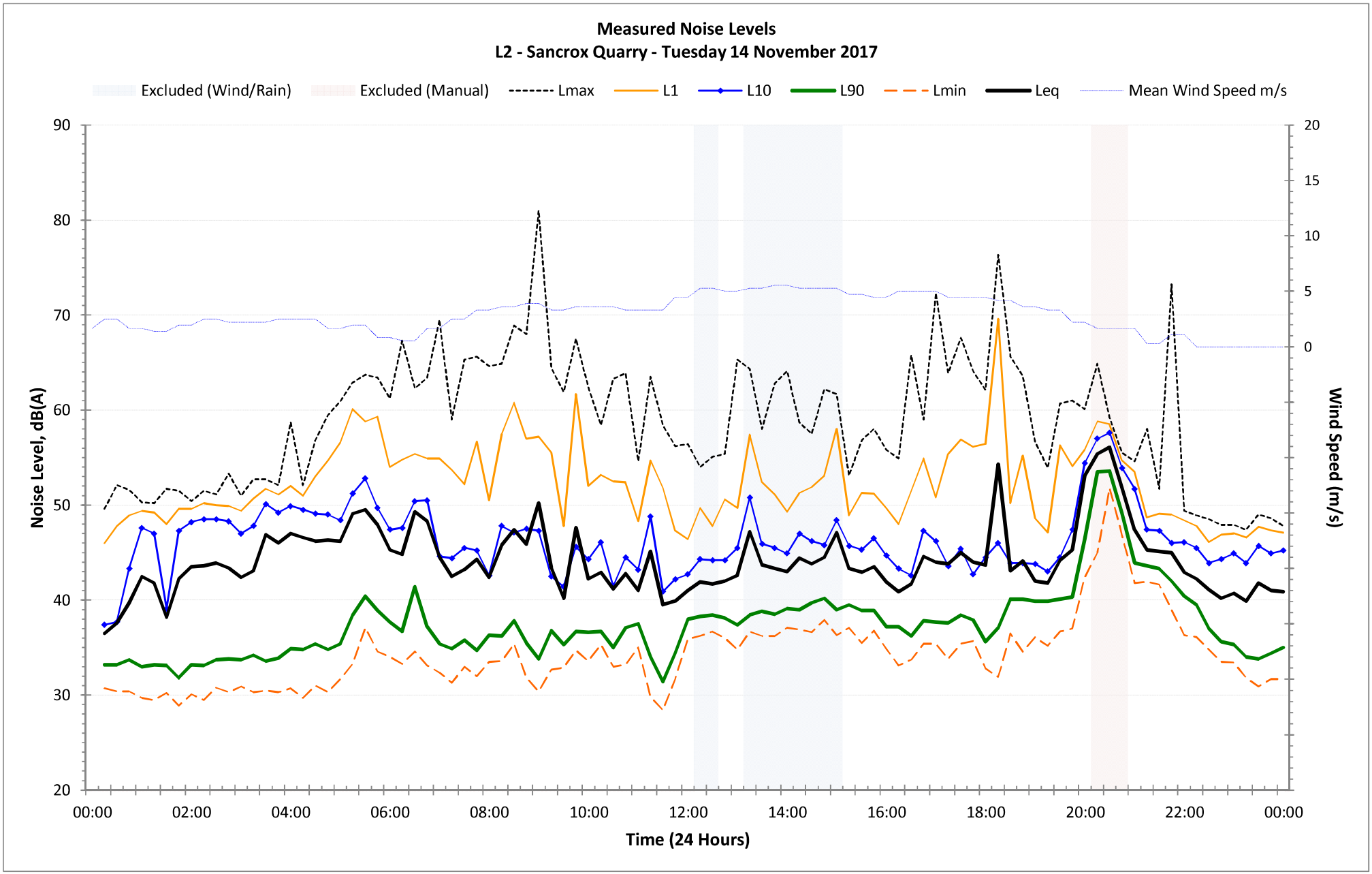

Measured Noise Levels
L2 - Sancrox Quarry - Thursday 9 November 2017
Excluded (Wind/Rain)
Excluded (Manual)
Lmax
L1
L10
L90
Lmin
Leq
Mean Wind Speed m/s
Noise Level, dB(A)
Wind Speed (m/s)
Time (24 Hours)
90
80
70
60
50
40
30
20
20
15
10
5
0
00:00
02:00
04:00
06:00
08:00
10:00
12:00
14:00
16:00
18:00
20:00
22:00
00:00

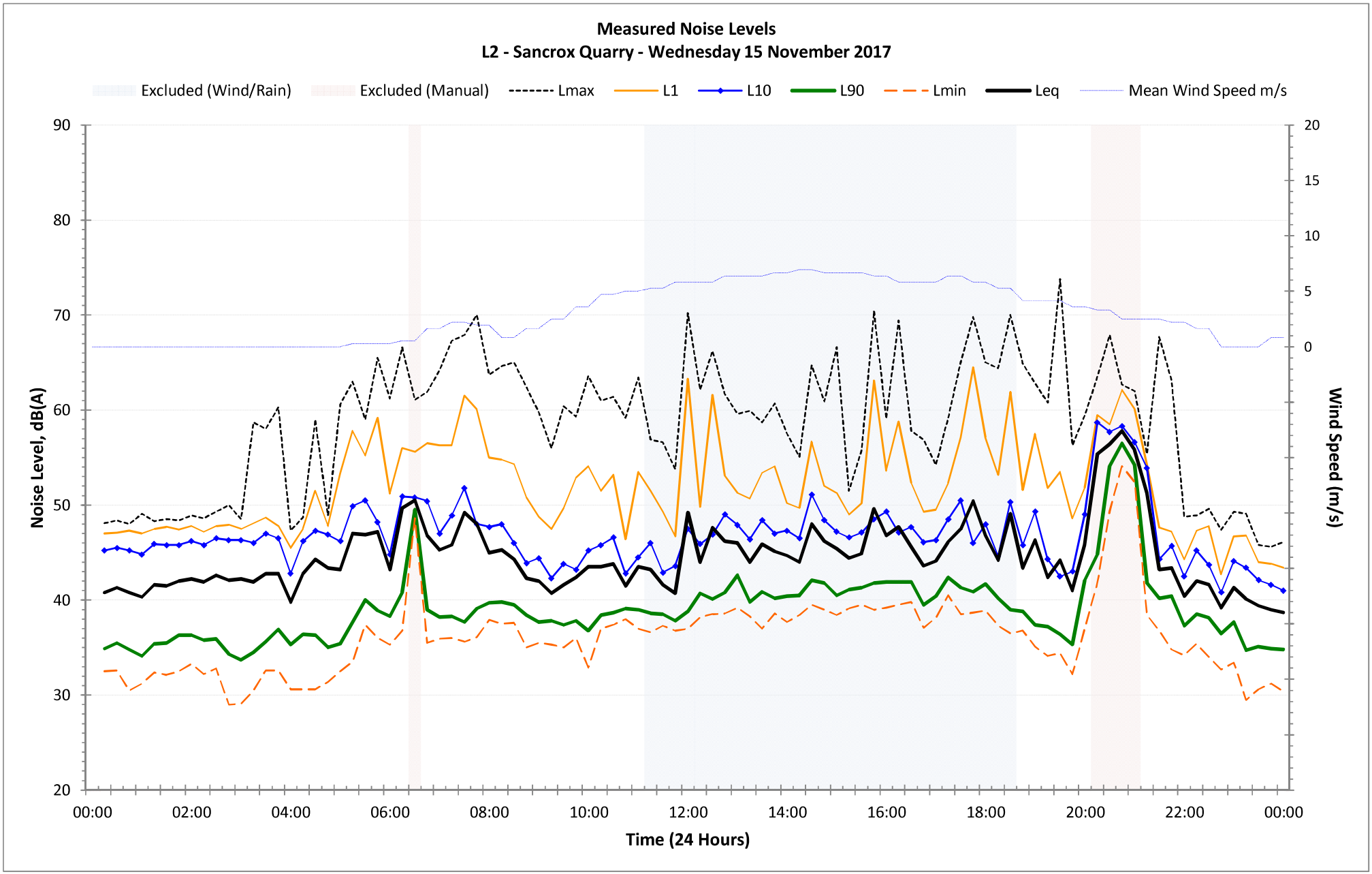

Measured Noise Levels
L2 - Sancrox Quarry - Friday 10 November 2017
Excluded (Wind/Rain)
Excluded (Manual)
Lmax
L1
L10
L90
Lmin
Leq
Mean Wind Speed m/s
Noise Level, dB(A)
Wind Speed (m/s)
Time (24 Hours)
90
80
70
60
50
40
30
20
20
15
10
5
0
00:00
02:00
04:00
06:00
08:00
10:00
12:00
14:00
16:00
18:00
20:00
22:00
00:00

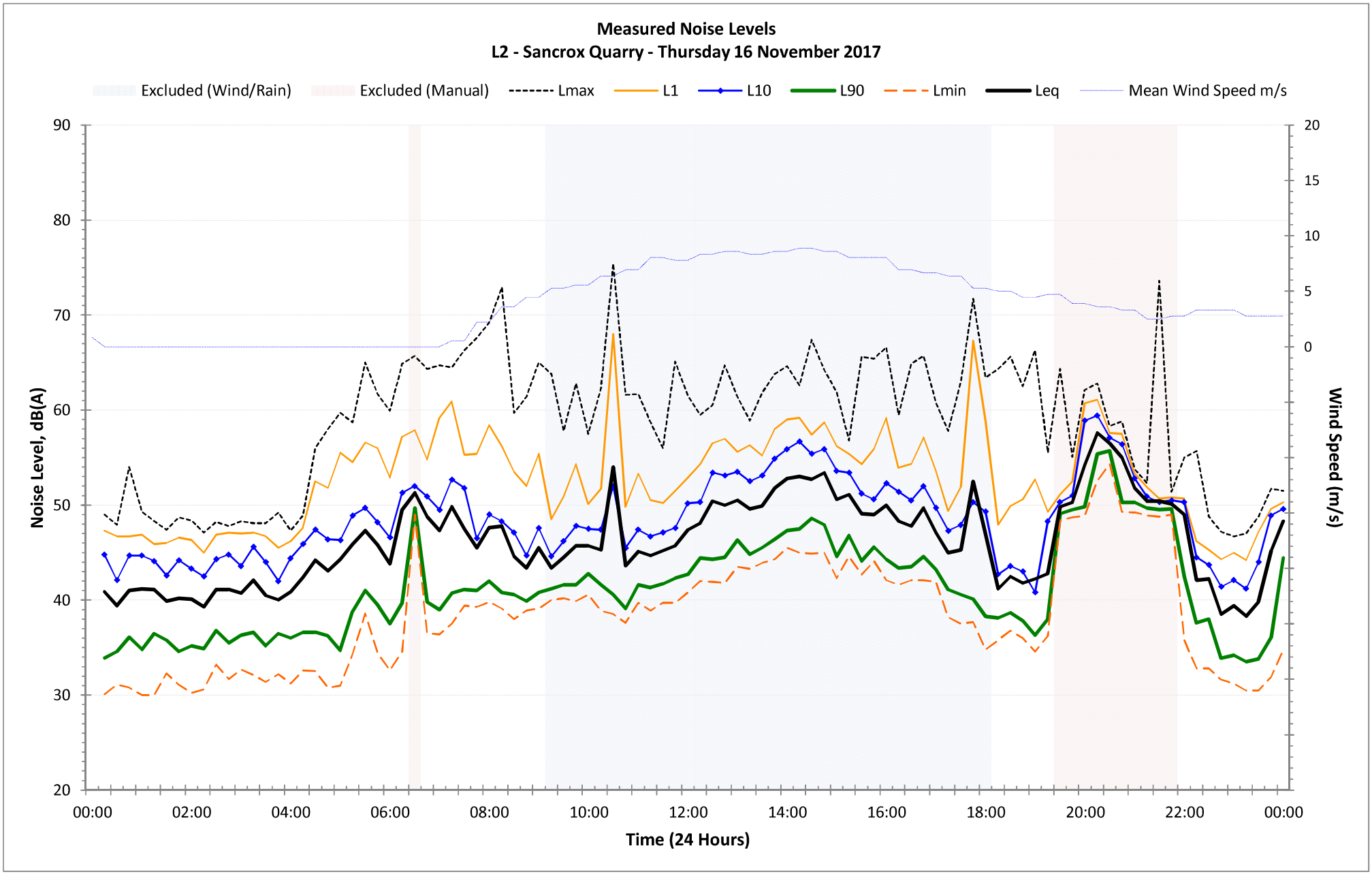

Measured Noise Levels
L2 - Sancrox Quarry - Saturday 11 November 2017
Excluded (Wind/Rain)
Excluded (Manual)
Lmax
L1
L10
L90
Lmin
Leq
Mean Wind Speed m/s
Noise Level, dB(A)
Wind Speed (m/s)
Time (24 Hours)
90
80
70
60
50
40
30
20
20
15
10
5
0
00:00
02:00
04:00
06:00
08:00
10:00
12:00
14:00
16:00
18:00
20:00
22:00
00:00

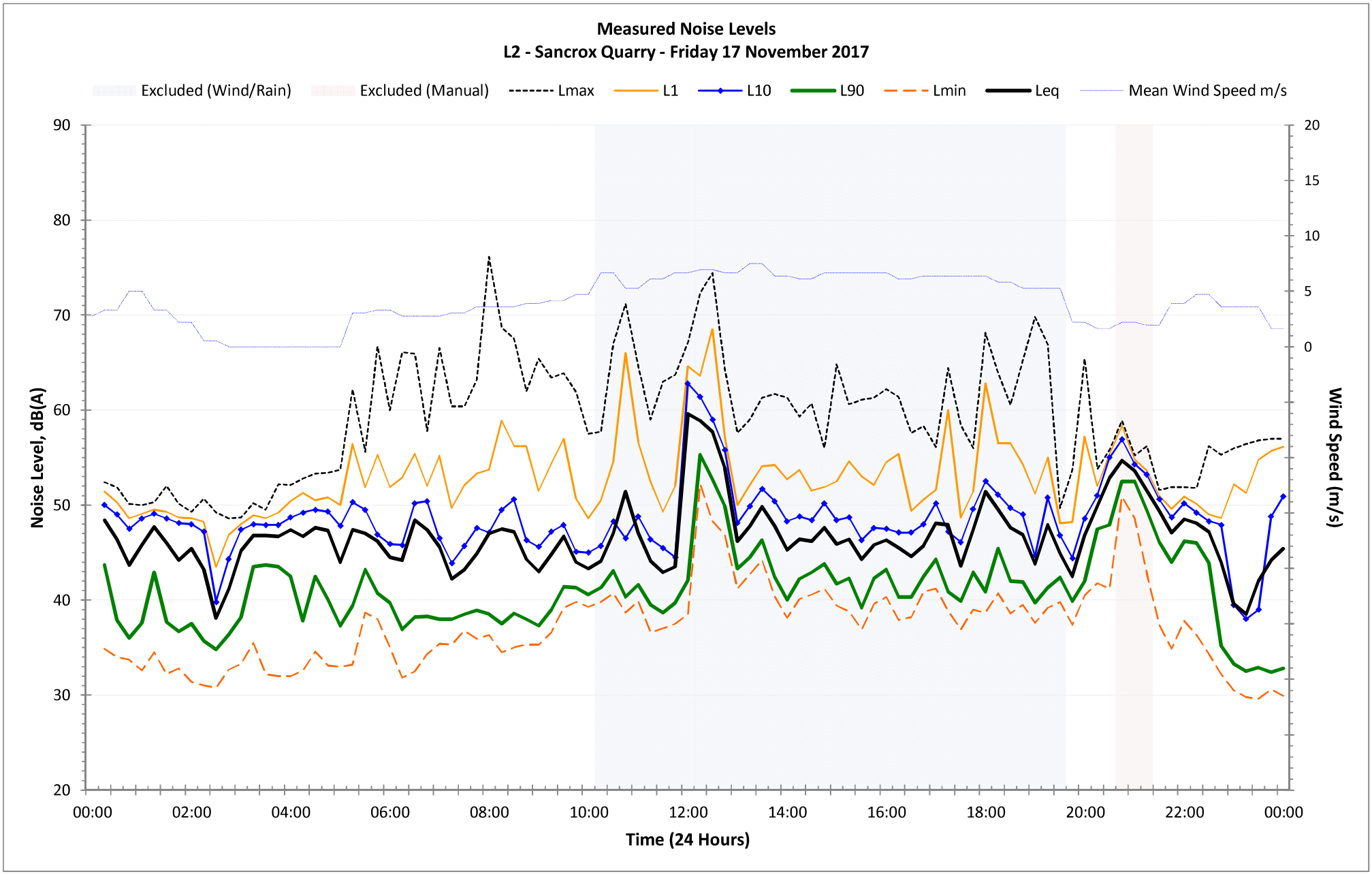

Measured Noise Levels
L2 - Sancrox Quarry - Sunday 12 November 2017
Excluded (Wind/Rain)
Excluded (Manual)
Lmax
L1
L10
L90
Lmin
Leq
Mean Wind Speed m/s
Noise Level, dB(A)
Wind Speed (m/s)
Time (24 Hours)
90
80
70
60
50
40
30
20
20
15
10
5
0
00:00
02:00
04:00
06:00
08:00
10:00
12:00
14:00
16:00
18:00
20:00
22:00
00:00

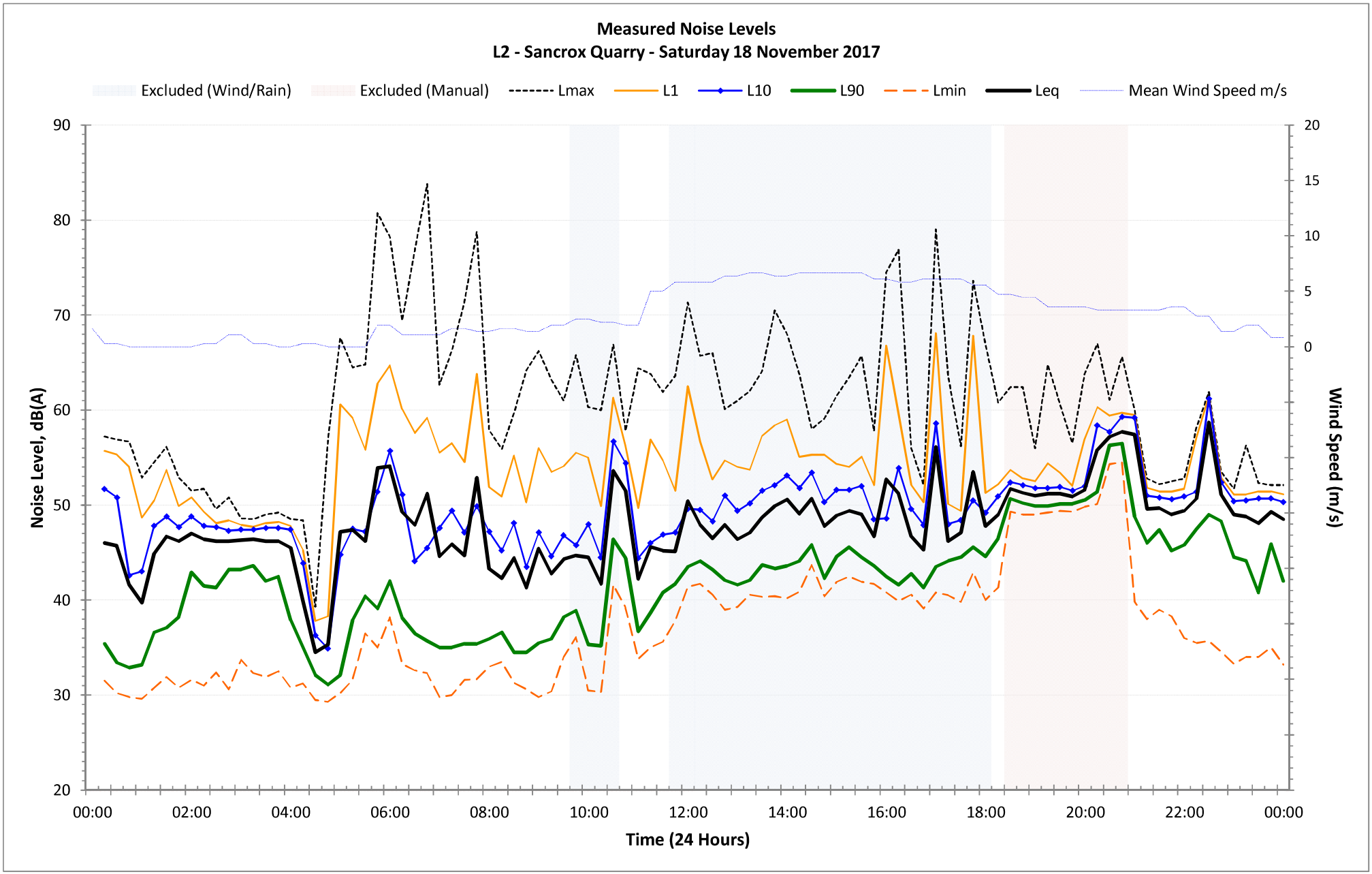

Measured Noise Levels
L2 - Sancrox Quarry - Monday 13 November 2017
Excluded (Wind/Rain)
Excluded (Manual)
Lmax
L1
L10
L90
Lmin
Leq
Mean Wind Speed m/s
Noise Level, dB(A)
Wind Speed (m/s)
Time (24 Hours)
90
80
70
60
50
40
30
20
20
15
10
5
0
00:00
02:00
04:00
06:00
08:00
10:00
12:00
14:00
16:00
18:00
20:00
22:00
00:00

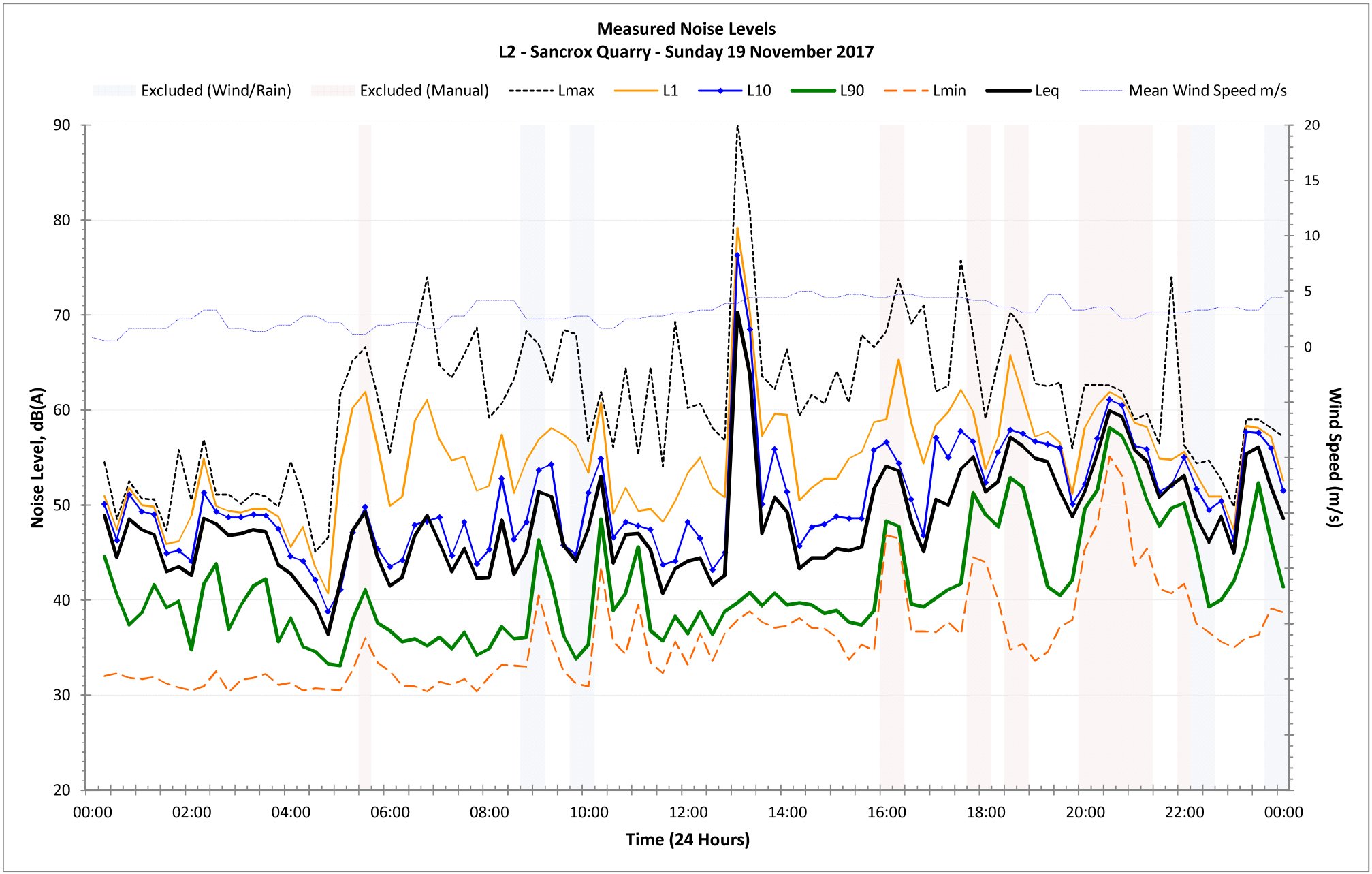

Measured Noise Levels
L2 - Sancrox Quarry - Tuesday 14 November 2017
Excluded (Wind/Rain)
Excluded (Manual)
Lmax
L1
L10
L90
Lmin
Leq
Mean Wind Speed m/s
Noise Level, dB(A)
Wind Speed (m/s)
Time (24 Hours)
90
80
70
60
50
40
30
20
20
15
10
5
0
00:00
02:00
04:00
06:00
08:00
10:00
12:00
14:00
16:00
18:00
20:00
22:00
00:00

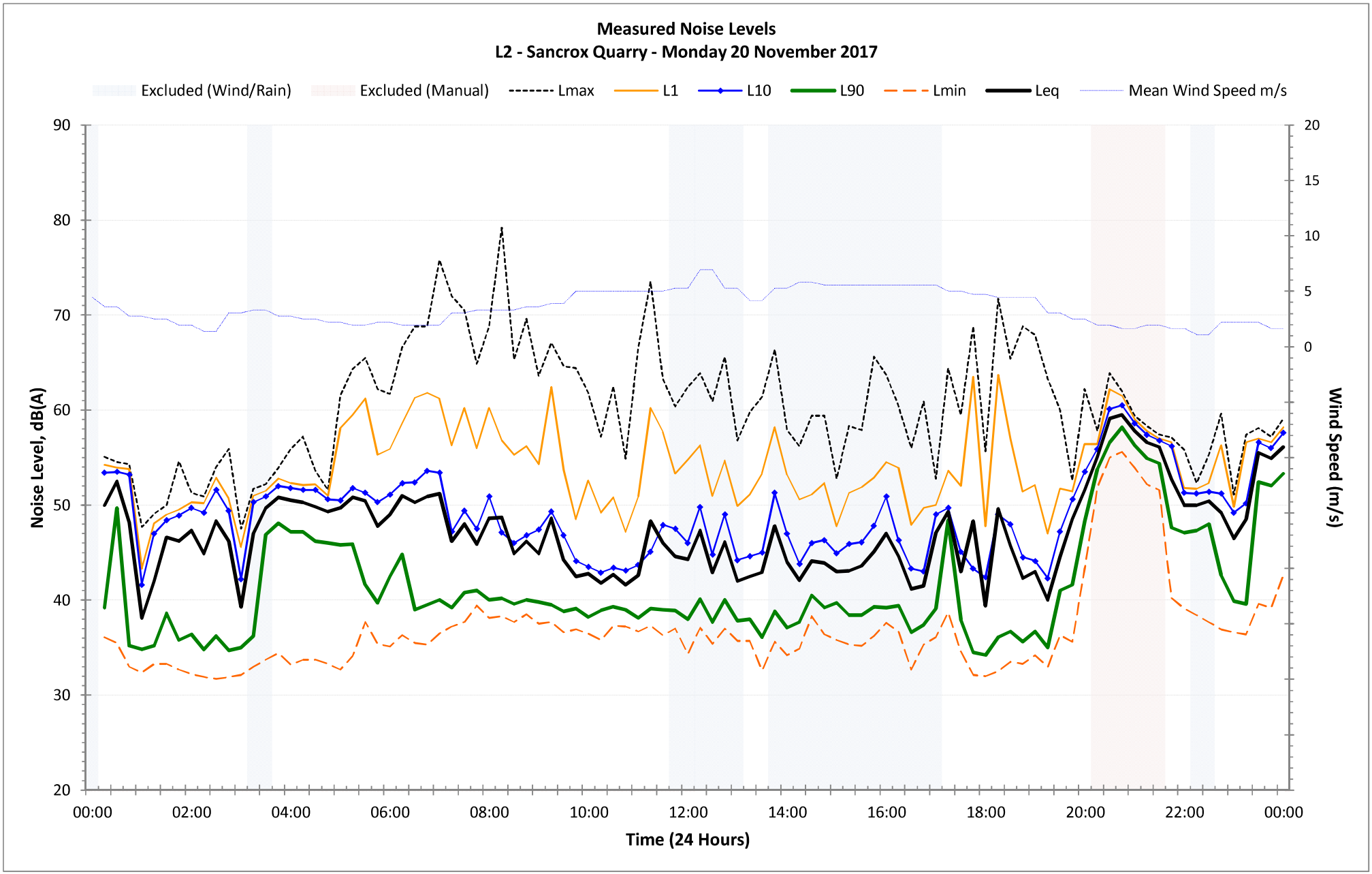

Measured Noise Levels
L2 - Sancrox Quarry - Wednesday 15 November 2017
Excluded (Wind/Rain)
Excluded (Manual)
Lmax
L1
L10
L90
Lmin
Leq
Mean Wind Speed m/s
Noise Level, dB(A)
Wind Speed (m/s)
Time (24 Hours)
90
80
70
60
50
40
30
20
20
15
10
5
0
00:00
02:00
04:00
06:00
08:00
10:00
12:00
14:00
16:00
18:00
20:00
22:00
00:00

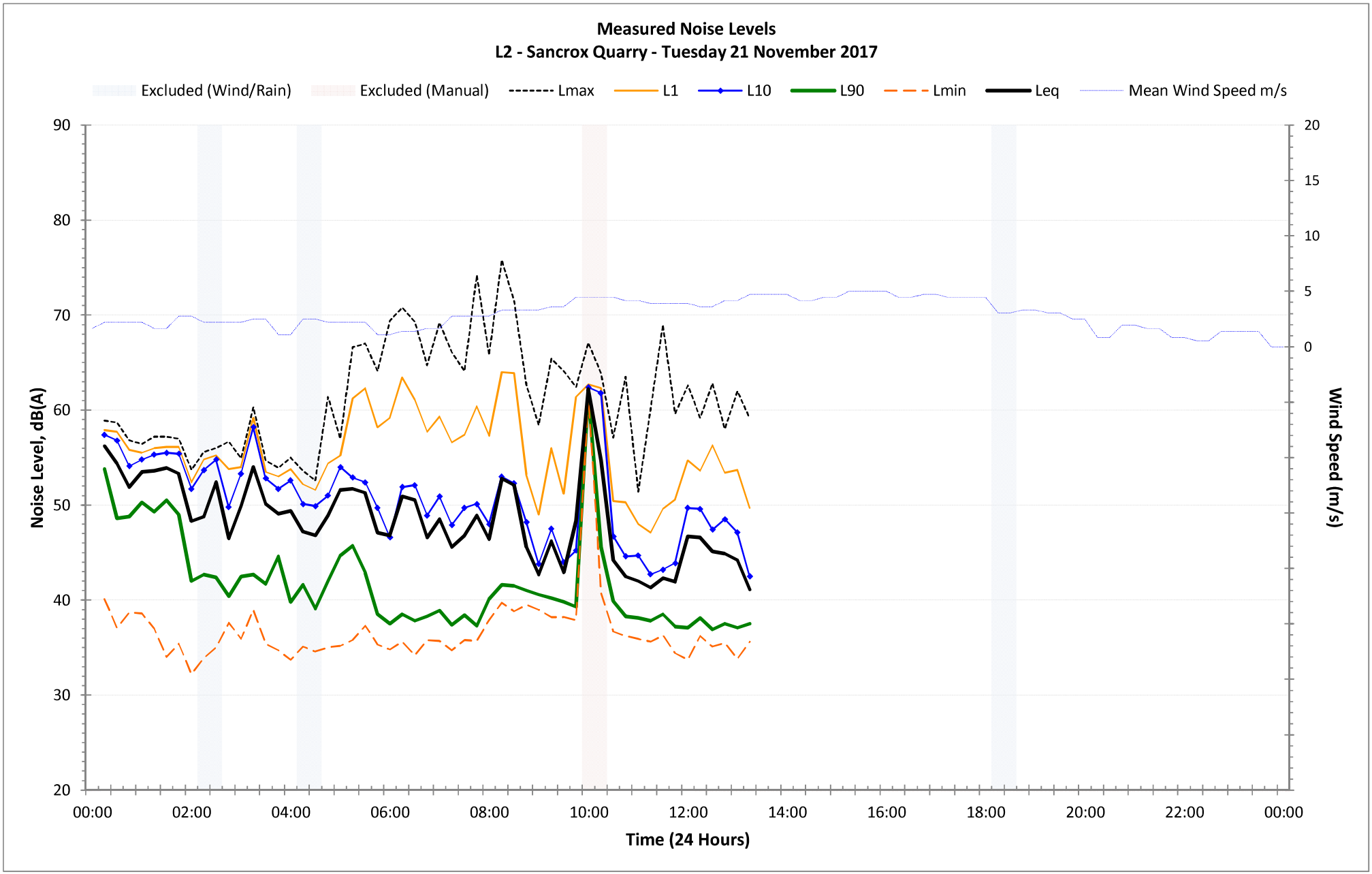

Measured Noise Levels
L2 - Sancrox Quarry - Thursday 16 November 2017
Excluded (Wind/Rain)
Excluded (Manual)
Lmax
L1
L10
L90
Lmin
Leq
Mean Wind Speed m/s
Noise Level, dB(A)
Wind Speed (m/s)
Time (24 Hours)
90
80
70
60
50
40
30
20
20
15
10
5
0
00:00
02:00
04:00
06:00
08:00
10:00
12:00
14:00
16:00
18:00
20:00
22:00
00:00

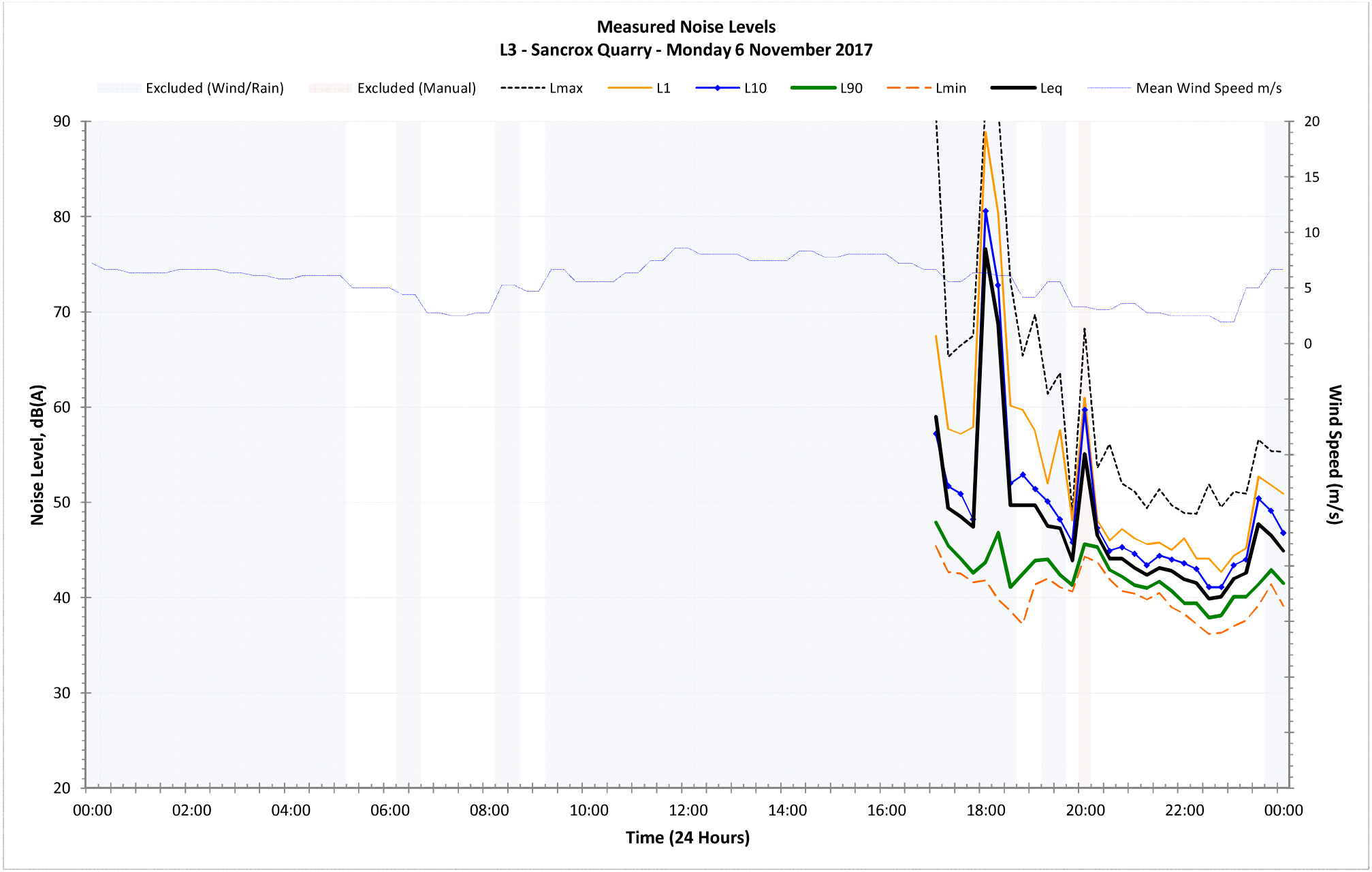

Measured Noise Levels
L2 - Sancrox Quarry - Friday 17 November 2017
Excluded (Wind/Rain)
Excluded (Manual)
Lmax
L1
L10
L90
Lmin
Leq
Mean Wind Speed m/s
Noise Level, dB(A)
Wind Speed (m/s)
Time (24 Hours)
90
80
70
60
50
40
30
20
20
15
10
5
0
00:00
02:00
04:00
06:00
08:00
10:00
12:00
14:00
16:00
18:00
20:00
22:00
00:00

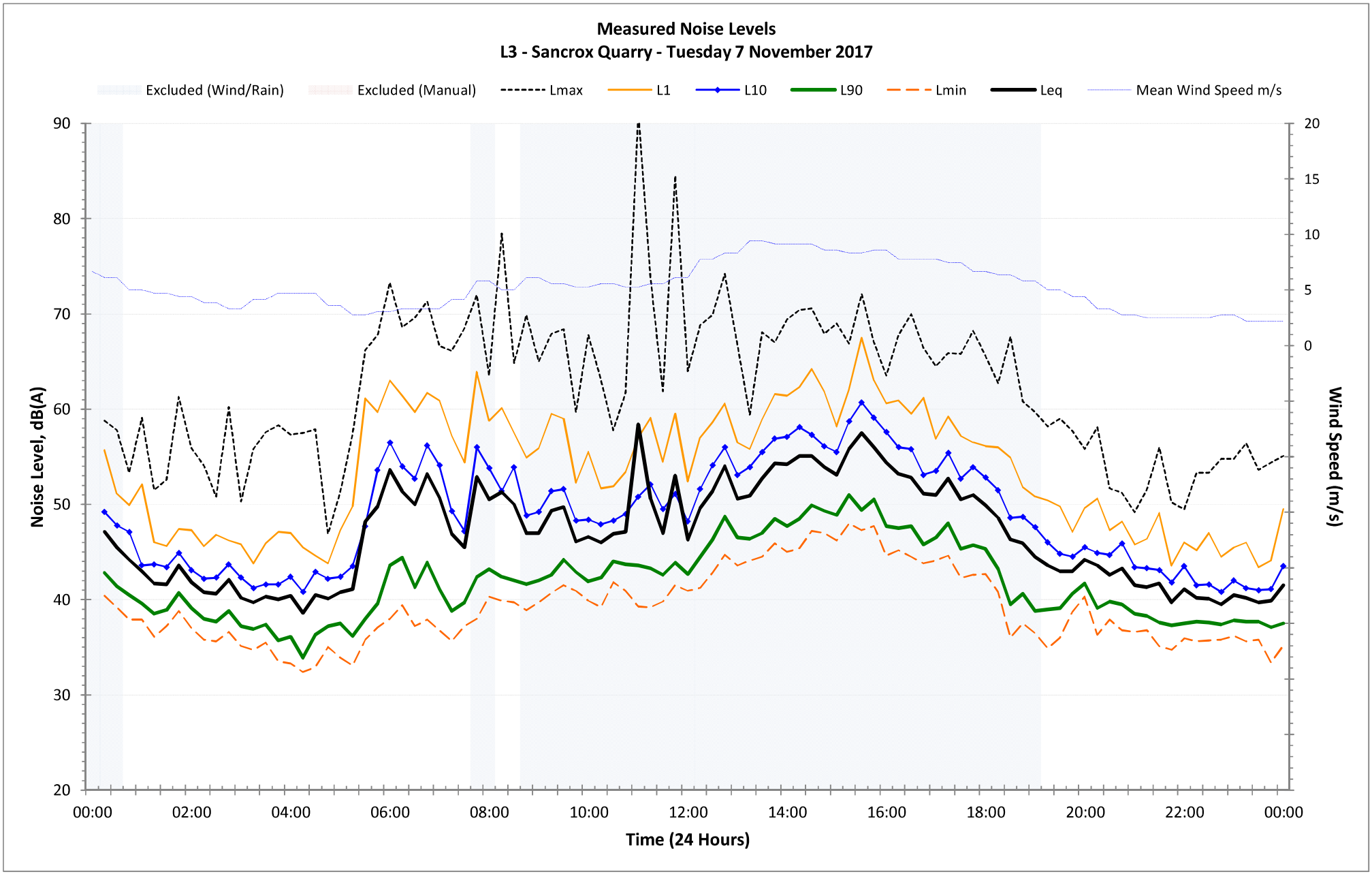

Measured Noise Levels
L2 - Sancrox Quarry - Saturday 18 November 2017
Excluded (Wind/Rain)
Excluded (Manual)
Lmax
L1
L10
L90
Lmin
Leq
Mean Wind Speed m/s
Noise Level, dB(A)
Wind Speed (m/s)
Time (24 Hours)
90
80
70
60
50
40
30
20
20
15
10
5
0
00:00
02:00
04:00
06:00
08:00
10:00
12:00
14:00
16:00
18:00
20:00
22:00
00:00

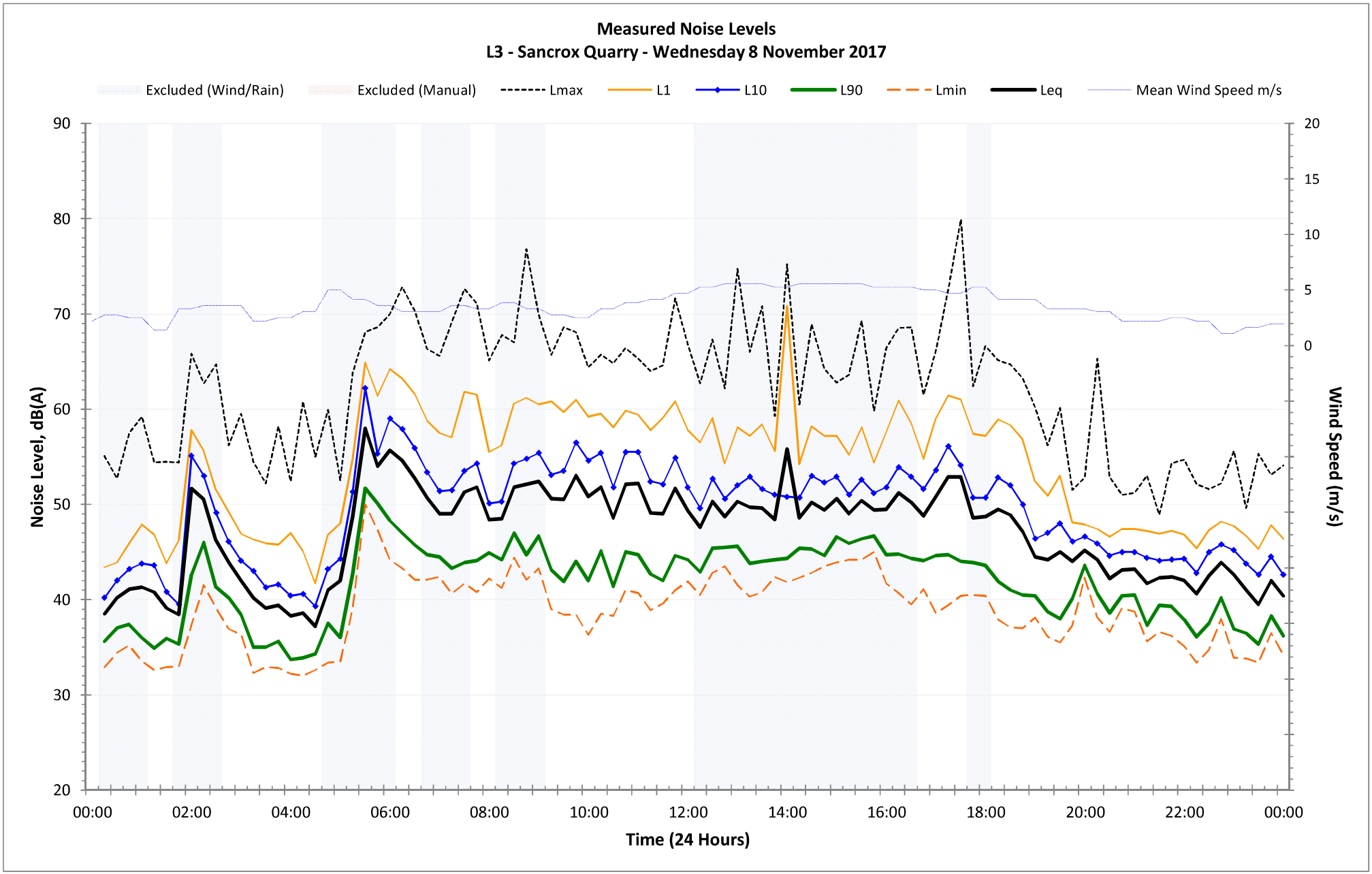

Measured Noise Levels
L2 - Sancrox Quarry - Sunday 19 November 2017
Excluded (Wind/Rain)
Excluded (Manual)
Lmax
L1
L10
L90
Lmin
Leq
Mean Wind Speed m/s
Noise Level, dB(A)
Wind Speed (m/s)
Time (24 Hours)
90
80
70
60
50
40
30
20
20
15
10
5
0
00:00
02:00
04:00
06:00
08:00
10:00
12:00
14:00
16:00
18:00
20:00
22:00
00:00

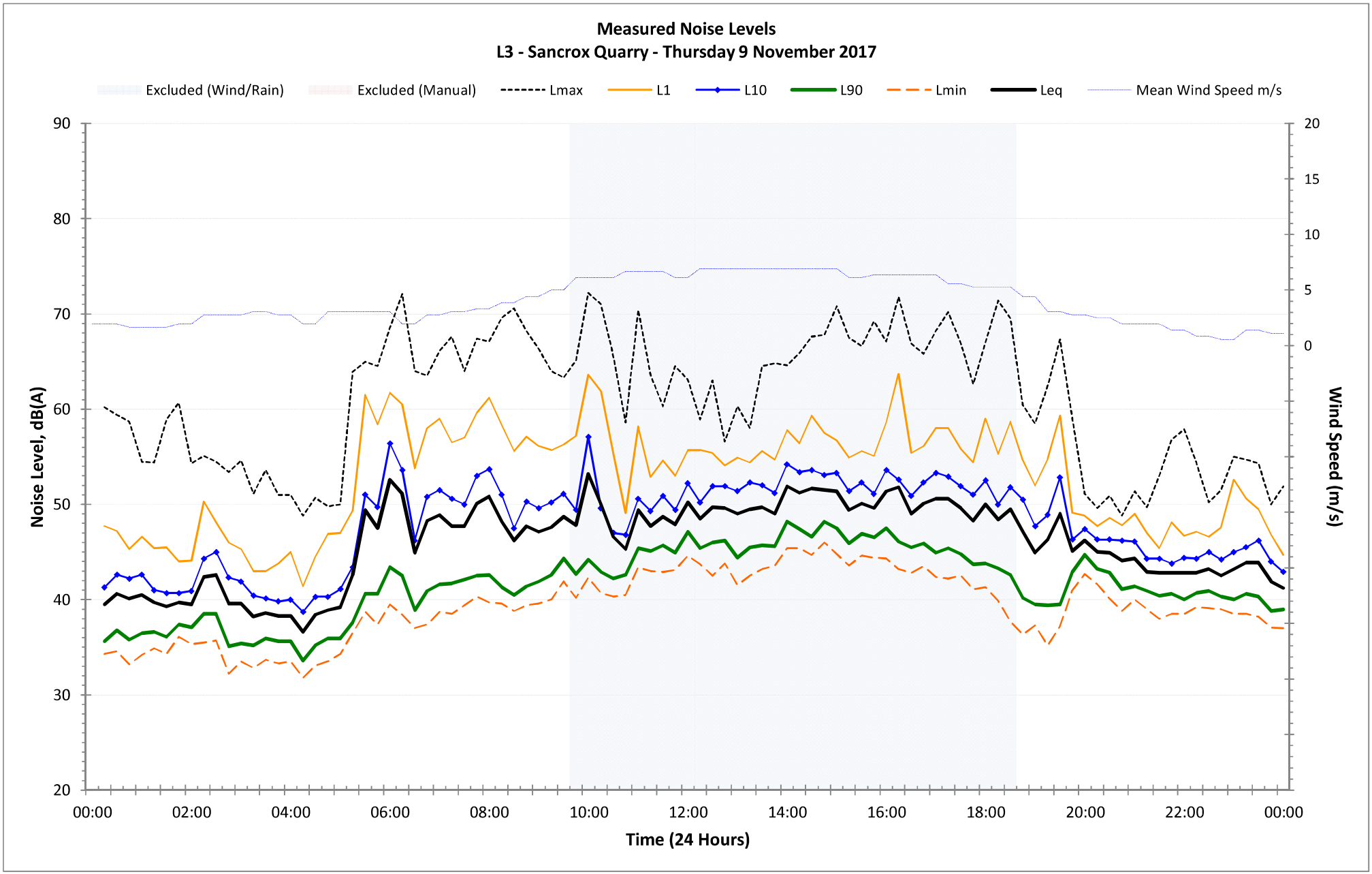

Measured Noise Levels
L2 - Sancrox Quarry - Monday 20 November 2017
Excluded (Wind/Rain)
Excluded (Manual)
Lmax
L1
L10
L90
Lmin
Leq
Mean Wind Speed m/s
Noise Level, dB(A)
Wind Speed (m/s)
Time (24 Hours)
90
80
70
60
50
40
30
20
20
15
10
5
0
00:00
02:00
04:00
06:00
08:00
10:00
12:00
14:00
16:00
18:00
20:00
22:00
00:00

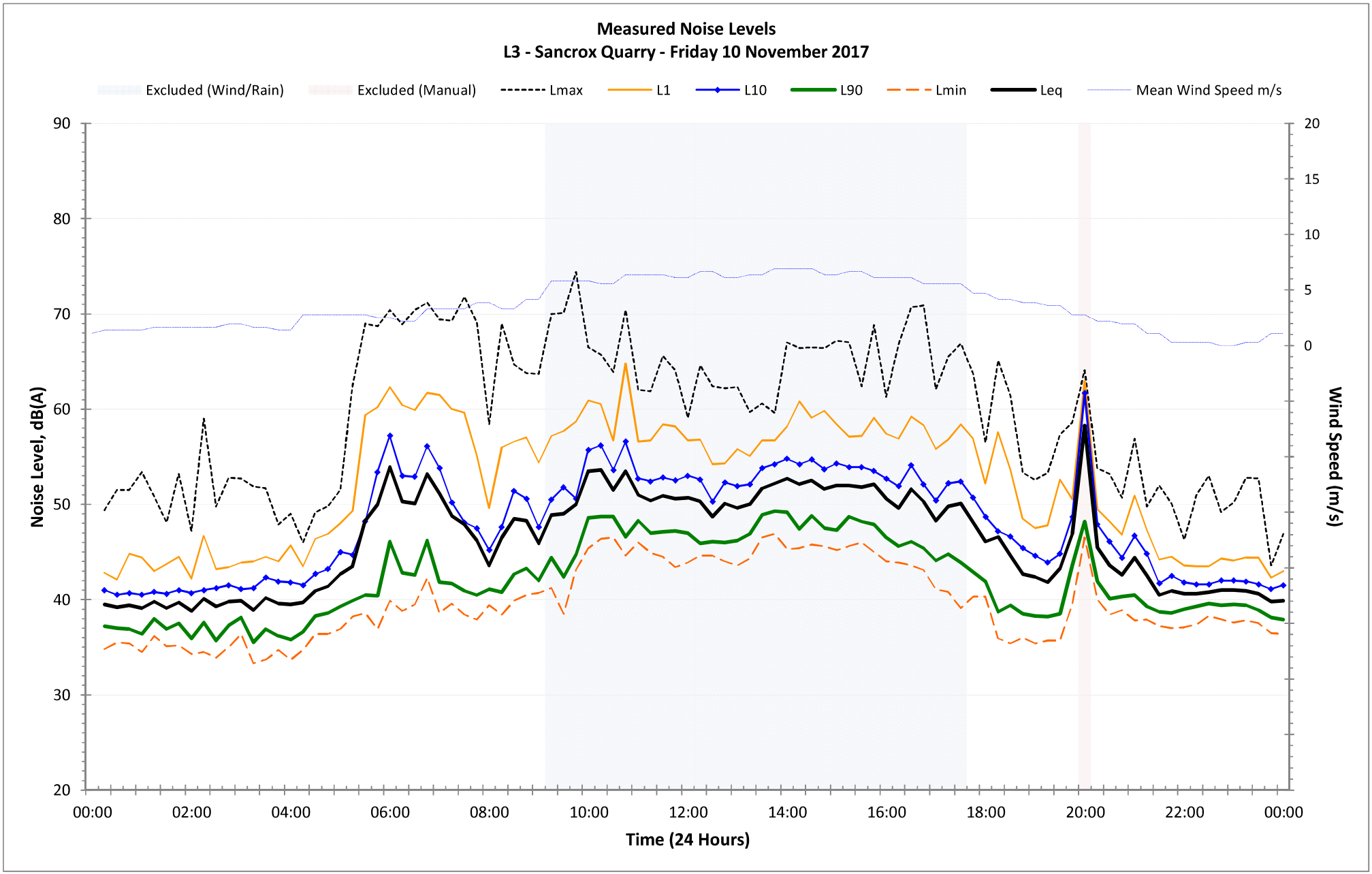

Measured Noise Levels
L2 - Sancrox Quarry - Tuesday 21 November 2017
Excluded (Wind/Rain)
Excluded (Manual)
Lmax
L1
L10
L90
Lmin
Leq
Mean Wind Speed m/s
Noise Level, dB(A)
Wind Speed (m/s)
Time (24 Hours)
90
80
70
60
50
40
30
20
20
15
10
5
0
00:00
02:00
04:00
06:00
08:00
10:00
12:00
14:00
16:00
18:00
20:00
22:00
00:00

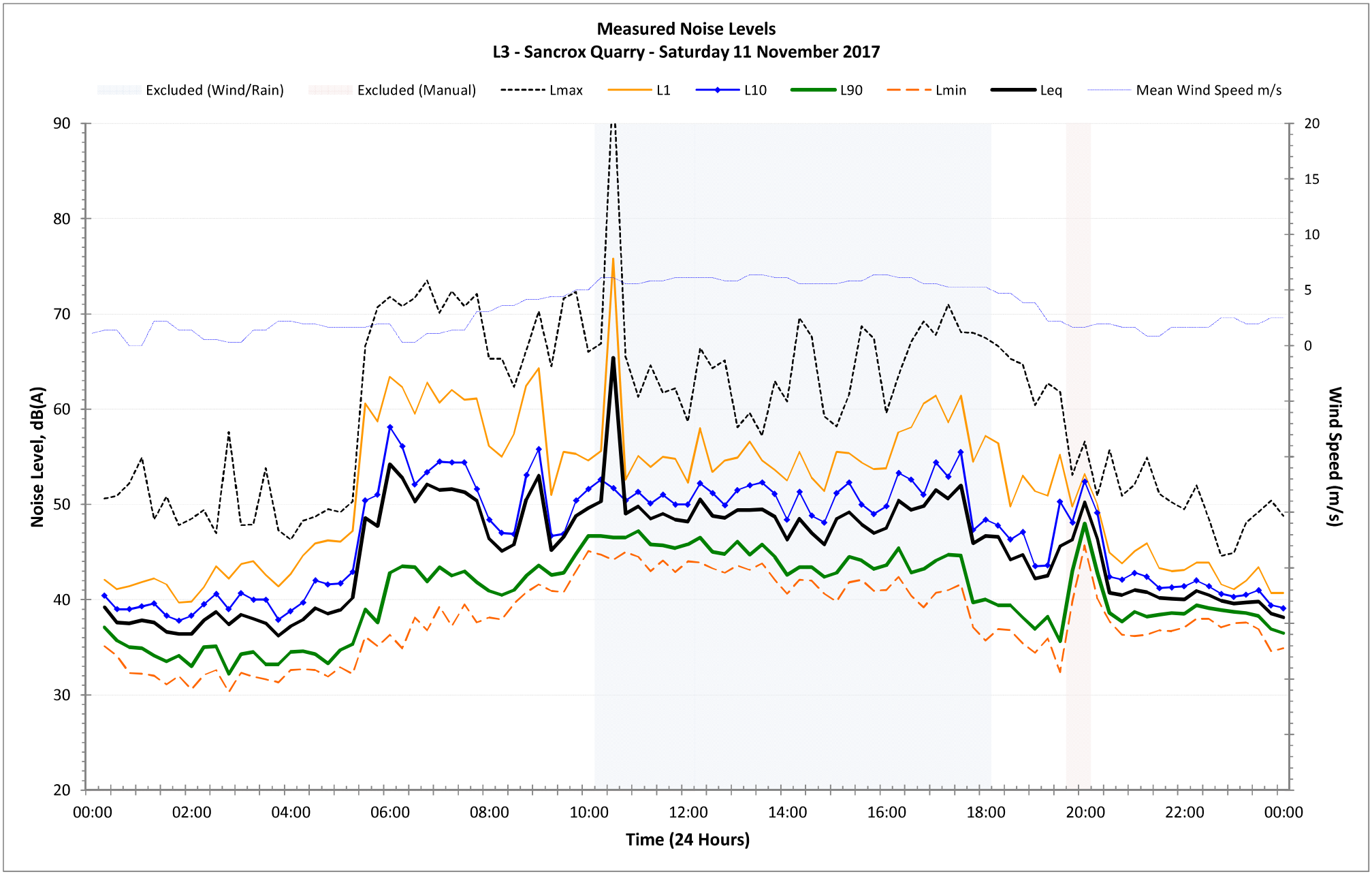

Measured Noise Levels
L3 - Sancrox Quarry - Monday 6 November 2017
Excluded (Wind/Rain)
Excluded (Manual)
Lmax
L1
L10
L90
Lmin
Leq
Mean Wind Speed m/s
Noise Level, dB(A)
Wind Speed (m/s)
Time (24 Hours)
90
80
70
60
50
40
30
20
20
15
10
5
0
00:00
02:00
04:00
06:00
08:00
10:00
12:00
14:00
16:00
18:00
20:00
22:00
00:00

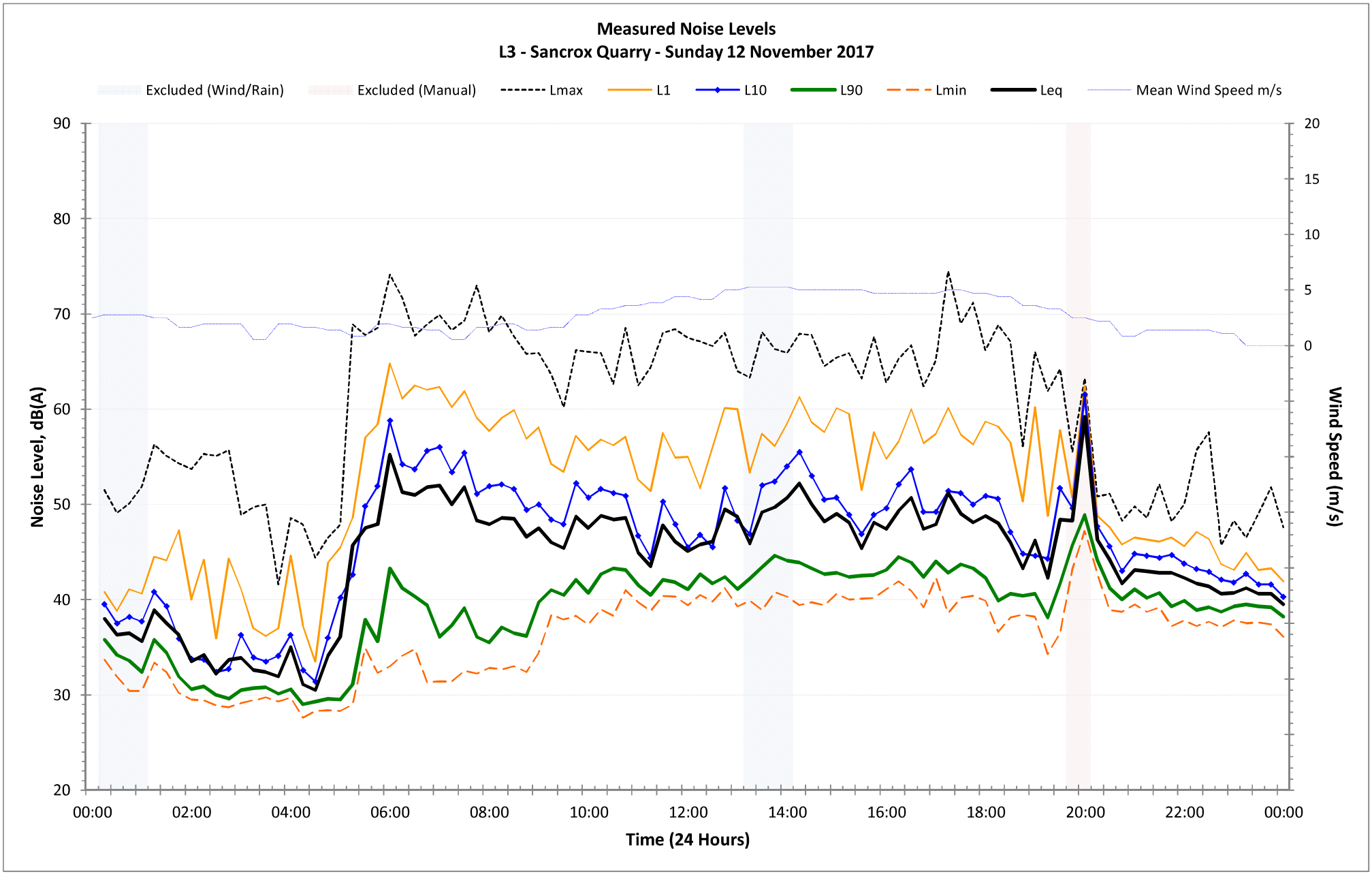

Measured Noise Levels
L3 - Sancrox Quarry - Tuesday 7 November 2017
Excluded (Wind/Rain)
Excluded (Manual)
Lmax
L1
L10
L90
Lmin
Leq
Mean Wind Speed m/s
Noise Level, dB(A)
Wind Speed (m/s)
Time (24 Hours)
90
80
70
60
50
40
30
20
20
15
10
5
0
00:00
02:00
04:00
06:00
08:00
10:00
12:00
14:00
16:00
18:00
20:00
22:00
00:00

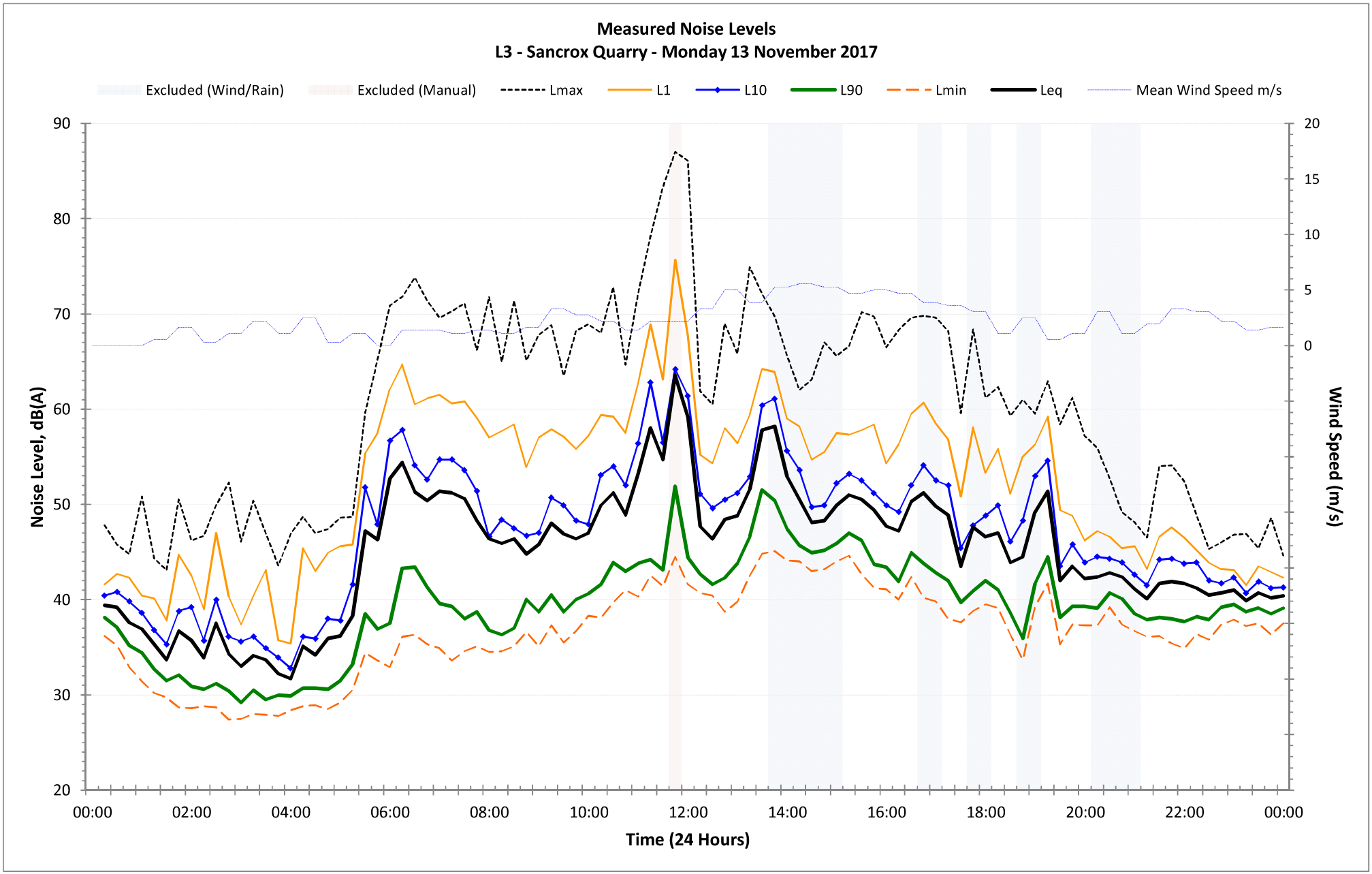

Measured Noise Levels
L3 - Sancrox Quarry - Wednesday 8 November 2017
Excluded (Wind/Rain)
Excluded (Manual)
Lmax
L1
L10
L90
Lmin
Leq
Mean Wind Speed m/s
Noise Level, dB(A)
Wind Speed (m/s)
Time (24 Hours)
90
80
70
60
50
40
30
20
20
15
10
5
0
00:00
02:00
04:00
06:00
08:00
10:00
12:00
14:00
16:00
18:00
20:00
22:00
00:00

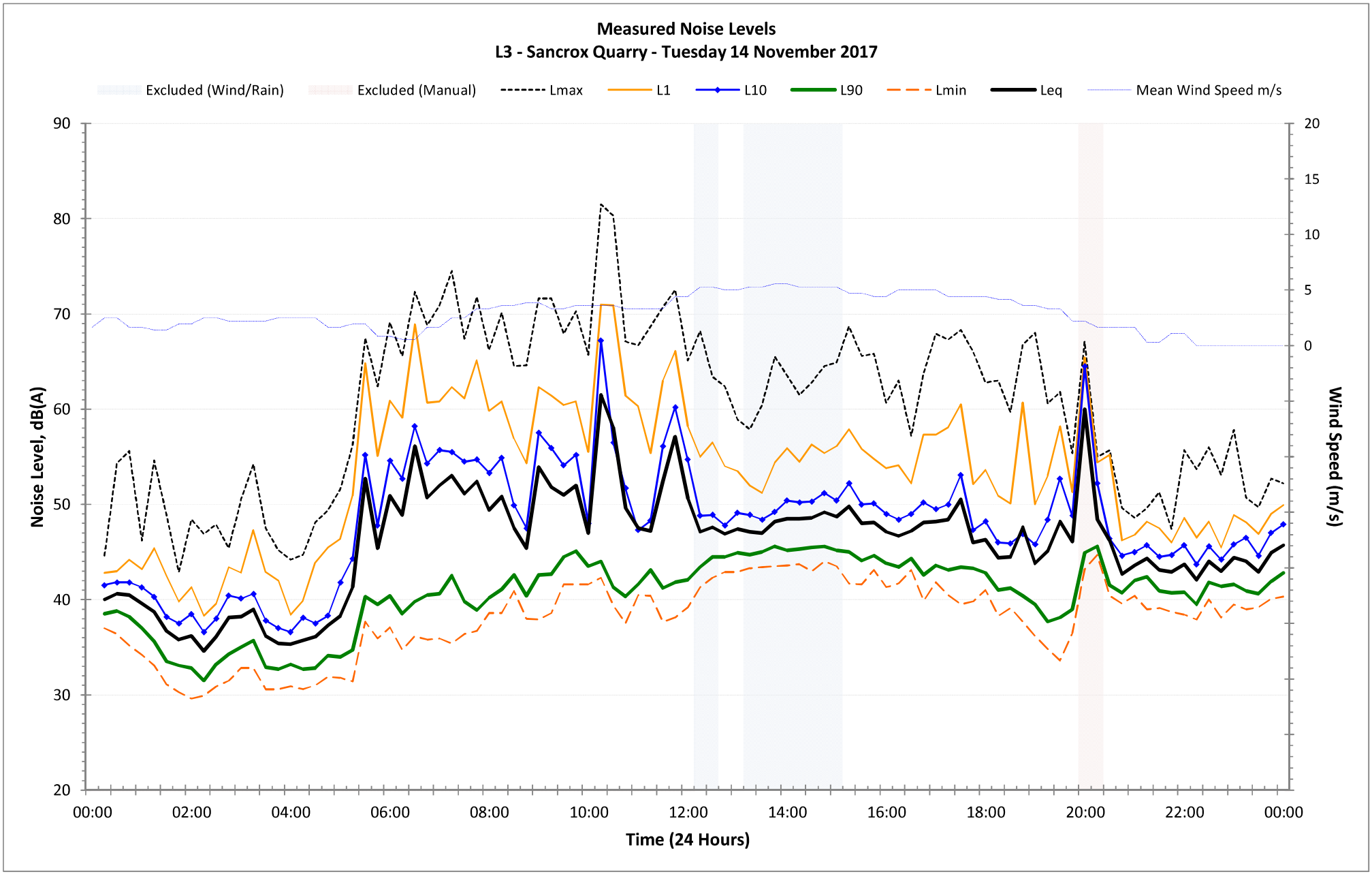

Measured Noise Levels
L3 - Sancrox Quarry - Thursday 9 November 2017
Excluded (Wind/Rain)
Excluded (Manual)
Lmax
L1
L10
L90
Lmin
Leq
Mean Wind Speed m/s
Noise Level, dB(A)
Wind Speed (m/s)
Time (24 Hours)
90
80
70
60
50
40
30
20
20
15
10
5
0
00:00
02:00
04:00
06:00
08:00
10:00
12:00
14:00
16:00
18:00
20:00
22:00
00:00

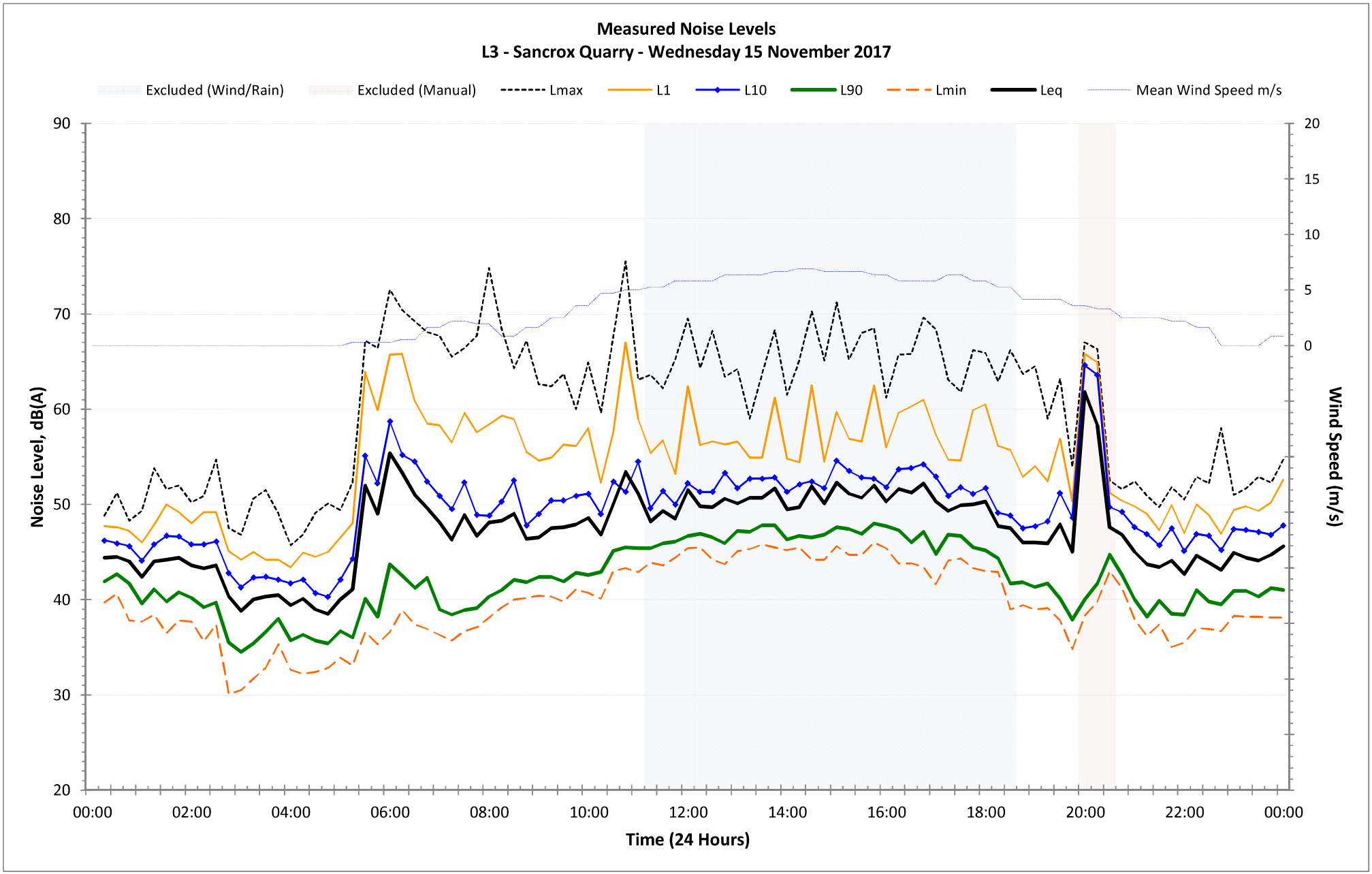

Measured Noise Levels
L3 - Sancrox Quarry - Friday 10 November 2017
Excluded (Wind/Rain)
Excluded (Manual)
Lmax
L1
L10
L90
Lmin
Leq
Mean Wind Speed m/s
Noise Level, dB(A)
Wind Speed (m/s)
Time (24 Hours)
90
80
70
60
50
40
30
20
20
15
10
5
0
00:00
02:00
04:00
06:00
08:00
10:00
12:00
14:00
16:00
18:00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

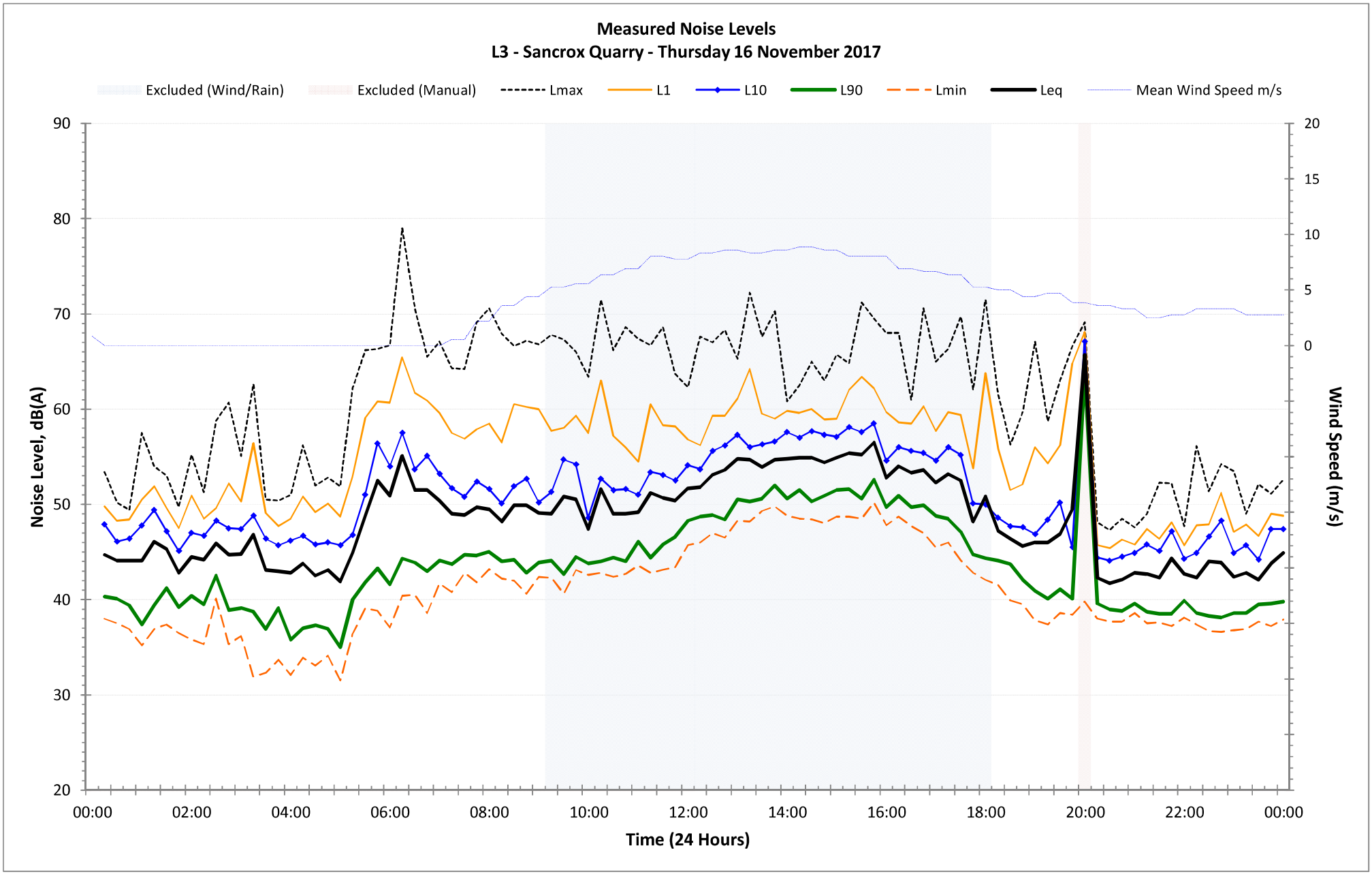

Measured Noise Levels
L3 - Sancrox Quarry - Saturday 11 November 2017
Excluded (Wind/Rain)
Excluded (Manual)
Lmax
L1
L10
L90
Lmin
Leq
Mean Wind Speed m/s
Noise Level, dB(A)
Wind Speed (m/s)
Time (24 Hours)
90
80
70
60
50
40
30
20
20
15
10
5
0
00:00
02:00
04:00
06:00
08:00
10:00
12:00
14:00
16:00
18:00
20:00
22:00
00:00

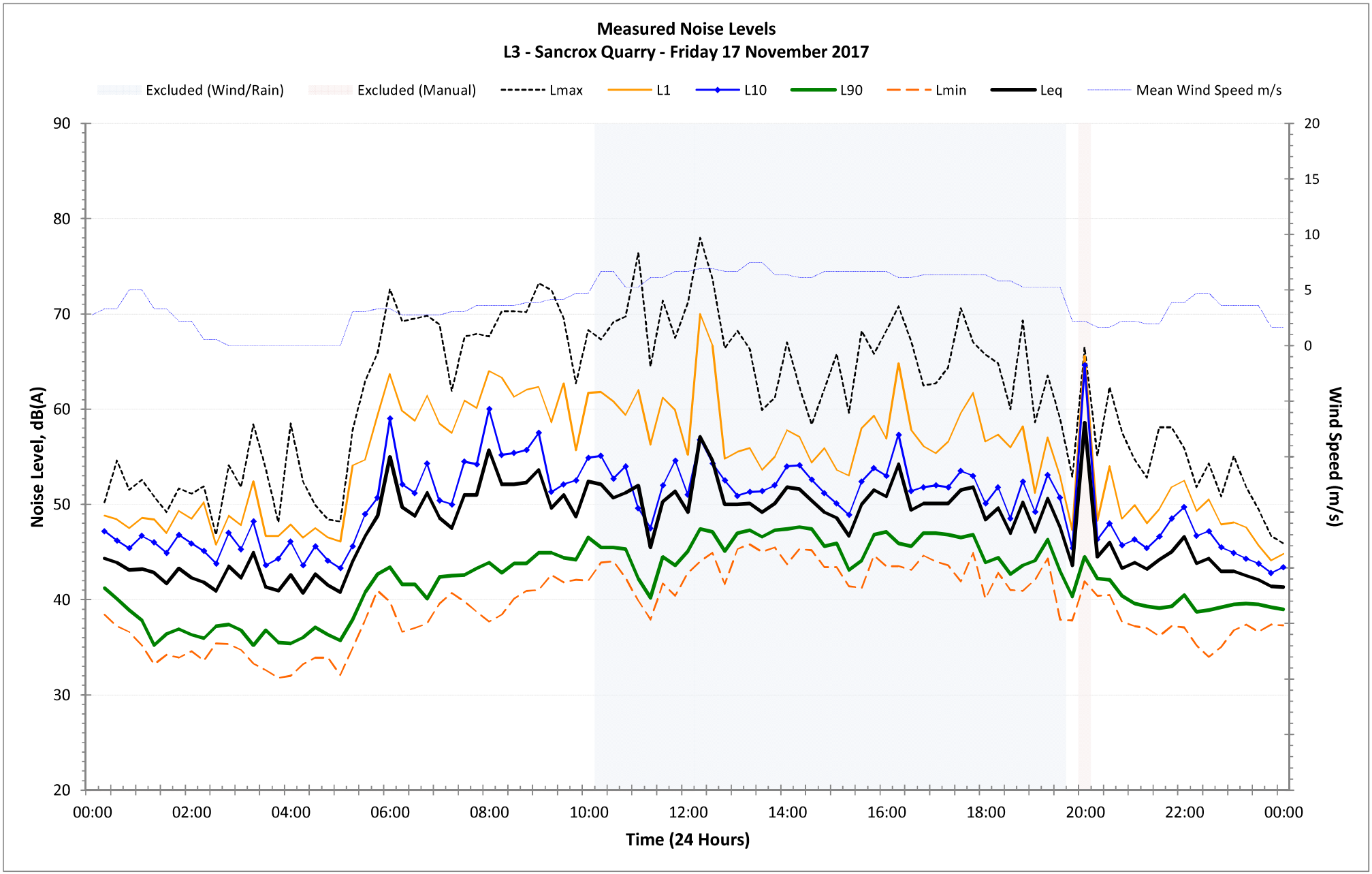

Measured Noise Levels
L3 - Sancrox Quarry - Sunday 12 November 2017
Excluded (Wind/Rain)
Excluded (Manual)
Lmax
L1
L10
L90
Lmin
Leq
Mean Wind Speed m/s
Noise Level, dB(A)
Wind Speed (m/s)
Time (24 Hours)
90
80
70
60
50
40
30
20
20
15
10
5
0
00:00
02:00
04:00
06:00
08:00
10:00
12:00
14:00
16:00
18:00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

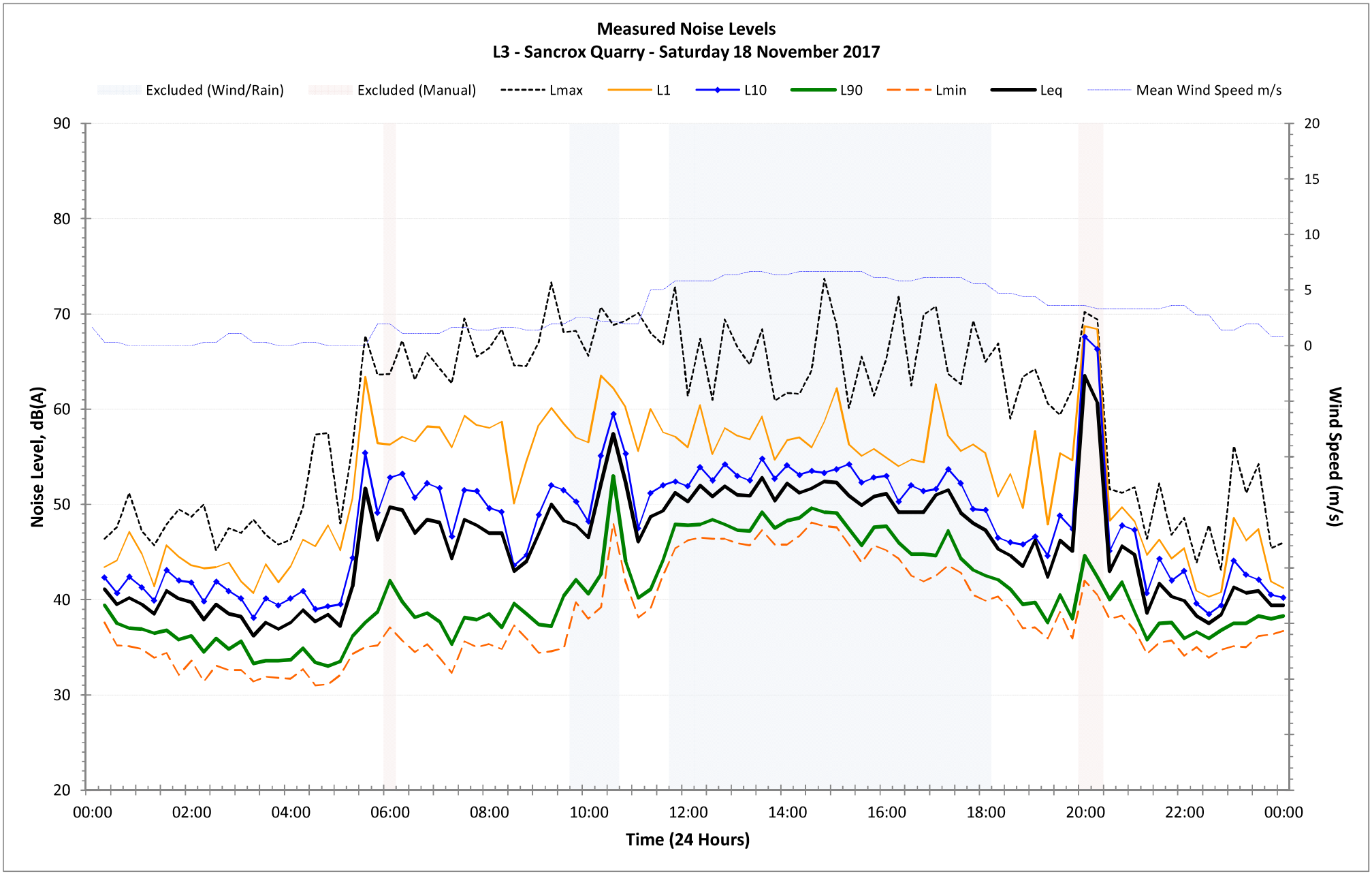

Measured Noise Levels
L3 - Sancrox Quarry - Monday 13 November 2017
Excluded (Wind/Rain)
Excluded (Manual)
Lmax
L1
L10
L90
Lmin
Leq
Mean Wind Speed m/s
Noise Level, dB(A)
Wind Speed (m/s)
Time (24 Hours)
90
80
70
60
50
40
30
20
20
15
10
5
0
00:00
02:00
04:00
06:00
08:00
10:00
12:00
14:00
16:00
18:00
20:00
22:00
00:00

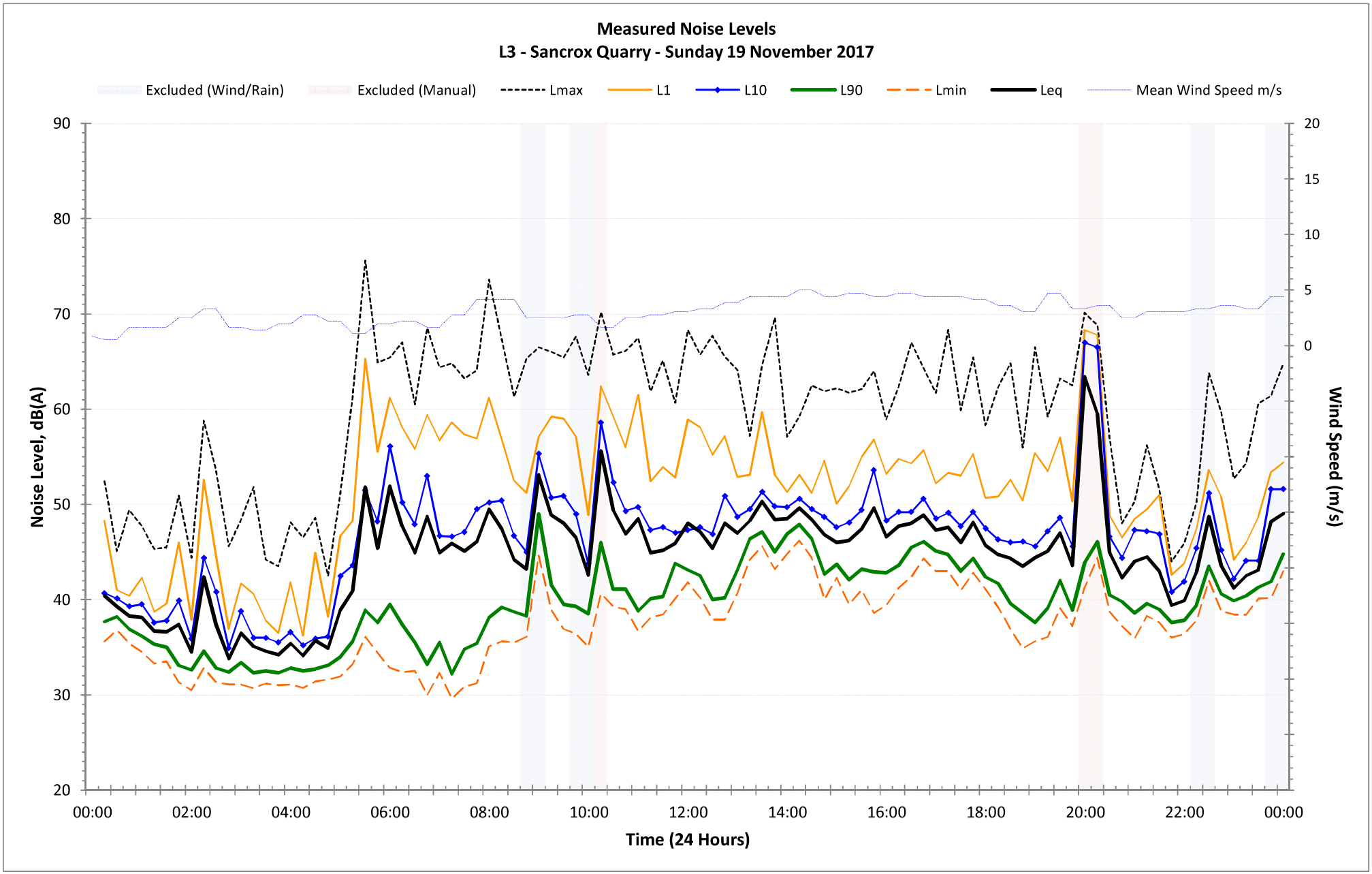

Measured Noise Levels
L3 - Sancrox Quarry - Tuesday 14 November 2017
Excluded (Wind/Rain)
Excluded (Manual)
Lmax
L1
L10
L90
Lmin
Leq
Mean Wind Speed m/s
Noise Level, dB(A)
Wind Speed (m/s)
Time (24 Hours)
90
80
70
60
50
40
30
20
20
15
10
5
0
00:00
02:00
04:00
06:00
08:00
10:00
12:00
14:00
16:00
18:00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

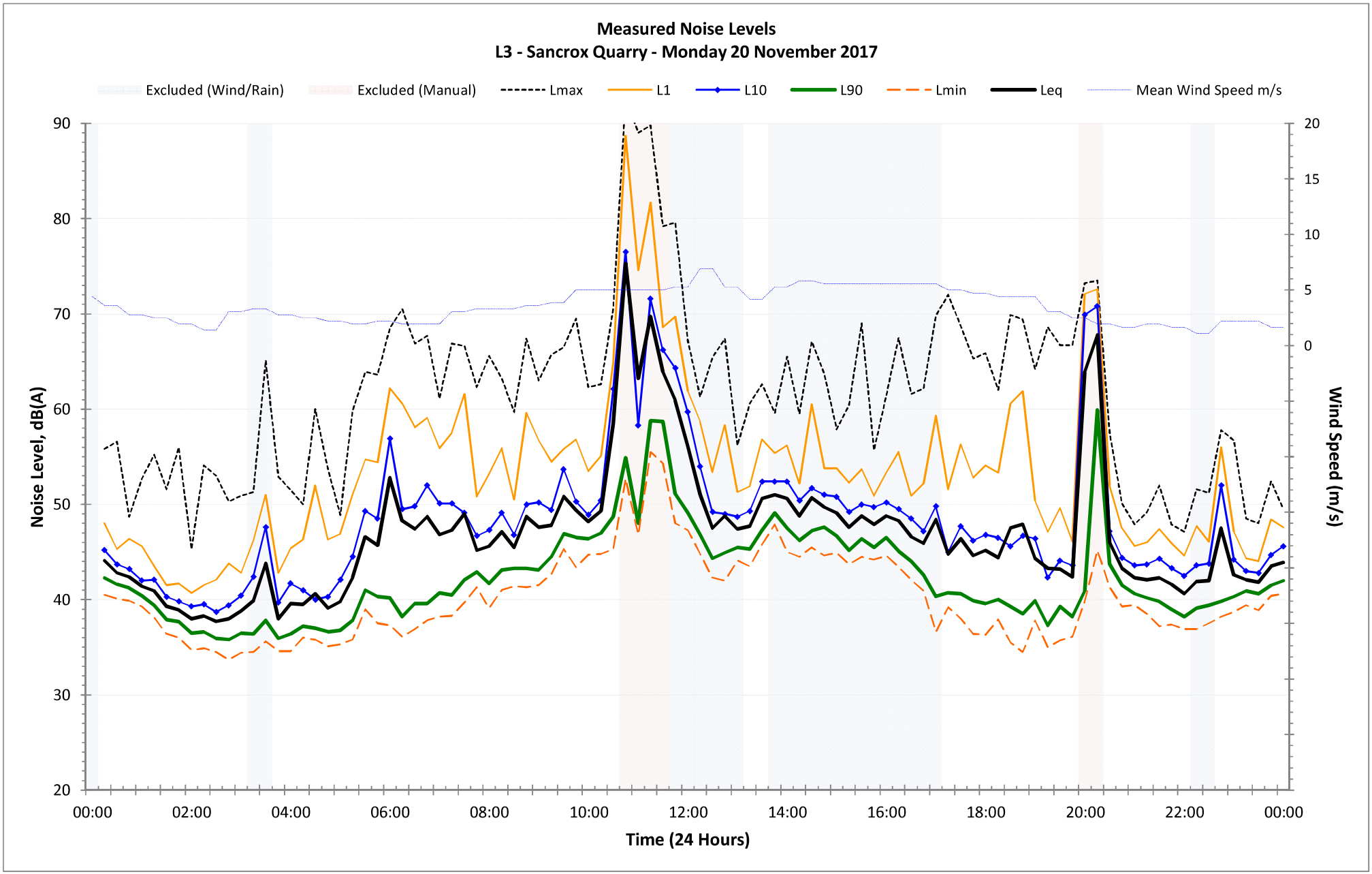

Measured Noise Levels
L3 - Sancrox Quarry - Wednesday 15 November 2017
Excluded (Wind/Rain)
Excluded (Manual)
Lmax
L1
L10
L90
Lmin
Leq
Mean Wind Speed m/s
Noise Level, dB(A)
Wind Speed (m/s)
Time (24 Hours)
90
80
70
60
50
40
30
20
20
15
10
5
0
00:00
02:00
04:00
06:00
08:00
10:00
12:00
14:00
16:00
18:00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

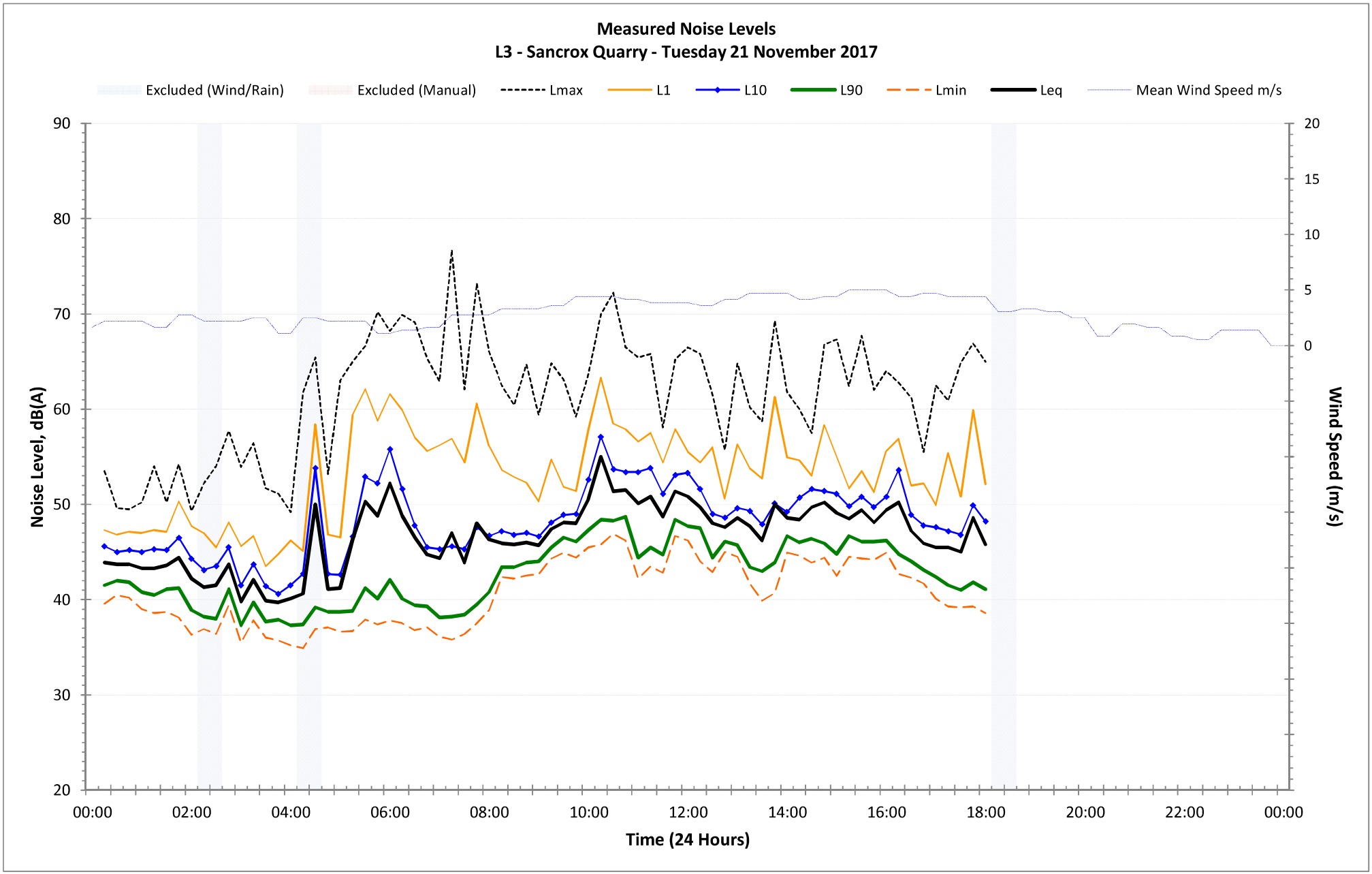

Measured Noise Levels
L3 - Sancrox Quarry - Thursday 16 November 2017
Excluded (Wind/Rain)
Excluded (Manual)
Lmax
L1
L10
L90
Lmin
Leq
Mean Wind Speed m/s
Noise Level, dB(A)
Wind Speed (m/s)
Time (24 Hours)
90
80
70
60
50
40
30
20
20
15
10
5
0
00:00
02:00
04:00
06:00
08:00
10:00
12:00
14:00
16:00
18:00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

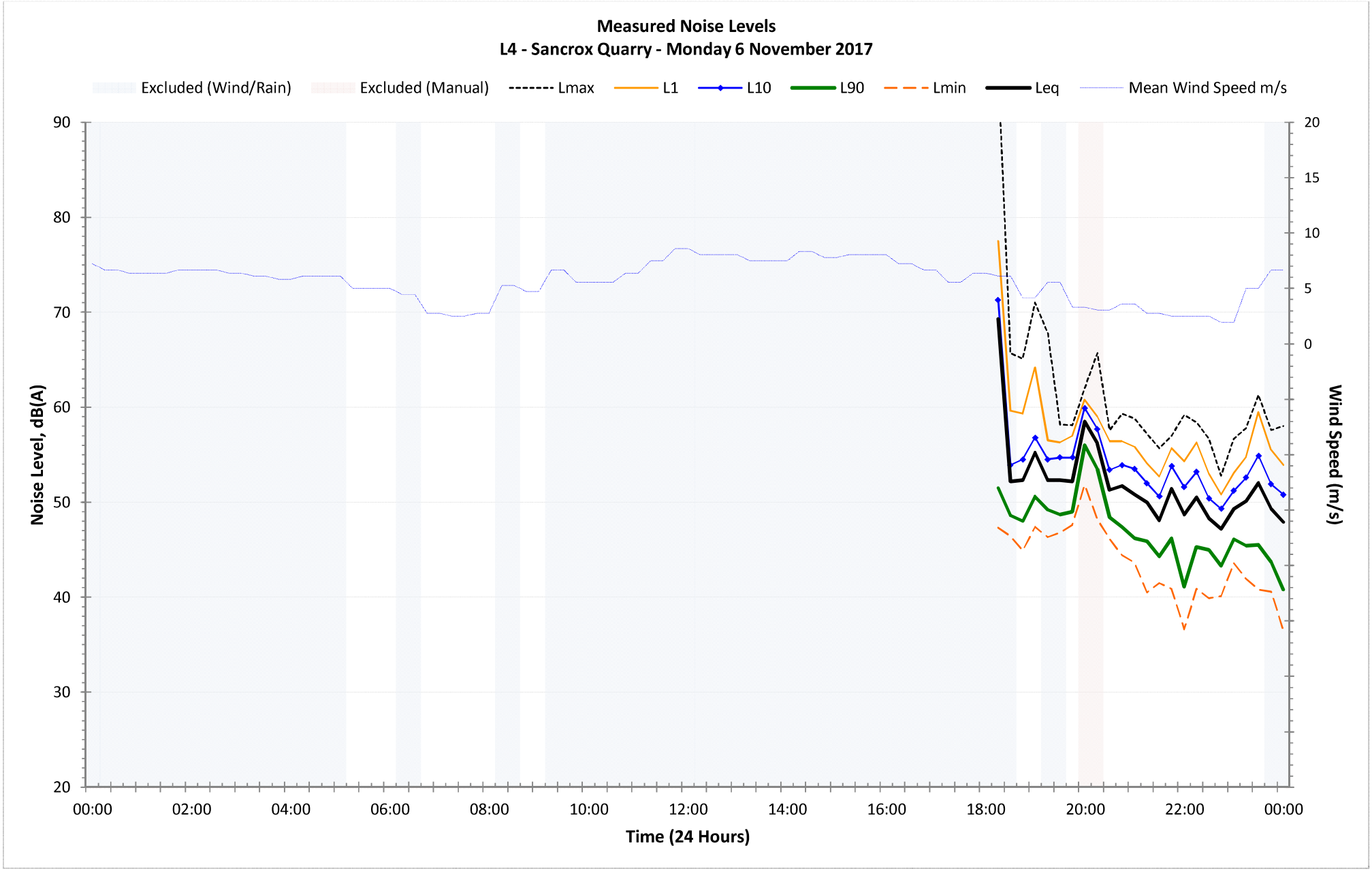

Measured Noise Levels
L3 - Sancrox Quarry - Friday 17 November 2017
Excluded (Wind/Rain)
Excluded (Manual)
Lmax
L1
L10
L90
Lmin
Leq
Mean Wind Speed m/s
Noise Level, dB(A)
Wind Speed (m/s)
Time (24 Hours)
90
80
70
60
50
40
30
20
20
15
10
5
0
00:00
02:00
04:00
06:00
08:00
10:00
12:00
14:00
16:00
18:00
20:00
22:00
00:00

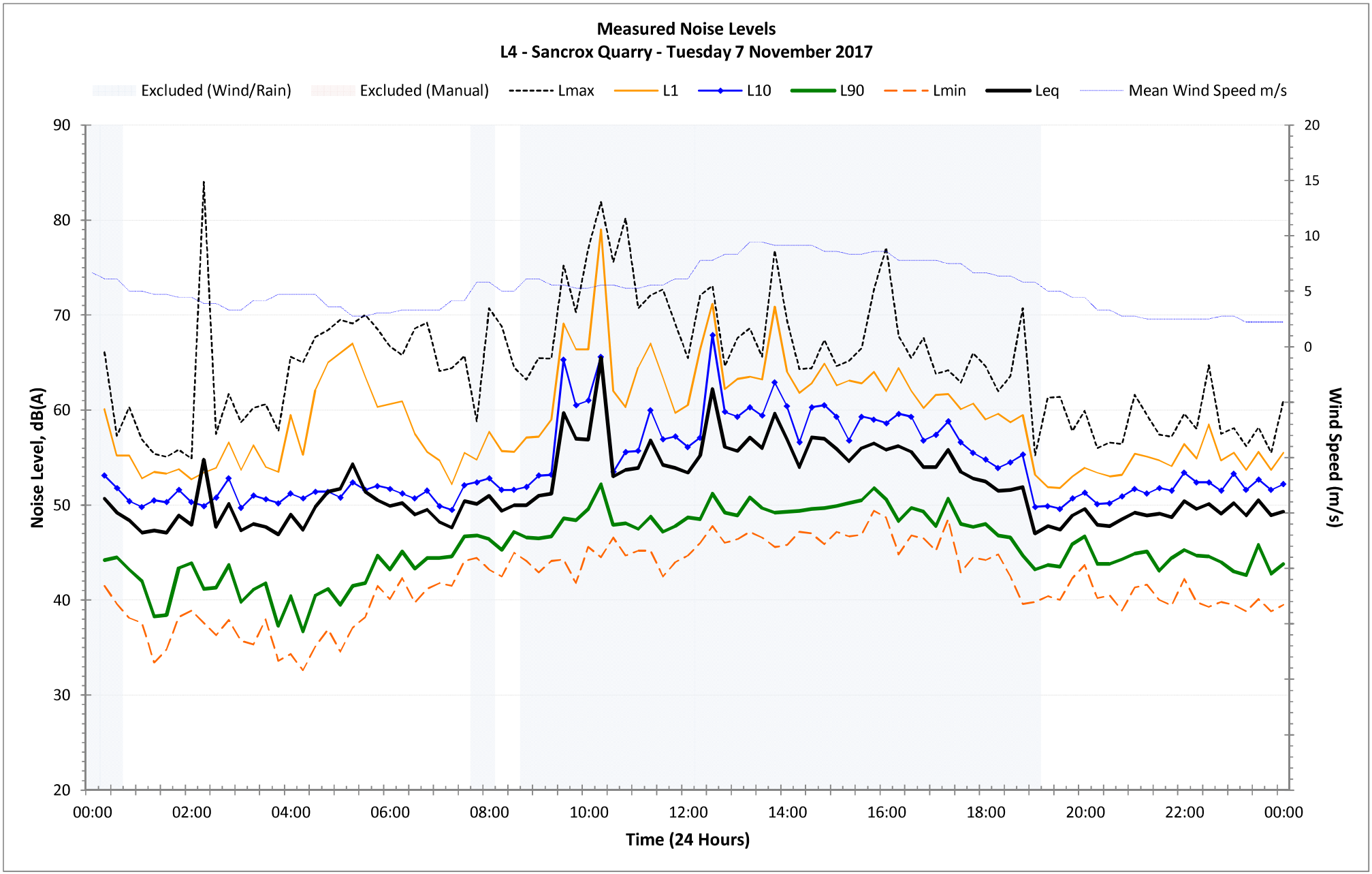

Measured Noise Levels
L3 - Sancrox Quarry - Saturday 18 November 2017
Excluded (Wind/Rain)
Excluded (Manual)
Lmax
L1
L10
L90
Lmin
Leq
Mean Wind Speed m/s
Noise Level, dB(A)
Wind Speed (m/s)
Time (24 Hours)
90
80
70
60
50
40
30
20
20
15
10
5
0
00:00
02:00
04:00
06:00
08:00
10:00
12:00
14:00
16:00
18:00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

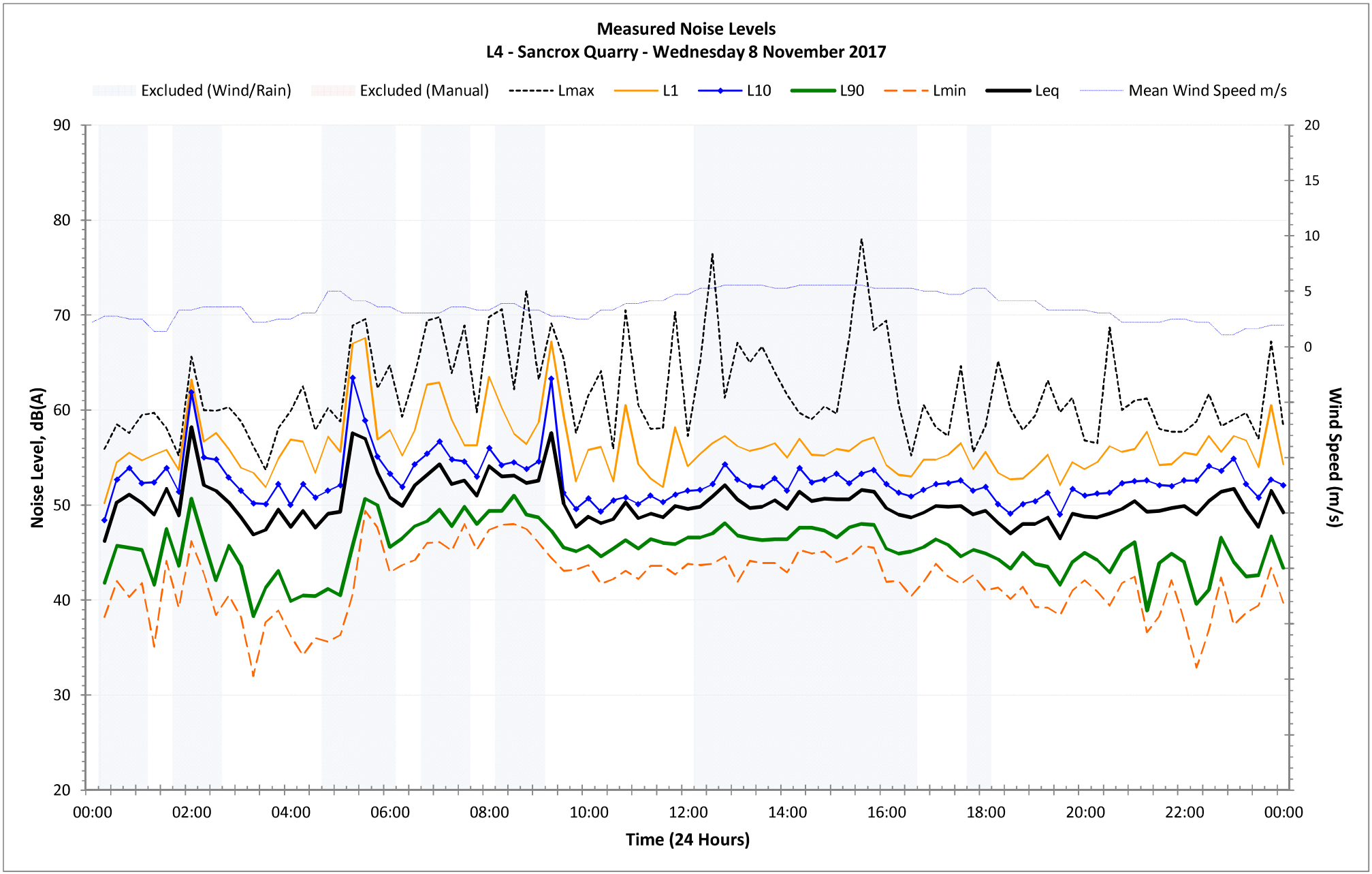

Measured Noise Levels
L3 - Sancrox Quarry - Sunday 19 November 2017
Excluded (Wind/Rain)
Excluded (Manual)
Lmax
L1
L10
L90
Lmin
Leq
Mean Wind Speed m/s
Noise Level, dB(A)
Wind Speed (m/s)
Time (24 Hours)
90
80
70
60
50
40
30
20
20
15
10
5
0
00:00
02:00
04:00
06:00
08:00
10:00
12:00
14:00
16:00
18:00
20:00
22:00
00:00

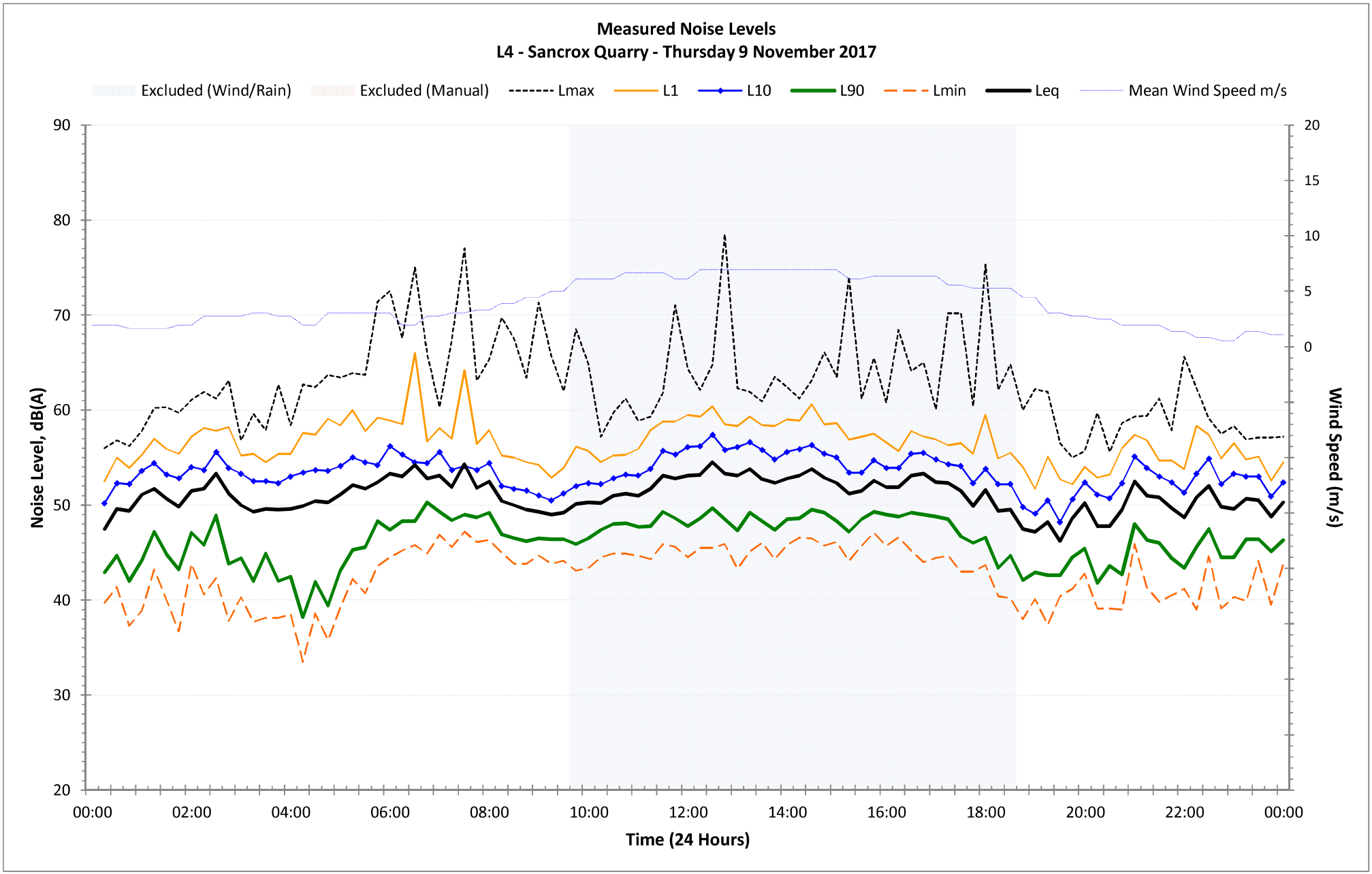

Measured Noise Levels
L3 - Sancrox Quarry - Monday 20 November 2017
Excluded (Wind/Rain)
Excluded (Manual)
Lmax
L1
L10
L90
Lmin
Leq
Mean Wind Speed m/s
Noise Level, dB(A)
Wind Speed (m/s)
Time (24 Hours)
90
80
70
60
50
40
30
20
20
15
10
5
0
00:00
02:00
04:00
06:00
08:00
10:00
12:00
14:00
16:00
18:00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

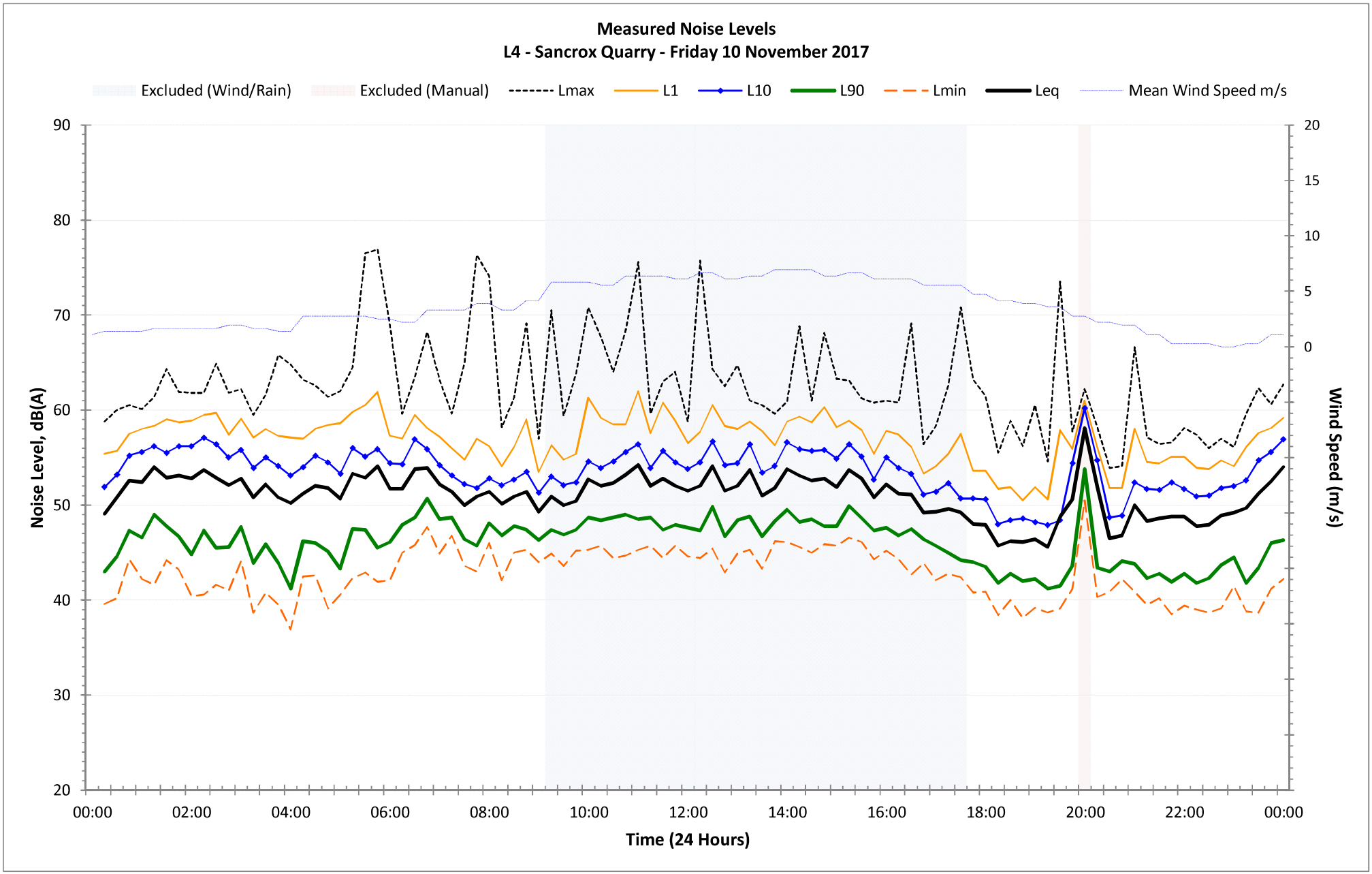

Measured Noise Levels
L3 - Sancrox Quarry - Tuesday 21 November 2017
Excluded (Wind/Rain)
Excluded (Manual)
Lmax
L1
L10
L90
Lmin
Leq
Mean Wind Speed m/s
Noise Level, dB(A)
Wind Speed (m/s)
Time (24 Hours)
90
80
70
60
50
40
30
20
20
15
10
5
0
00:00
02:00
04:00
06:00
08:00
10:00
12:00
14:00
16:00
18:00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

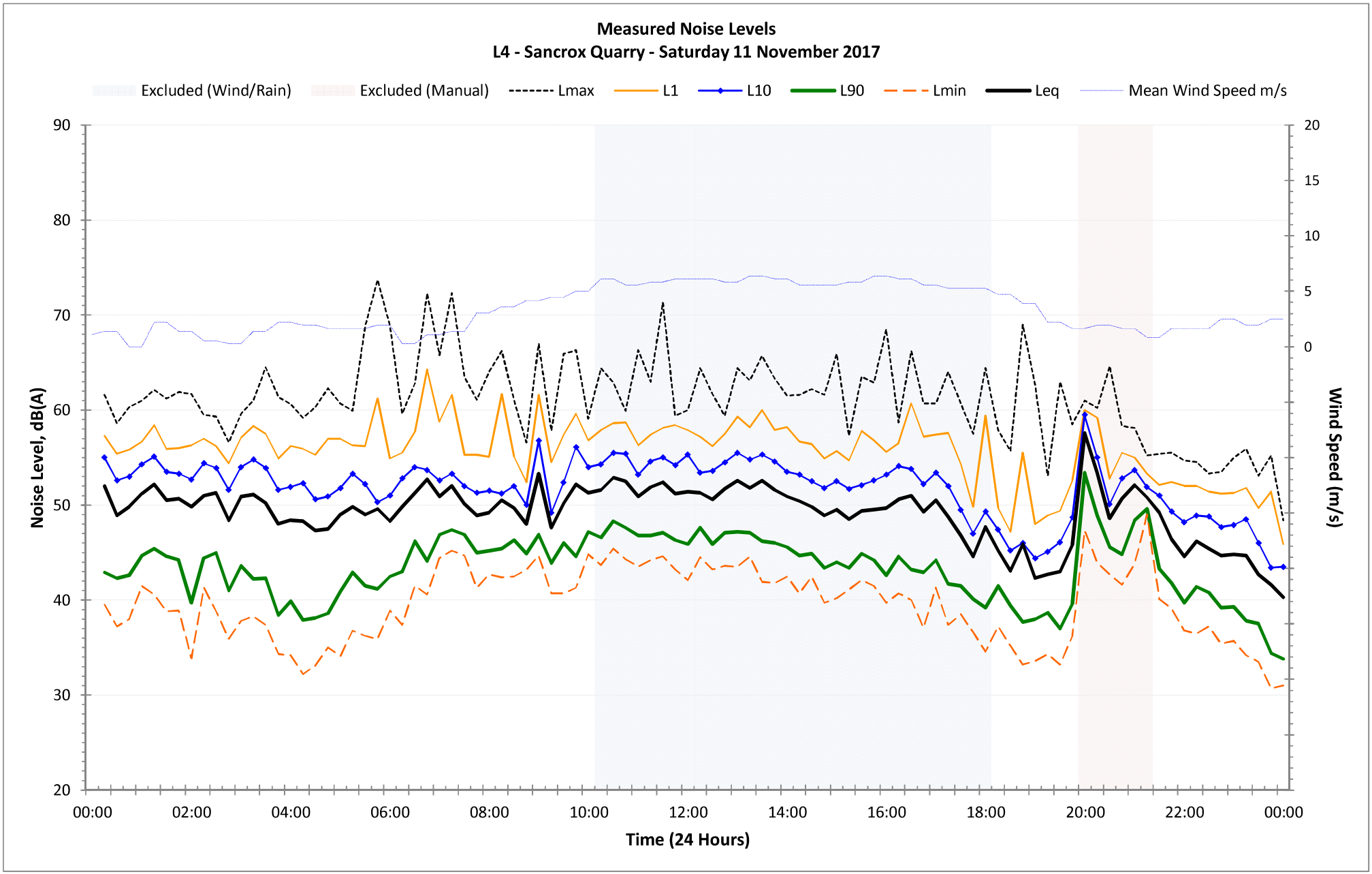

Measured Noise Levels
L4 - Sancrox Quarry - Monday 6 November 2017
Excluded (Wind/Rain)
Excluded (Manual)
Lmax
L1
L10
L90
Lmin
Leq
Mean Wind Speed m/s
Noise Level, dB(A)
Wind Speed (m/s)
Time (24 Hours)
90
80
70
60
50
40
30
20
20
15
10
5
0
00:00
02:00
04:00
06:00
08:00
10:00
12:00
14:00
16:00
18:00
20:00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

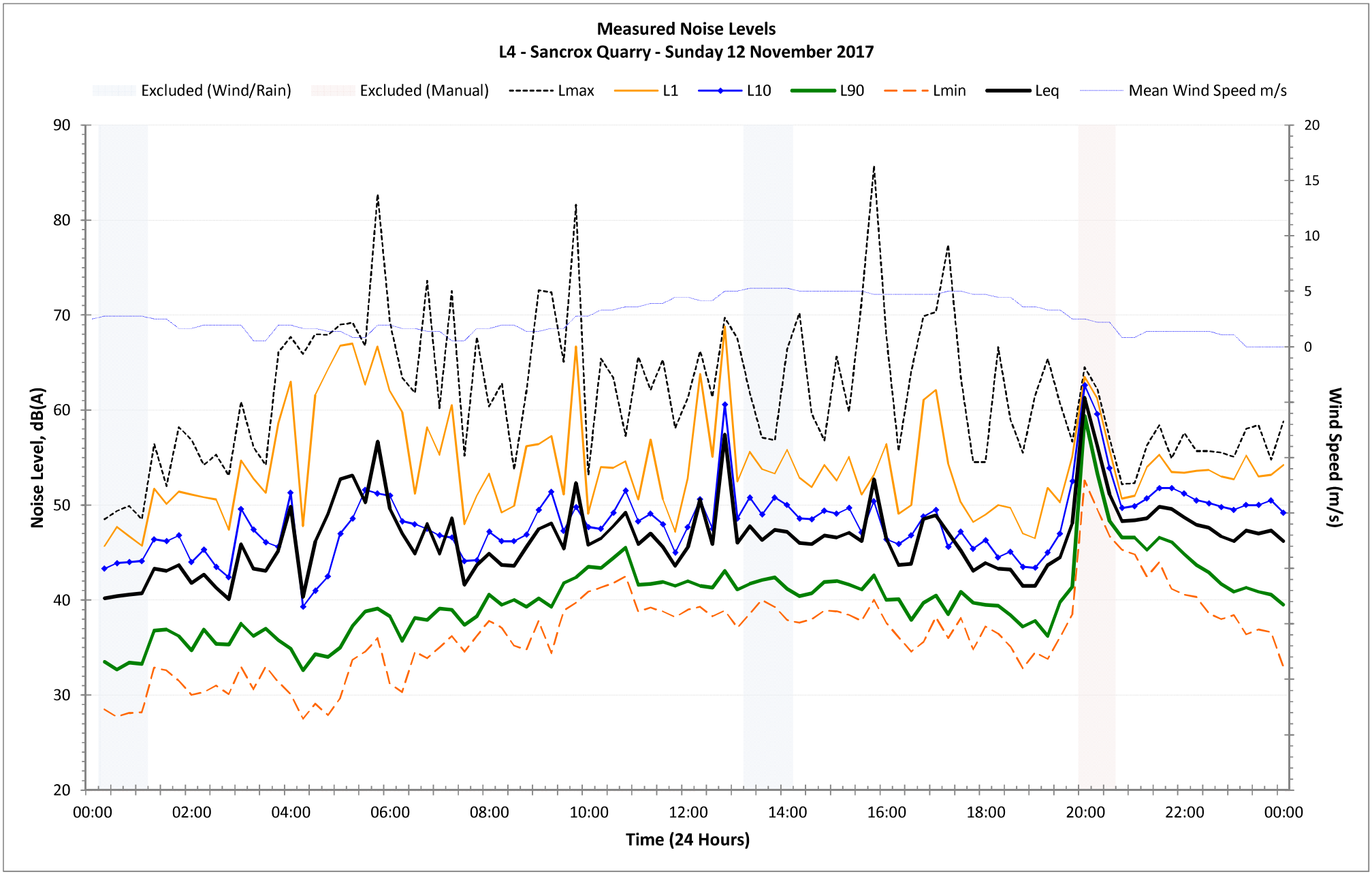

Measured Noise Levels
L4 - Sancrox Quarry - Tuesday 7 November 2017
Excluded (Wind/Rain)
Excluded (Manual)
Lmax
L1
L10
L90
Lmin
Leq
Mean Wind Speed m/s
Noise Level, dB(A)
Wind Speed (m/s)
Time (24 Hours)
90
80
70
60
50
40
30
20
20
15
10
5
0
00:00
02:00
04:00
06:00
08:00
10:00
12:00
14:00
16:00
18:00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

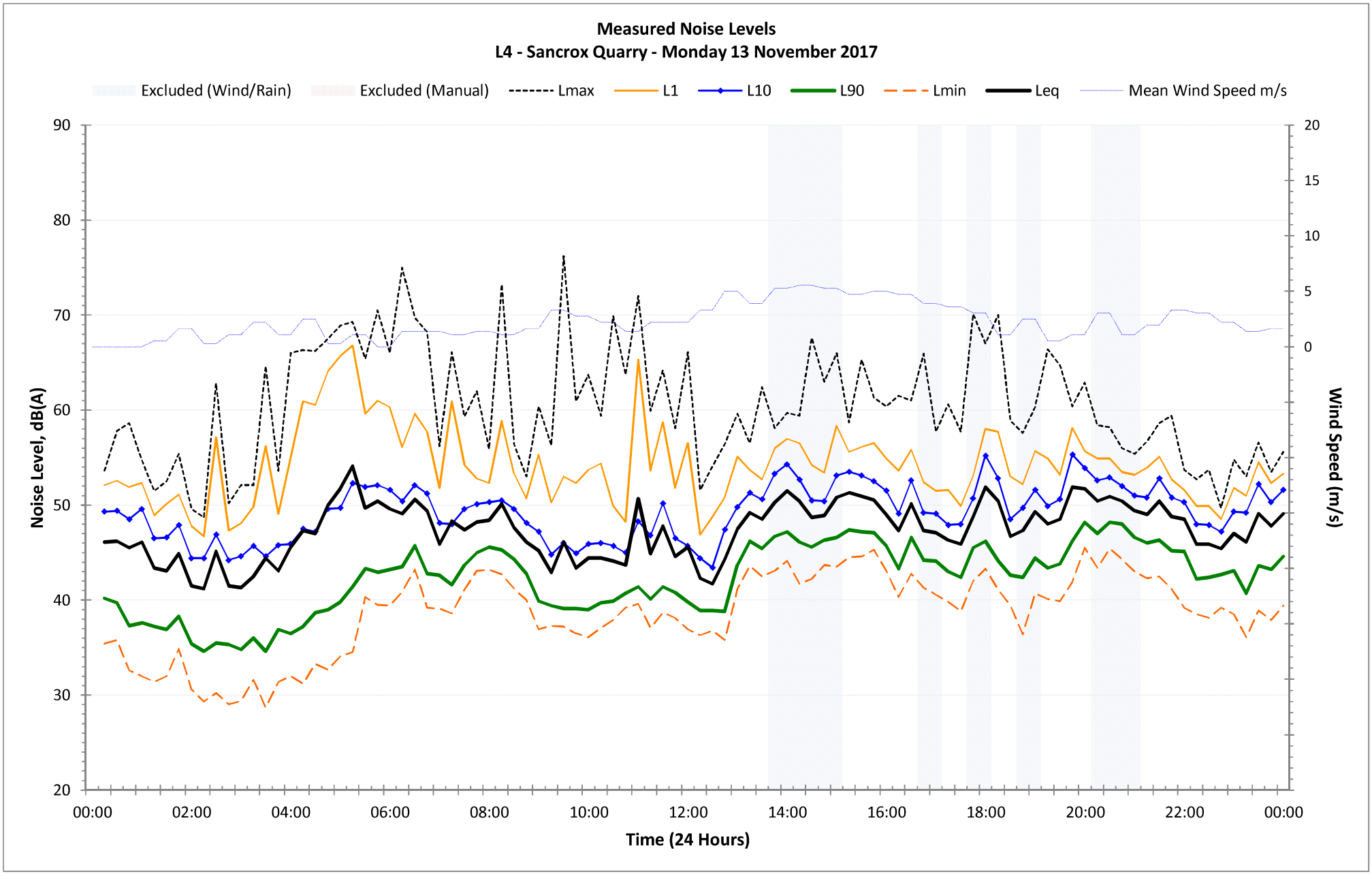

Measured Noise Levels
L4 - Sancrox Quarry - Wednesday 8 November 2017
Excluded (Wind/Rain)
Excluded (Manual)
Lmax
L1
L10
L90
Lmin
Leq
Mean Wind Speed m/s
Noise Level, dB(A)
Wind Speed (m/s)
Time (24 Hours)
90
80
70
60
50
40
30
20
20
15
10
5
0
00:00
02:00
04:00
06:00
08:00
10:00
12:00
14:00
16:00
18:00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

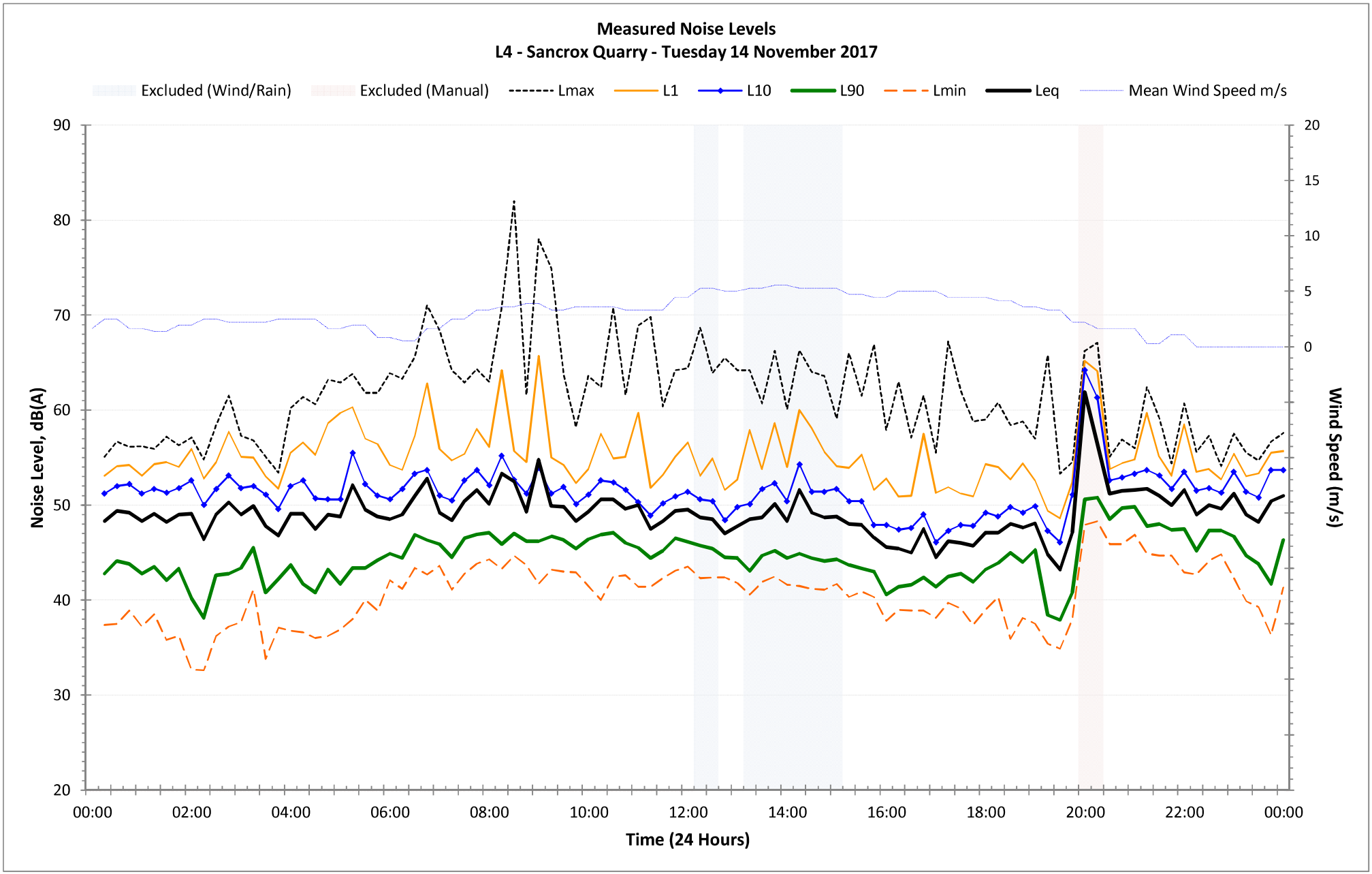

Measured Noise Levels
L4 - Sancrox Quarry - Thursday 9 November 2017
Excluded (Wind/Rain)
Excluded (Manual)
Lmax
L1
L10
L90
Lmin
Leq
Mean Wind Speed m/s
Noise Level, dB(A)
Wind Speed (m/s)
Time (24 Hours)
90
80
70
60
50
40
30
20
20
15
10
5
0
00:00
02:00
04:00
06:00
08:00
10:00
12:00
14:00
16:00
18:00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

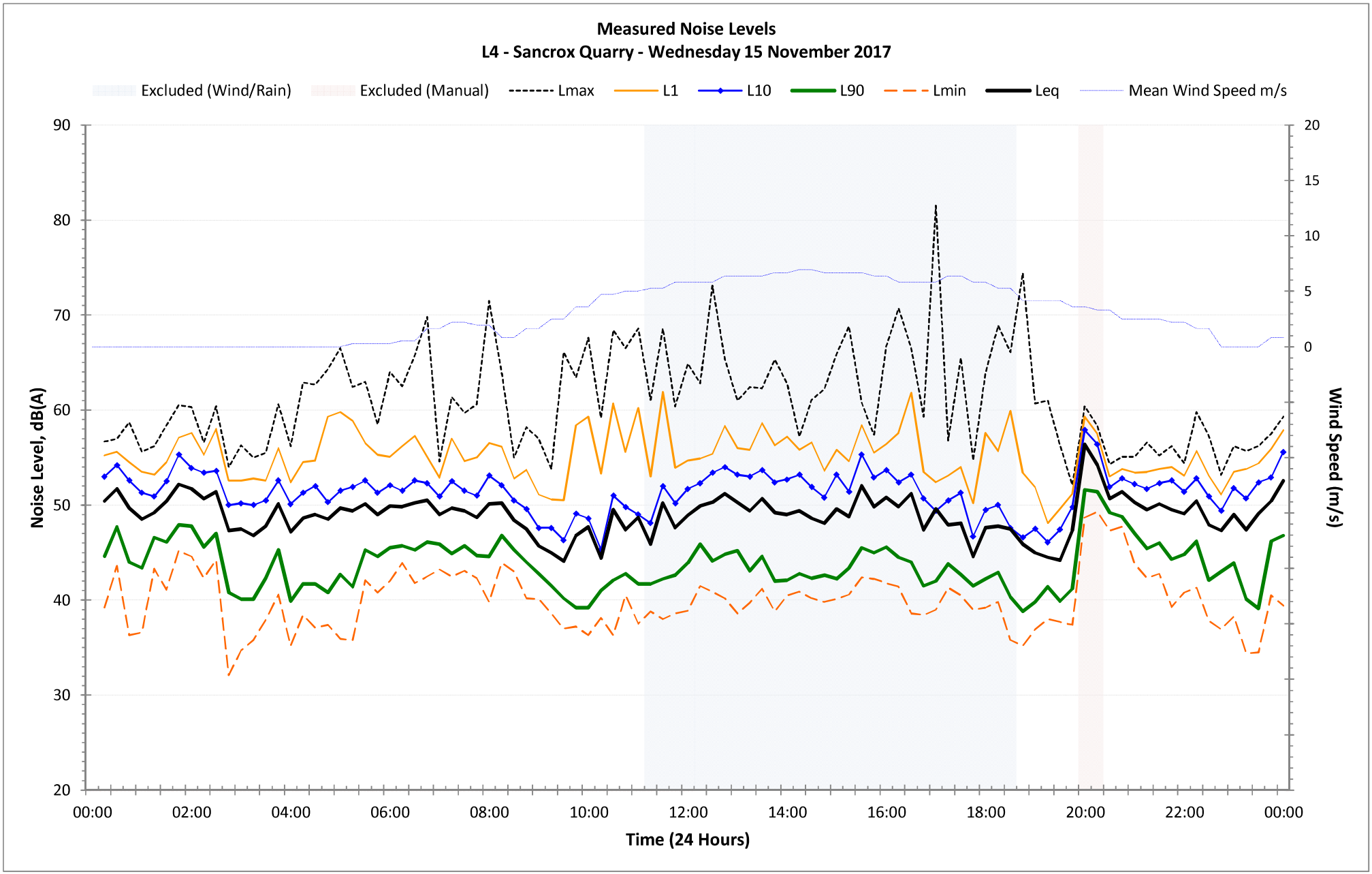

Measured Noise Levels
L4 - Sancrox Quarry - Friday 10 November 2017
Excluded (Wind/Rain)
Excluded (Manual)
Lmax
L1
L10
L90
Lmin
Leq
Mean Wind Speed m/s
Noise Level, dB(A)
Wind Speed (m/s)
Time (24 Hours)
90
80
70
60
50
40
30
20
20
15
10
5
0
00:00
02:00
04:00
06:00
08:00
10:00
12:00
14:00
16:00
18:00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

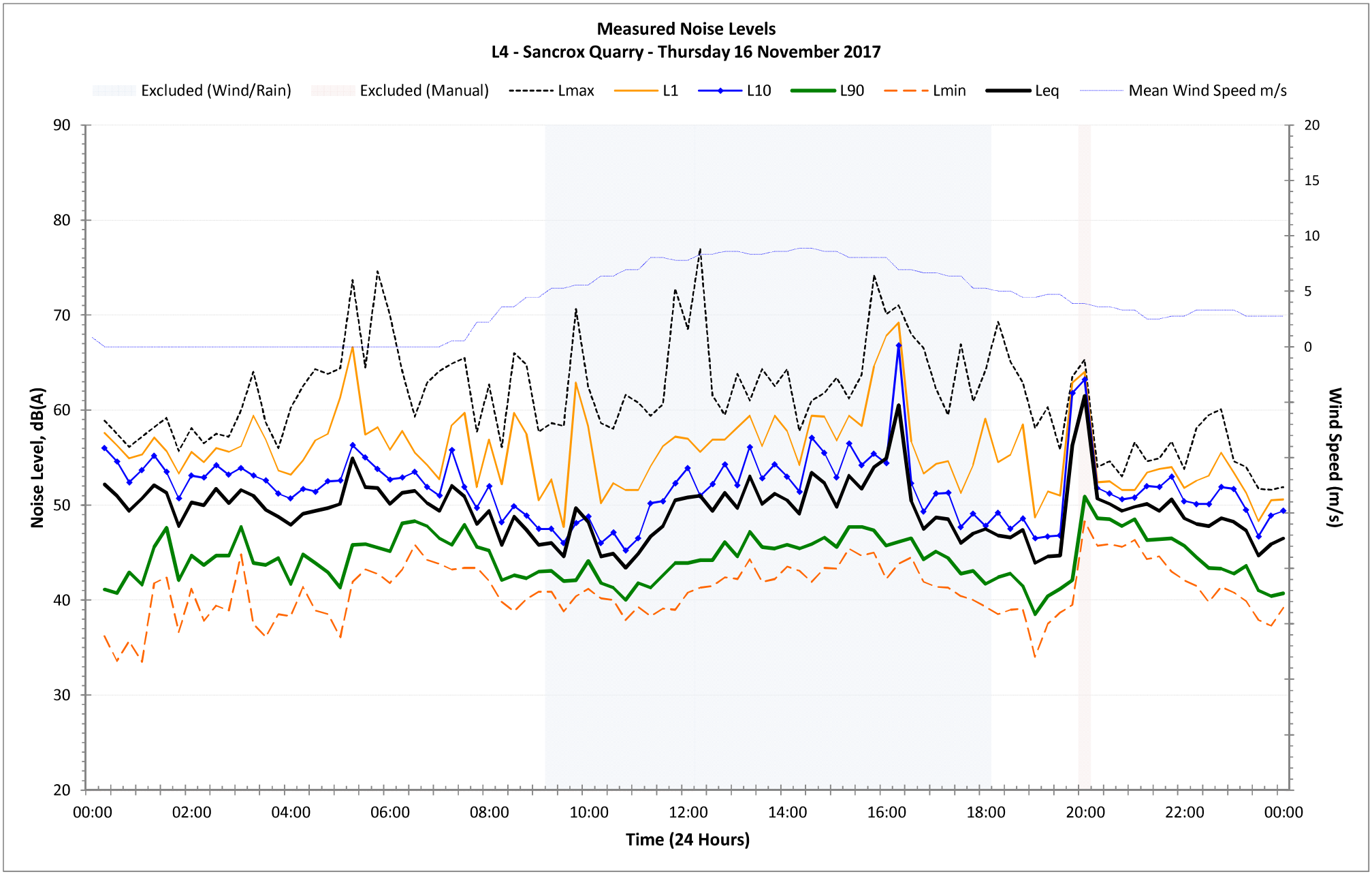

Measured Noise Levels
L4 - Sancrox Quarry - Saturday 11 November 2017
Excluded (Wind/Rain)
Excluded (Manual)
Lmax
L1
L10
L90
Lmin
Leq
Mean Wind Speed m/s
Noise Level, dB(A)
Wind Speed (m/s)
Time (24 Hours)
90
80
70
60
50
40
30
20
20
15
10
5
0
00:00
02:00
04:00
06:00
08:00
10:00
12:00
14:00
16:00
18:00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

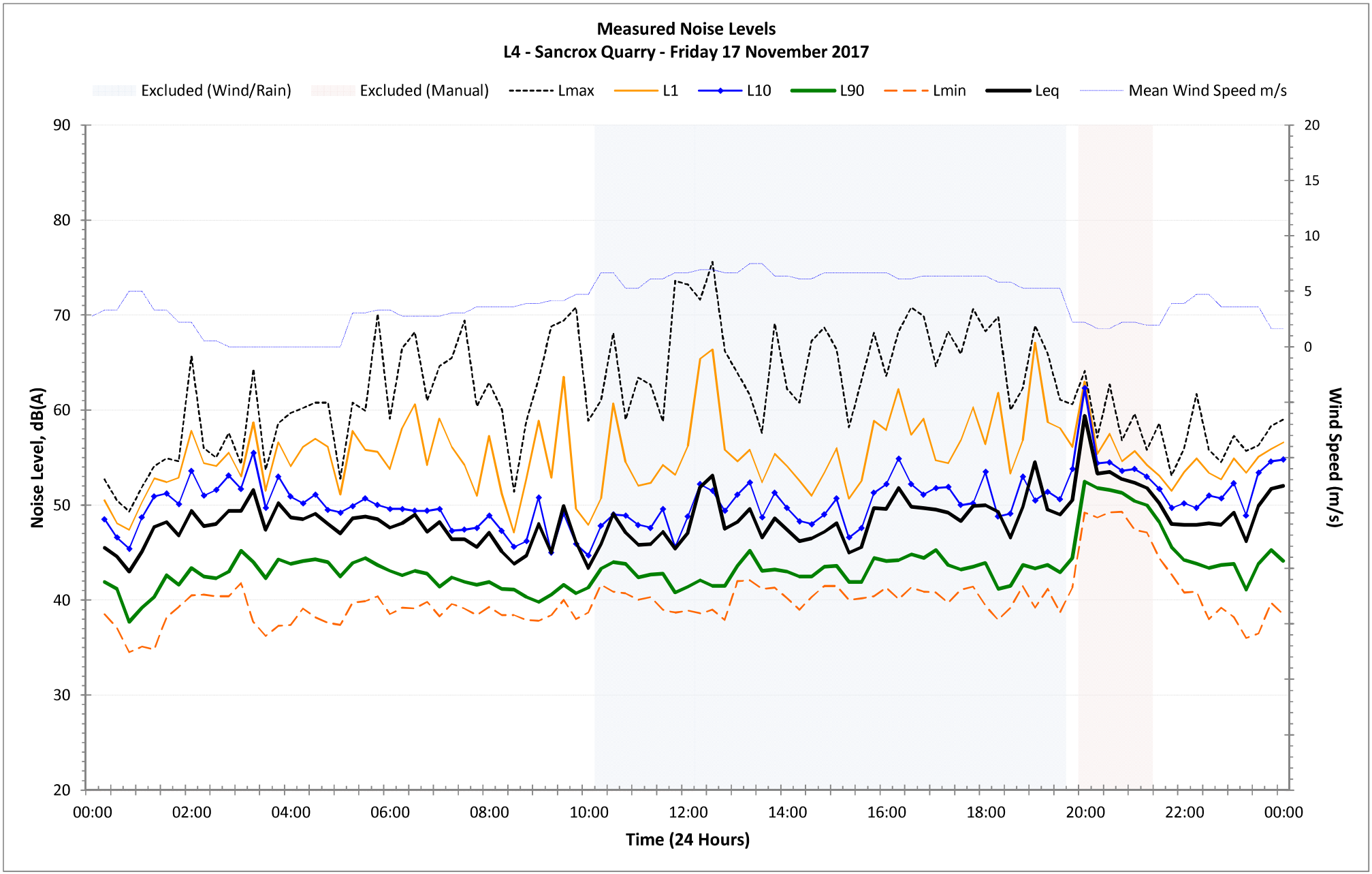

Measured Noise Levels
L4 - Sancrox Quarry - Sunday 12 November 2017
Excluded (Wind/Rain)
Excluded (Manual)
Lmax
L1
L10
L90
Lmin
Leq
Mean Wind Speed m/s
Noise Level, dB(A)
Wind Speed (m/s)
Time (24 Hours)
90
80
70
60
50
40
30
20
20
15
10
5
0
00:00
02:00
04:00
06:00
08:00
10:00
12:00
14:00
16:00
18:00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

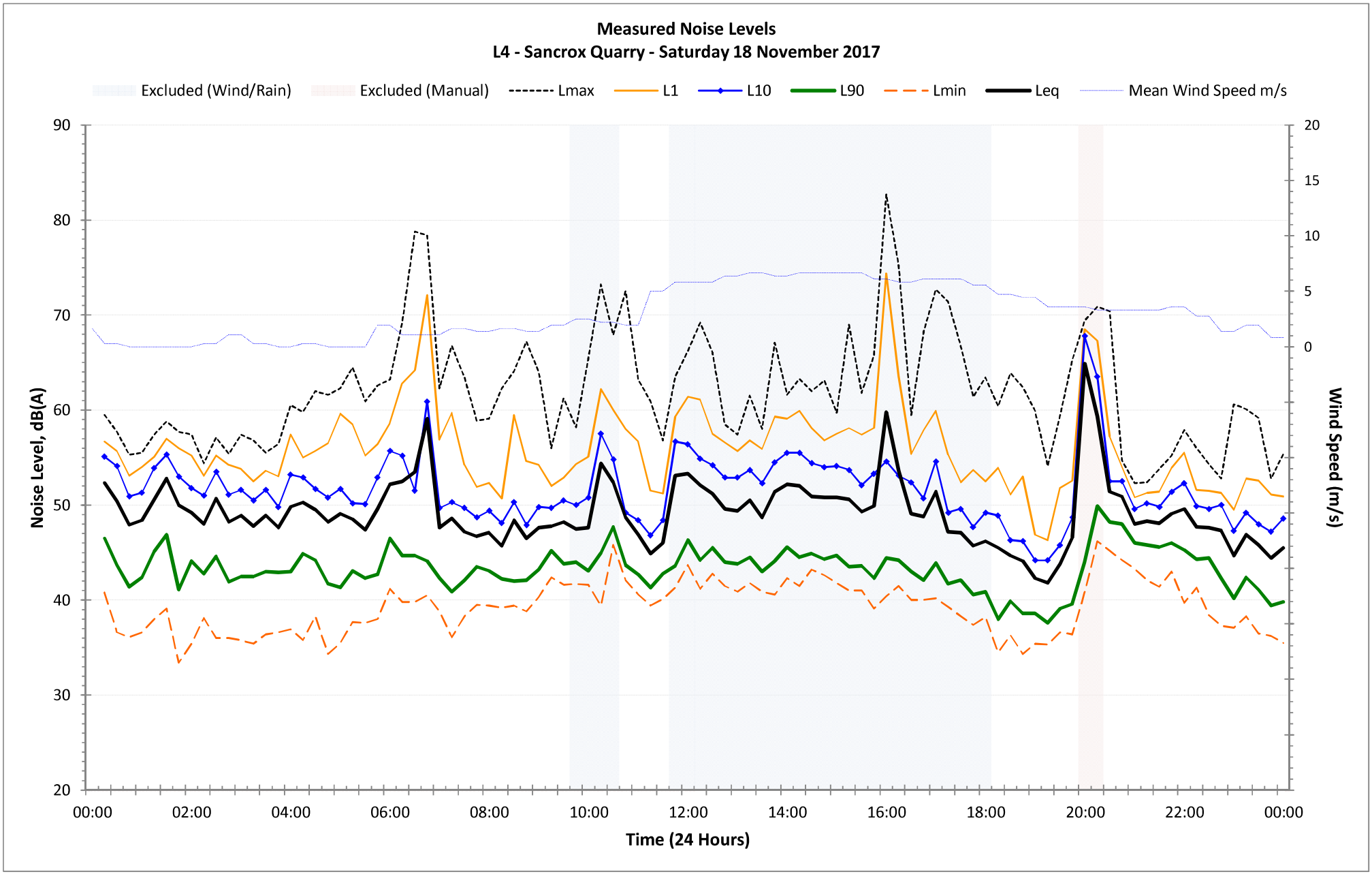

Measured Noise Levels
L4 - Sancrox Quarry - Monday 13 November 2017
Excluded (Wind/Rain)
Excluded (Manual)
Lmax
L1
L10
L90
Lmin
Leq
Mean Wind Speed m/s
Noise Level, dB(A)
Wind Speed (m/s)
Time (24 Hours)
90
80
70
60
50
40
30
20
20
15
10
5
0
00:00
02:00
04:00
06:00
08:00
10:00
12:00
14:00
16:00
18:00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

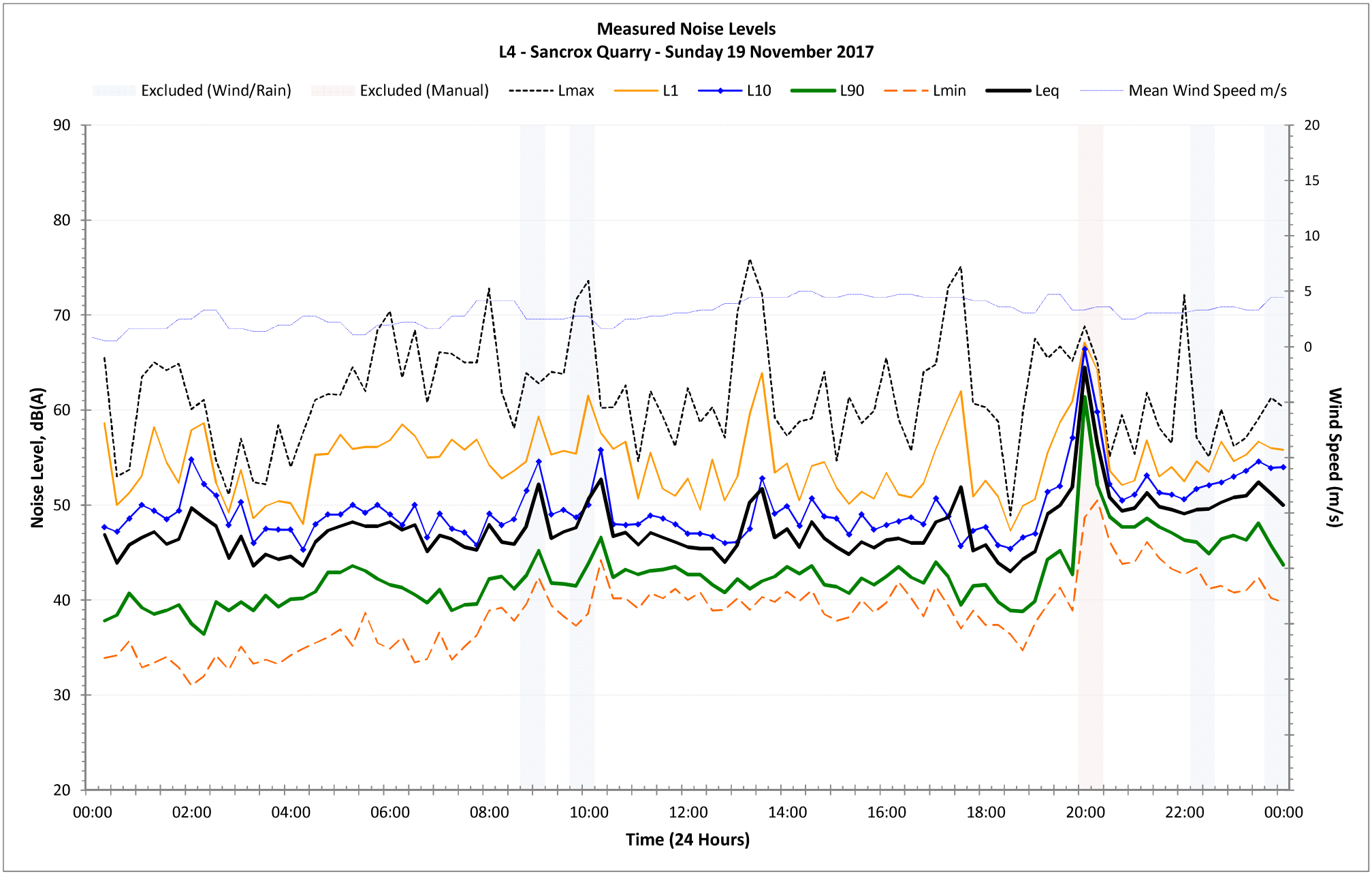

Measured Noise Levels
L4 - Sancrox Quarry - Tuesday 14 November 2017
Excluded (Wind/Rain)
Excluded (Manual)
Lmax
L1
L10
L90
Lmin
Leq
Mean Wind Speed m/s
Noise Level, dB(A)
Wind Speed (m/s)
Time (24 Hours)
90
80
70
60
50
40
30
20
20
15
10
5
0
00:00
02:00
04:00
06:00
08:00
10:00
12:00
14:00
16:00
18:00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

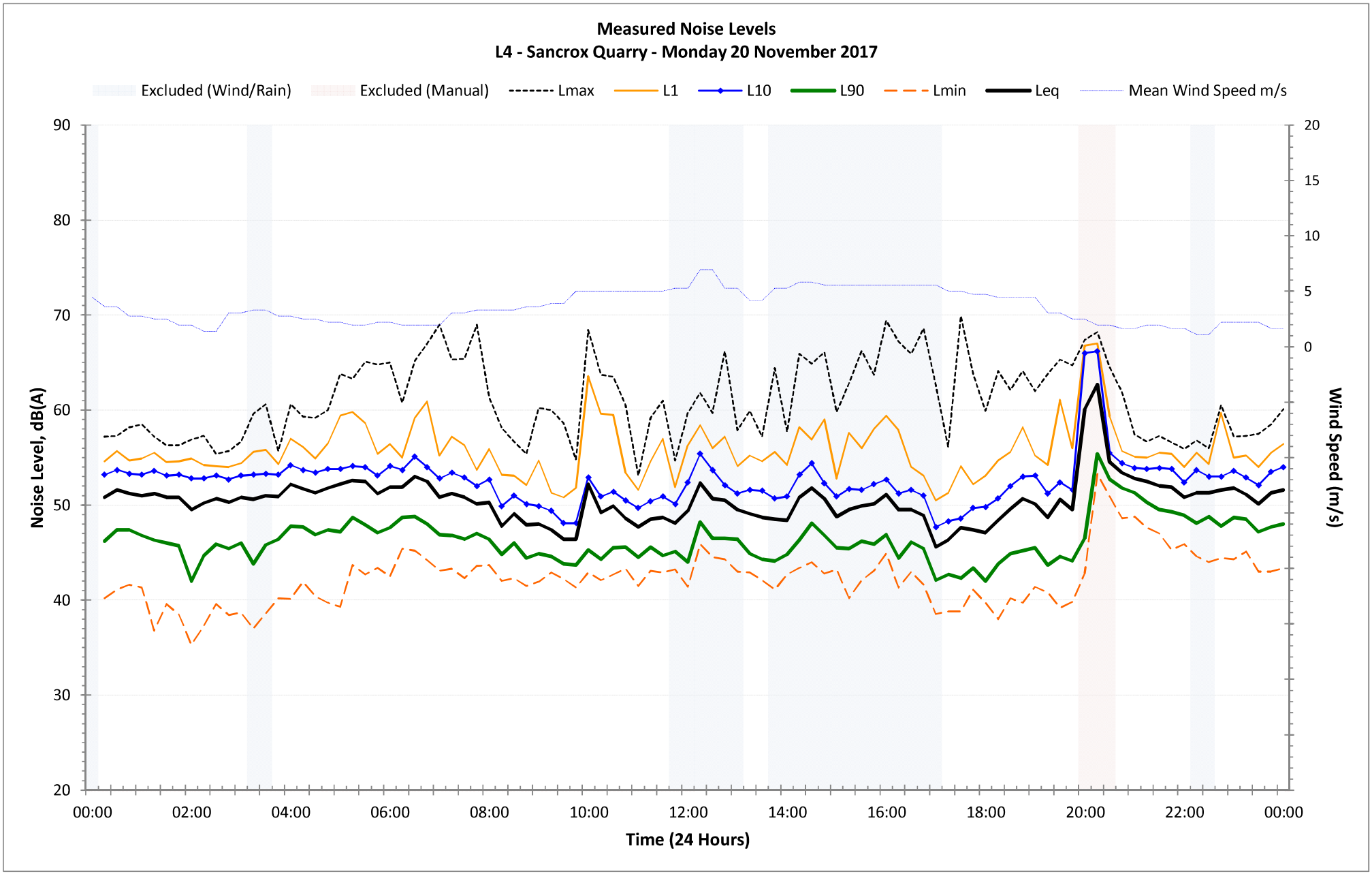

Measured Noise Levels
L4 - Sancrox Quarry - Wednesday 15 November 2017
Excluded (Wind/Rain)
Excluded (Manual)
Lmax
L1
L10
L90
Lmin
Leq
Mean Wind Speed m/s
Noise Level, dB(A)
Wind Speed (m/s)
Time (24 Hours)
90
80
70
60
50
40
30
20
20
15
10
5
0
00:00
02:00
04:00
06:00
08:00
10:00
12:00
14:00
16:00
18:00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

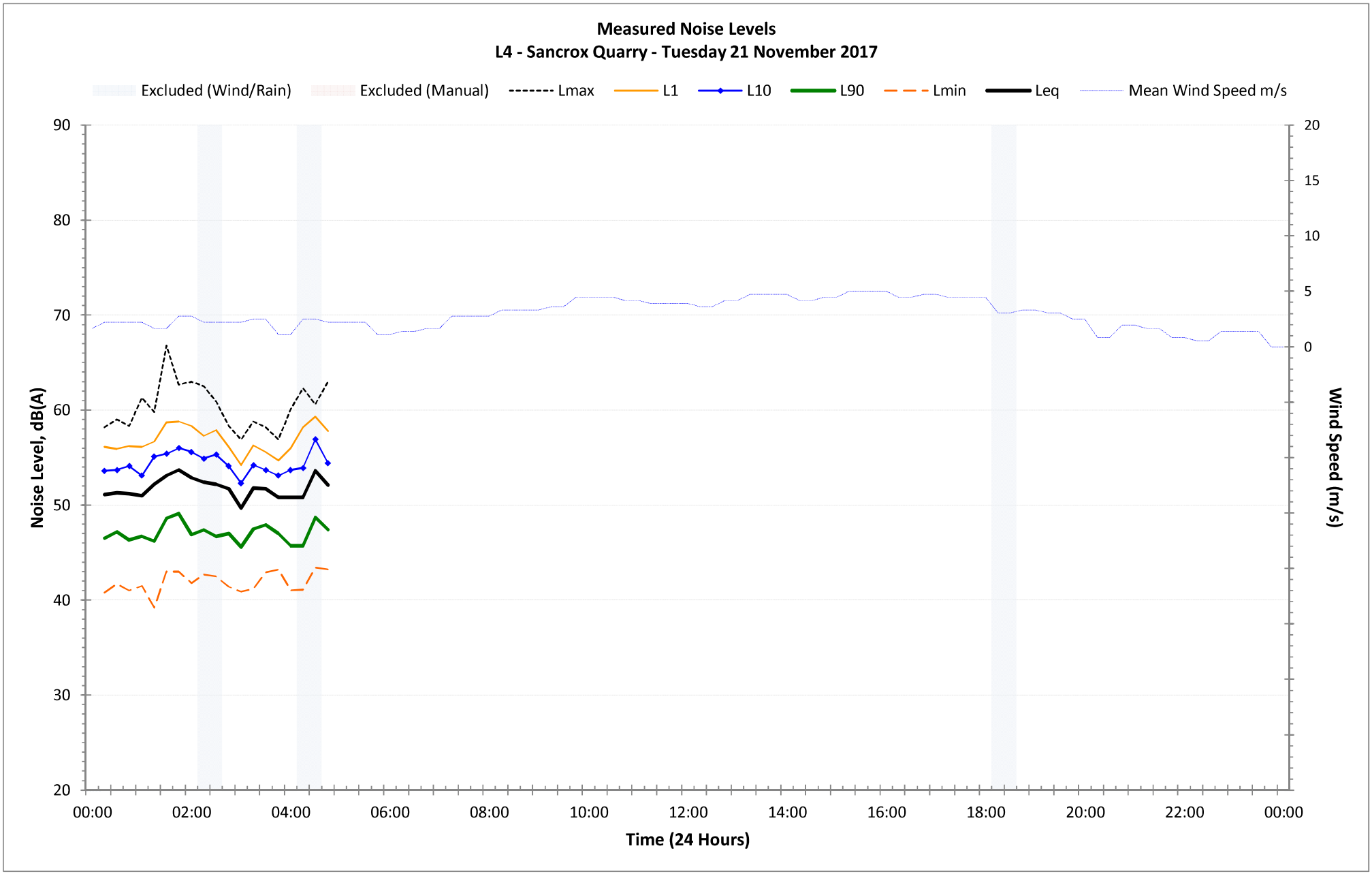

Measured Noise Levels
L4 - Sancrox Quarry - Thursday 16 November 2017
Excluded (Wind/Rain)
Excluded (Manual)
Lmax
L1
L10
L90
Lmin
Leq
Mean Wind Speed m/s
Noise Level, dB(A)
Wind Speed (m/s)
Time (24 Hours)
90
80
70
60
50
40
30
20
20
15
10
5
0
00:00
02:00
04:00
06:00
08:00
10:00
12:00
14:00
16:00
18:00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

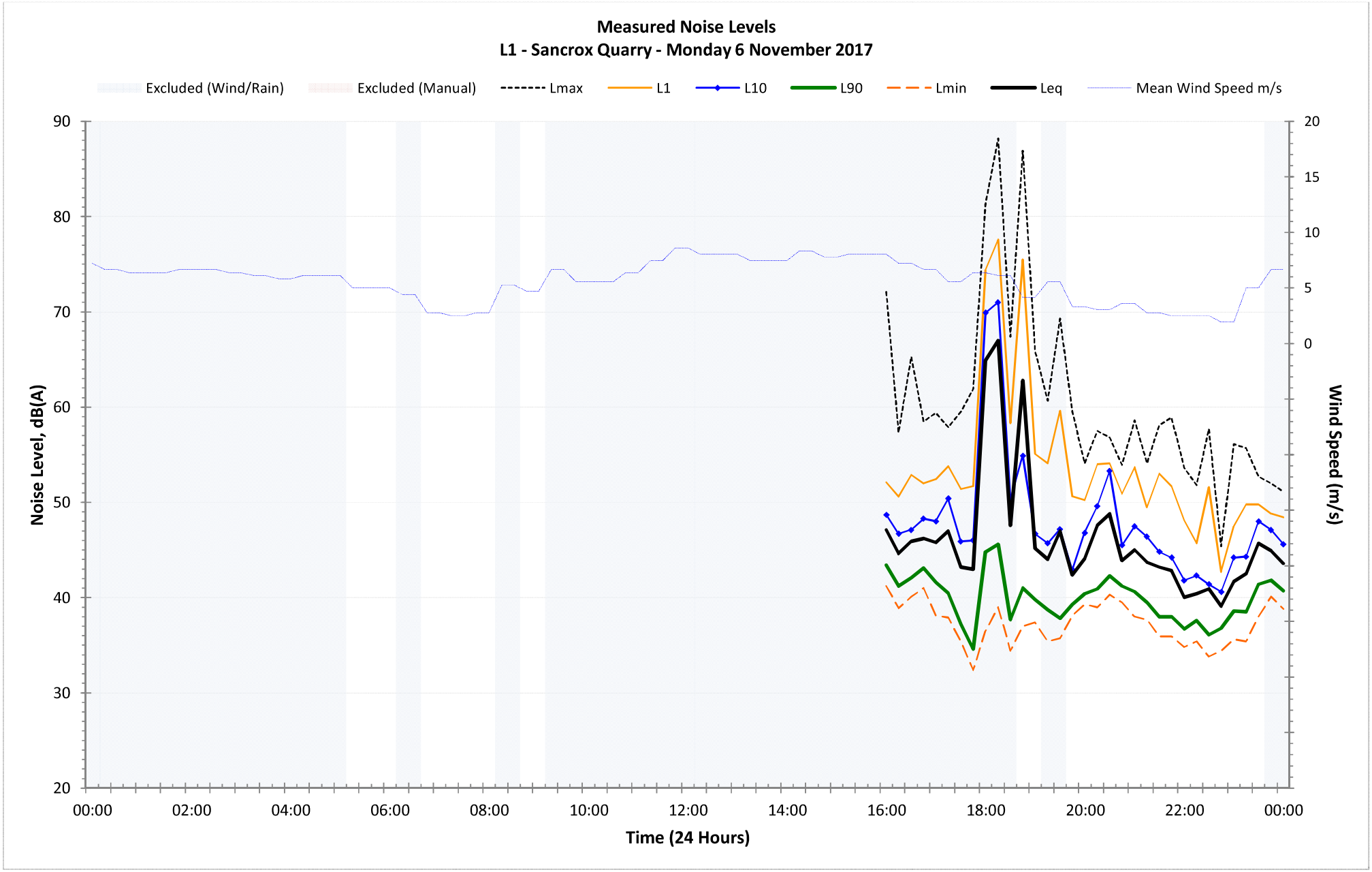

Measured Noise Levels
L4 - Sancrox Quarry - Friday 17 November 2017
Excluded (Wind/Rain)
Excluded (Manual)
Lmax
L1
L10
L90
Lmin
Leq
Mean Wind Speed m/s
Noise Level, dB(A)
Wind Speed (m/s)
Time (24 Hours)
90
80
70
60
50
40
30
20
20
15
10
5
0
00:00
02:00
04:00
06:00
08:00
10:00
12:00
14:00
16:00
18:00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

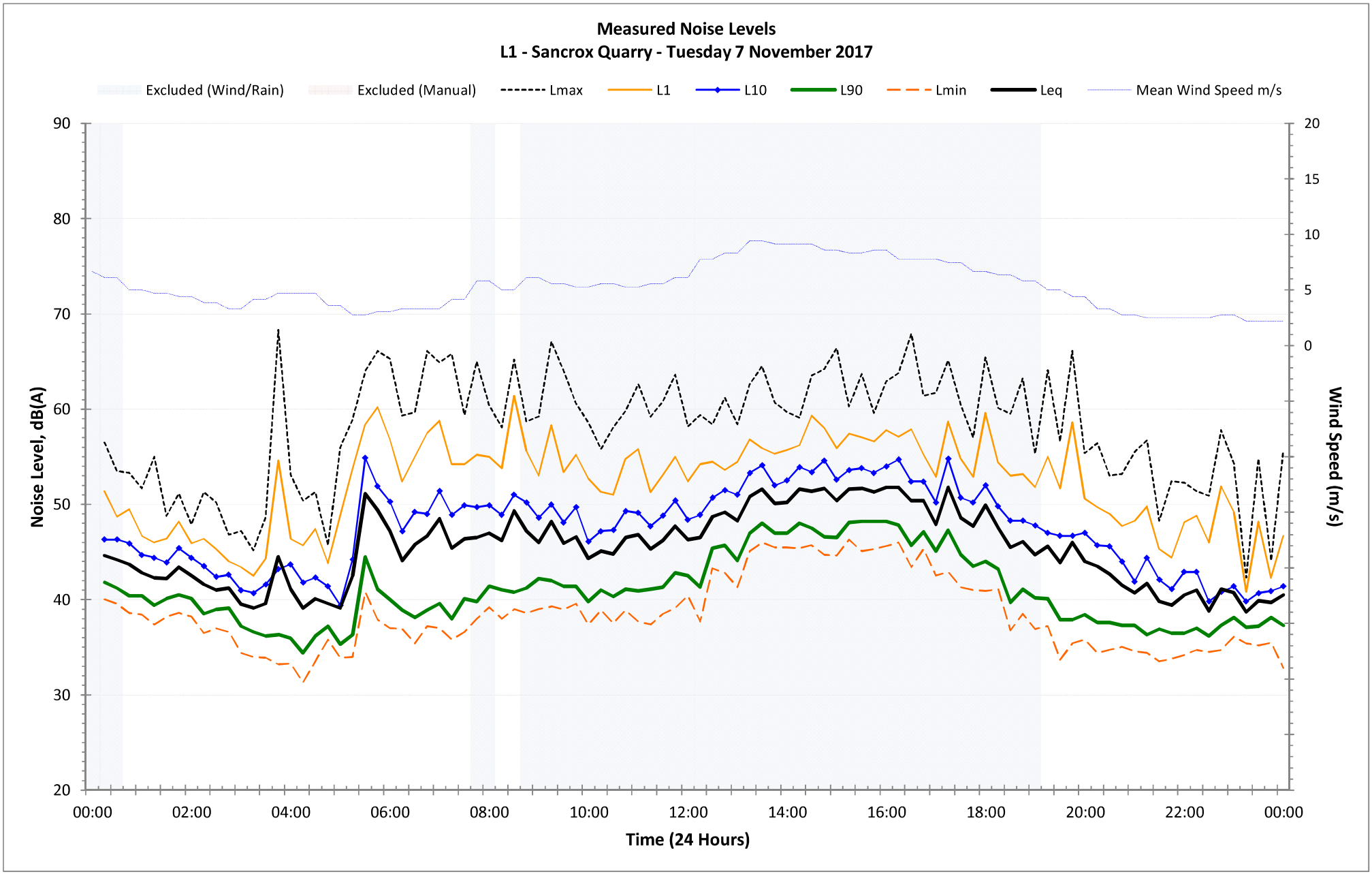

Measured Noise Levels
L4 - Sancrox Quarry - Saturday 18 November 2017
Excluded (Wind/Rain)
Excluded (Manual)
Lmax
L1
L10
L90
Lmin
Leq
Mean Wind Speed m/s
Noise Level, dB(A)
Wind Speed (m/s)
Time (24 Hours)
90
80
70
60
50
40
30
20
20
15
10
5
0
00:00
02:00
04:00
06:00
08:00
10:00
12:00
14:00
16:00
18:00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

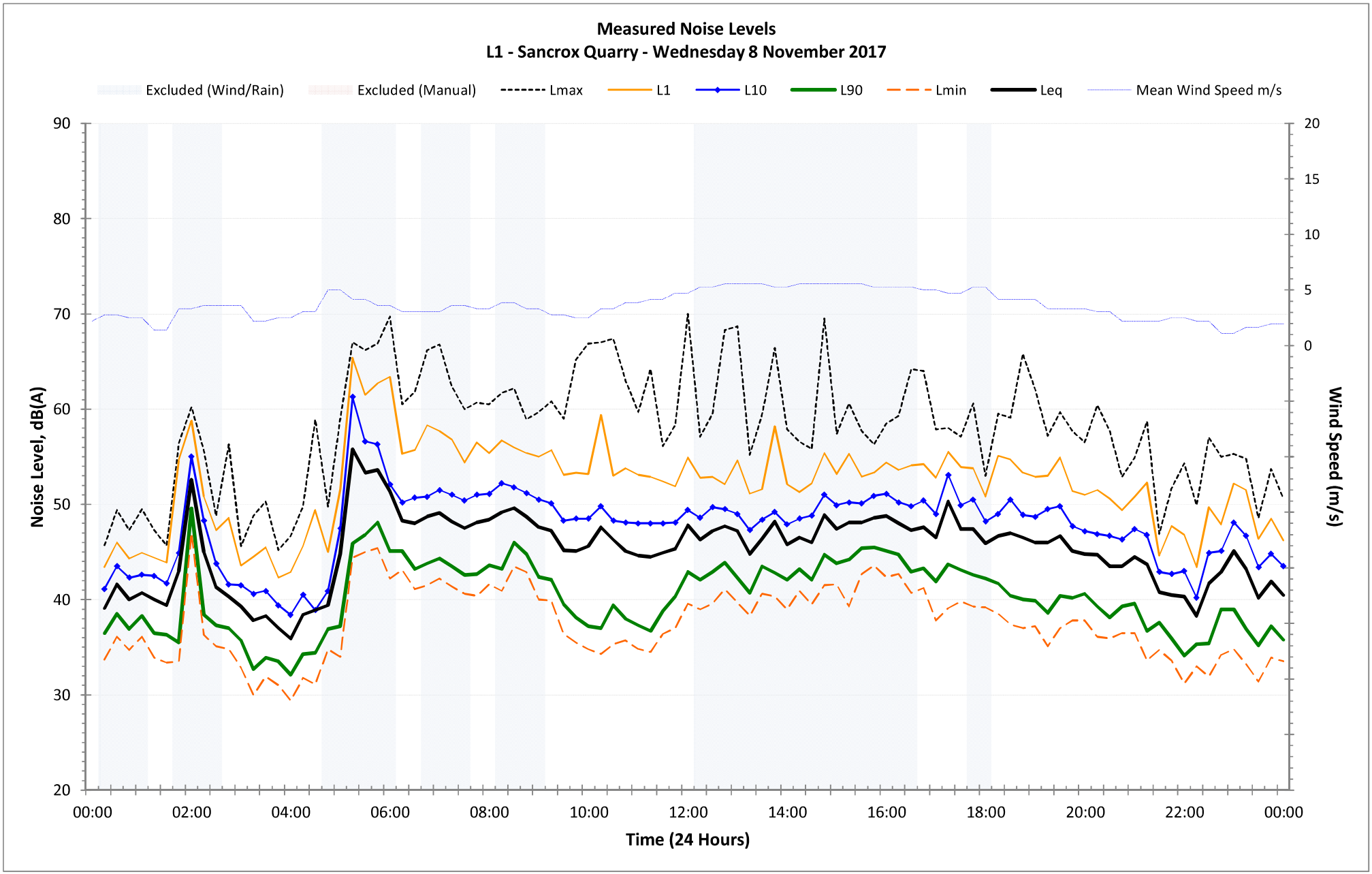

Measured Noise Levels
L4 - Sancrox Quarry - Sunday 19 November 2017
Excluded (Wind/Rain)
Excluded (Manual)
Lmax
L1
L10
L90
Lmin
Leq
Mean Wind Speed m/s
Noise Level, dB(A)
Wind Speed (m/s)
Time (24 Hours)
90
80
70
60
50
40
30
20
20
15
10
5
0
00:00
02:00
04:00
06:00
08:00
10:00
12:00
14:00
16:00
18:00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

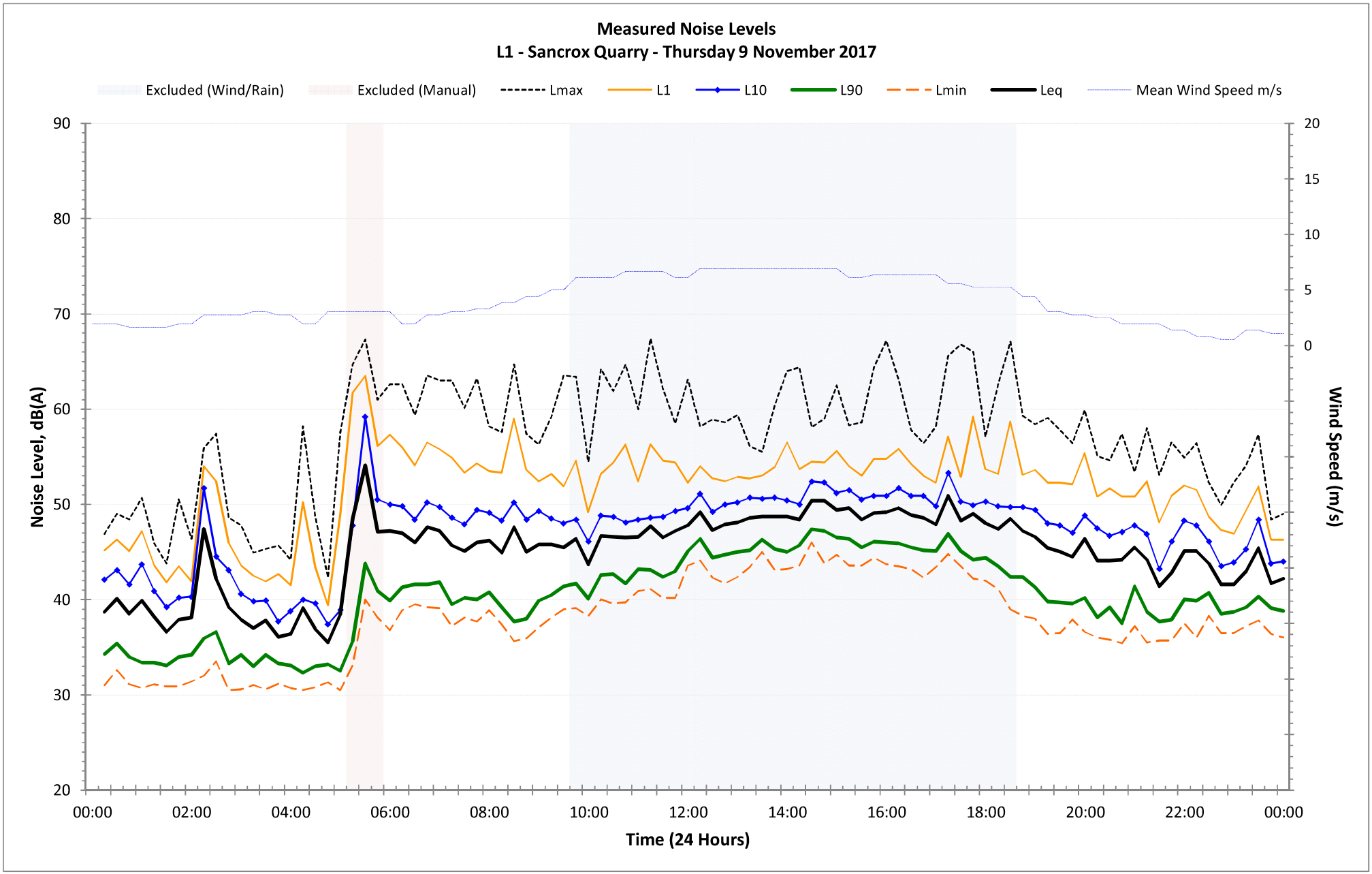

Measured Noise Levels
L4 - Sancrox Quarry - Monday 20 November 2017
Excluded (Wind/Rain)
Excluded (Manual)
Lmax
L1
L10
L90
Lmin
Leq
Mean Wind Speed m/s
Noise Level, dB(A)
Wind Speed (m/s)
Time (24 Hours)
90
80
70
60
50
40
30
20
20
15
10
5
0
00:00
02:00
04:00
06:00
08:00
10:00
12:00
14:00
16:00
18:00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

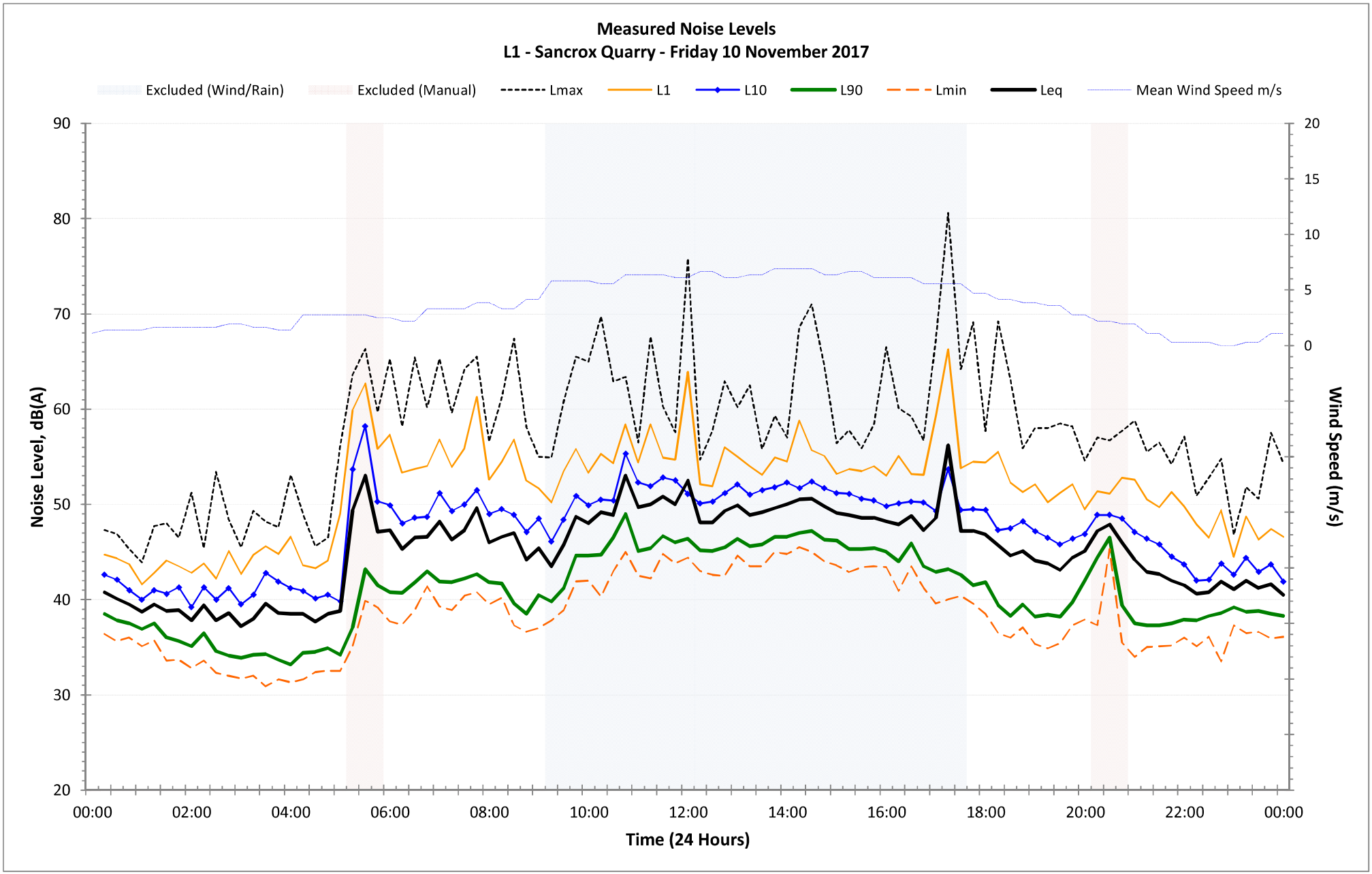

Measured Noise Levels
L4 - Sancrox Quarry - Tuesday 21 November 2017
Excluded (Wind/Rain)
Excluded (Manual)
Lmax
L1
L10
L90
Lmin
Leq
Mean Wind Speed m/s
Noise Level, dB(A)
Wind Speed (m/s)
Time (24 Hours)
90
80
70
60
50
40
30
20
20
15
10
5
0
00:00
02:00
04:00
06:00
08:00
10:00
12:00
14:00
16:00
18:00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

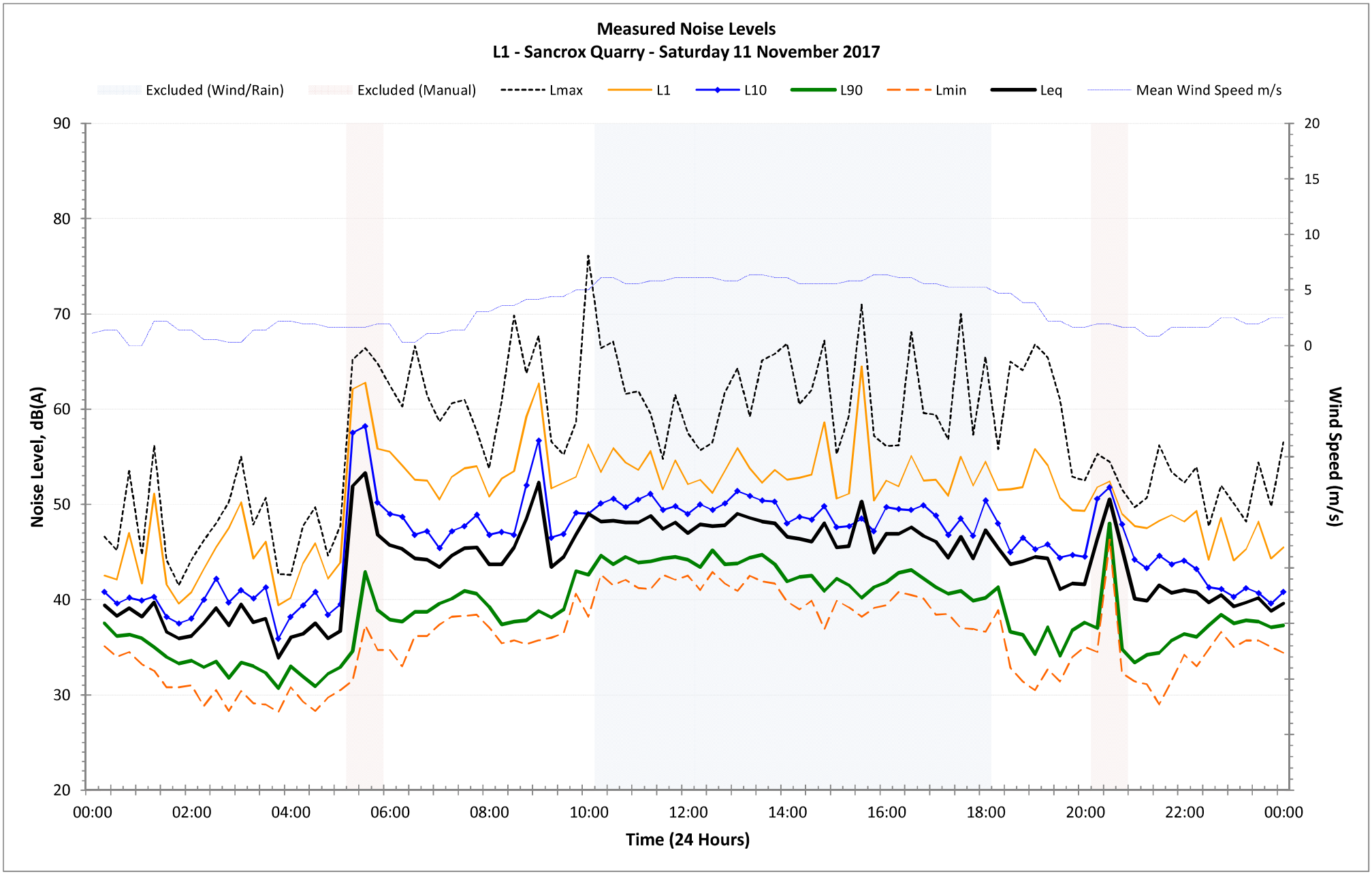

Measured Noise Levels
L1 - Sancrox Quarry - Monday 6 November 2017
Excluded (Wind/Rain)
Excluded (Manual)
Lmax
L1
L10
L90
Lmin
Leq
Mean Wind Speed m/s
Noise Level, dB(A)
Wind Speed (m/s)
Time (24 Hours)
90
80
70
60
50
40
30
20
20
15
10
5
0
00:00
02:00
04:00
06:00
08:00
10:00
12:00
14:00
16:00
18:00
20:00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

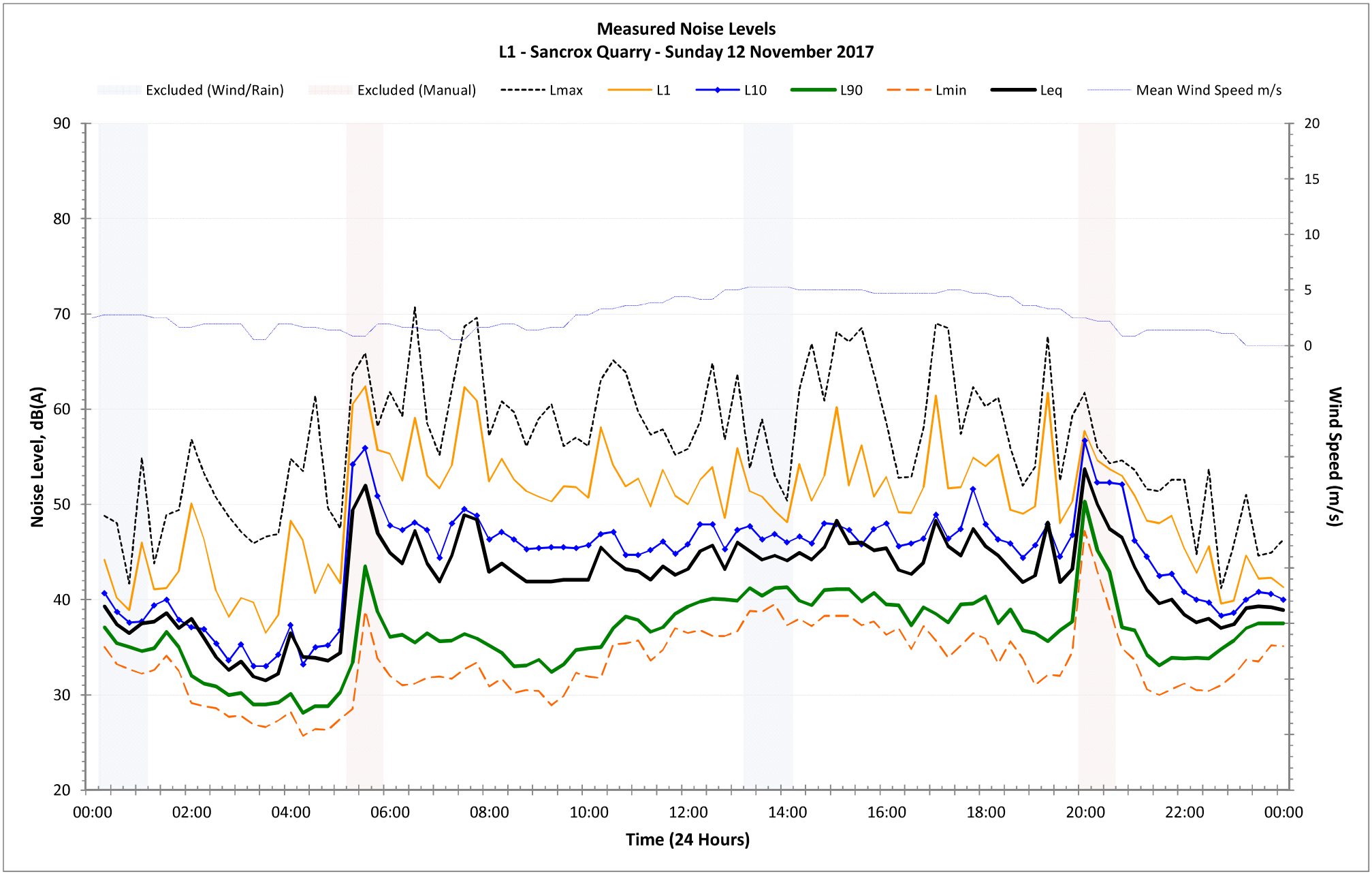

Measured Noise Levels
L1 - Sancrox Quarry - Tuesday 7 November 2017
Excluded (Wind/Rain)
Excluded (Manual)
Lmax
L1
L10
L90
Lmin
Leq
Mean Wind Speed m/s
Noise Level, dB(A)
Wind Speed (m/s)
Time (24 Hours)
90
80
70
60
50
40
30
20
20
15
10
5
0
00:00
02:00
04:00
06:00
08:00
10:00
12:00
14:00
16:00
18:00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

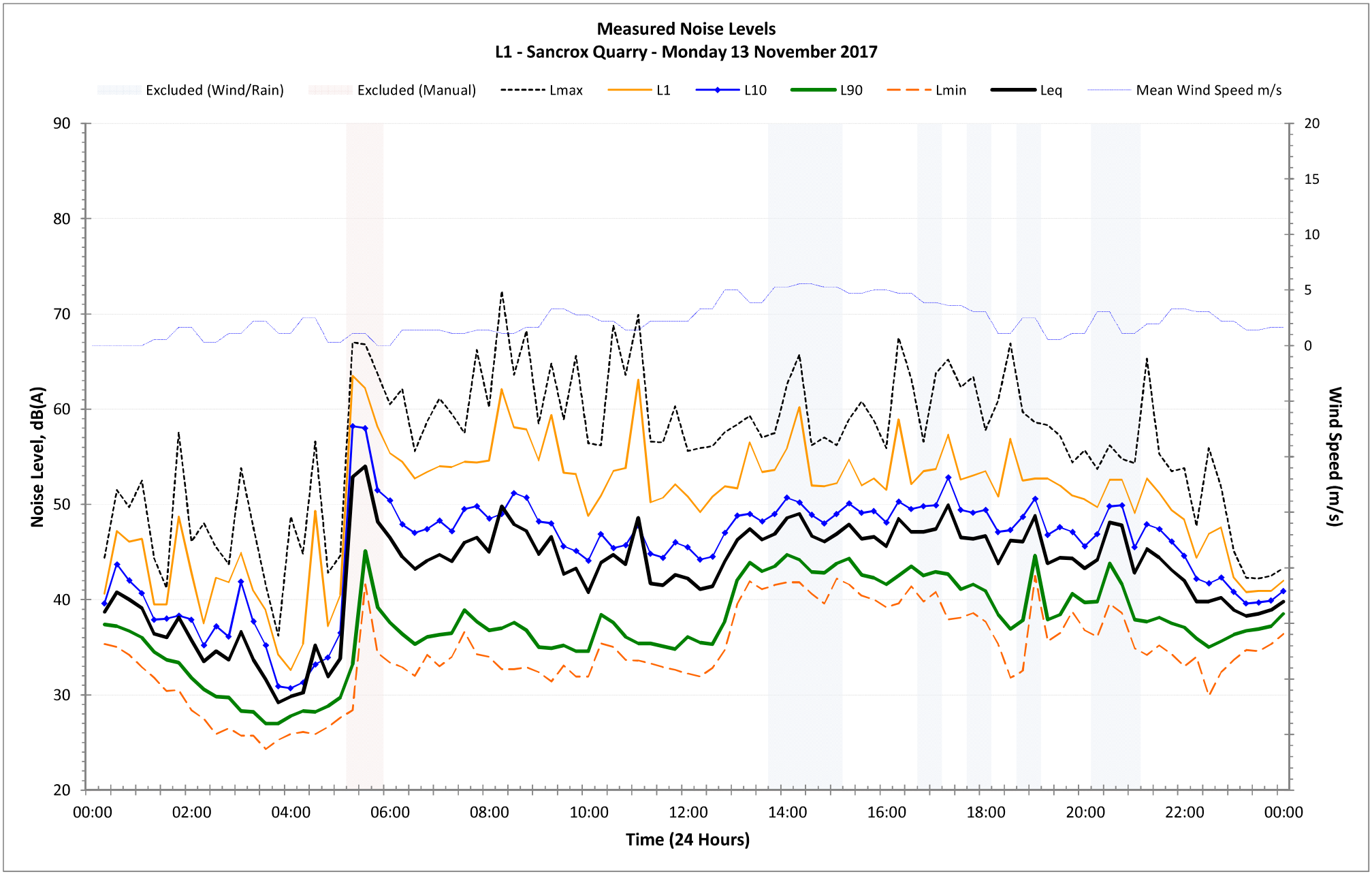

Measured Noise Levels
L1 - Sancrox Quarry - Wednesday 8 November 2017
Excluded (Wind/Rain)
Excluded (Manual)
Lmax
L1
L10
L90
Lmin
Leq
Mean Wind Speed m/s
Noise Level, dB(A)
Wind Speed (m/s)
Time (24 Hours)
90
80
70
60
50
40
30
20
20
15
10
5
0
00:00
02:00
04:00
06:00
08:00
10:00
12:00
14:00
16:00
18:00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

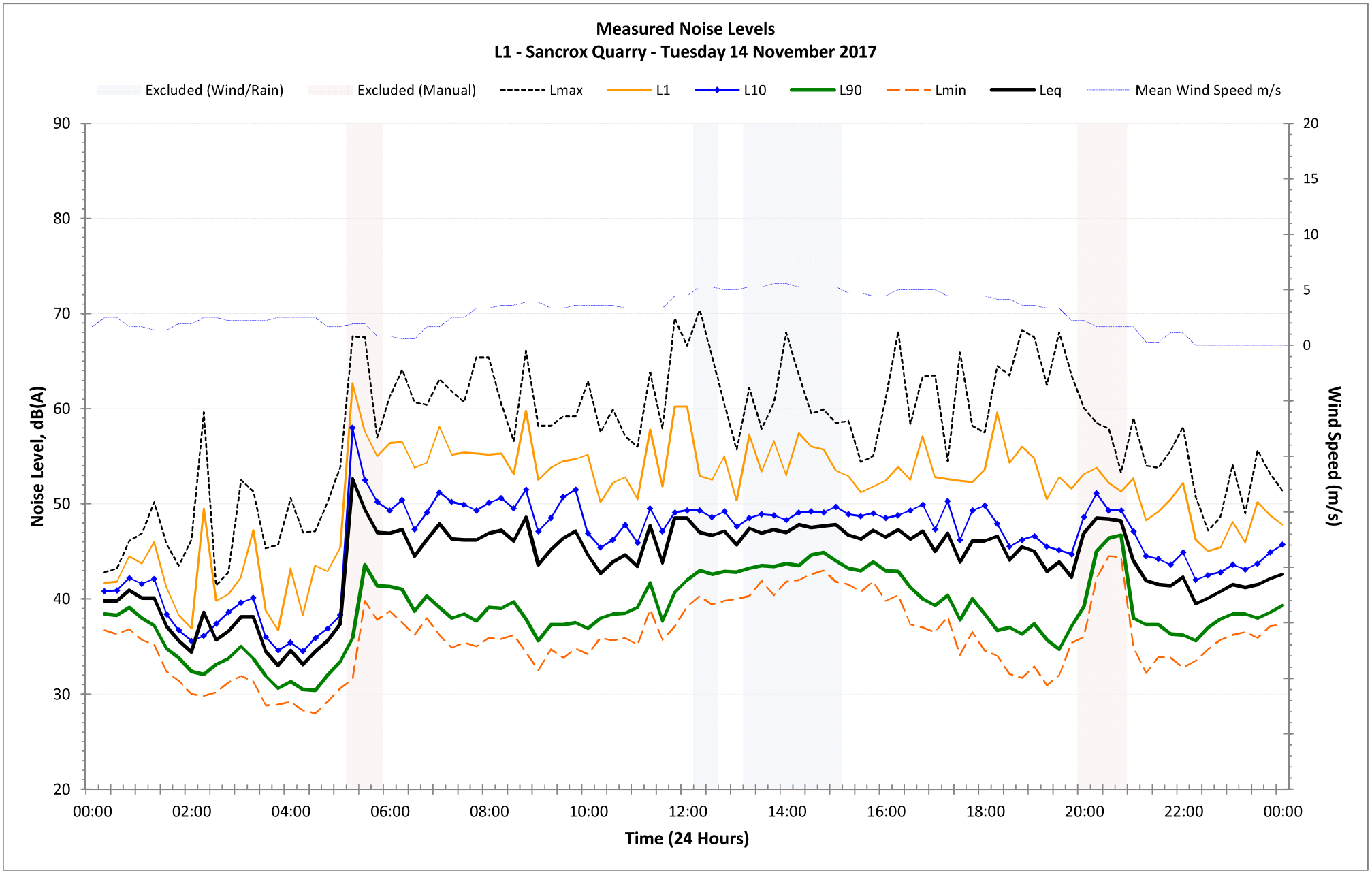

Measured Noise Levels
L1 - Sancrox Quarry - Thursday 9 November 2017
Excluded (Wind/Rain)
Excluded (Manual)
Lmax
L1
L10
L90
Lmin
Leq
Mean Wind Speed m/s
Noise Level, dB(A)
Wind Speed (m/s)
Time (24 Hours)
90
80
70
60
50
40
30
20
20
15
10
5
0
00:00
02:00
04:00
06:00
08:00
10:00
12:00
14:00
16:00
18:00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

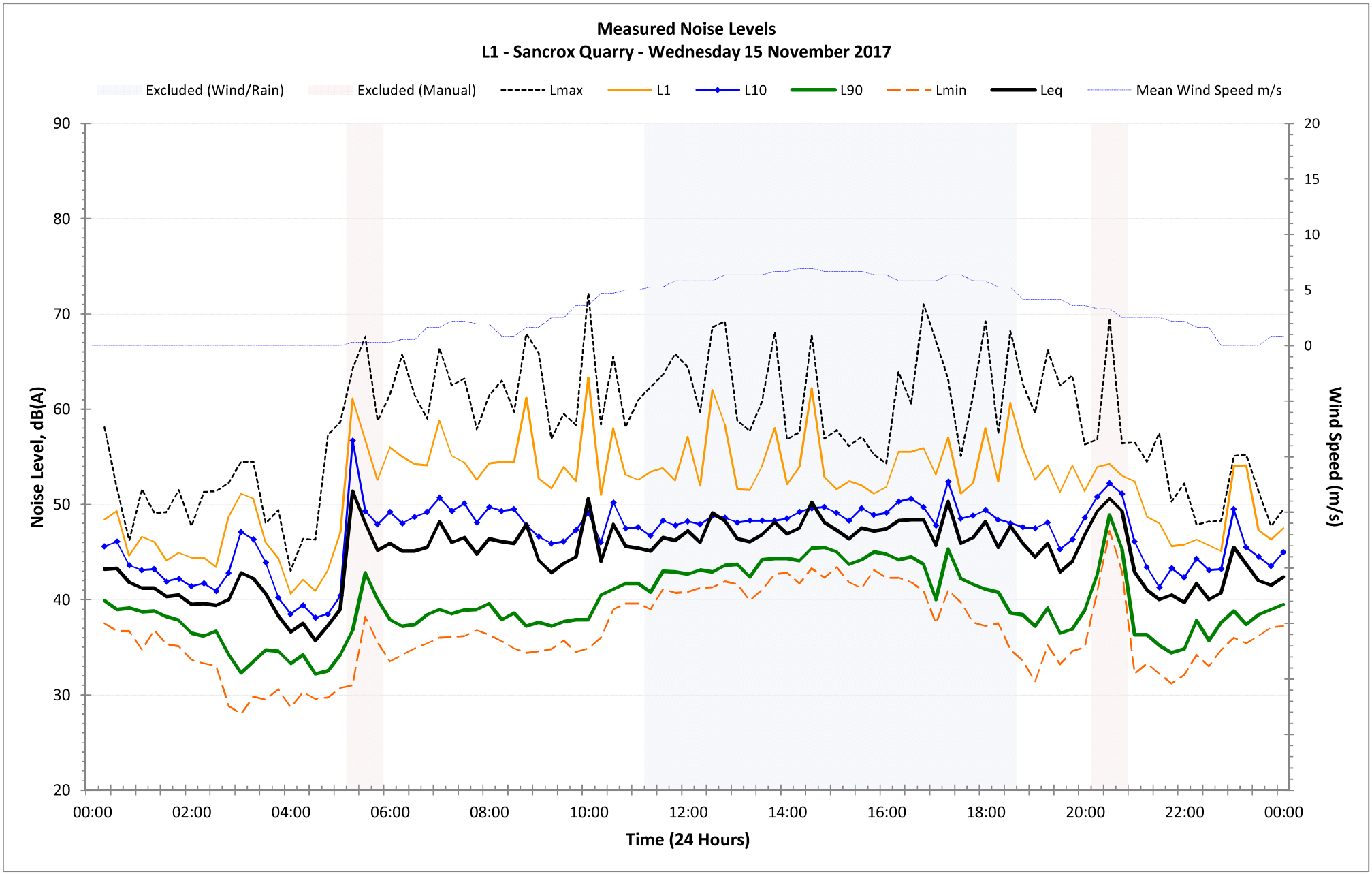

Measured Noise Levels
L1 - Sancrox Quarry - Friday 10 November 2017
Excluded (Wind/Rain)
Excluded (Manual)
Lmax
L1
L10
L90
Lmin
Leq
Mean Wind Speed m/s
Noise Level, dB(A)
Wind Speed (m/s)
Time (24 Hours)
90
80
70
60
50
40
30
20
20
15
10
5
0
00:00
02:00
04:00
06:00
08:00
10:00
12:00
14:00
16:00
18:00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

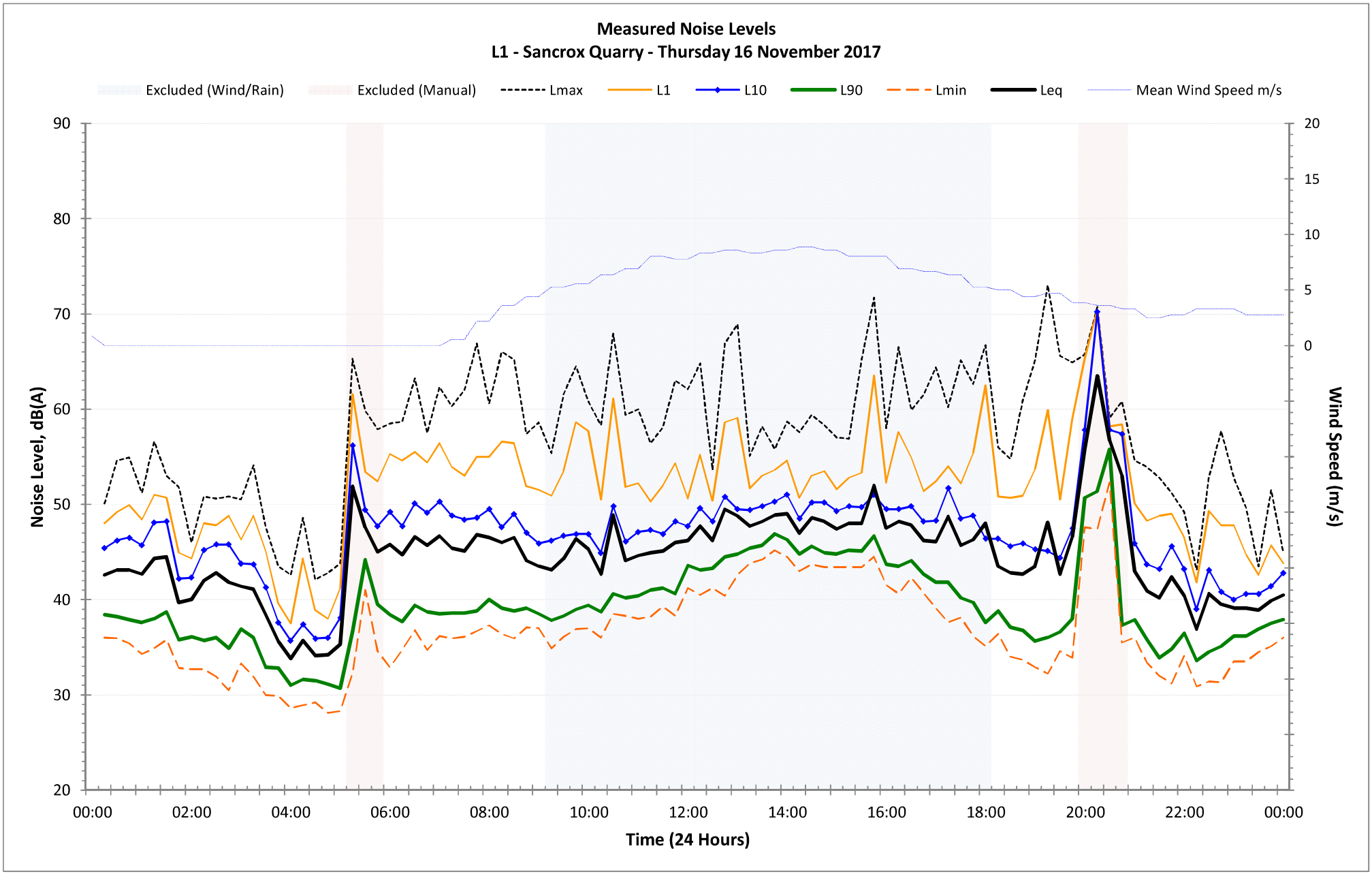

Measured Noise Levels
L1 - Sancrox Quarry - Saturday 11 November 2017
Excluded (Wind/Rain)
Excluded (Manual)
Lmax
L1
L10
L90
Lmin
Leq
Mean Wind Speed m/s
Noise Level, dB(A)
Wind Speed (m/s)
Time (24 Hours)
90
80
70
60
50
40
30
20
20
15
10
5
0
00:00
02:00
04:00
06:00
08:00
10:00
12:00
14:00
16:00
18:00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

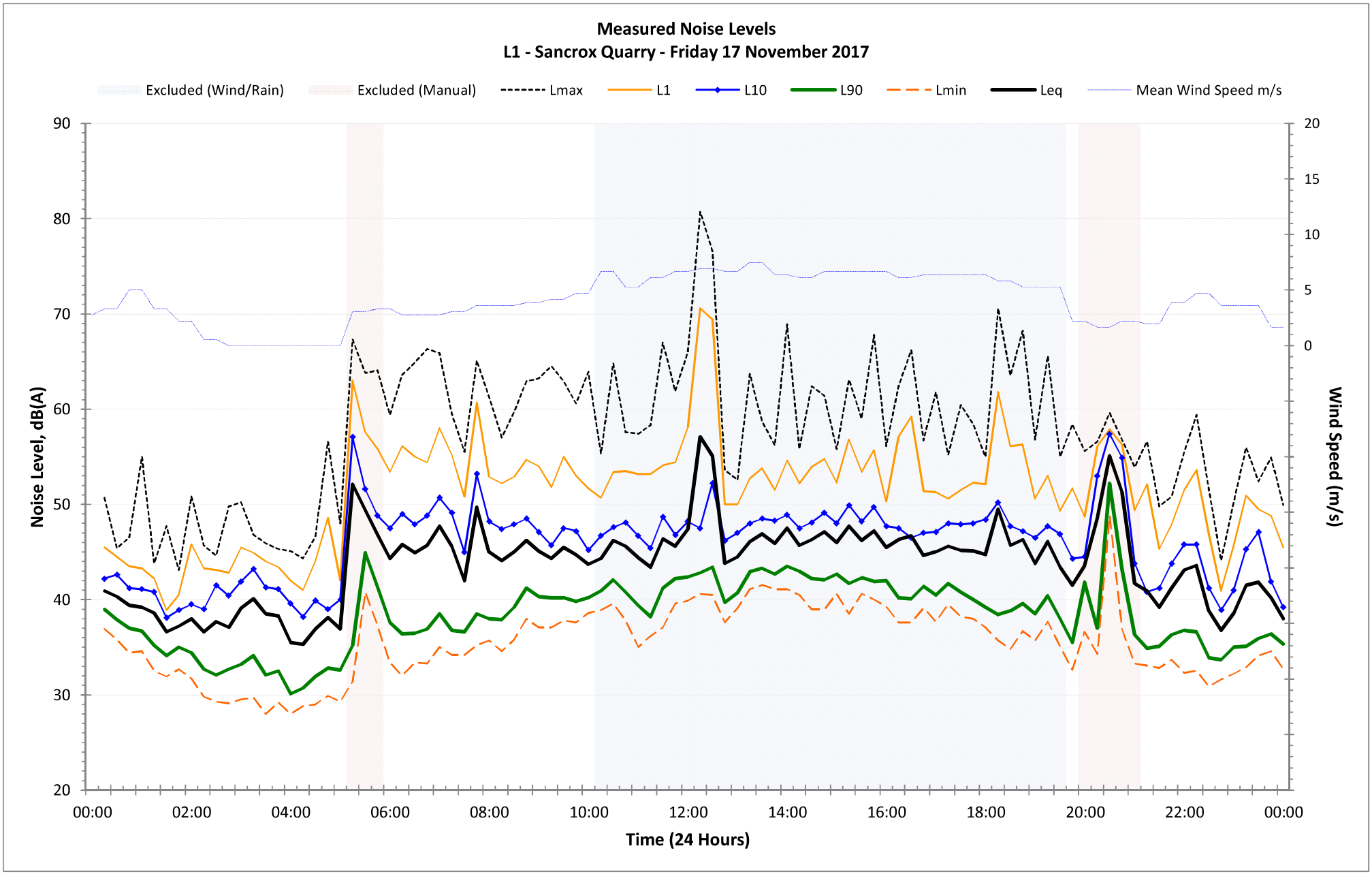

Measured Noise Levels
L1 - Sancrox Quarry - Sunday 12 November 2017
Excluded (Wind/Rain)
Excluded (Manual)
Lmax
L1
L10
L90
Lmin
Leq
Mean Wind Speed m/s
Noise Level, dB(A)
Wind Speed (m/s)
Time (24 Hours)
90
80
70
60
50
40
30
20
20
15
10
5
0
00:00
02:00
04:00
06:00
08:00
10:00
12:00
14:00
16:00
18:00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

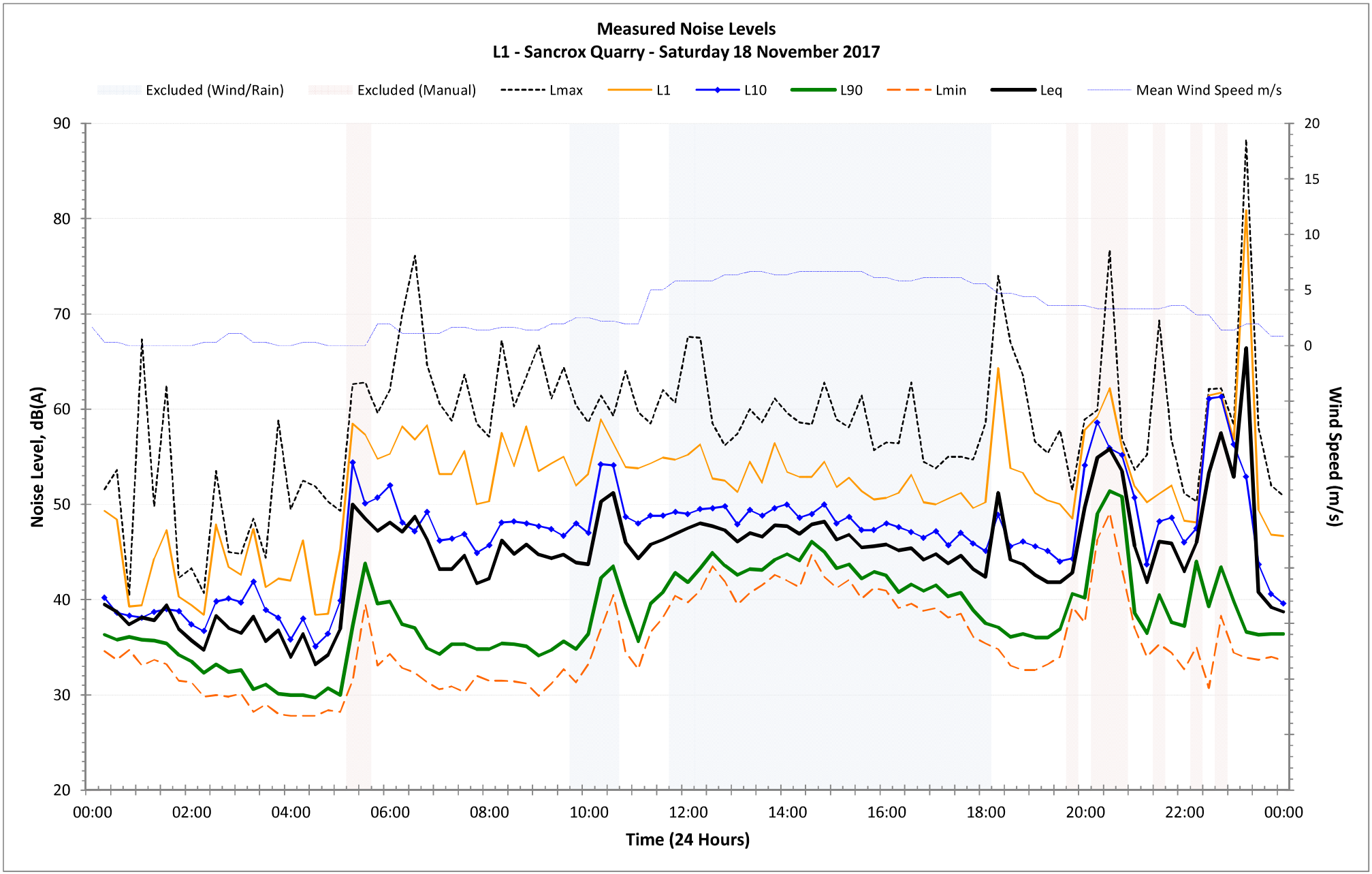

Measured Noise Levels
L1 - Sancrox Quarry - Monday 13 November 2017
Excluded (Wind/Rain)
Excluded (Manual)
Lmax
L1
L10
L90
Lmin
Leq
Mean Wind Speed m/s
Noise Level, dB(A)
Wind Speed (m/s)
Time (24 Hours)
90
80
70
60
50
40
30
20
20
15
10
5
0
00:00
02:00
04:00
06:00
08:00
10:00
12:00
14:00
16:00
18:00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

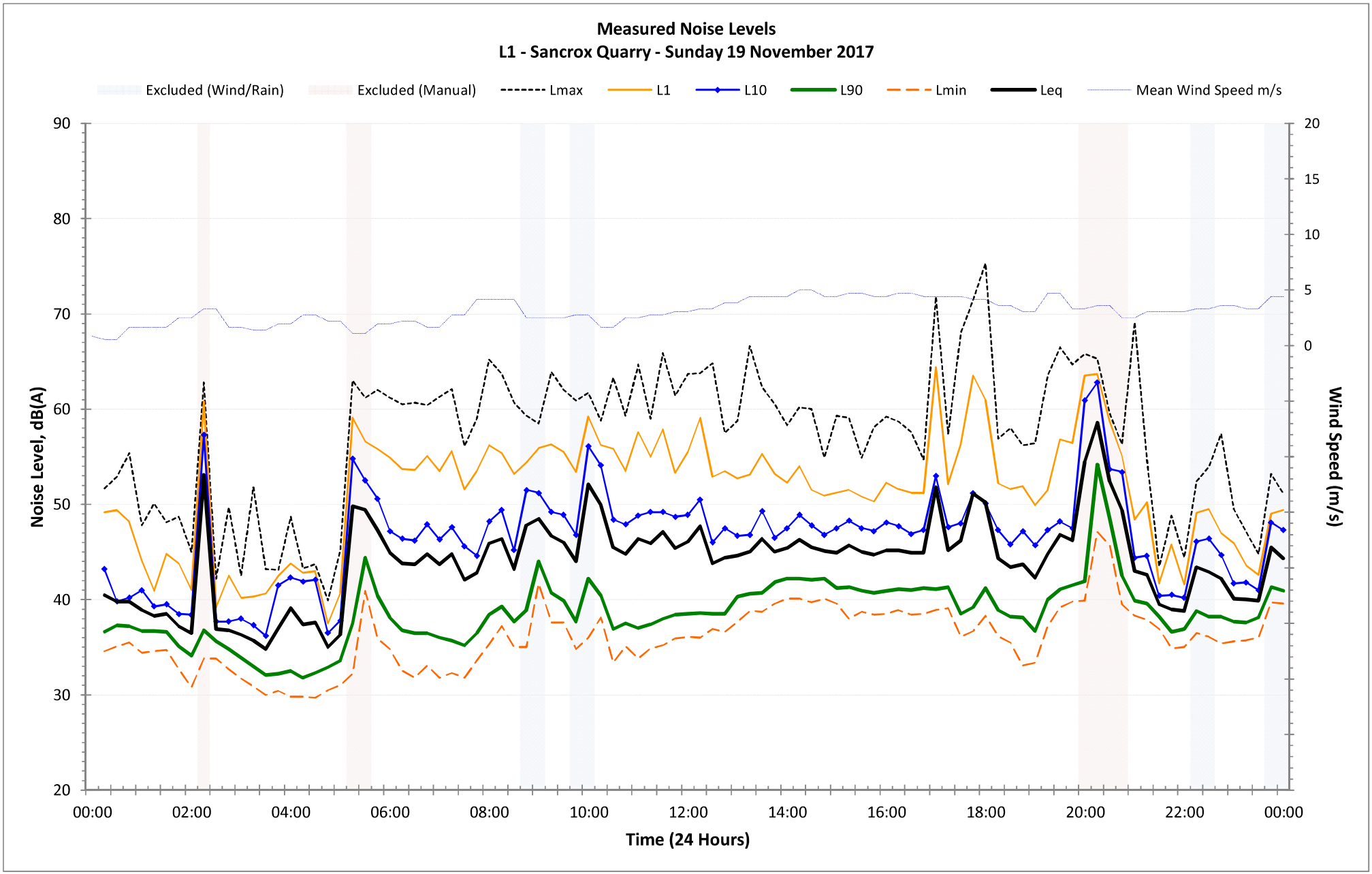

Measured Noise Levels
L1 - Sancrox Quarry - Tuesday 14 November 2017
Excluded (Wind/Rain)
Excluded (Manual)
Lmax
L1
L10
L90
Lmin
Leq
Mean Wind Speed m/s
Noise Level, dB(A)
Wind Speed (m/s)
Time (24 Hours)
90
80
70
60
50
40
30
20
20
15
10
5
0
00:00
02:00
04:00
06:00
08:00
10:00
12:00
14:00
16:00
18:00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

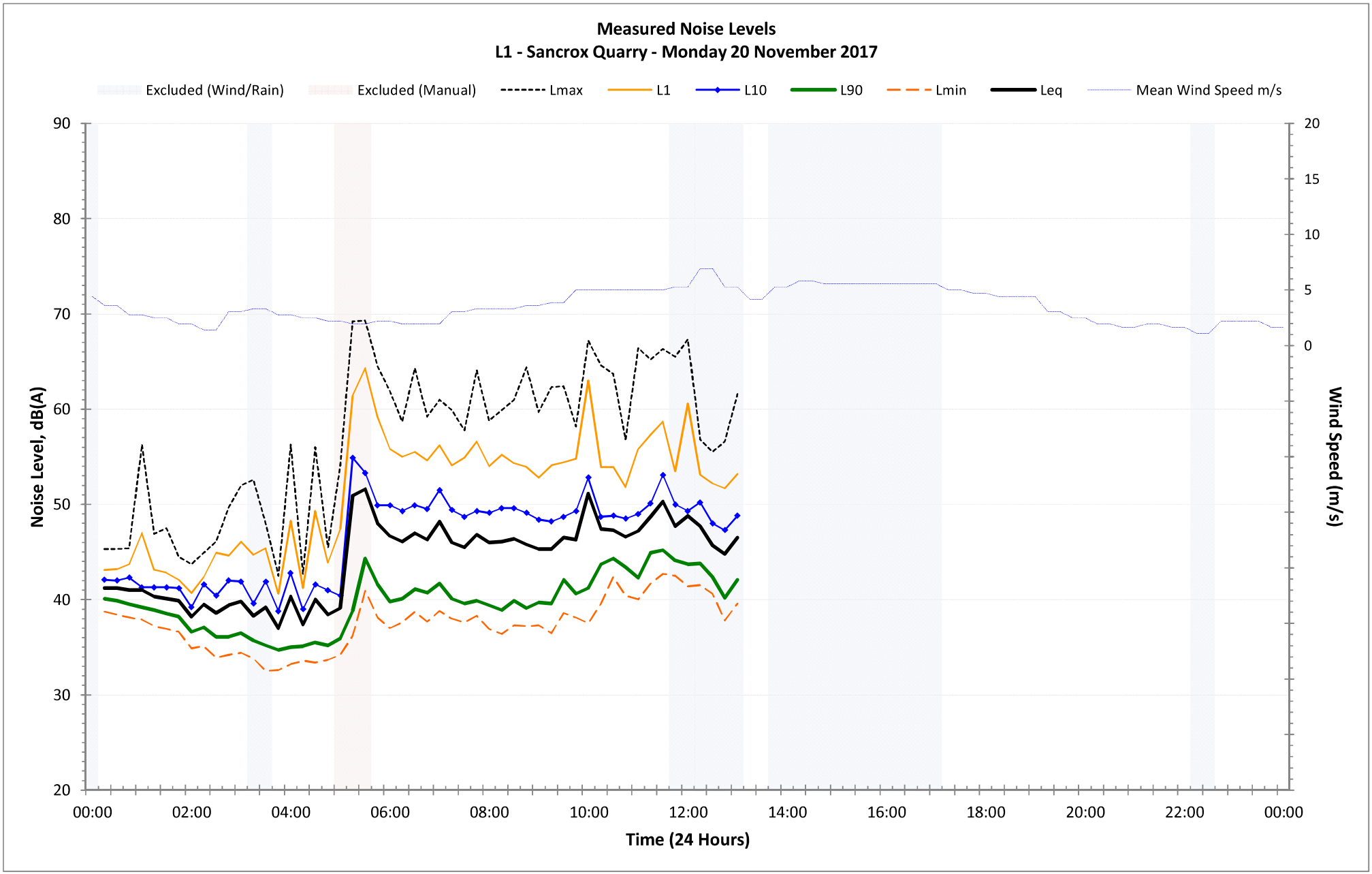

Measured Noise Levels
L1 - Sancrox Quarry - Wednesday 15 November 2017
Excluded (Wind/Rain)
Excluded (Manual)
Lmax
L1
L10
L90
Lmin
Leq
Mean Wind Speed m/s
Noise Level, dB(A)
Wind Speed (m/s)
Time (24 Hours)
90
80
70
60
50
40
30
20
20
15
10
5
0
00:00
02:00
04:00
06:00
08:00
10:00
12:00
14:00
16:00
18:00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

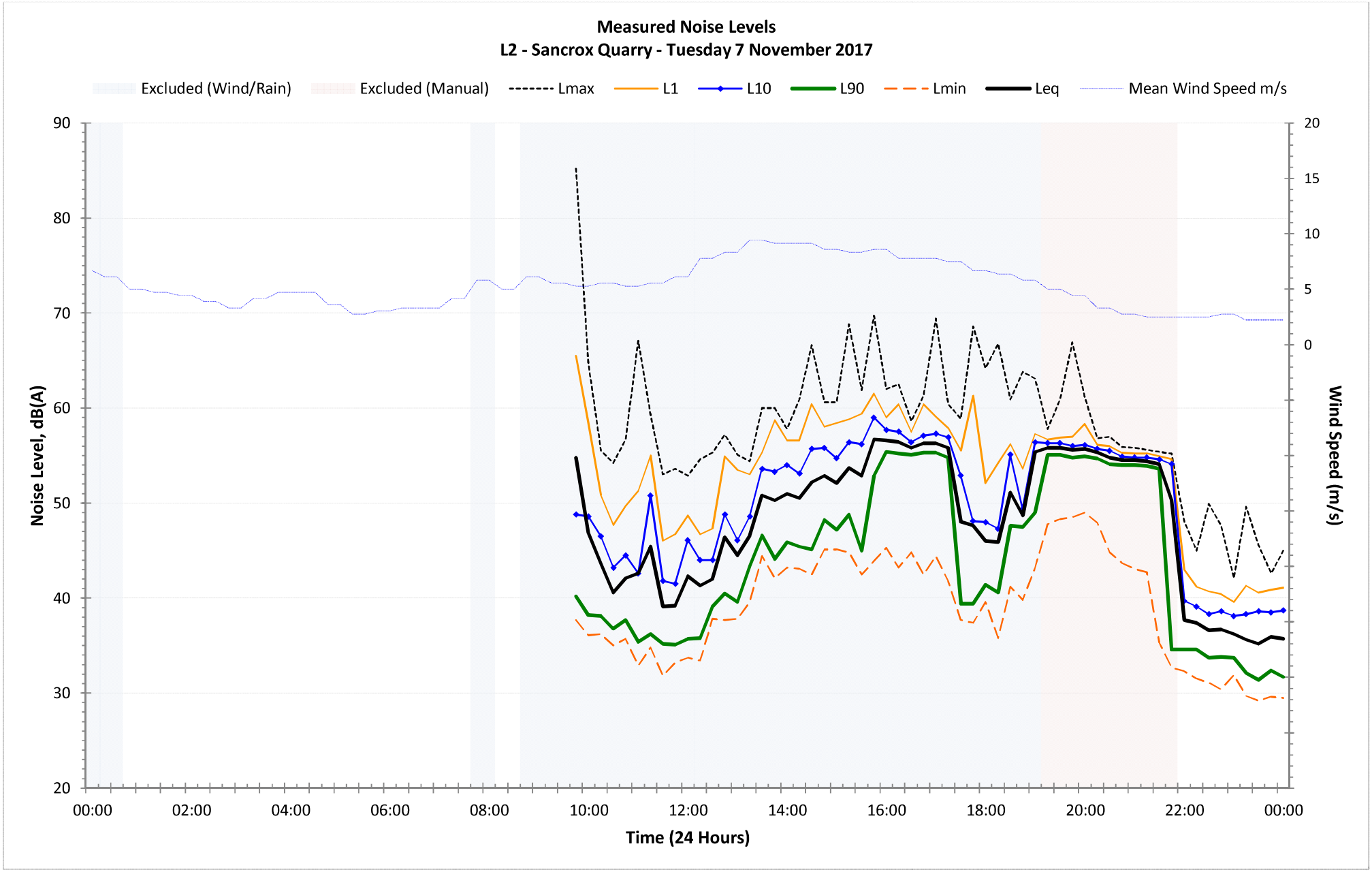

Measured Noise Levels
L1 - Sancrox Quarry - Thursday 16 November 2017
Excluded (Wind/Rain)
Excluded (Manual)
Lmax
L1
L10
L90
Lmin
Leq
Mean Wind Speed m/s
Noise Level, dB(A)
Wind Speed (m/s)
Time (24 Hours)
90
80
70
60
50
40
30
20
20
15
10
5
0
00:00
02:00
04:00
06:00
08:00
10:00
12:00
14:00
16:00
18:00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

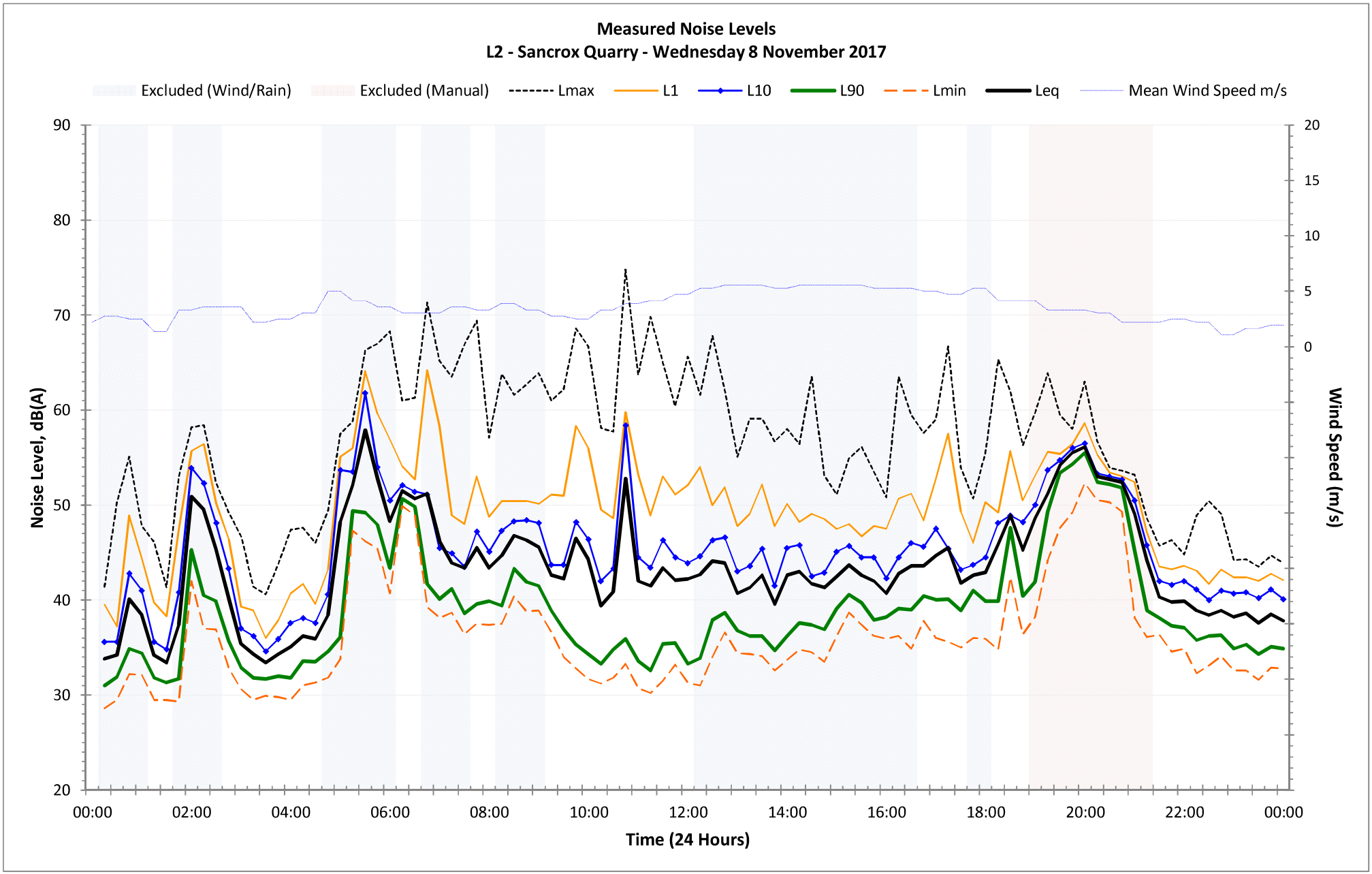

Measured Noise Levels
L1 - Sancrox Quarry - Friday 17 November 2017
Excluded (Wind/Rain)
Excluded (Manual)
Lmax
L1
L10
L90
Lmin
Leq
Mean Wind Speed m/s
Noise Level, dB(A)
Wind Speed (m/s)
Time (24 Hours)
90
80
70
60
50
40
30
20
20
15
10
5
0
00:00
02:00
04:00
06:00
08:00
10:00
12:00
14:00
16:00
18:00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

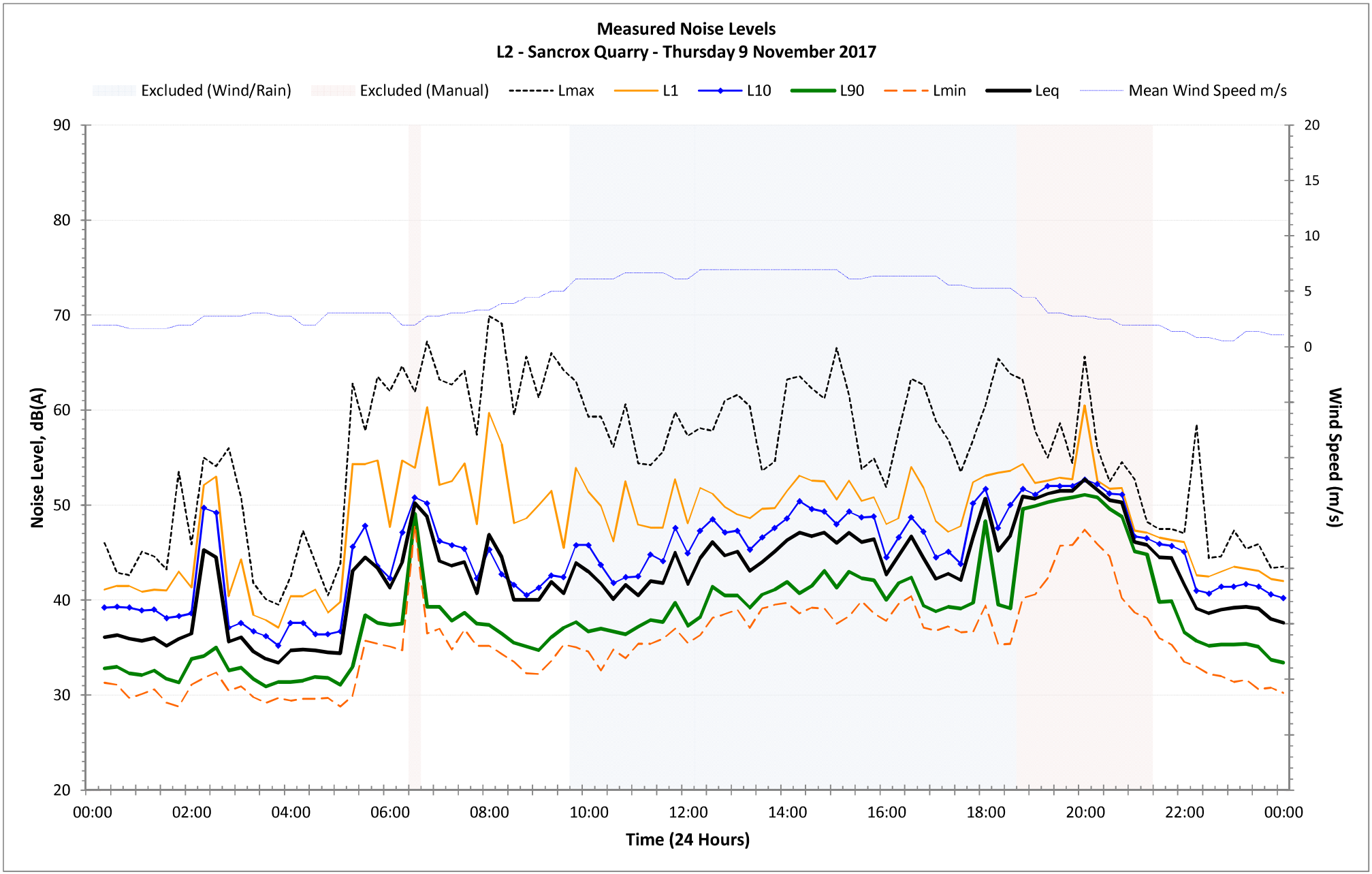

Measured Noise Levels
L1 - Sancrox Quarry - Saturday 18 November 2017
Excluded (Wind/Rain)
Excluded (Manual)
Lmax
L1
L10
L90
Lmin
Leq
Mean Wind Speed m/s
Noise Level, dB(A)
Wind Speed (m/s)
Time (24 Hours)
90
80
70
60
50
40
30
20
20
15
10
5
0
00:00
02:00
04:00
06:00
08:00
10:00
12:00
14:00
16:00
18:00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

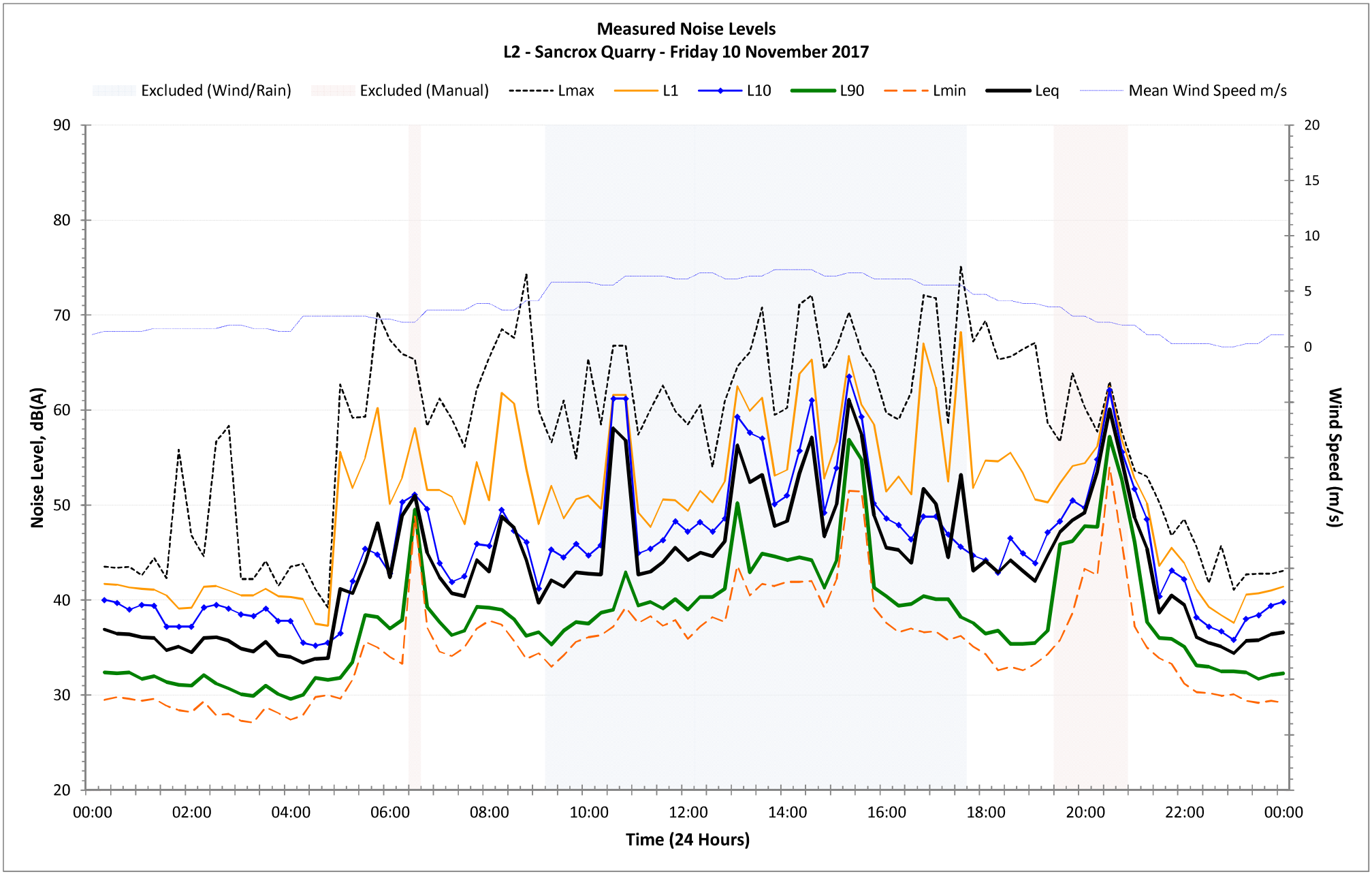

Measured Noise Levels
L1 - Sancrox Quarry - Sunday 19 November 2017
Excluded (Wind/Rain)
Excluded (Manual)
Lmax
L1
L10
L90
Lmin
Leq
Mean Wind Speed m/s
Noise Level, dB(A)
Wind Speed (m/s)
Time (24 Hours)
90
80
70
60
50
40
30
20
20
15
10
5
0
00:00
02:00
04:00
06:00
08:00
10:00
12:00
14:00
16:00
18:00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

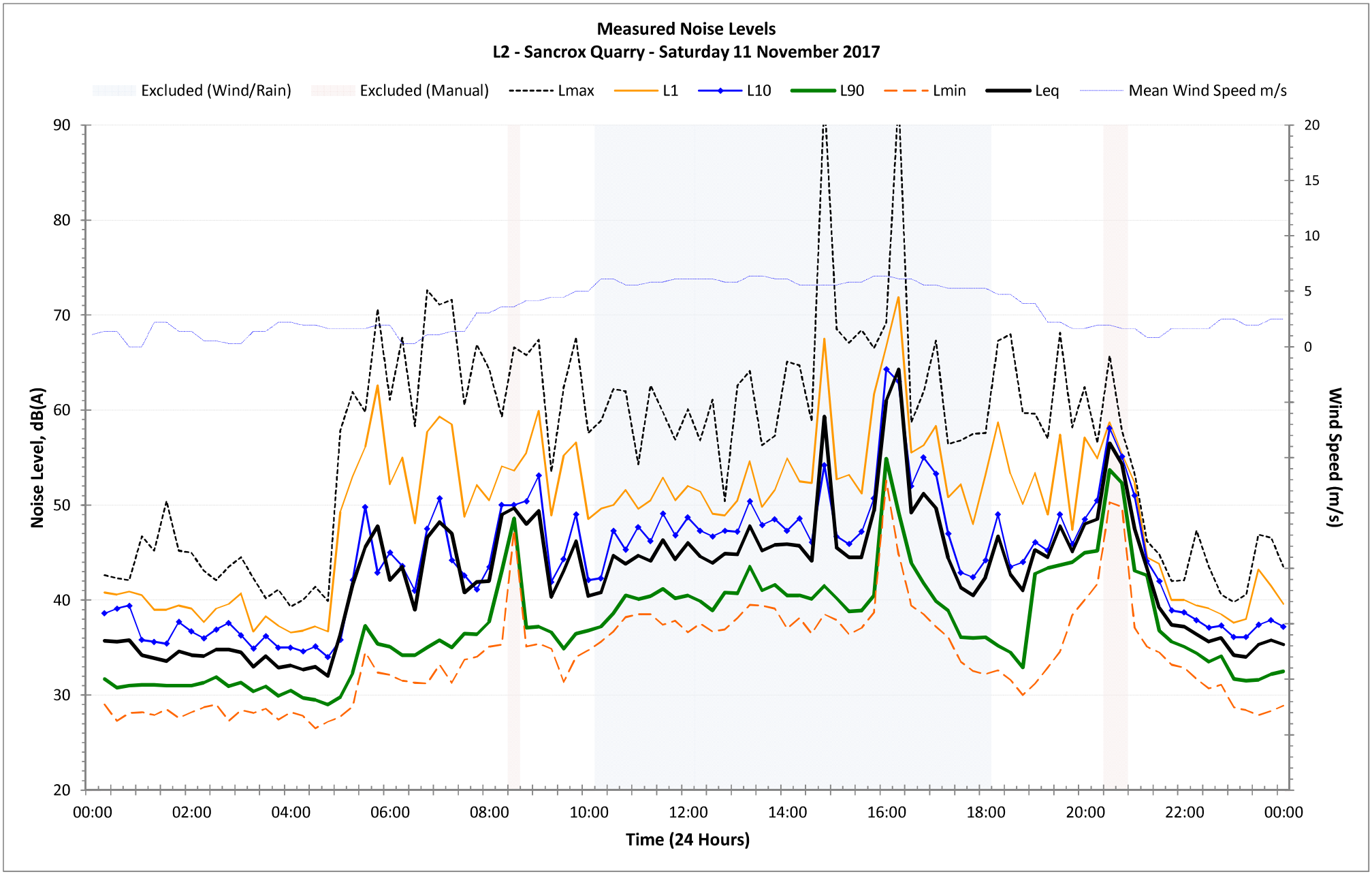

Measured Noise Levels
L1 - Sancrox Quarry - Monday 20 November 2017
Excluded (Wind/Rain)
Excluded (Manual)
Lmax
L1
L10
L90
Lmin
Leq
Mean Wind Speed m/s
Noise Level, dB(A)
Wind Speed (m/s)
Time (24 Hours)
90
80
70
60
50
40
30
20
20
15
10
5
0
00:00
02:00
04:00
06:00
08:00
10:00
12:00
14:00
16:00
18:00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

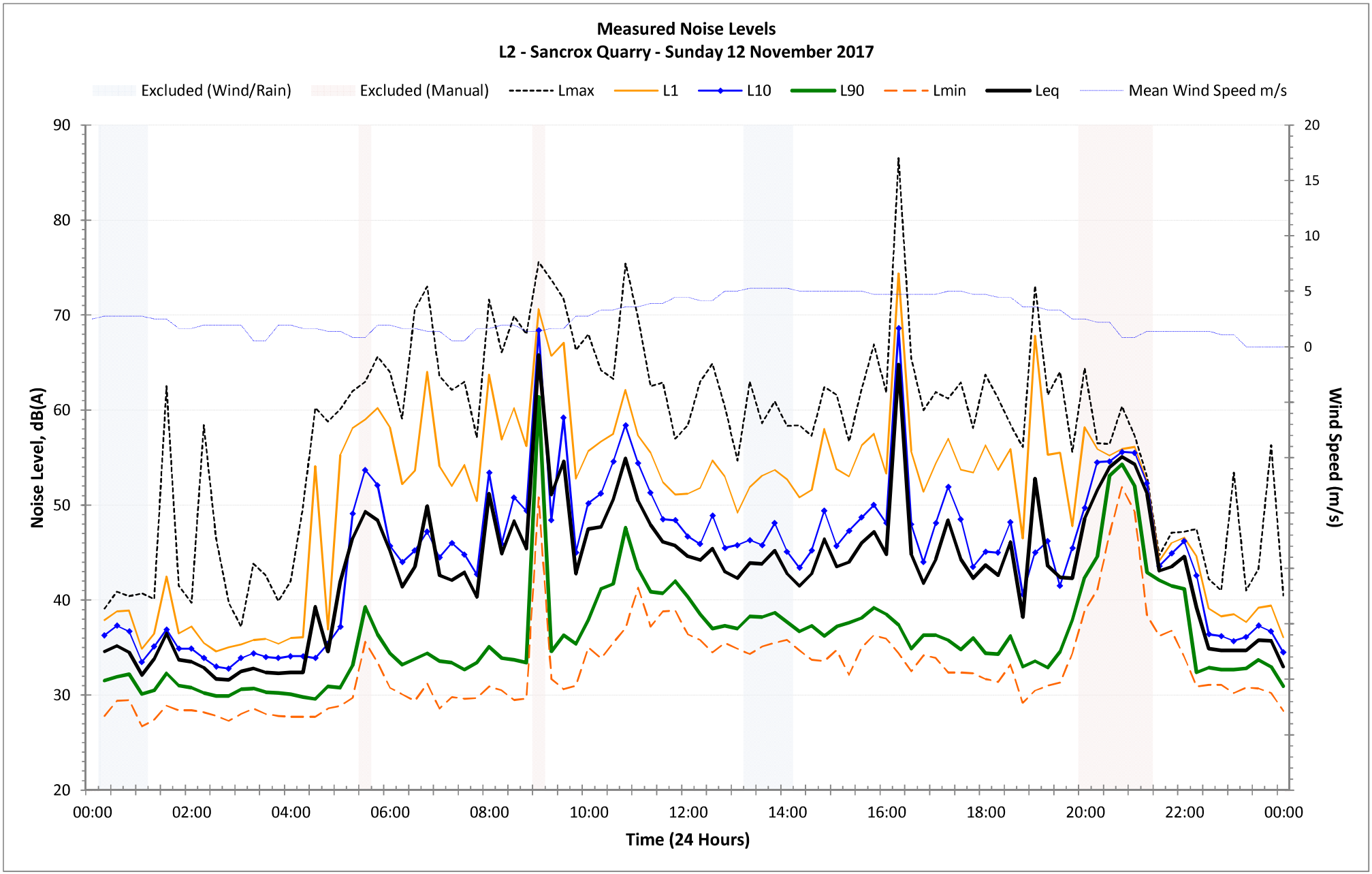

Measured Noise Levels
L2 - Sancrox Quarry - Tuesday 7 November 2017
Excluded (Wind/Rain)
Excluded (Manual)
Lmax
L1
L10
L90
Lmin
Leq
Mean Wind Speed m/s
Noise Level, dB(A)
Wind Speed (m/s)
Time (24 Hours)
90
80
70
60
50
40
30
20
20
15
10
5
0
00:00
02:00
04:00
06:00
08:00
10:00
12:00
14:00
16:00
18:00
20:00
22:00
00:00

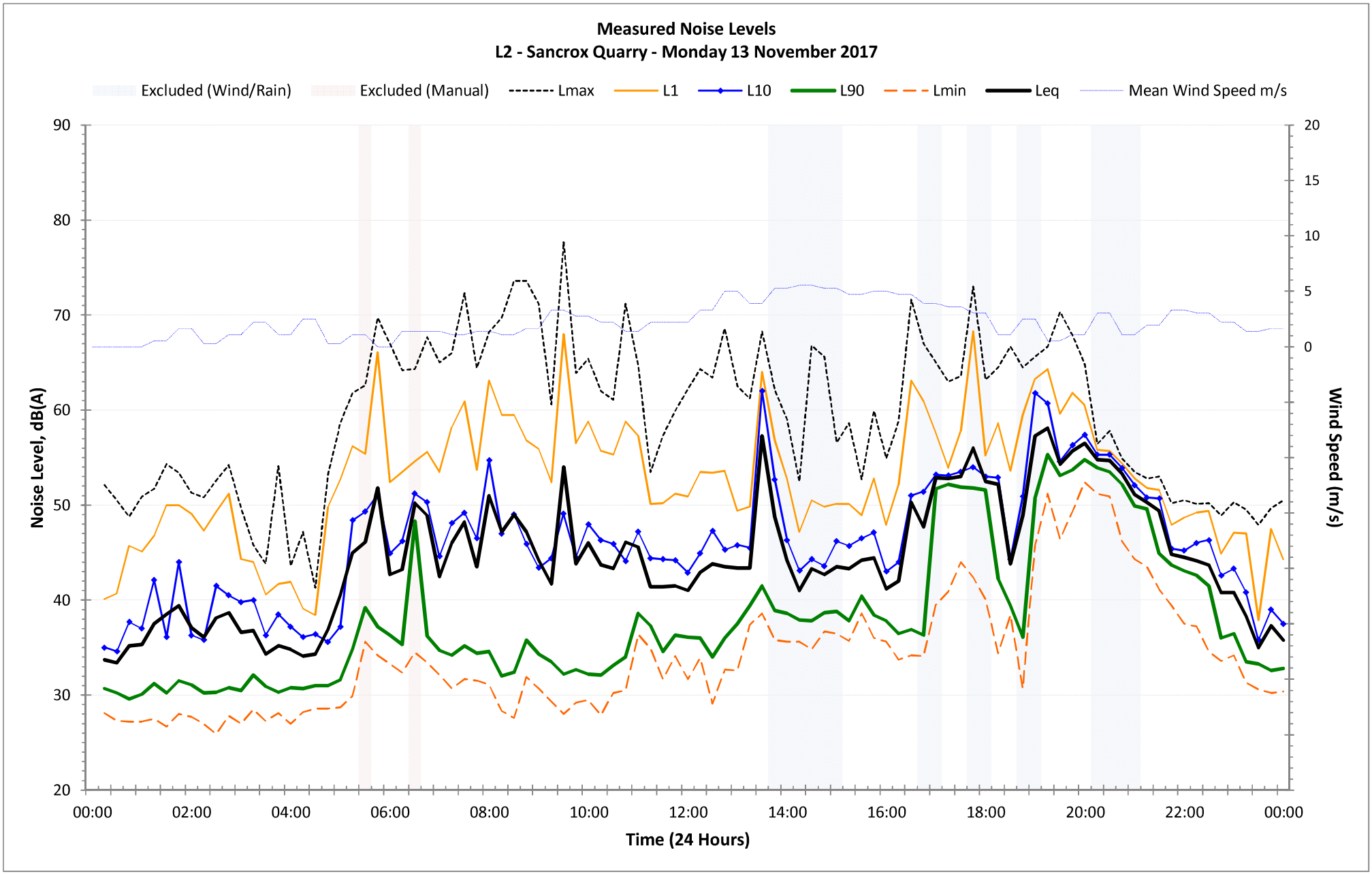

Measured Noise Levels
L2 - Sancrox Quarry - Wednesday 8 November 2017
Excluded (Wind/Rain)
Excluded (Manual)
Lmax
L1
L10
L90
Lmin
Leq
Mean Wind Speed m/s
Noise Level, dB(A)
Wind Speed (m/s)
Time (24 Hours)
90
80
70
60
50
40
30
20
20
15
10
5
0
00:00
02:00
04:00
06:00
08:00
10:00
12:00
14:00
16:00
18:00
20:00
22:00
00:00

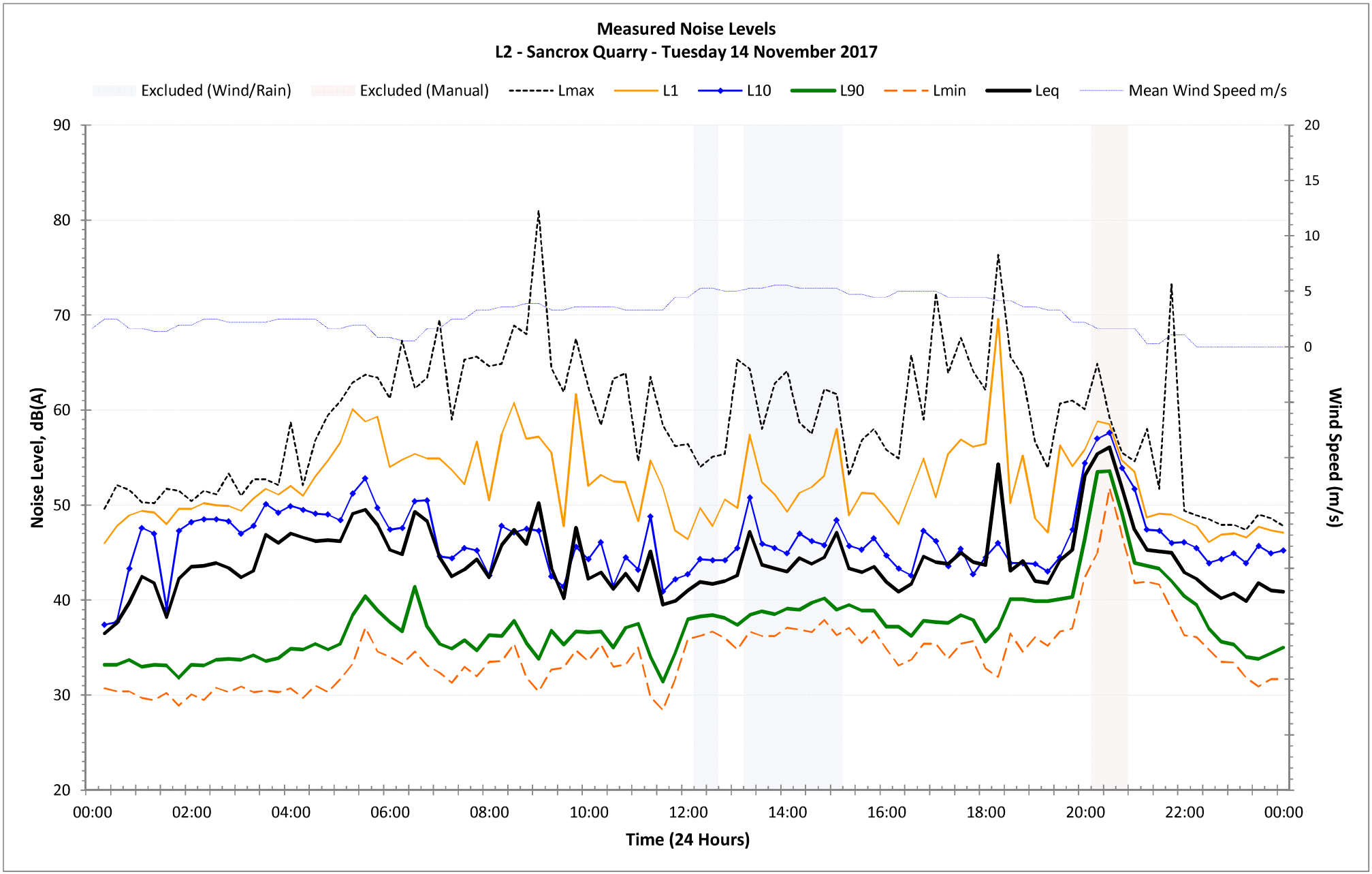

Measured Noise Levels
L2 - Sancrox Quarry - Thursday 9 November 2017
Excluded (Wind/Rain)
Excluded (Manual)
Lmax
L1
L10
L90
Lmin
Leq
Mean Wind Speed m/s
Noise Level, dB(A)
Wind Speed (m/s)
Time (24 Hours)
90
80
70
60
50
40
30
20
20
15
10
5
0
00:00
02:00
04:00
06:00
08:00
10:00
12:00
14:00
16:00
18:00
20:00
22:00
00:00

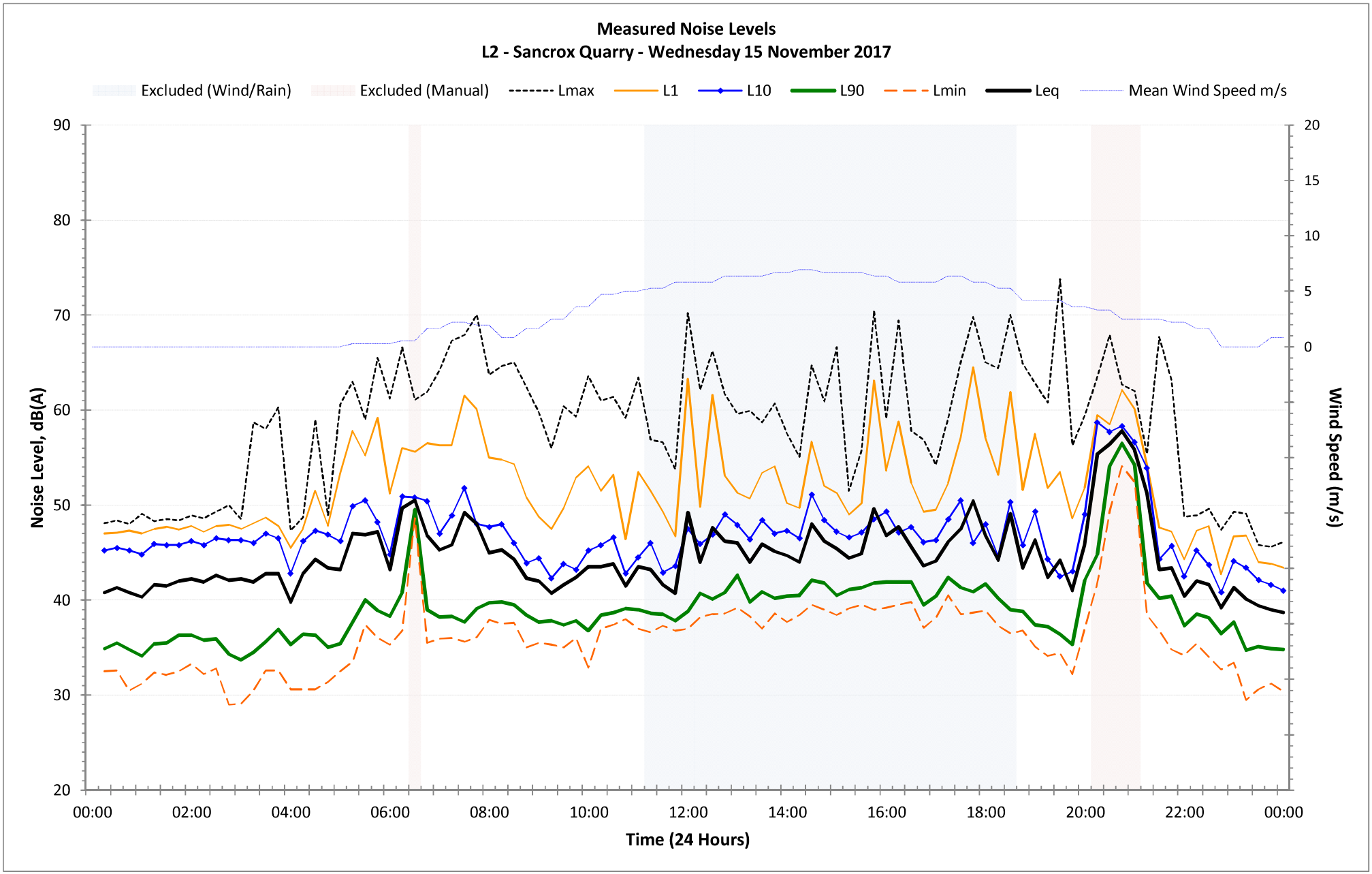

Measured Noise Levels
L2 - Sancrox Quarry - Friday 10 November 2017
Excluded (Wind/Rain)
Excluded (Manual)
Lmax
L1
L10
L90
Lmin
Leq
Mean Wind Speed m/s
Noise Level, dB(A)
Wind Speed (m/s)
Time (24 Hours)
90
80
70
60
50
40
30
20
20
15
10
5
0
00:00
02:00
04:00
06:00
08:00
10:00
12:00
14:00
16:00
18:00
20:00
22:00
00:00

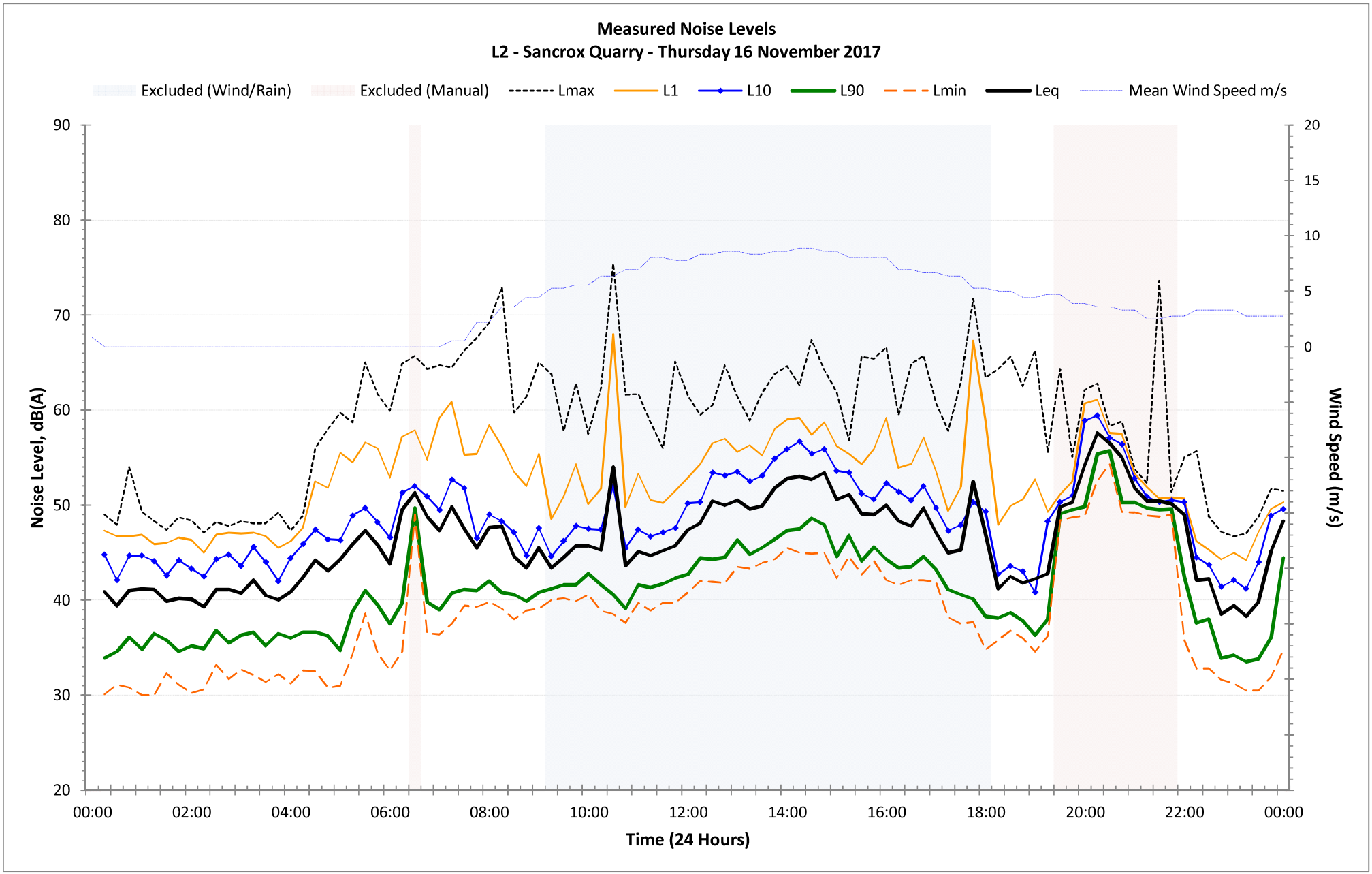

Measured Noise Levels
L2 - Sancrox Quarry - Saturday 11 November 2017
Excluded (Wind/Rain)
Excluded (Manual)
Lmax
L1
L10
L90
Lmin
Leq
Mean Wind Speed m/s
Noise Level, dB(A)
Wind Speed (m/s)
Time (24 Hours)
90
80
70
60
50
40
30
20
20
15
10
5
0
00:00
02:00
04:00
06:00
08:00
10:00
12:00
14:00
16:00
18:00
20:00
22:00
00:00

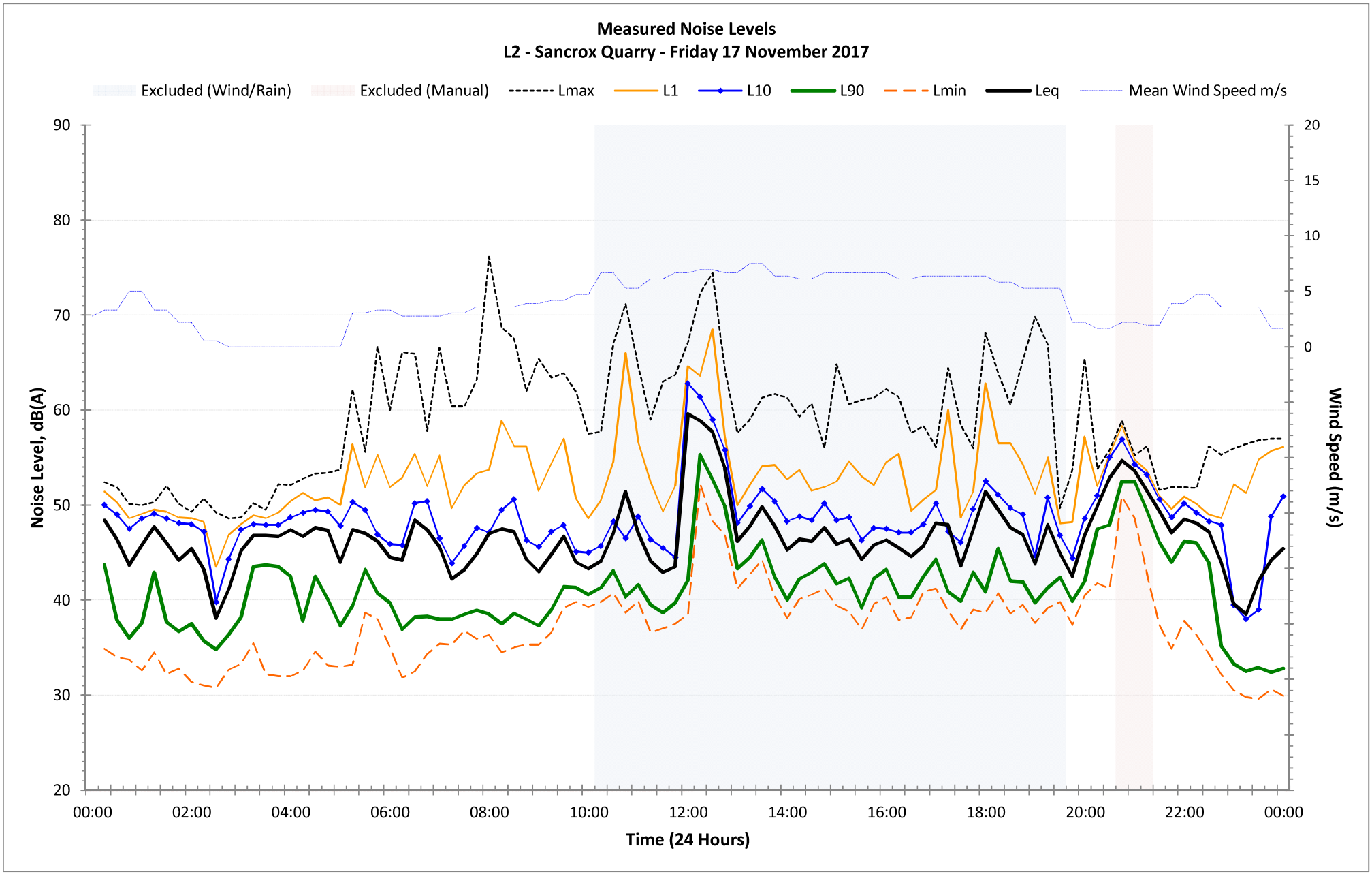

Measured Noise Levels
L2 - Sancrox Quarry - Sunday 12 November 2017
Excluded (Wind/Rain)
Excluded (Manual)
Lmax
L1
L10
L90
Lmin
Leq
Mean Wind Speed m/s
Noise Level, dB(A)
Wind Speed (m/s)
Time (24 Hours)
90
80
70
60
50
40
30
20
20
15
10
5
0
00:00
02:00
04:00
06:00
08:00
10:00
12:00
14:00
16:00
18:00
20:00
22:00
00:00

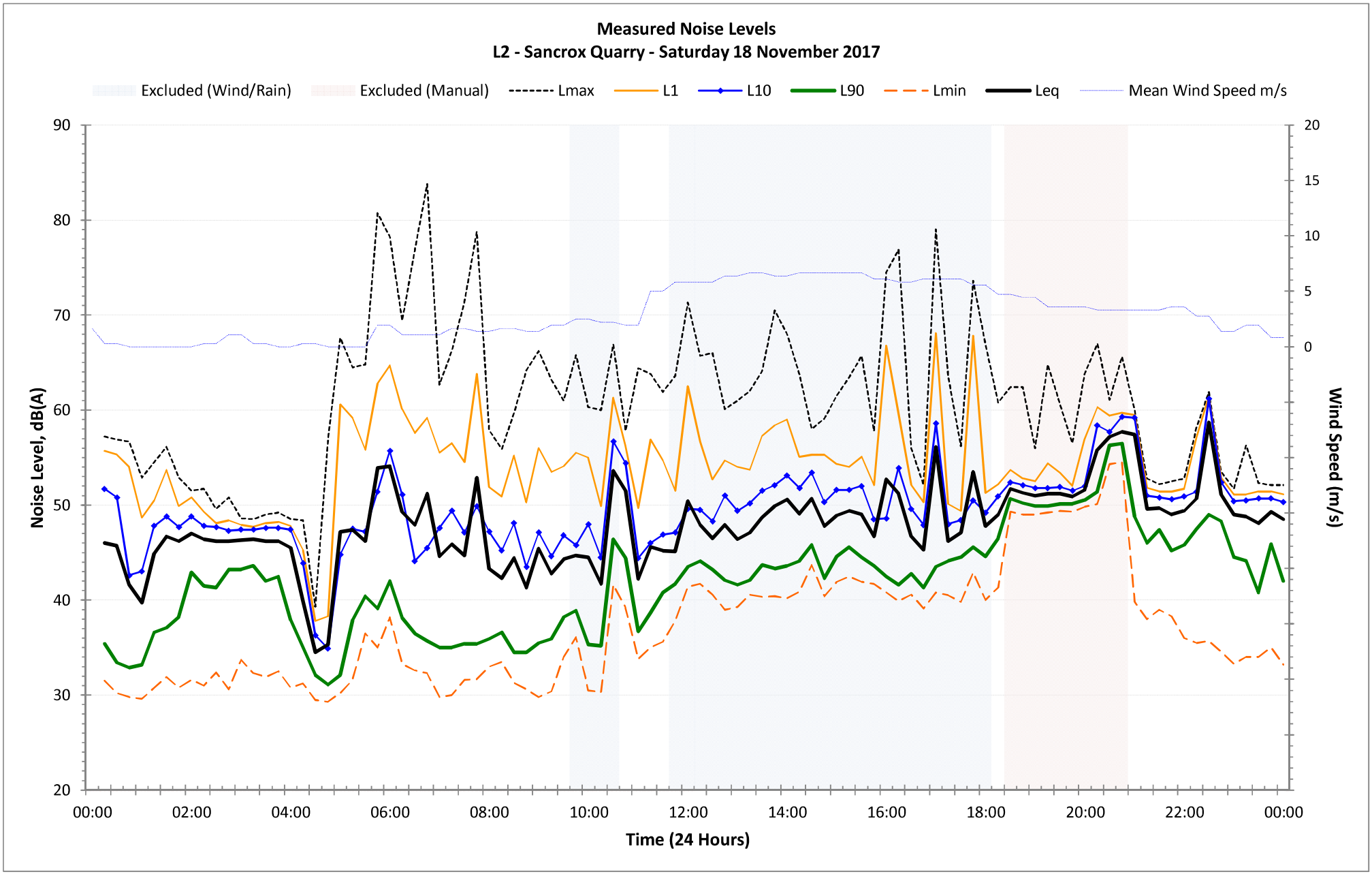

Measured Noise Levels
L2 - Sancrox Quarry - Monday 13 November 2017
Excluded (Wind/Rain)
Excluded (Manual)
Lmax
L1
L10
L90
Lmin
Leq
Mean Wind Speed m/s
Noise Level, dB(A)
Wind Speed (m/s)
Time (24 Hours)
90
80
70
60
50
40
30
20
20
15
10
5
0
00:00
02:00
04:00
06:00
08:00
10:00
12:00
14:00
16:00
18:00
20:00
22:00
00:00

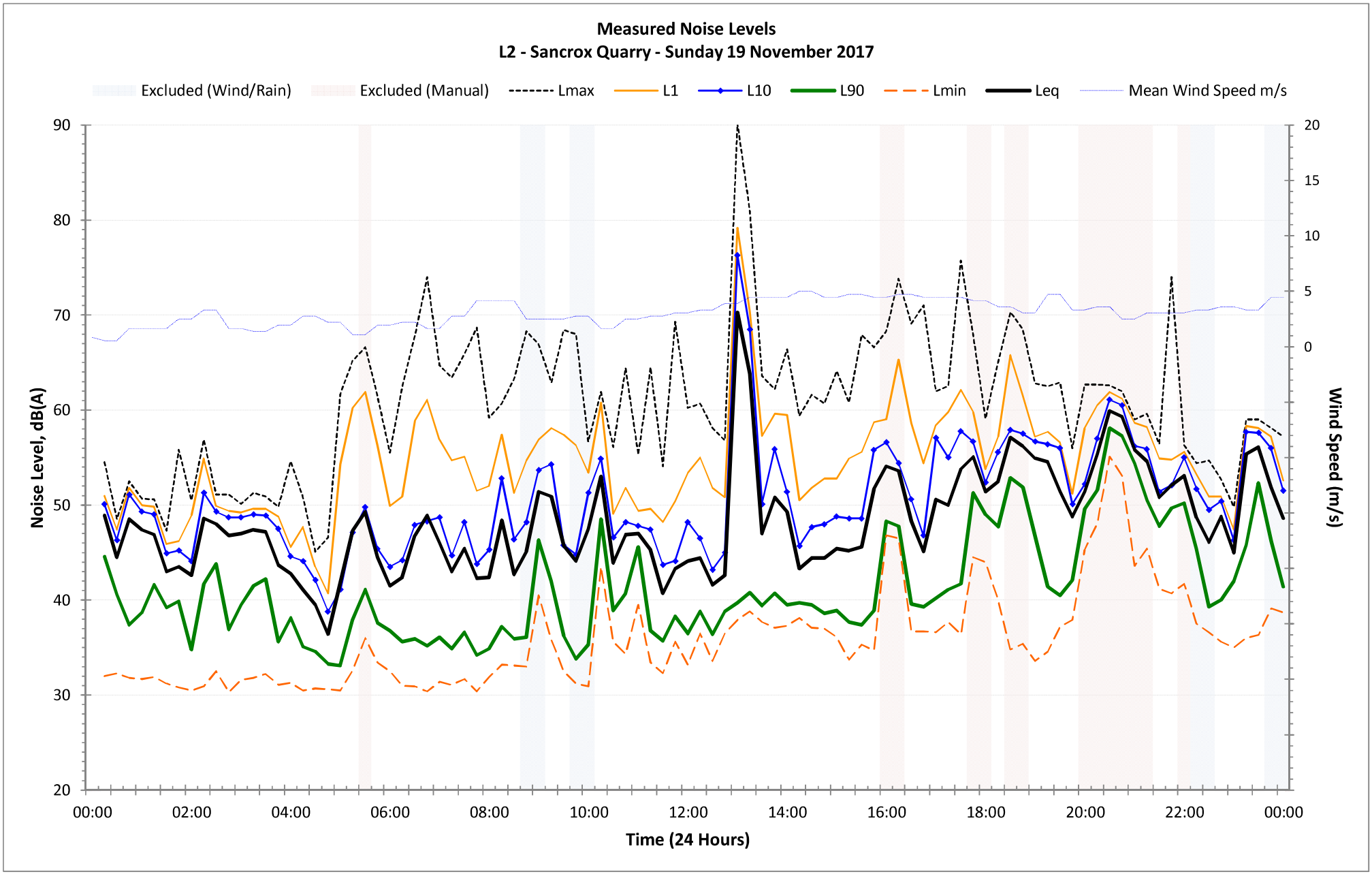

Measured Noise Levels
L2 - Sancrox Quarry - Tuesday 14 November 2017
Excluded (Wind/Rain)
Excluded (Manual)
Lmax
L1
L10
L90
Lmin
Leq
Mean Wind Speed m/s
Noise Level, dB(A)
Wind Speed (m/s)
Time (24 Hours)
90
80
70
60
50
40
30
20
20
15
10
5
0
00:00
02:00
04:00
06:00
08:00
10:00
12:00
14:00
16:00
18:00
20:00
22:00
00:00

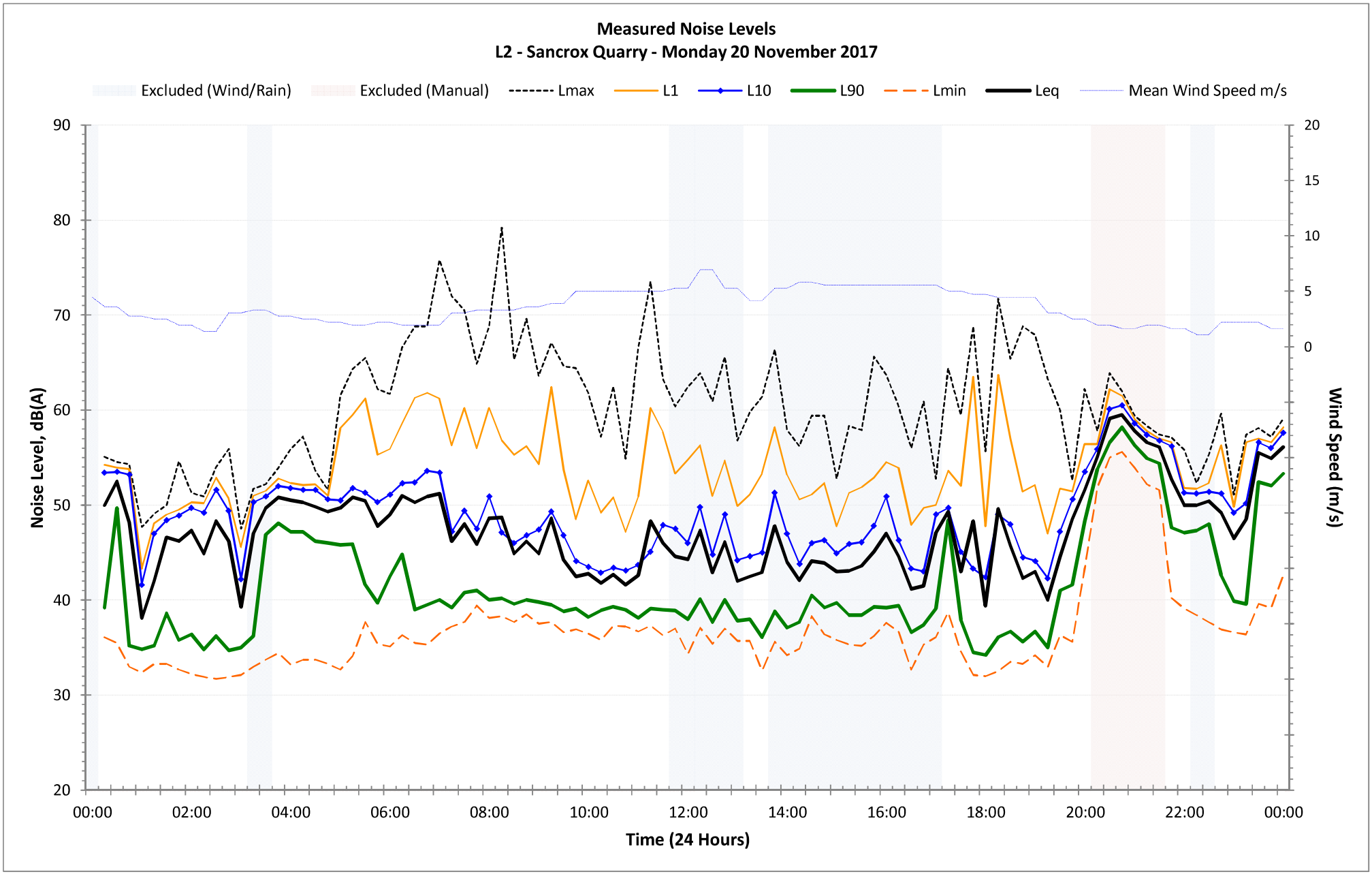

Measured Noise Levels
L2 - Sancrox Quarry - Wednesday 15 November 2017
Excluded (Wind/Rain)
Excluded (Manual)
Lmax
L1
L10
L90
Lmin
Leq
Mean Wind Speed m/s
Noise Level, dB(A)
Wind Speed (m/s)
Time (24 Hours)
90
80
70
60
50
40
30
20
20
15
10
5
0
00:00
02:00
04:00
06:00
08:00
10:00
12:00
14:00
16:00
18:00
20:00
22:00
00:00

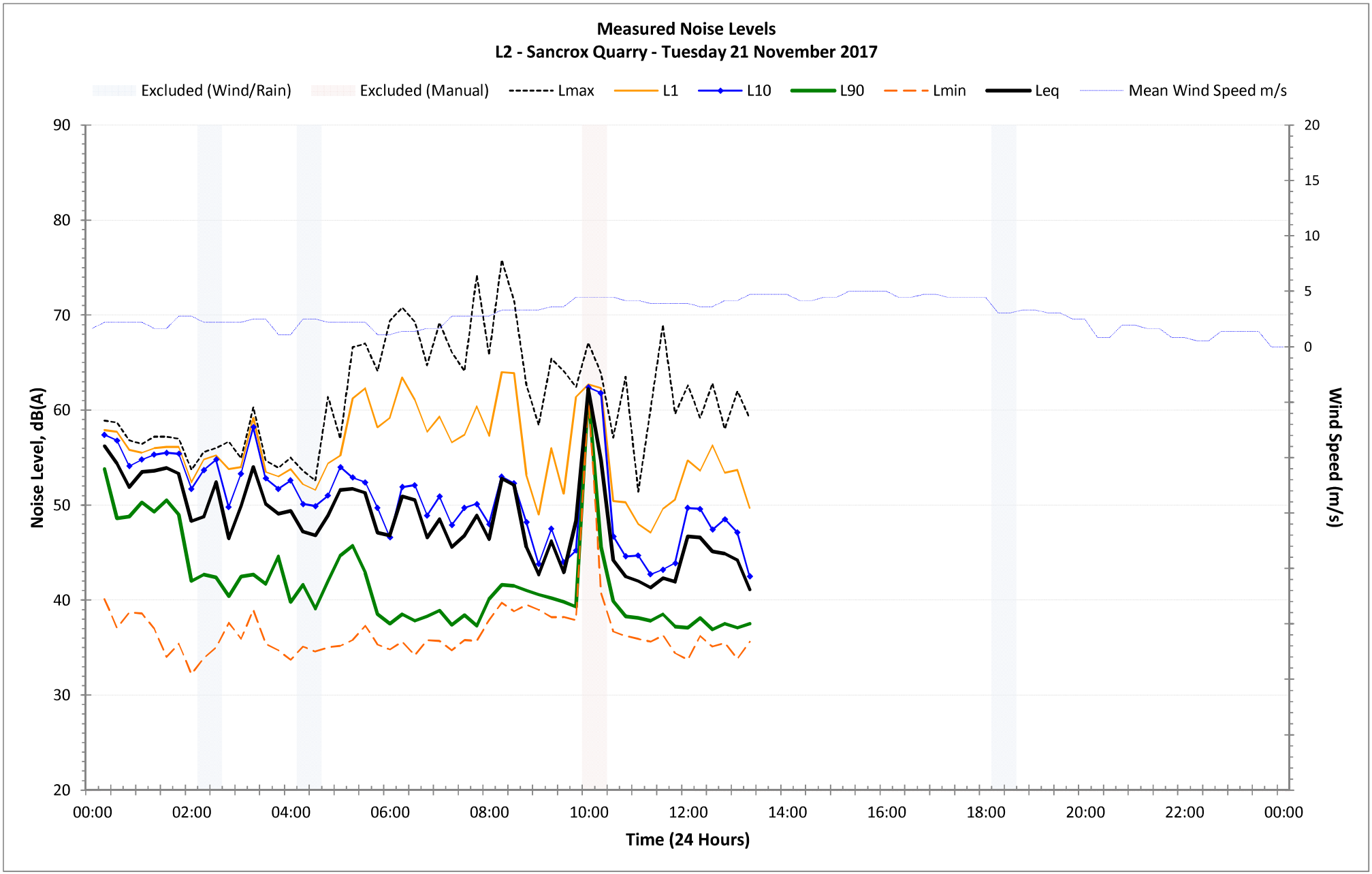

Measured Noise Levels
L2 - Sancrox Quarry - Thursday 16 November 2017
Excluded (Wind/Rain)
Excluded (Manual)
Lmax
L1
L10
L90
Lmin
Leq
Mean Wind Speed m/s
Noise Level, dB(A)
Wind Speed (m/s)
Time (24 Hours)
90
80
70
60
50
40
30
20
20
15
10
5
0
00:00
02:00
04:00
06:00
08:00
10:00
12:00
14:00
16:00
18:00
20:00
22:00
00:00

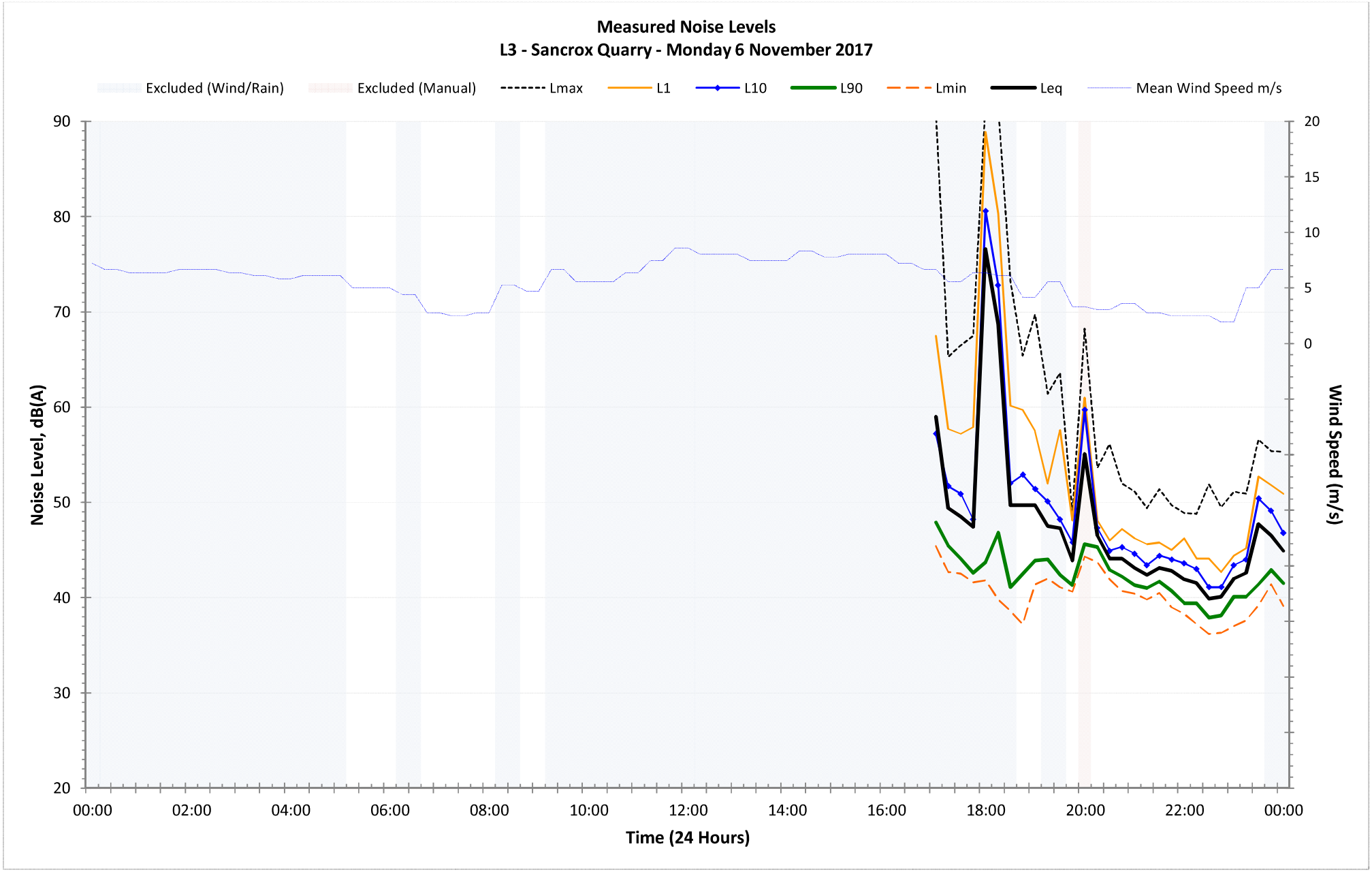

Measured Noise Levels
L2 - Sancrox Quarry - Friday 17 November 2017
Excluded (Wind/Rain)
Excluded (Manual)
Lmax
L1
L10
L90
Lmin
Leq
Mean Wind Speed m/s
Noise Level, dB(A)
Wind Speed (m/s)
Time (24 Hours)
90
80
70
60
50
40
30
20
20
15
10
5
0
00:00
02:00
04:00
06:00
08:00
10:00
12:00
14:00
16:00
18:00
20:00
22:00
00:00

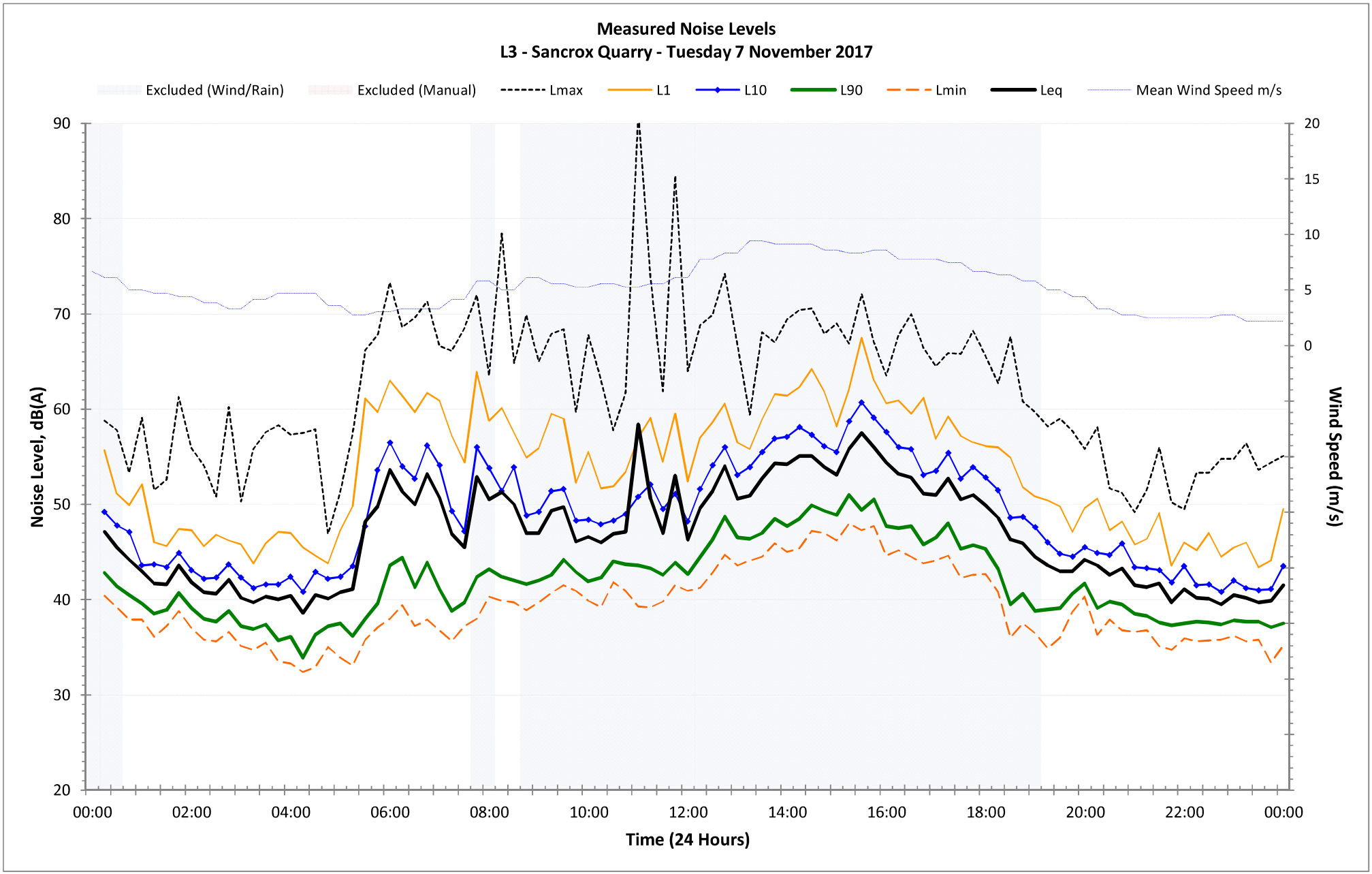

Measured Noise Levels
L2 - Sancrox Quarry - Saturday 18 November 2017
Excluded (Wind/Rain)
Excluded (Manual)
Lmax
L1
L10
L90
Lmin
Leq
Mean Wind Speed m/s
Noise Level, dB(A)
Wind Speed (m/s)
Time (24 Hours)
90
80
70
60
50
40
30
20
20
15
10
5
0
00:00
02:00
04:00
06:00
08:00
10:00
12:00
14:00
16:00
18:00
20:00
22:00
00:00

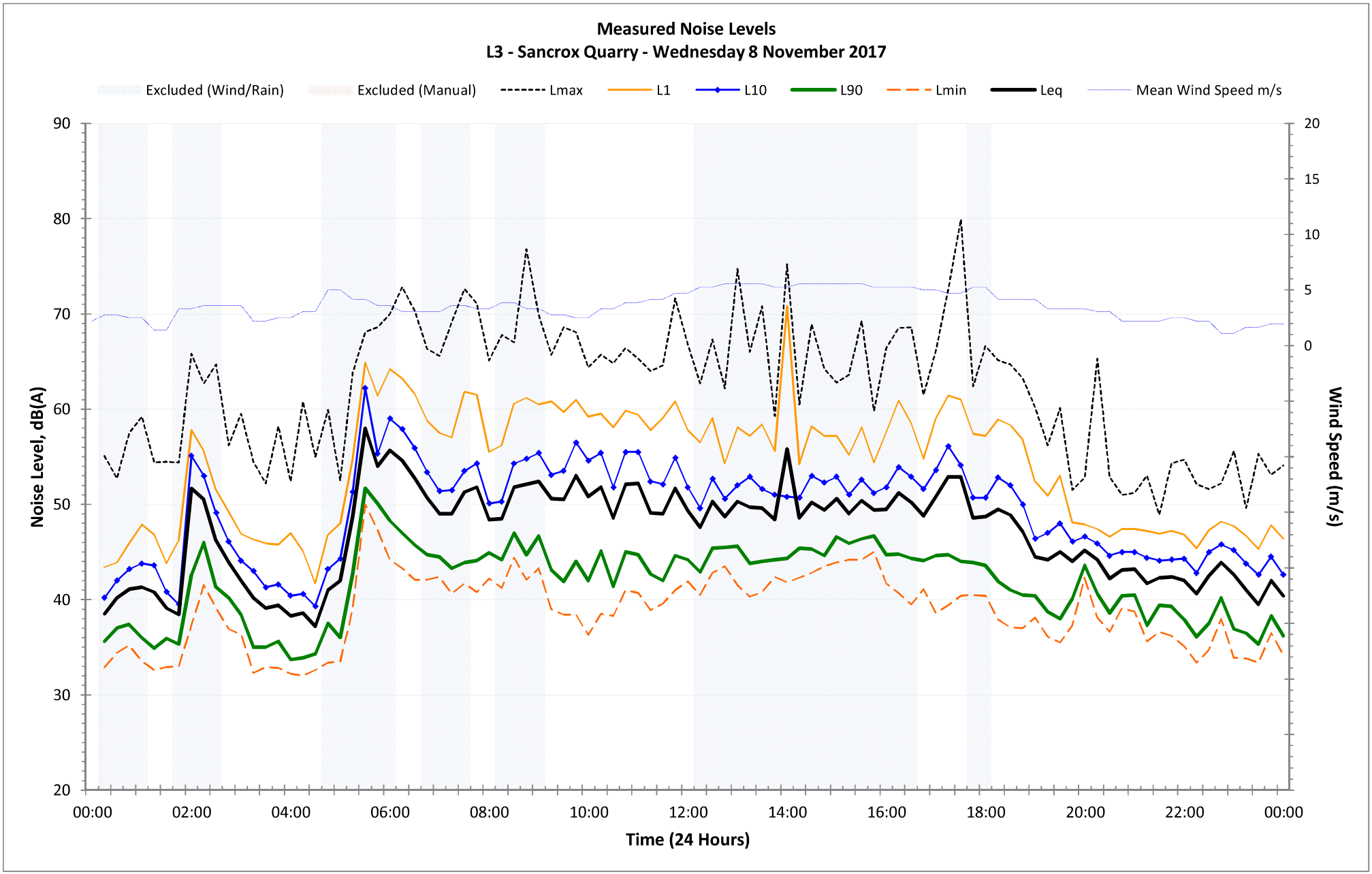

Measured Noise Levels
L2 - Sancrox Quarry - Sunday 19 November 2017
Excluded (Wind/Rain)
Excluded (Manual)
Lmax
L1
L10
L90
Lmin
Leq
Mean Wind Speed m/s
Noise Level, dB(A)
Wind Speed (m/s)
Time (24 Hours)
90
80
70
60
50
40
30
20
20
15
10
5
0
00:00
02:00
04:00
06:00
08:00
10:00
12:00
14:00
16:00
18:00
20:00
22:00
00:00

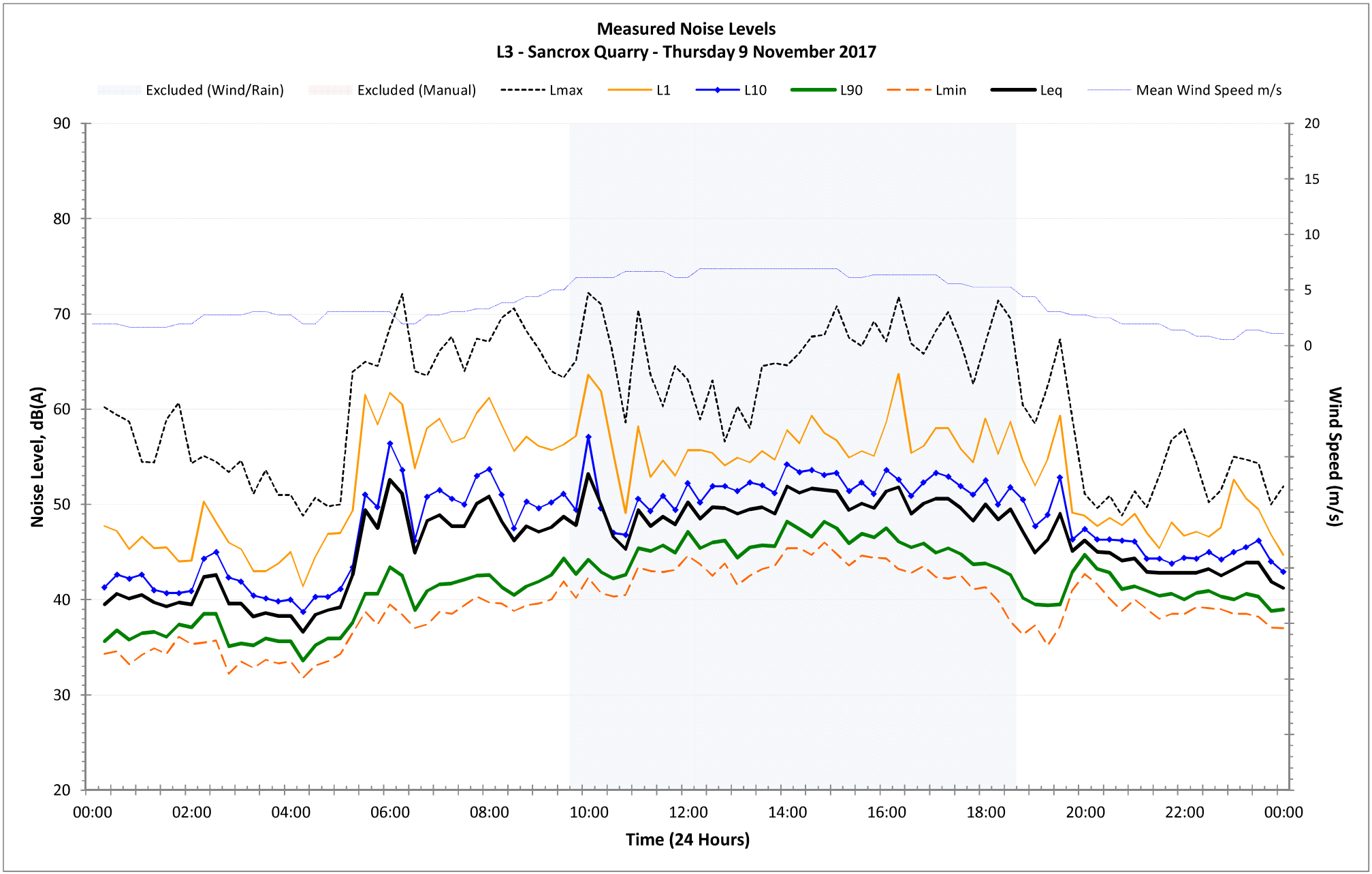

Measured Noise Levels
L2 - Sancrox Quarry - Monday 20 November 2017
Excluded (Wind/Rain)
Excluded (Manual)
Lmax
L1
L10
L90
Lmin
Leq
Mean Wind Speed m/s
Noise Level, dB(A)
Wind Speed (m/s)
Time (24 Hours)
90
80
70
60
50
40
30
20
20
15
10
5
0
00:00
02:00
04:00
06:00
08:00
10:00
12:00
14:00
16:00
18:00
20:00
22:00
00:00

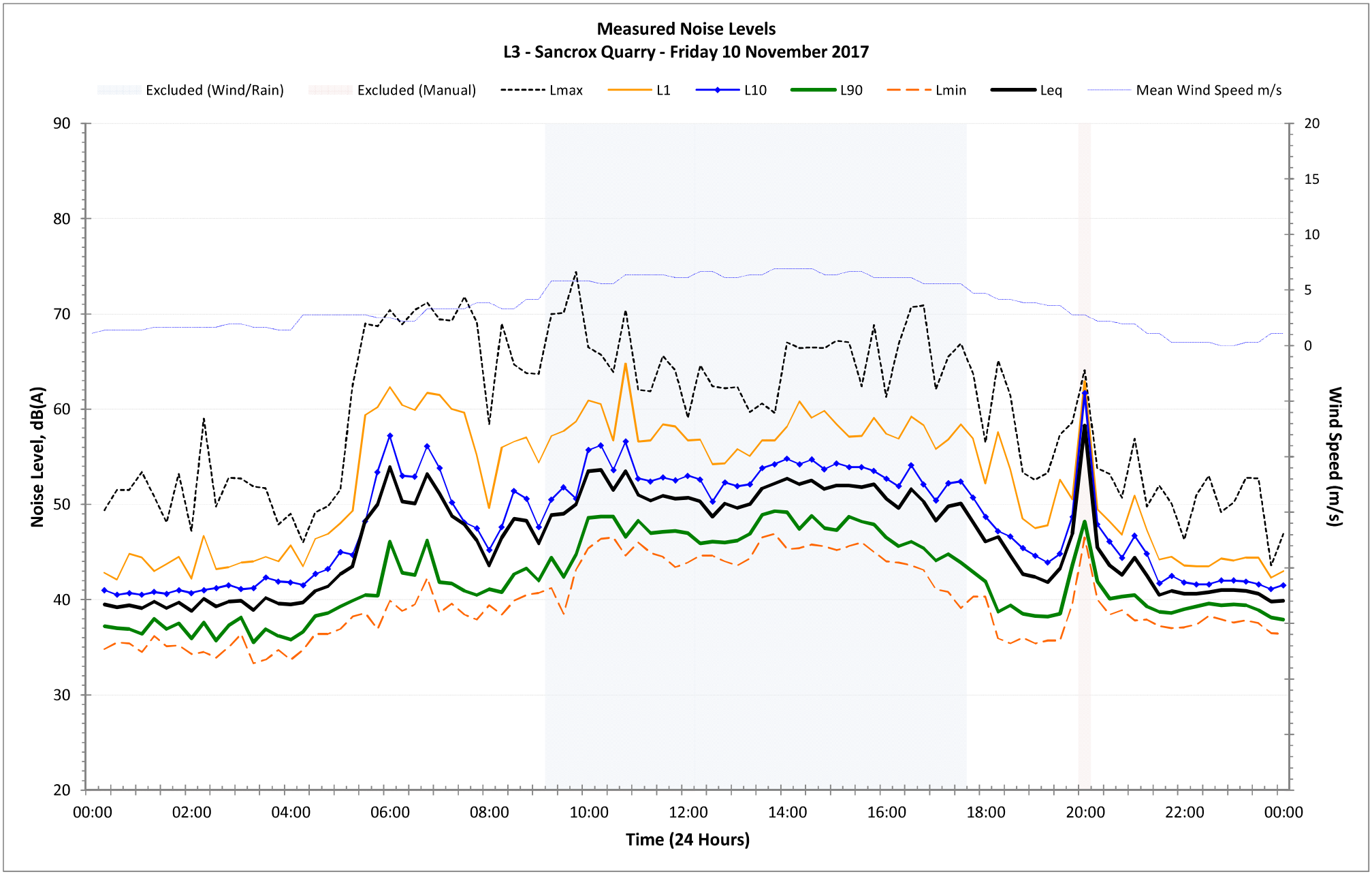

Measured Noise Levels
L2 - Sancrox Quarry - Tuesday 21 November 2017
Excluded (Wind/Rain)
Excluded (Manual)
Lmax
L1
L10
L90
Lmin
Leq
Mean Wind Speed m/s
Noise Level, dB(A)
Wind Speed (m/s)
Time (24 Hours)
90
80
70
60
50
40
30
20
20
15
10
5
0
00:00
02:00
04:00
06:00
08:00
10:00
12:00
14:00
16:00
18:00
20:00
22:00
00:00

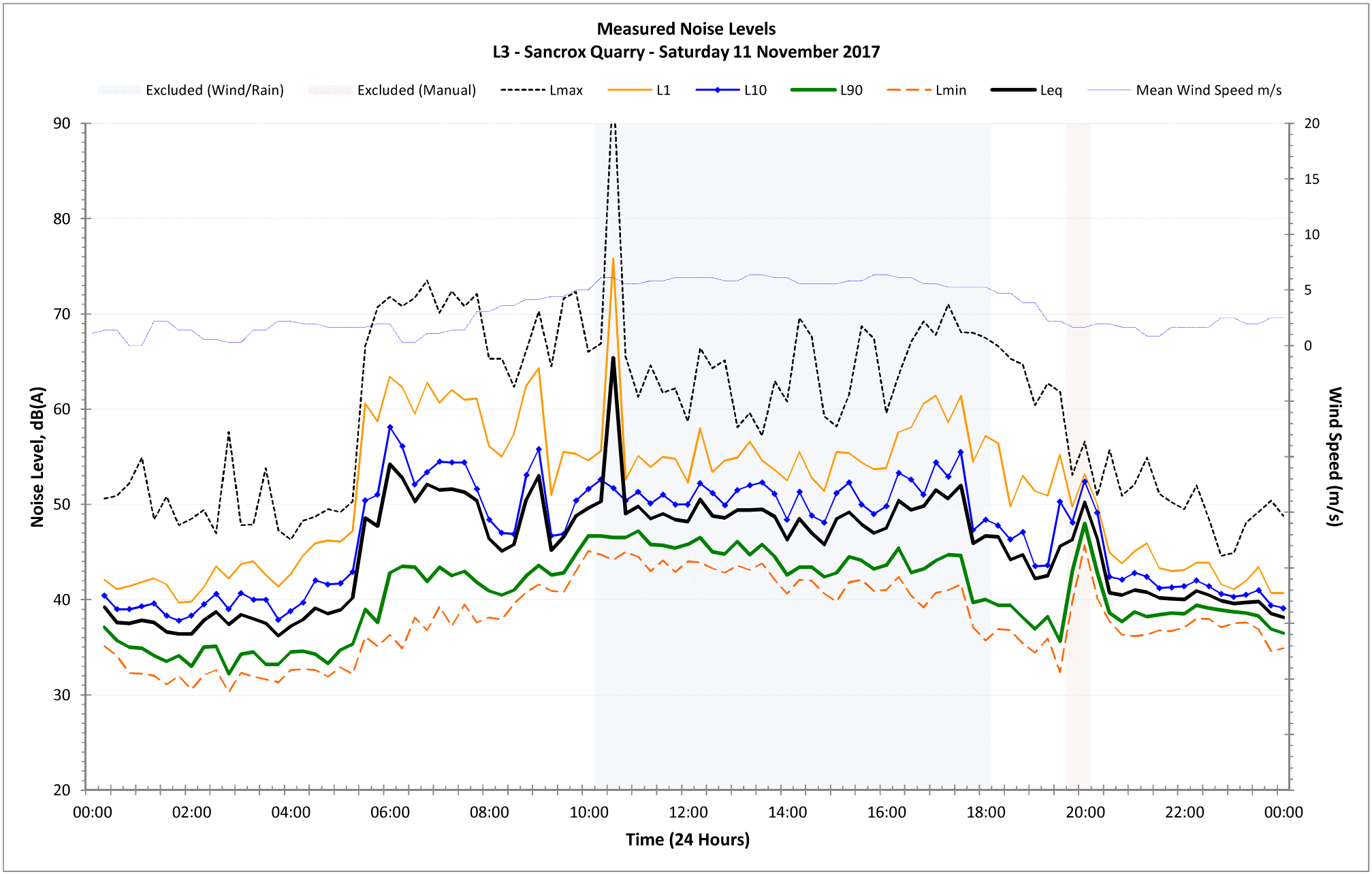

Measured Noise Levels
L3 - Sancrox Quarry - Monday 6 November 2017
Excluded (Wind/Rain)
Excluded (Manual)
Lmax
L1
L10
L90
Lmin
Leq
Mean Wind Speed m/s
Noise Level, dB(A)
Wind Speed (m/s)
Time (24 Hours)
90
80
70
60
50
40
30
20
20
15
10
5
0
00:00
02:00
04:00
06:00
08:00
10:00
12:00
14:00
16:00
18:00
20:00
22:00
00:00

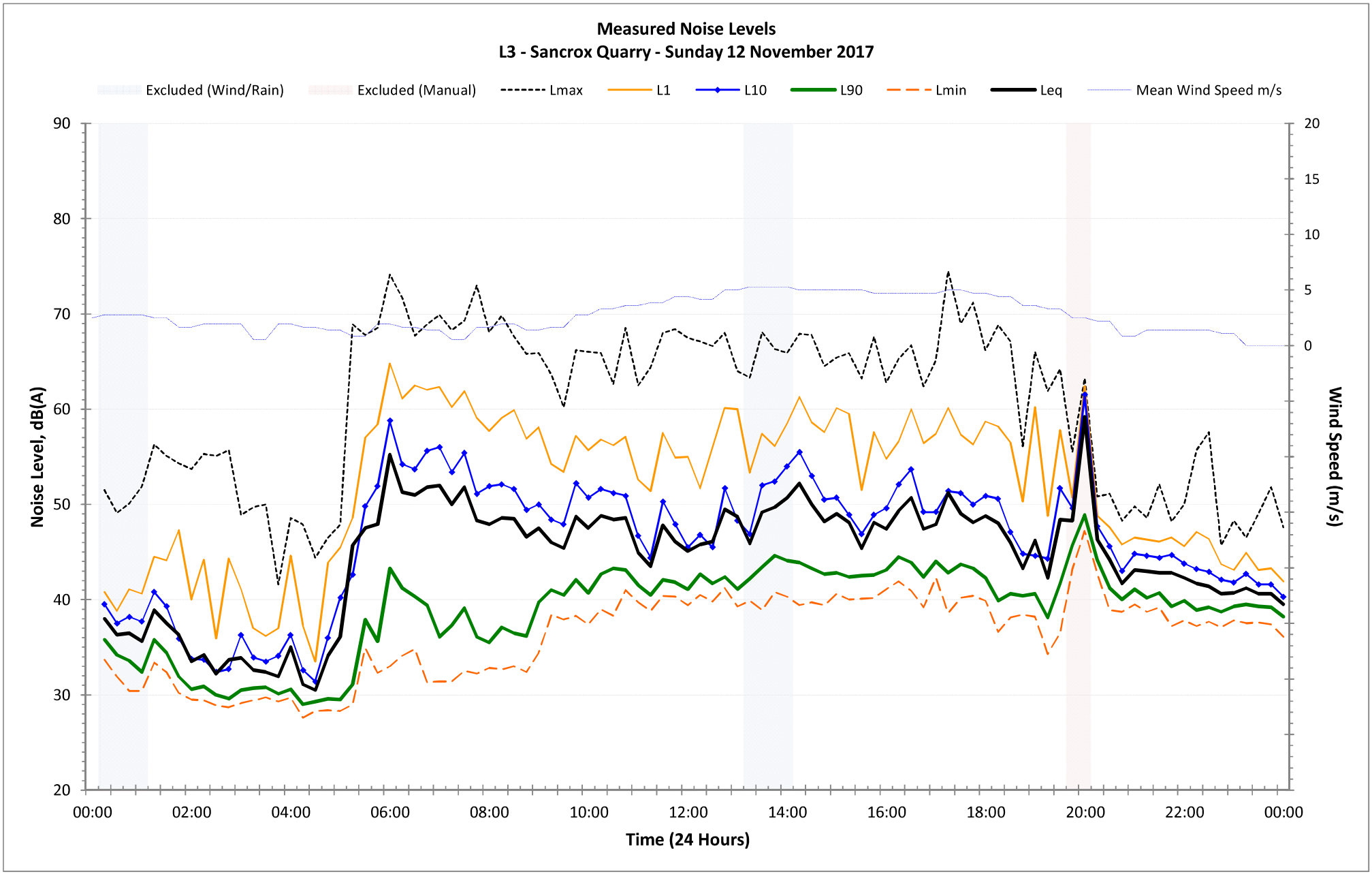

Measured Noise Levels
L3 - Sancrox Quarry - Tuesday 7 November 2017
Excluded (Wind/Rain)
Excluded (Manual)
Lmax
L1
L10
L90
Lmin
Leq
Mean Wind Speed m/s
Noise Level, dB(A)
Wind Speed (m/s)
Time (24 Hours)
90
80
70
60
50
40
30
20
20
15
10
5
0
00:00
02:00
04:00
06:00
08:00
10:00
12:00
14:00
16:00
18:00
20:00
22:00
00:00

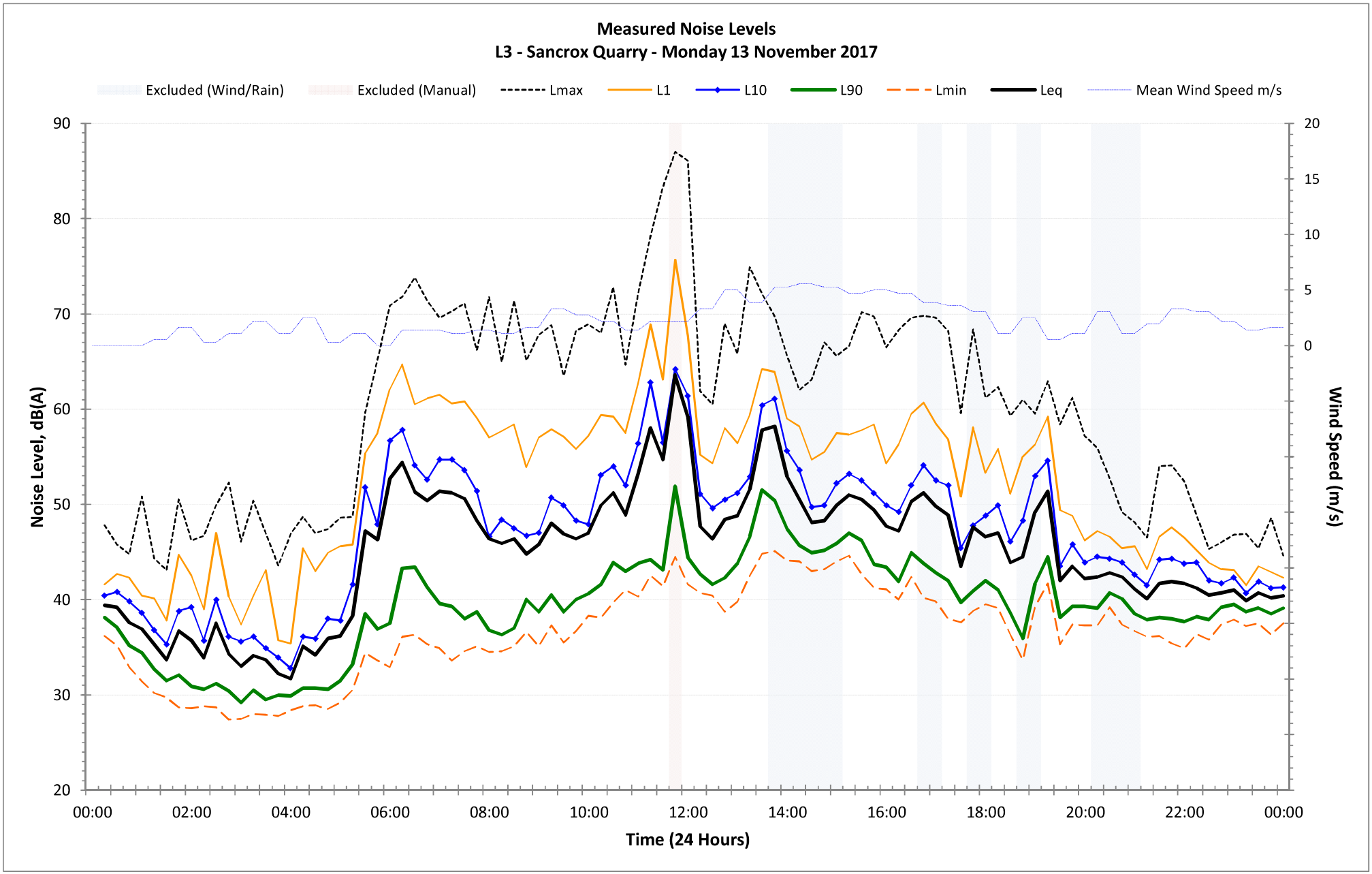

Measured Noise Levels
L3 - Sancrox Quarry - Wednesday 8 November 2017
Excluded (Wind/Rain)
Excluded (Manual)
Lmax
L1
L10
L90
Lmin
Leq
Mean Wind Speed m/s
Noise Level, dB(A)
Wind Speed (m/s)
Time (24 Hours)
90
80
70
60
50
40
30
20
20
15
10
5
0
00:00
02:00
04:00
06:00
08:00
10:00
12:00
14:00
16:00
18:00
20:00
22:00
00:00

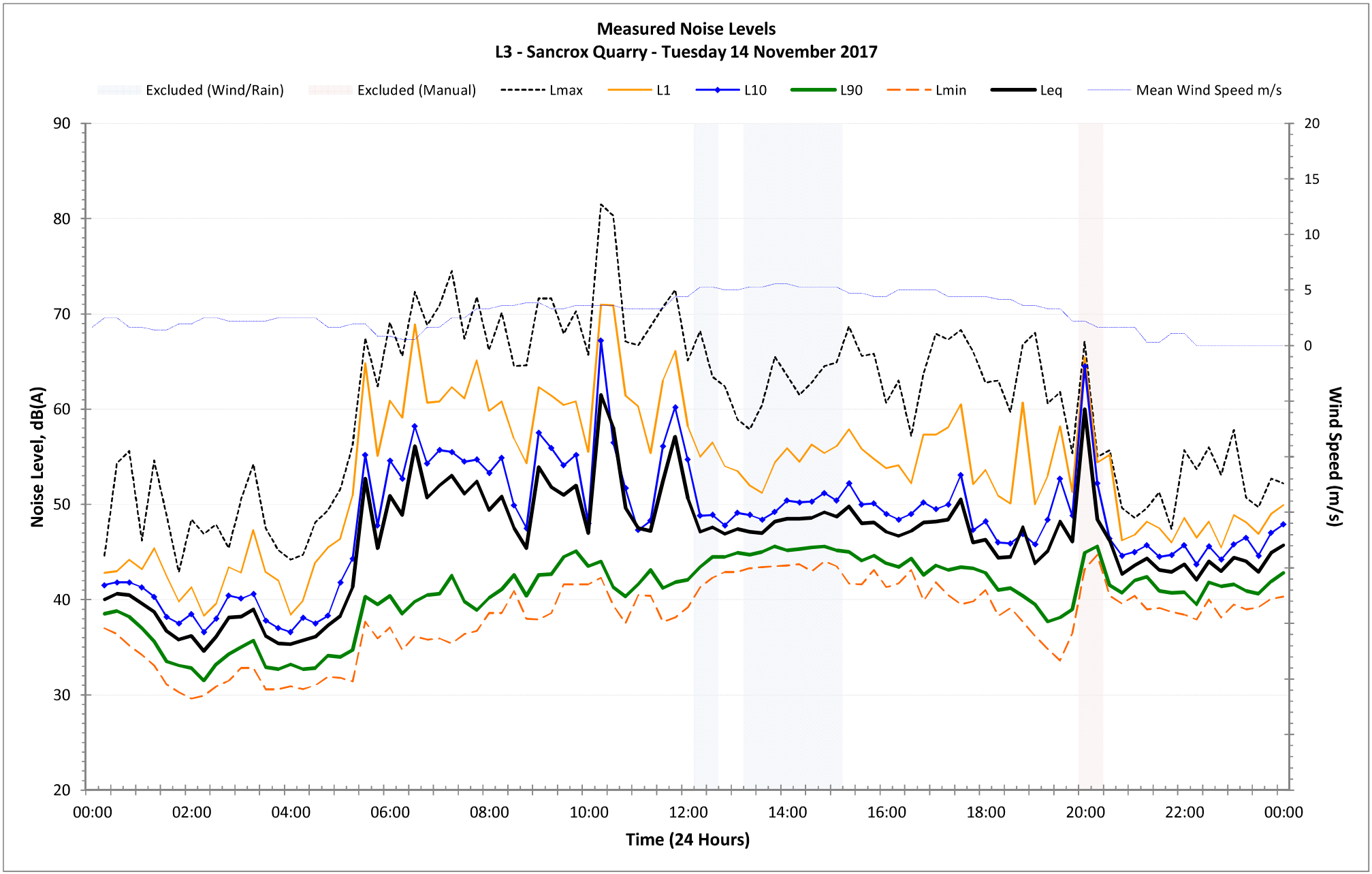

Measured Noise Levels
L3 - Sancrox Quarry - Thursday 9 November 2017
Excluded (Wind/Rain)
Excluded (Manual)
Lmax
L1
L10
L90
Lmin
Leq
Mean Wind Speed m/s
Noise Level, dB(A)
Wind Speed (m/s)
Time (24 Hours)
90
80
70
60
50
40
30
20
20
15
10
5
0
00:00
02:00
04:00
06:00
08:00
10:00
12:00
14:00
16:00
18:00
20:00
22:00
00:00

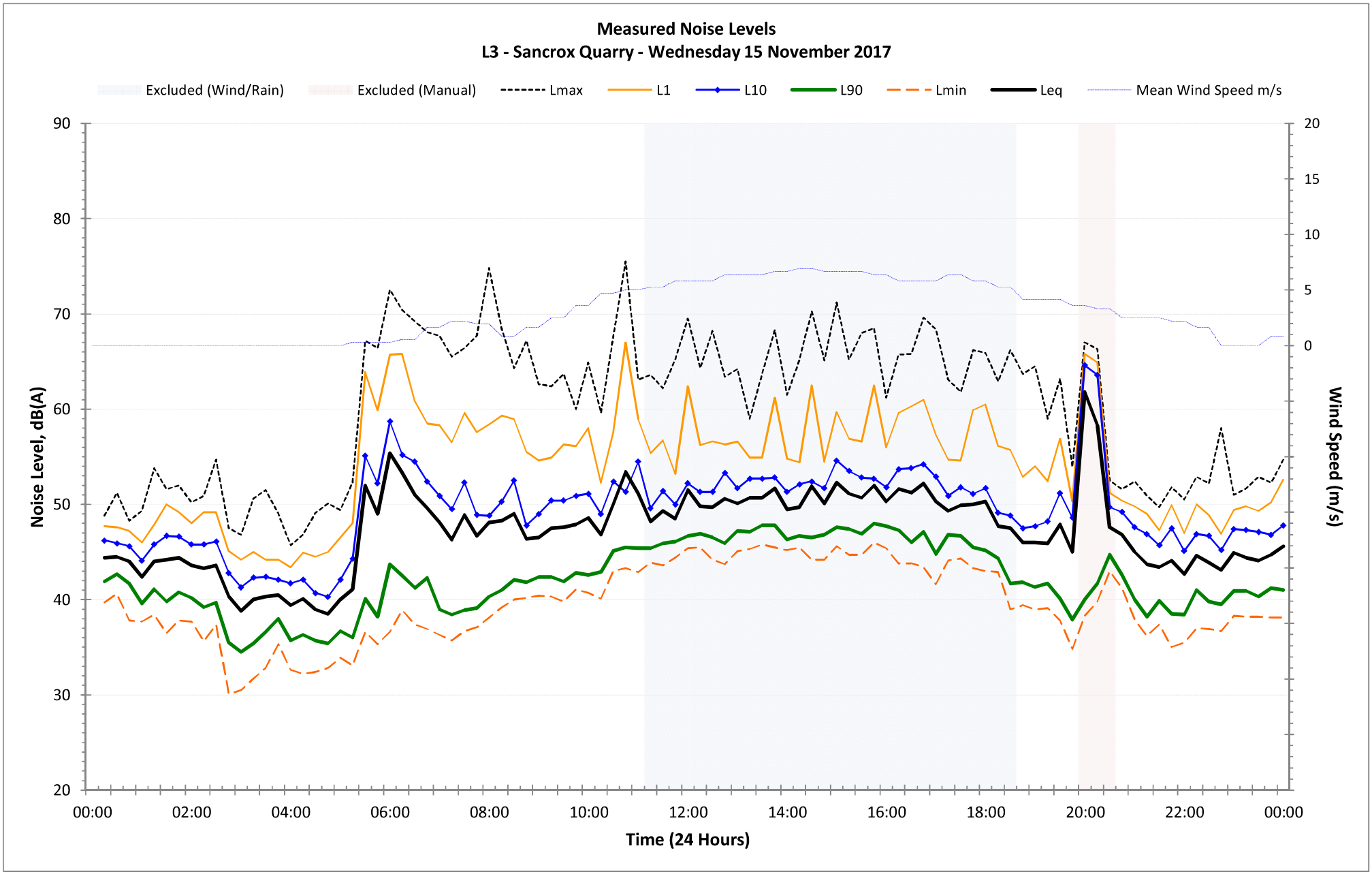

Measured Noise Levels
L3 - Sancrox Quarry - Friday 10 November 2017
Excluded (Wind/Rain)
Excluded (Manual)
Lmax
L1
L10
L90
Lmin
Leq
Mean Wind Speed m/s
Noise Level, dB(A)
Wind Speed (m/s)
Time (24 Hours)
90
80
70
60
50
40
30
20
20
15
10
5
0
00:00
02:00
04:00
06:00
08:00
10:00
12:00
14:00
16:00
18:00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

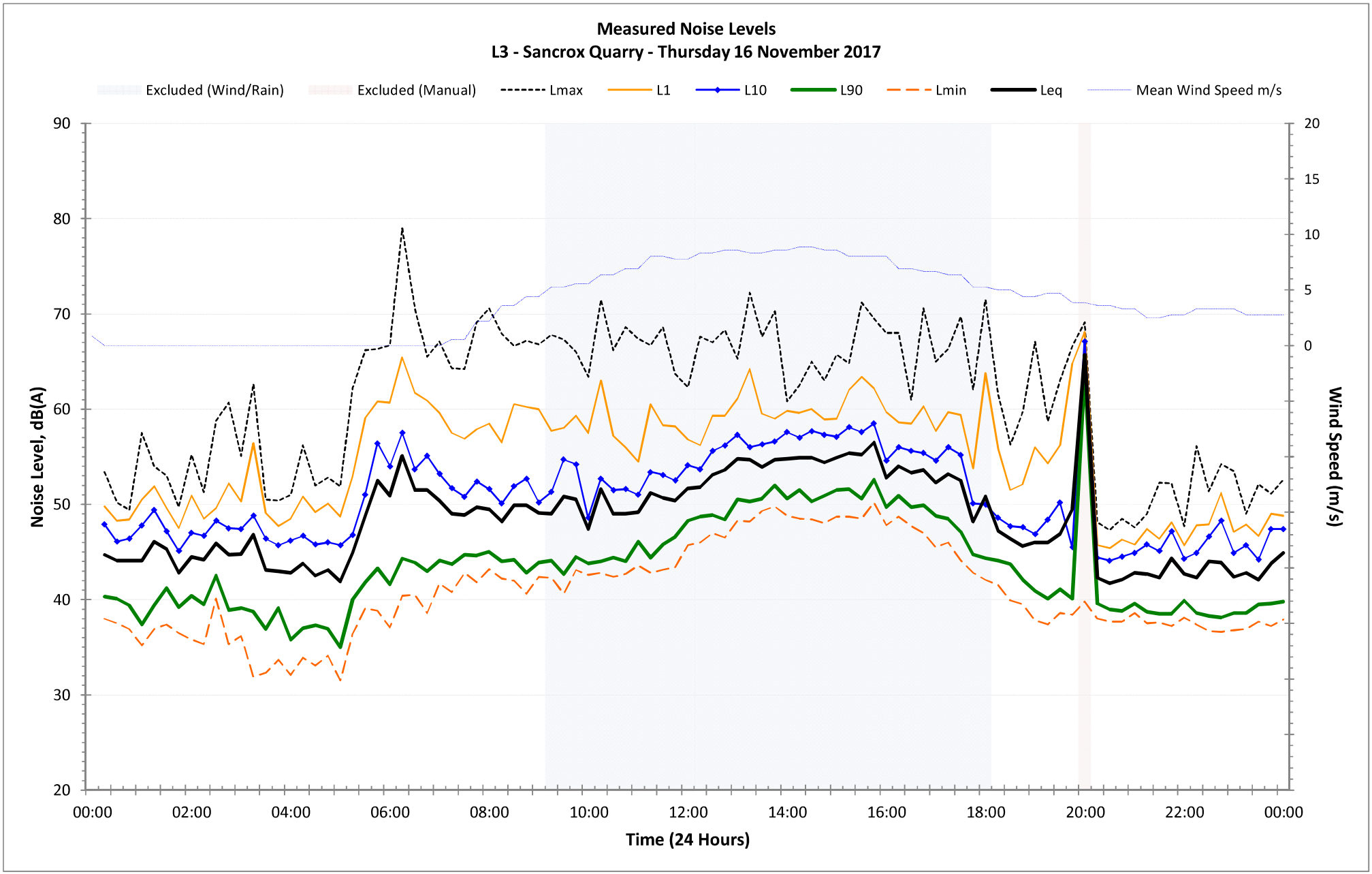

Measured Noise Levels
L3 - Sancrox Quarry - Saturday 11 November 2017
Excluded (Wind/Rain)
Excluded (Manual)
Lmax
L1
L10
L90
Lmin
Leq
Mean Wind Speed m/s
Noise Level, dB(A)
Wind Speed (m/s)
Time (24 Hours)
90
80
70
60
50
40
30
20
20
15
10
5
0
00:00
02:00
04:00
06:00
08:00
10:00
12:00
14:00
16:00
18:00
20:00
22:00
00:00

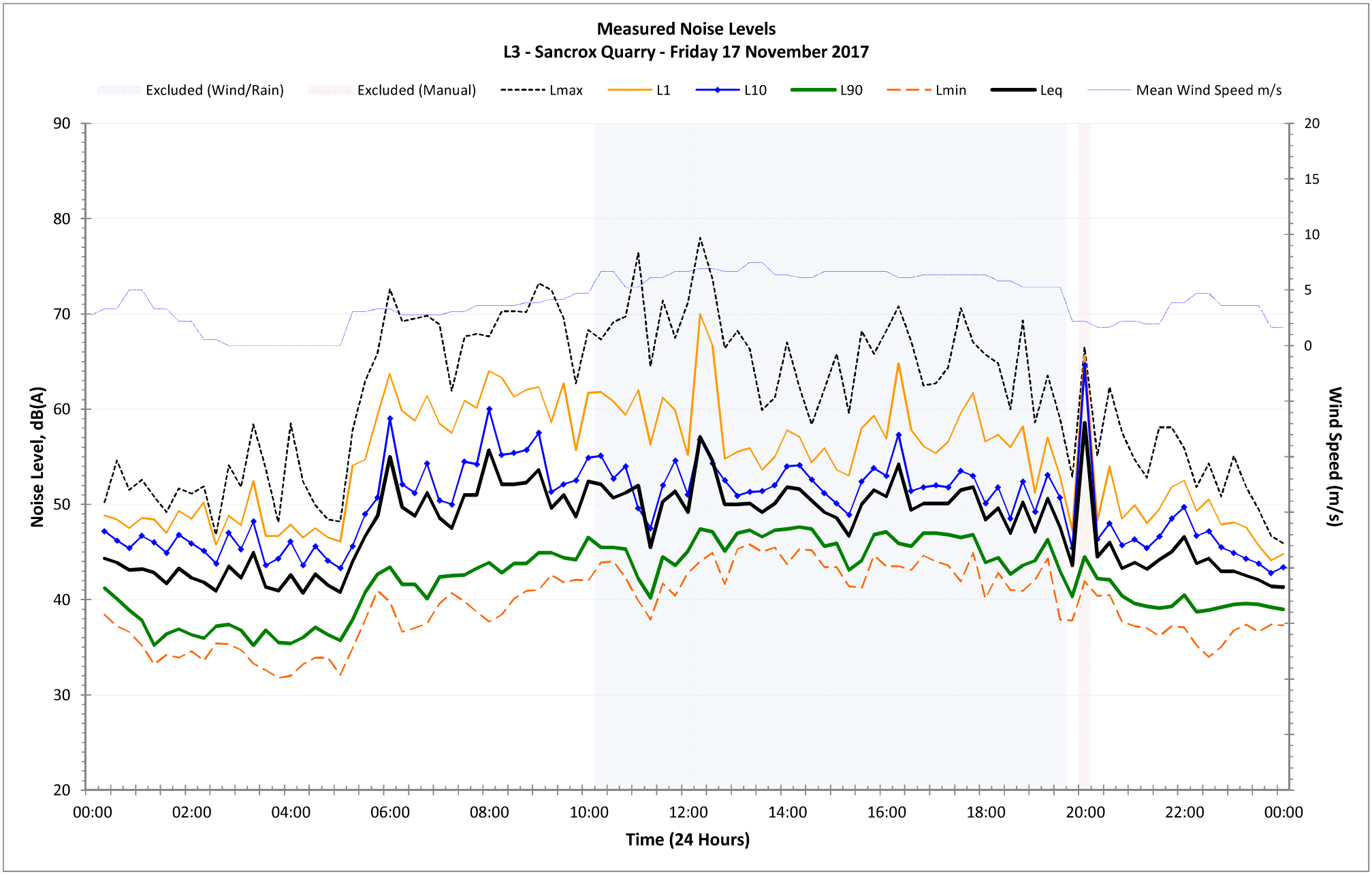

Measured Noise Levels
L3 - Sancrox Quarry - Sunday 12 November 2017
Excluded (Wind/Rain)
Excluded (Manual)
Lmax
L1
L10
L90
Lmin
Leq
Mean Wind Speed m/s
Noise Level, dB(A)
Wind Speed (m/s)
Time (24 Hours)
90
80
70
60
50
40
30
20
20
15
10
5
0
00:00
02:00
04:00
06:00
08:00
10:00
12:00
14:00
16:00
18:00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

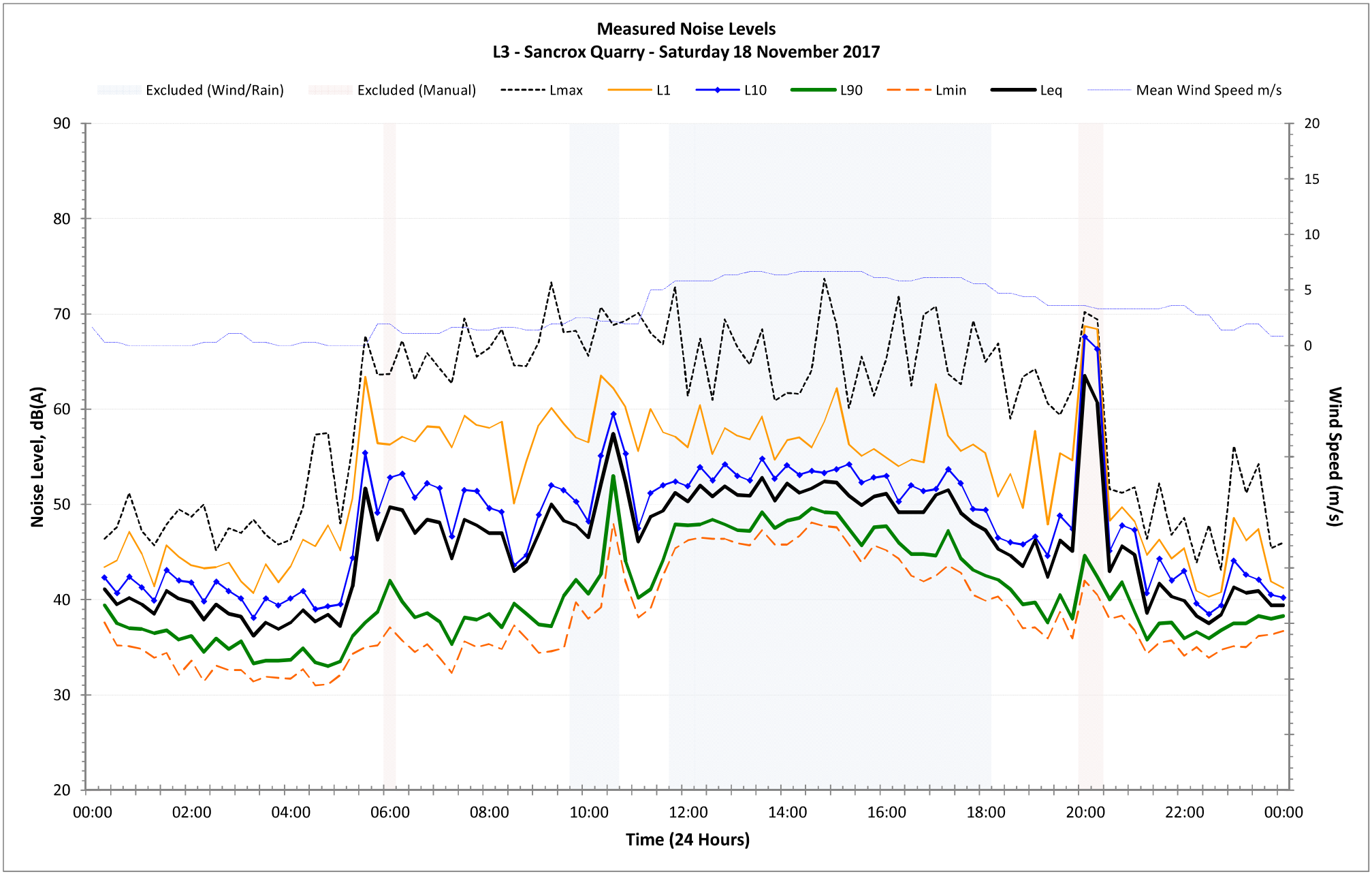

Measured Noise Levels
L3 - Sancrox Quarry - Monday 13 November 2017
Excluded (Wind/Rain)
Excluded (Manual)
Lmax
L1
L10
L90
Lmin
Leq
Mean Wind Speed m/s
Noise Level, dB(A)
Wind Speed (m/s)
Time (24 Hours)
90
80
70
60
50
40
30
20
20
15
10
5
0
00:00
02:00
04:00
06:00
08:00
10:00
12:00
14:00
16:00
18:00
20:00
22:00
00:00

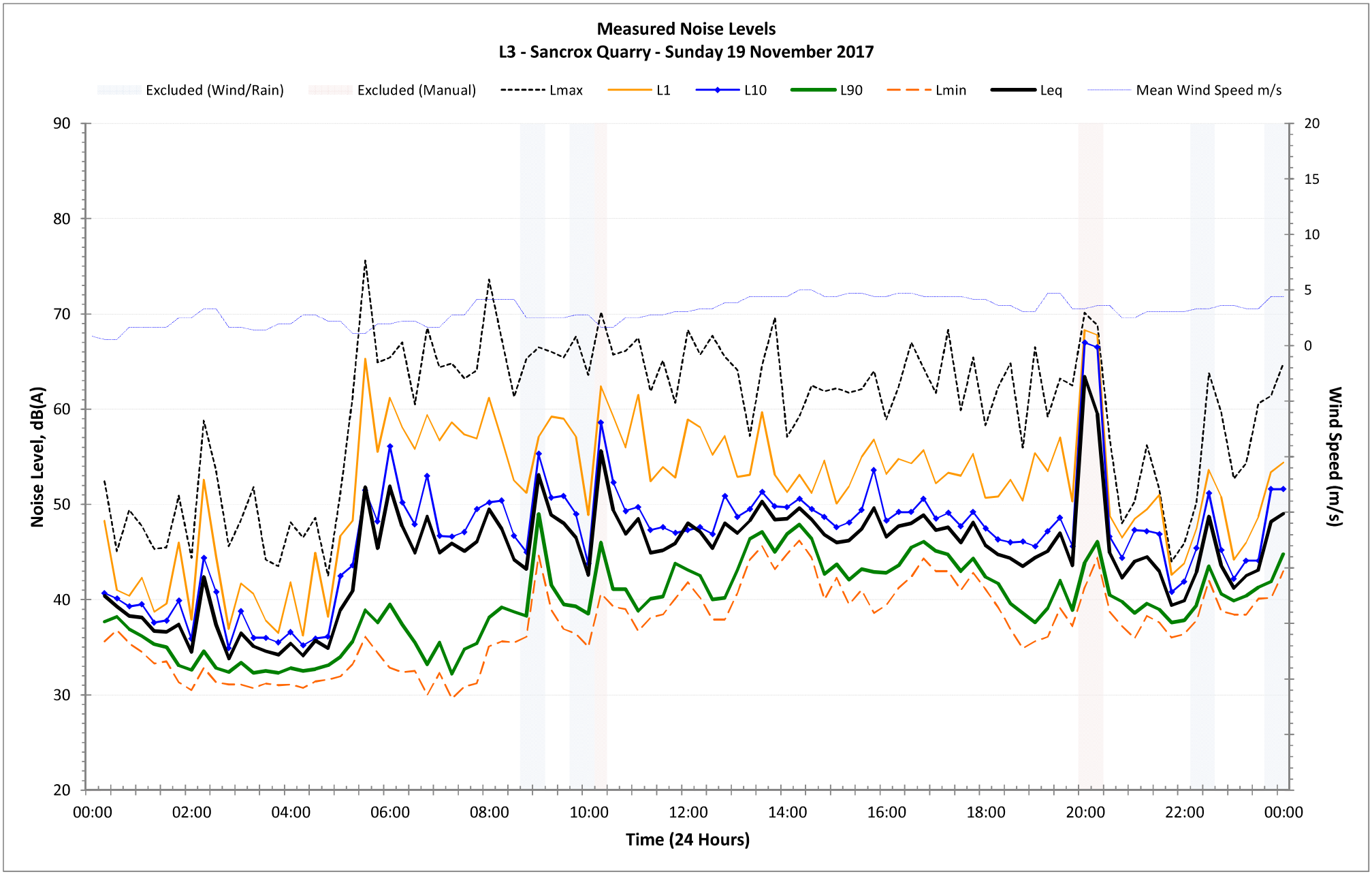

Measured Noise Levels
L3 - Sancrox Quarry - Tuesday 14 November 2017
Excluded (Wind/Rain)
Excluded (Manual)
Lmax
L1
L10
L90
Lmin
Leq
Mean Wind Speed m/s
Noise Level, dB(A)
Wind Speed (m/s)
Time (24 Hours)
90
80
70
60
50
40
30
20
20
15
10
5
0
00:00
02:00
04:00
06:00
08:00
10:00
12:00
14:00
16:00
18:00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

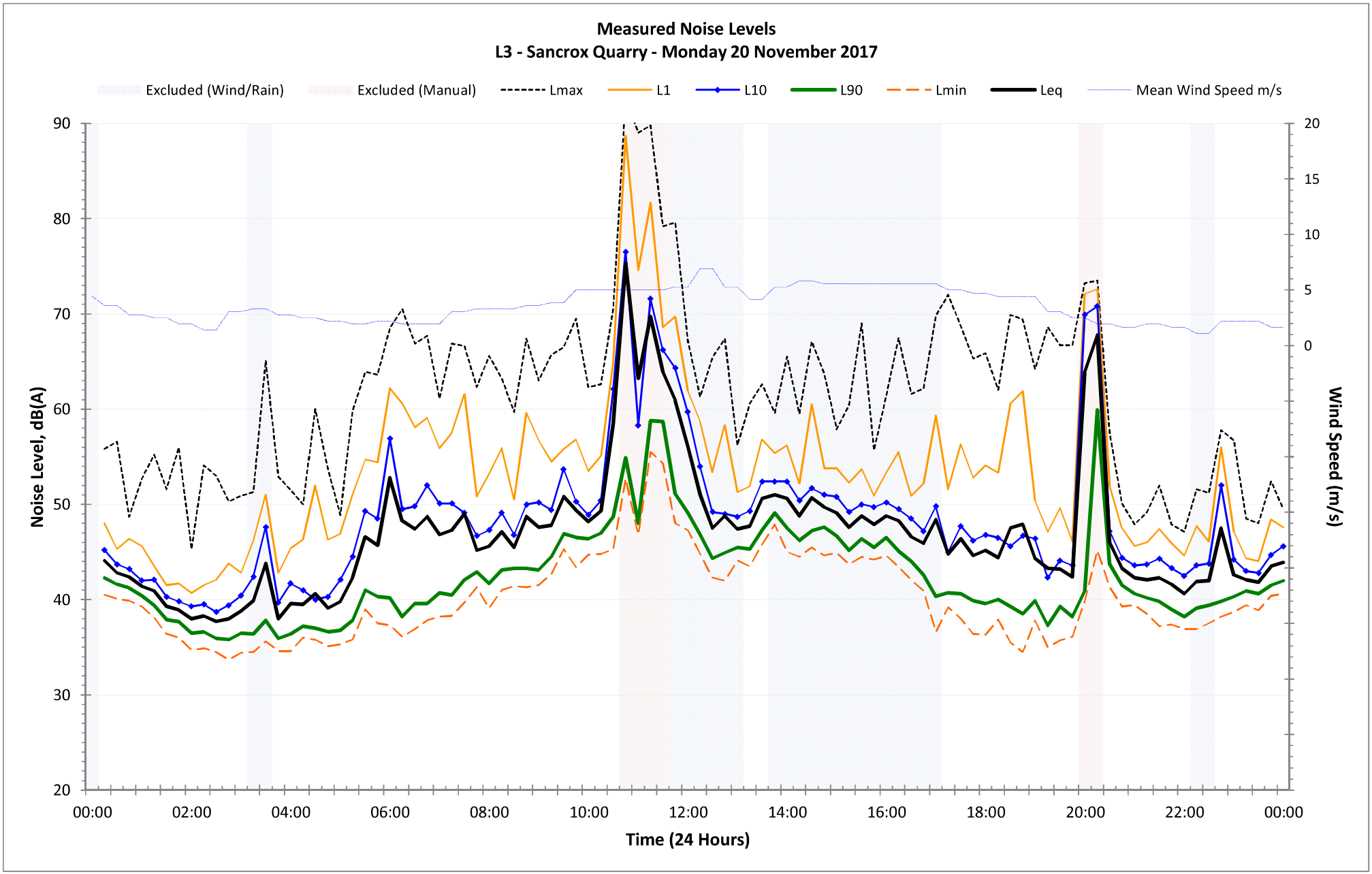

Measured Noise Levels
L3 - Sancrox Quarry - Wednesday 15 November 2017
Excluded (Wind/Rain)
Excluded (Manual)
Lmax
L1
L10
L90
Lmin
Leq
Mean Wind Speed m/s
Noise Level, dB(A)
Wind Speed (m/s)
Time (24 Hours)
90
80
70
60
50
40
30
20
20
15
10
5
0
00:00
02:00
04:00
06:00
08:00
10:00
12:00
14:00
16:00
18:00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

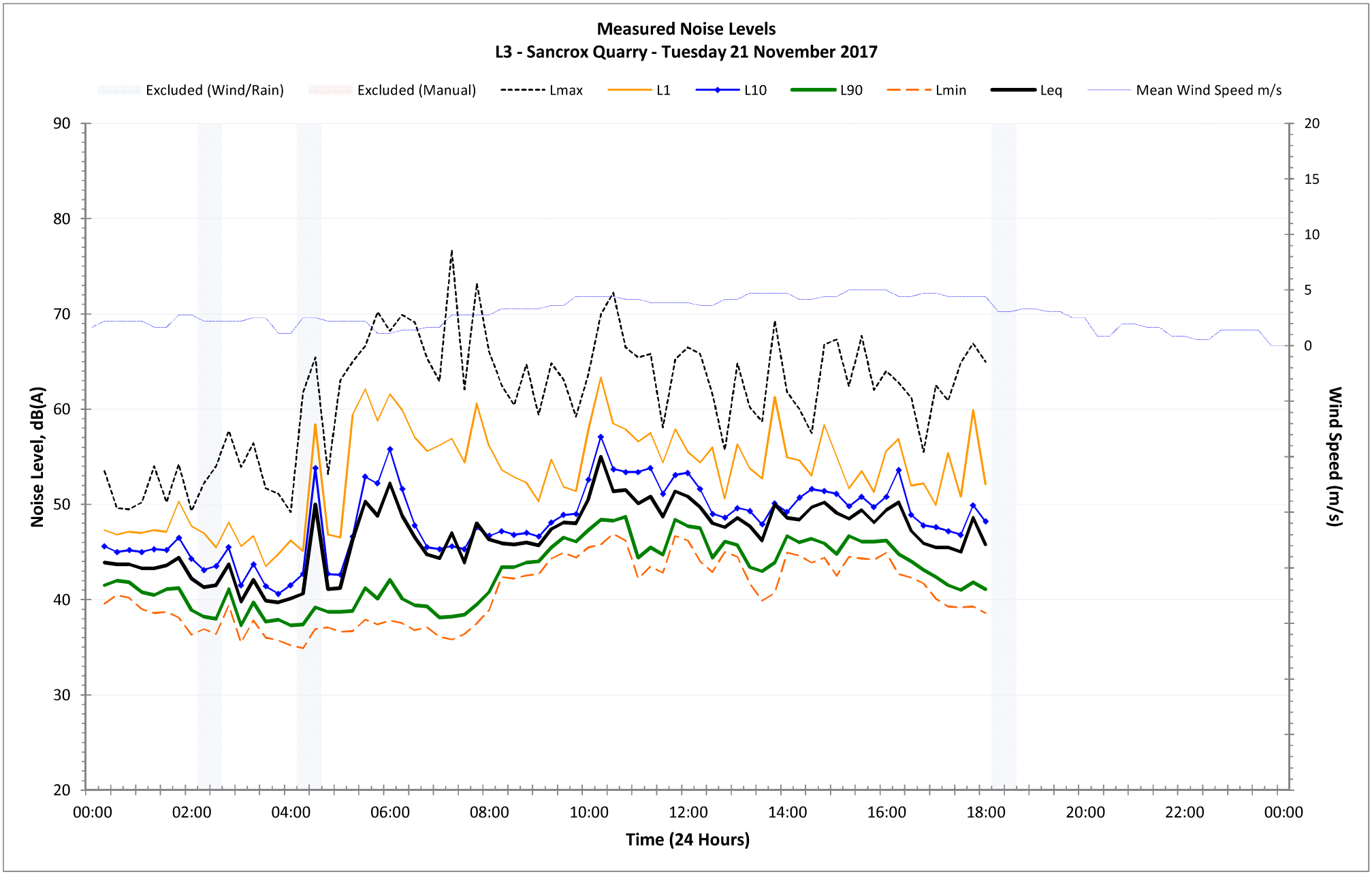

Measured Noise Levels
L3 - Sancrox Quarry - Thursday 16 November 2017
Excluded (Wind/Rain)
Excluded (Manual)
Lmax
L1
L10
L90
Lmin
Leq
Mean Wind Speed m/s
Noise Level, dB(A)
Wind Speed (m/s)
Time (24 Hours)
90
80
70
60
50
40
30
20
20
15
10
5
0
00:00
02:00
04:00
06:00
08:00
10:00
12:00
14:00
16:00
18:00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

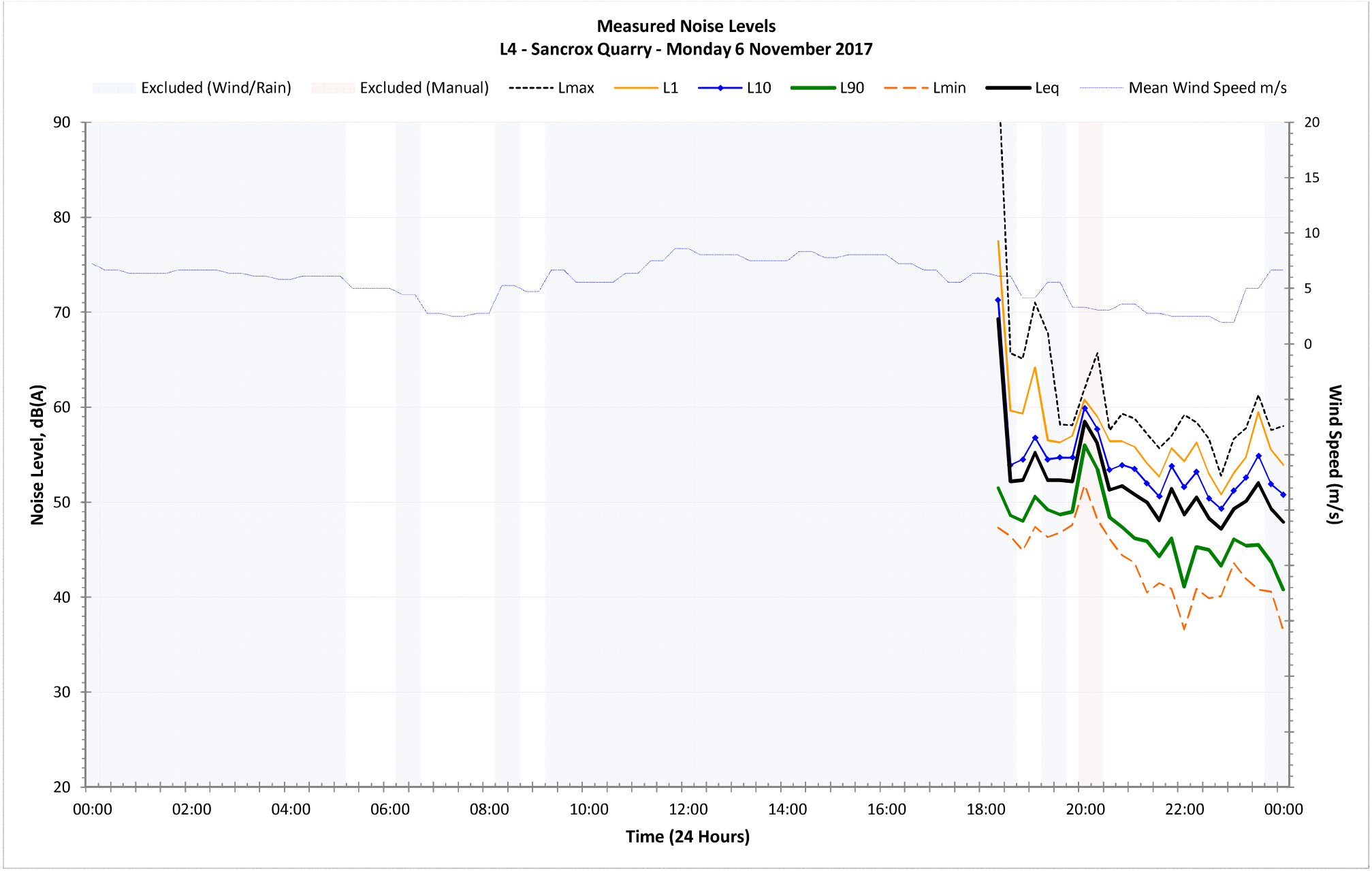

Measured Noise Levels
L3 - Sancrox Quarry - Friday 17 November 2017
Excluded (Wind/Rain)
Excluded (Manual)
Lmax
L1
L10
L90
Lmin
Leq
Mean Wind Speed m/s
Noise Level, dB(A)
Wind Speed (m/s)
Time (24 Hours)
90
80
70
60
50
40
30
20
20
15
10
5
0
00:00
02:00
04:00
06:00
08:00
10:00
12:00
14:00
16:00
18:00
20:00
22:00
00:00

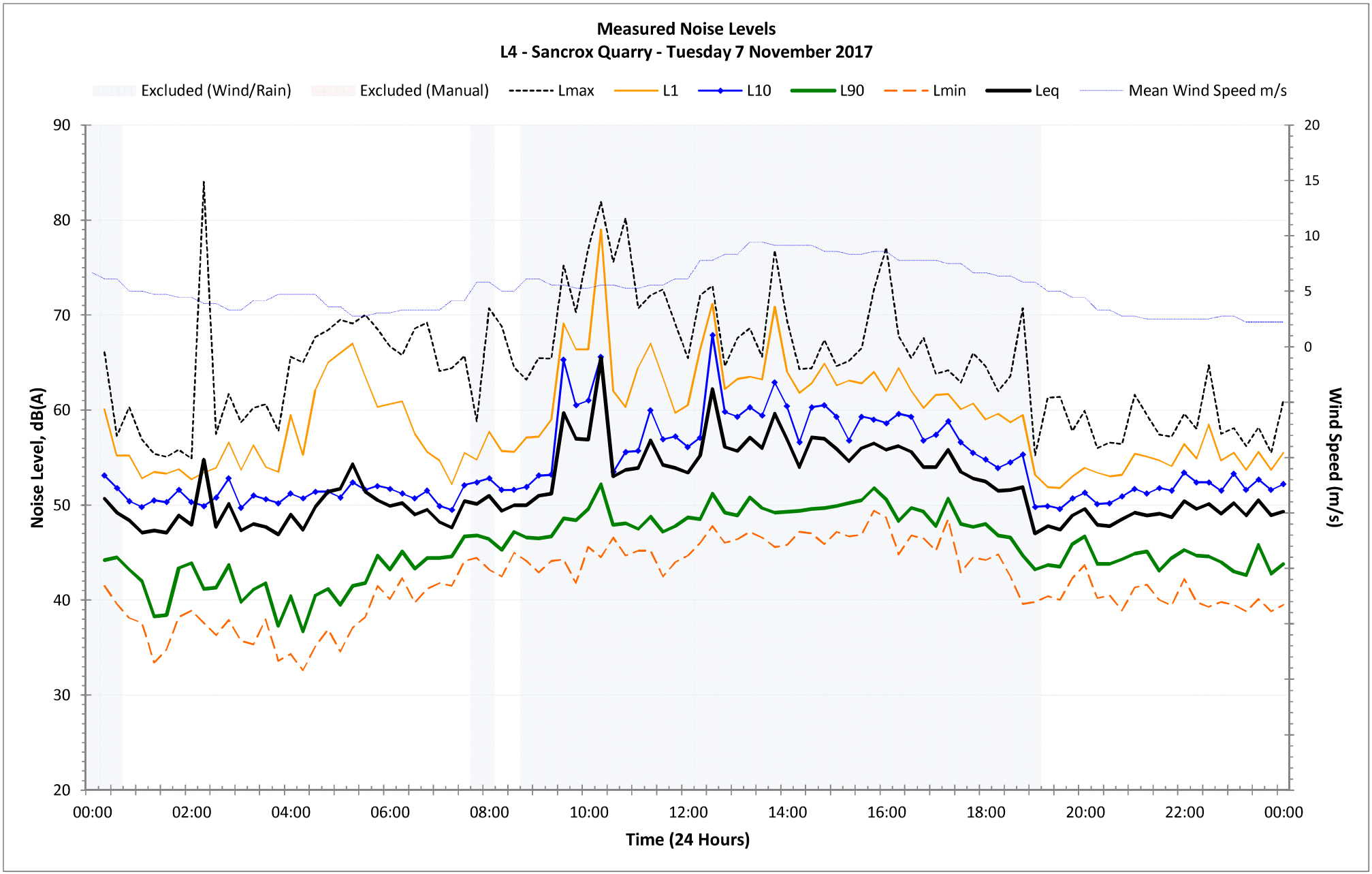

Measured Noise Levels
L3 - Sancrox Quarry - Saturday 18 November 2017
Excluded (Wind/Rain)
Excluded (Manual)
Lmax
L1
L10
L90
Lmin
Leq
Mean Wind Speed m/s
Noise Level, dB(A)
Wind Speed (m/s)
Time (24 Hours)
90
80
70
60
50
40
30
20
20
15
10
5
0
00:00
02:00
04:00
06:00
08:00
10:00
12:00
14:00
16:00
18:00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

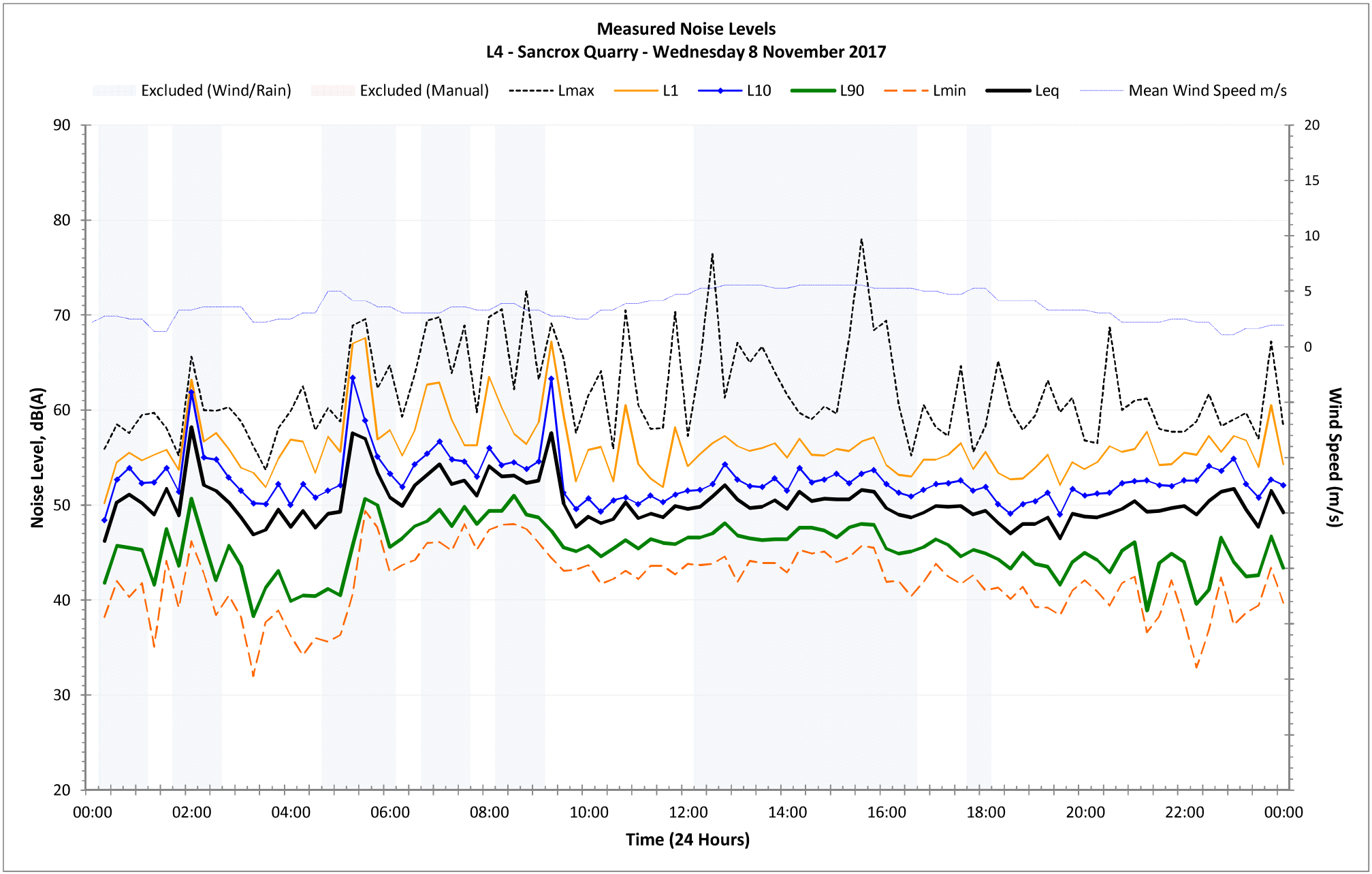

Measured Noise Levels
L3 - Sancrox Quarry - Sunday 19 November 2017
Excluded (Wind/Rain)
Excluded (Manual)
Lmax
L1
L10
L90
Lmin
Leq
Mean Wind Speed m/s
Noise Level, dB(A)
Wind Speed (m/s)
Time (24 Hours)
90
80
70
60
50
40
30
20
20
15
10
5
0
00:00
02:00
04:00
06:00
08:00
10:00
12:00
14:00
16:00
18:00
20:00
22:00
00:00

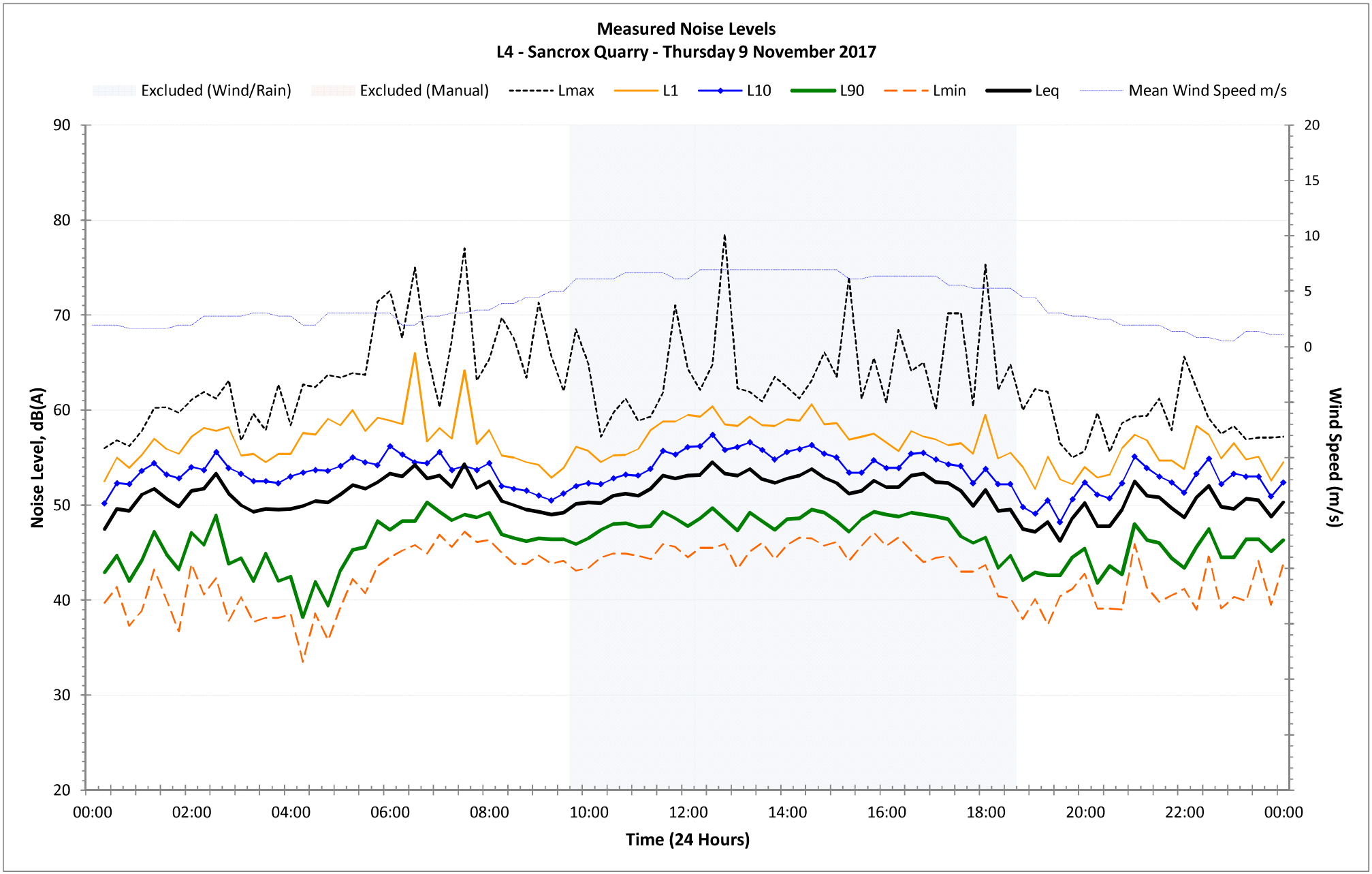

Measured Noise Levels
L3 - Sancrox Quarry - Monday 20 November 2017
Excluded (Wind/Rain)
Excluded (Manual)
Lmax
L1
L10
L90
Lmin
Leq
Mean Wind Speed m/s
Noise Level, dB(A)
Wind Speed (m/s)
Time (24 Hours)
90
80
70
60
50
40
30
20
20
15
10
5
0
00:00
02:00
04:00
06:00
08:00
10:00
12:00
14:00
16:00
18:00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

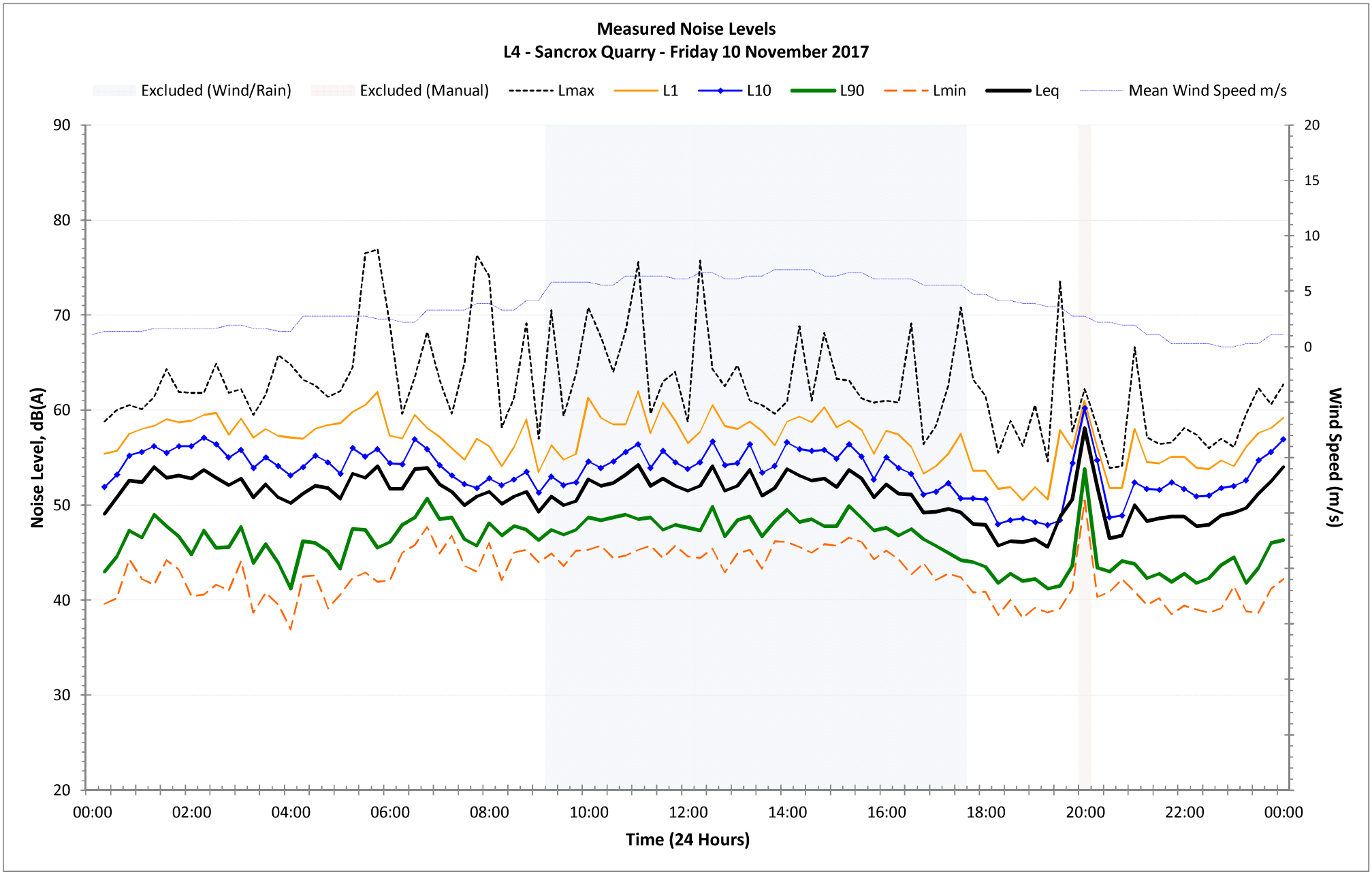

Measured Noise Levels
L3 - Sancrox Quarry - Tuesday 21 November 2017
Excluded (Wind/Rain)
Excluded (Manual)
Lmax
L1
L10
L90
Lmin
Leq
Mean Wind Speed m/s
Noise Level, dB(A)
Wind Speed (m/s)
Time (24 Hours)
90
80
70
60
50
40
30
20
20
15
10
5
0
00:00
02:00
04:00
06:00
08:00
10:00
12:00
14:00
16:00
18:00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

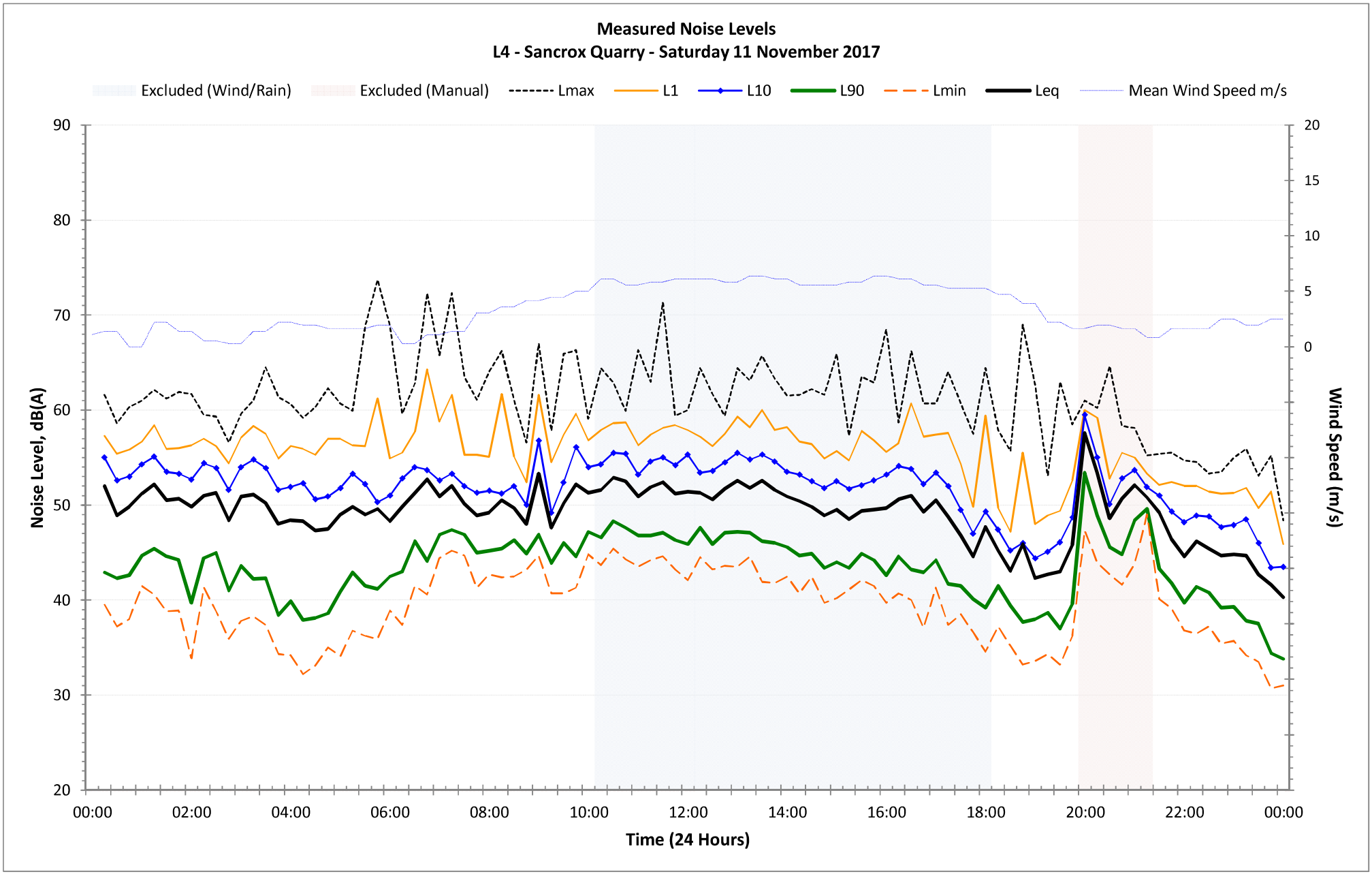

Measured Noise Levels
L4 - Sancrox Quarry - Monday 6 November 2017
Excluded (Wind/Rain)
Excluded (Manual)
Lmax
L1
L10
L90
Lmin
Leq
Mean Wind Speed m/s
Noise Level, dB(A)
Wind Speed (m/s)
Time (24 Hours)
90
80
70
60
50
40
30
20
20
15
10
5
0
00:00
02:00
04:00
06:00
08:00
10:00
12:00
14:00
16:00
18:00
20:00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

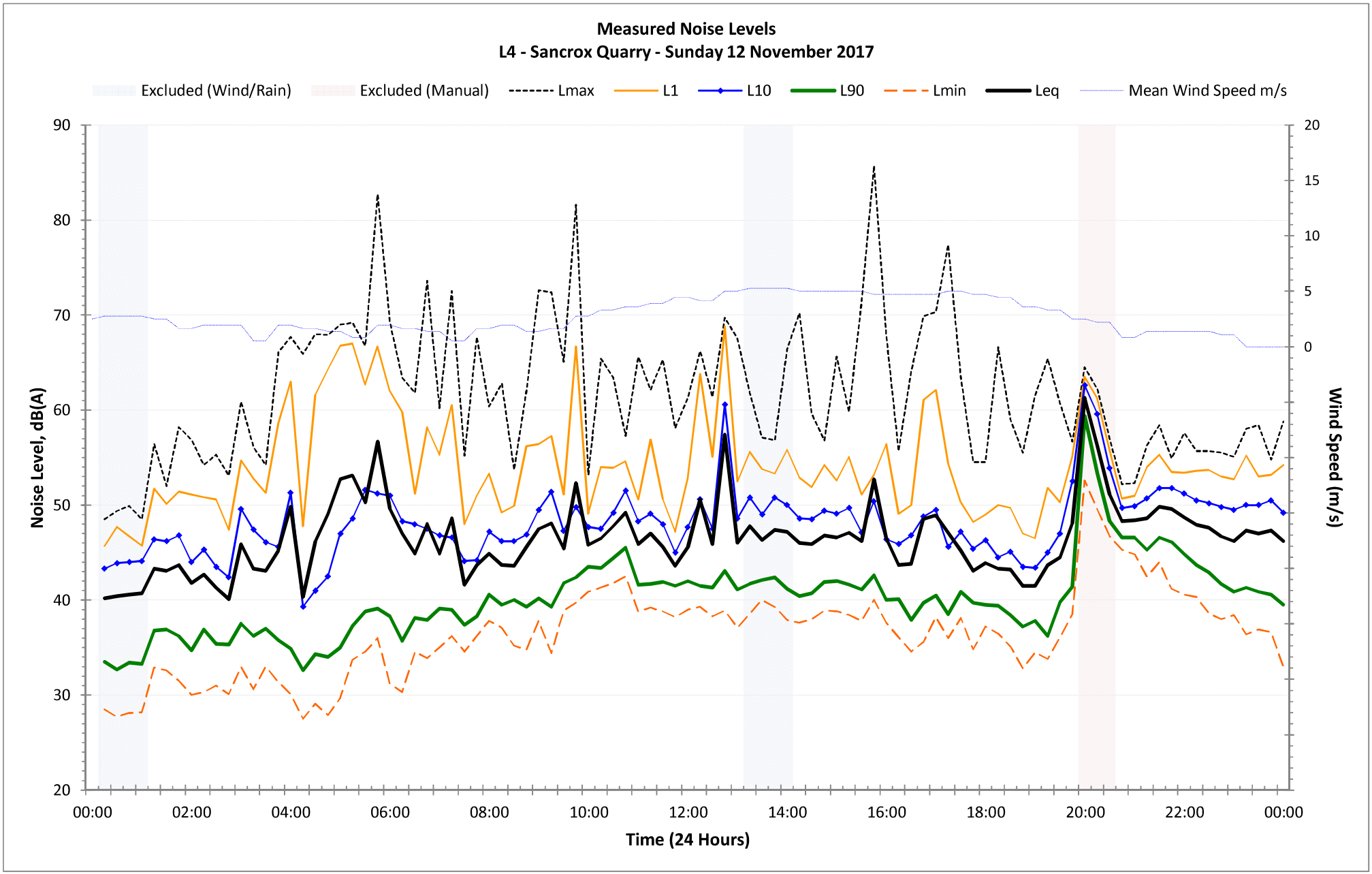

Measured Noise Levels
L4 - Sancrox Quarry - Tuesday 7 November 2017
Excluded (Wind/Rain)
Excluded (Manual)
Lmax
L1
L10
L90
Lmin
Leq
Mean Wind Speed m/s
Noise Level, dB(A)
Wind Speed (m/s)
Time (24 Hours)
90
80
70
60
50
40
30
20
20
15
10
5
0
00:00
02:00
04:00
06:00
08:00
10:00
12:00
14:00
16:00
18:00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

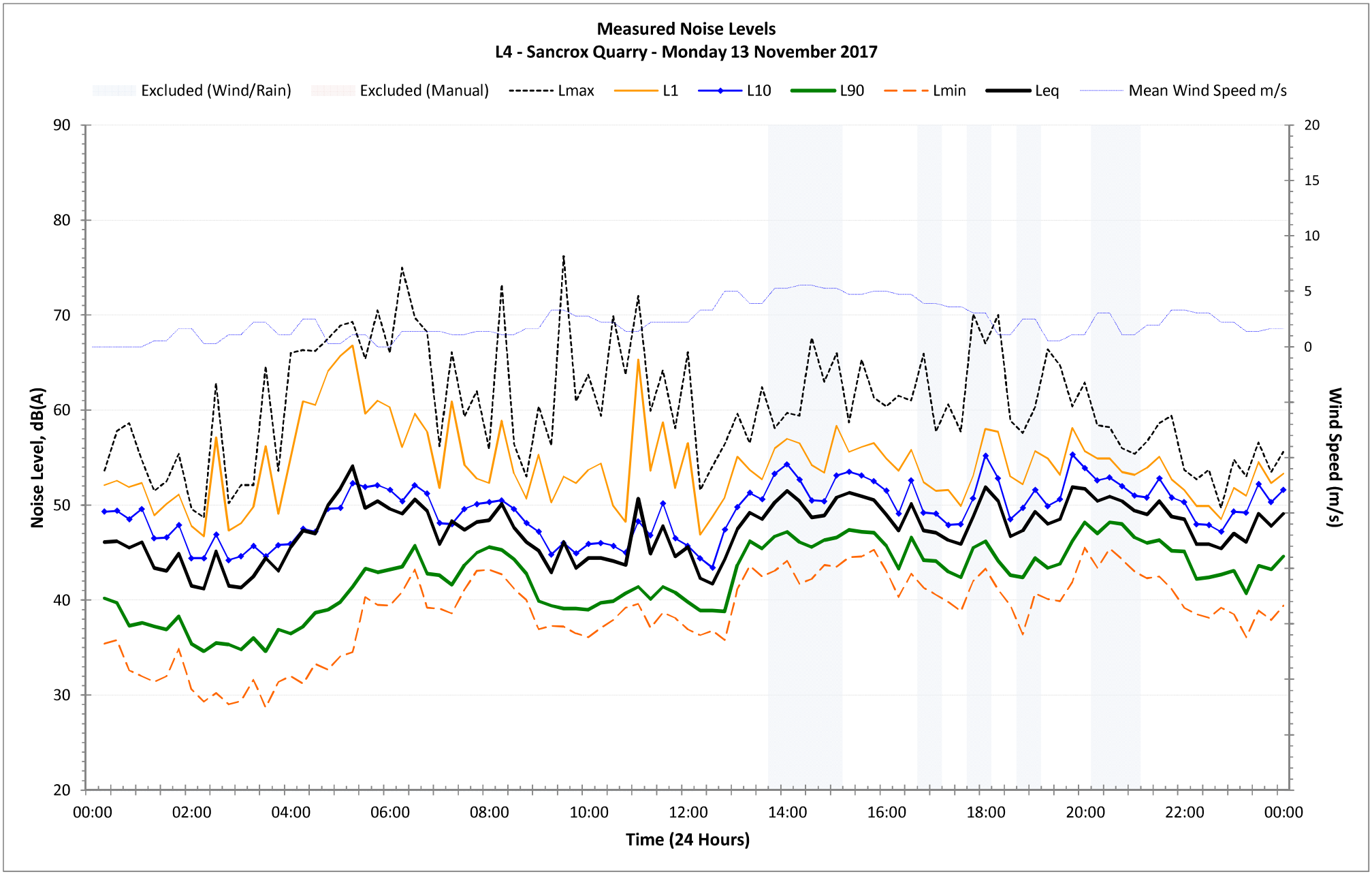

Measured Noise Levels
L4 - Sancrox Quarry - Wednesday 8 November 2017
Excluded (Wind/Rain)
Excluded (Manual)
Lmax
L1
L10
L90
Lmin
Leq
Mean Wind Speed m/s
Noise Level, dB(A)
Wind Speed (m/s)
Time (24 Hours)
90
80
70
60
50
40
30
20
20
15
10
5
0
00:00
02:00
04:00
06:00
08:00
10:00
12:00
14:00
16:00
18:00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

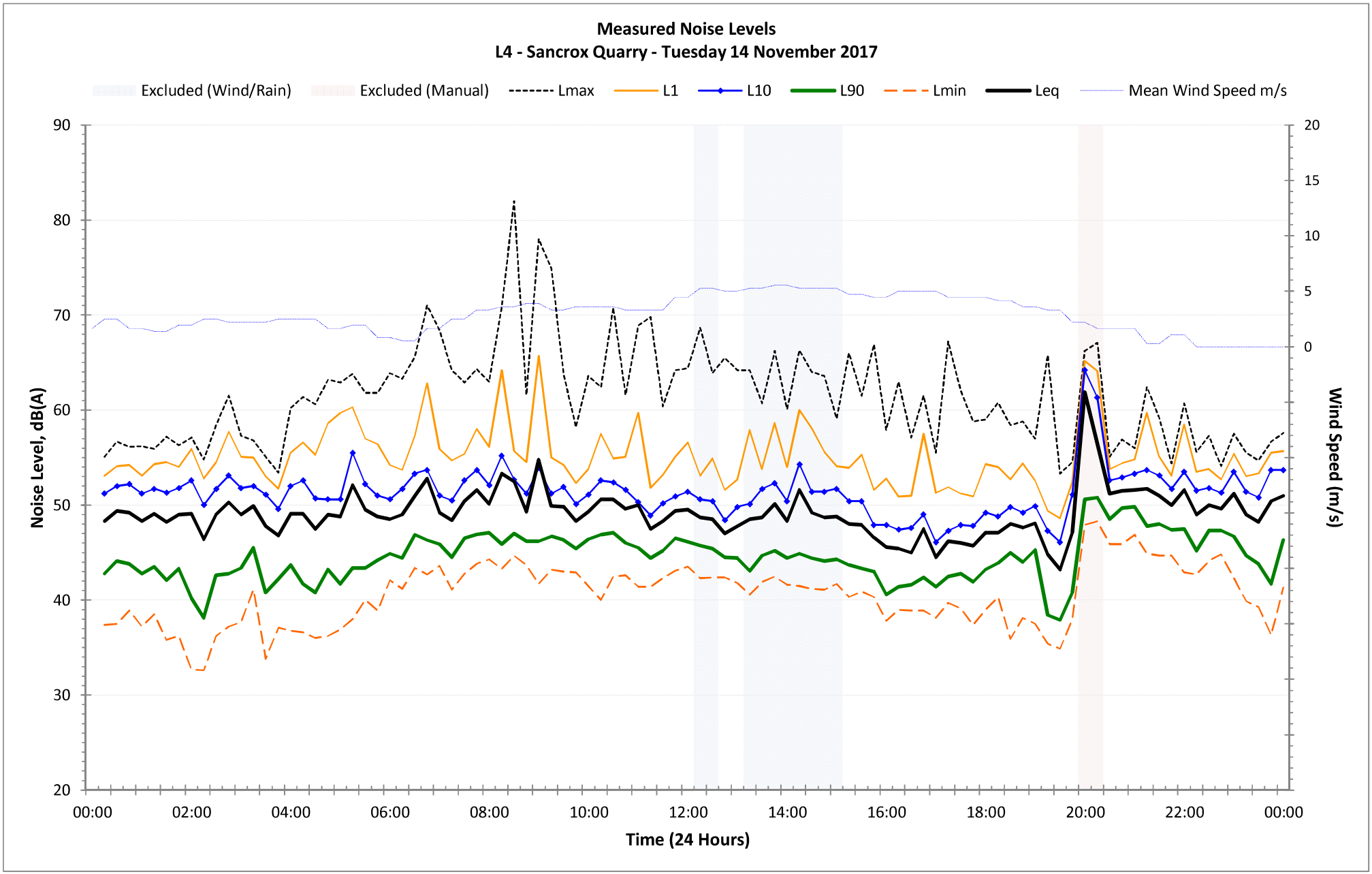

Measured Noise Levels
L4 - Sancrox Quarry - Thursday 9 November 2017
Excluded (Wind/Rain)
Excluded (Manual)
Lmax
L1
L10
L90
Lmin
Leq
Mean Wind Speed m/s
Noise Level, dB(A)
Wind Speed (m/s)
Time (24 Hours)
90
80
70
60
50
40
30
20
20
15
10
5
0
00:00
02:00
04:00
06:00
08:00
10:00
12:00
14:00
16:00
18:00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

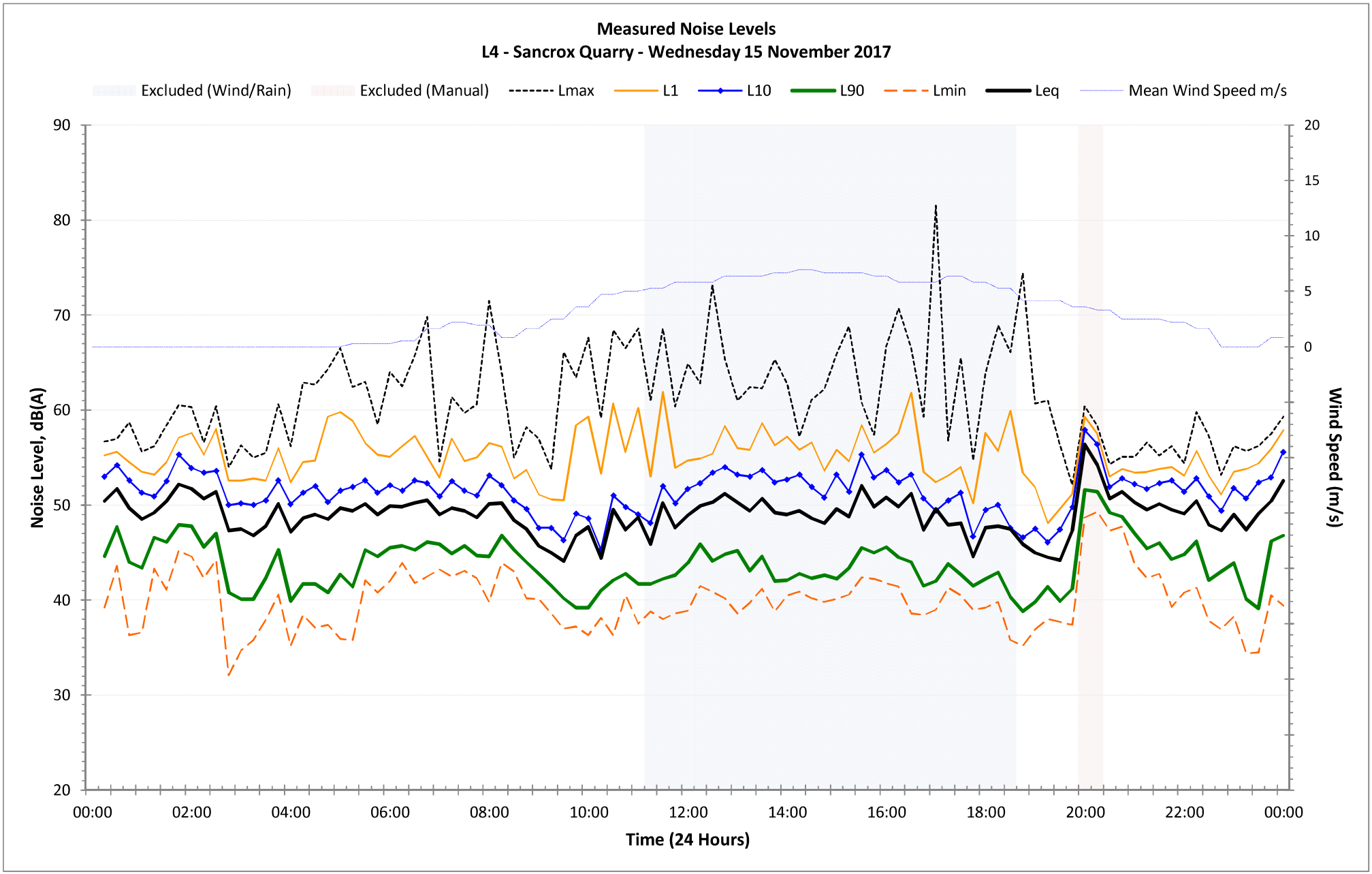

Measured Noise Levels
L4 - Sancrox Quarry - Friday 10 November 2017
Excluded (Wind/Rain)
Excluded (Manual)
Lmax
L1
L10
L90
Lmin
Leq
Mean Wind Speed m/s
Noise Level, dB(A)
Wind Speed (m/s)
Time (24 Hours)
90
80
70
60
50
40
30
20
20
15
10
5
0
00:00
02:00
04:00
06:00
08:00
10:00
12:00
14:00
16:00
18:00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

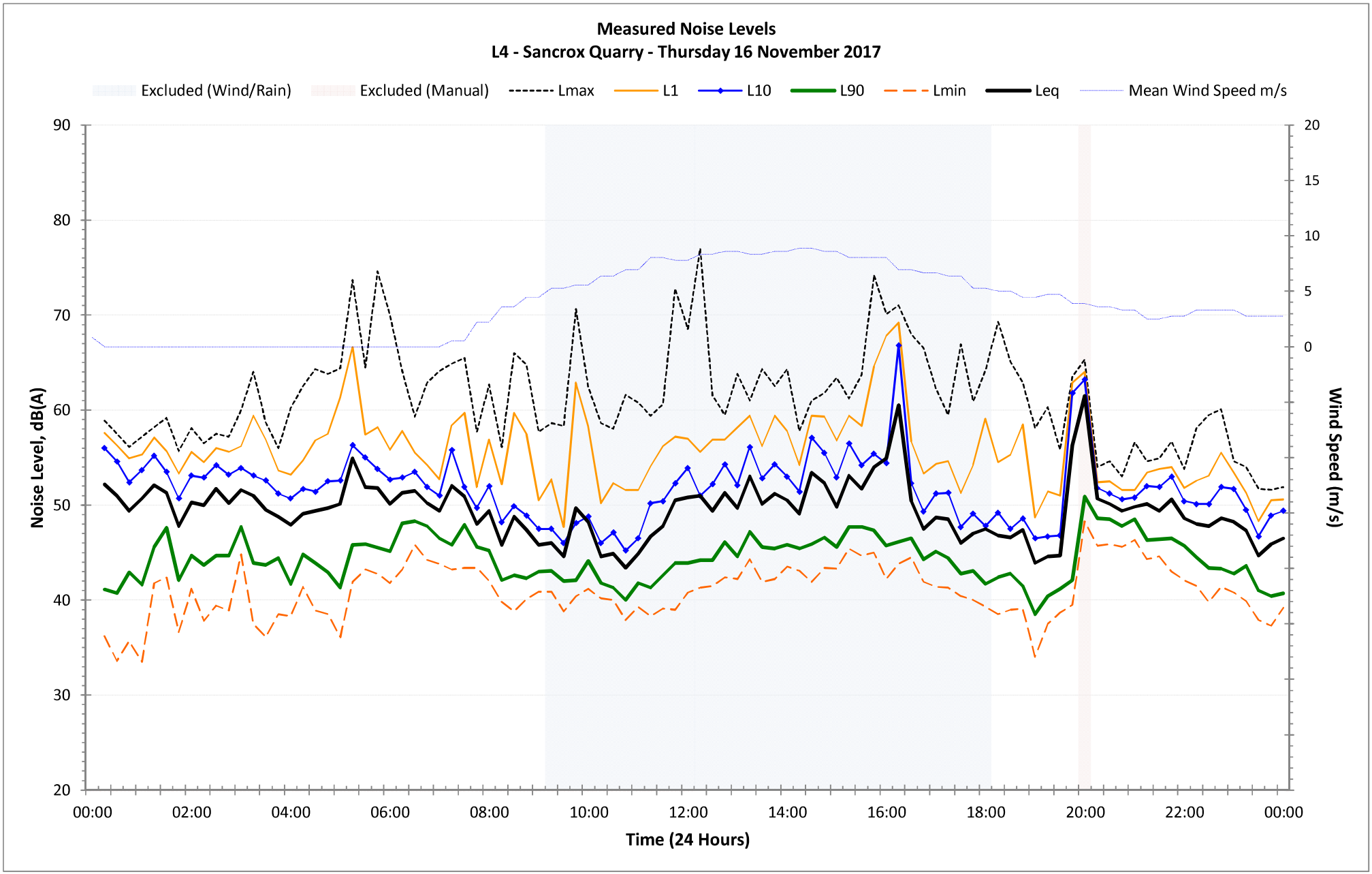

Measured Noise Levels
L4 - Sancrox Quarry - Saturday 11 November 2017
Excluded (Wind/Rain)
Excluded (Manual)
Lmax
L1
L10
L90
Lmin
Leq
Mean Wind Speed m/s
Noise Level, dB(A)
Wind Speed (m/s)
Time (24 Hours)
90
80
70
60
50
40
30
20
20
15
10
5
0
00:00
02:00
04:00
06:00
08:00
10:00
12:00
14:00
16:00
18:00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

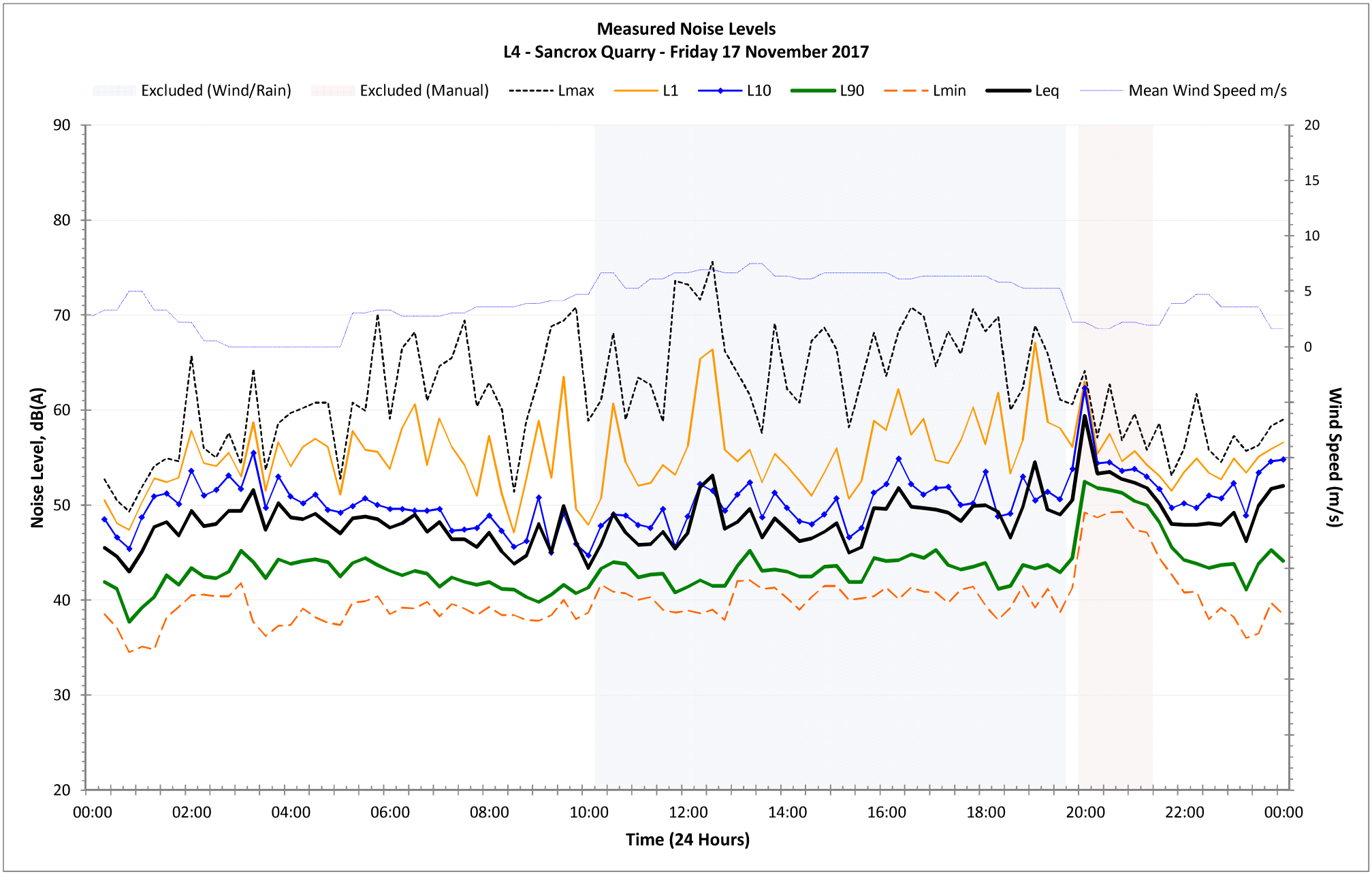

Measured Noise Levels
L4 - Sancrox Quarry - Sunday 12 November 2017
Excluded (Wind/Rain)
Excluded (Manual)
Lmax
L1
L10
L90
Lmin
Leq
Mean Wind Speed m/s
Noise Level, dB(A)
Wind Speed (m/s)
Time (24 Hours)
90
80
70
60
50
40
30
20
20
15
10
5
0
00:00
02:00
04:00
06:00
08:00
10:00
12:00
14:00
16:00
18:00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

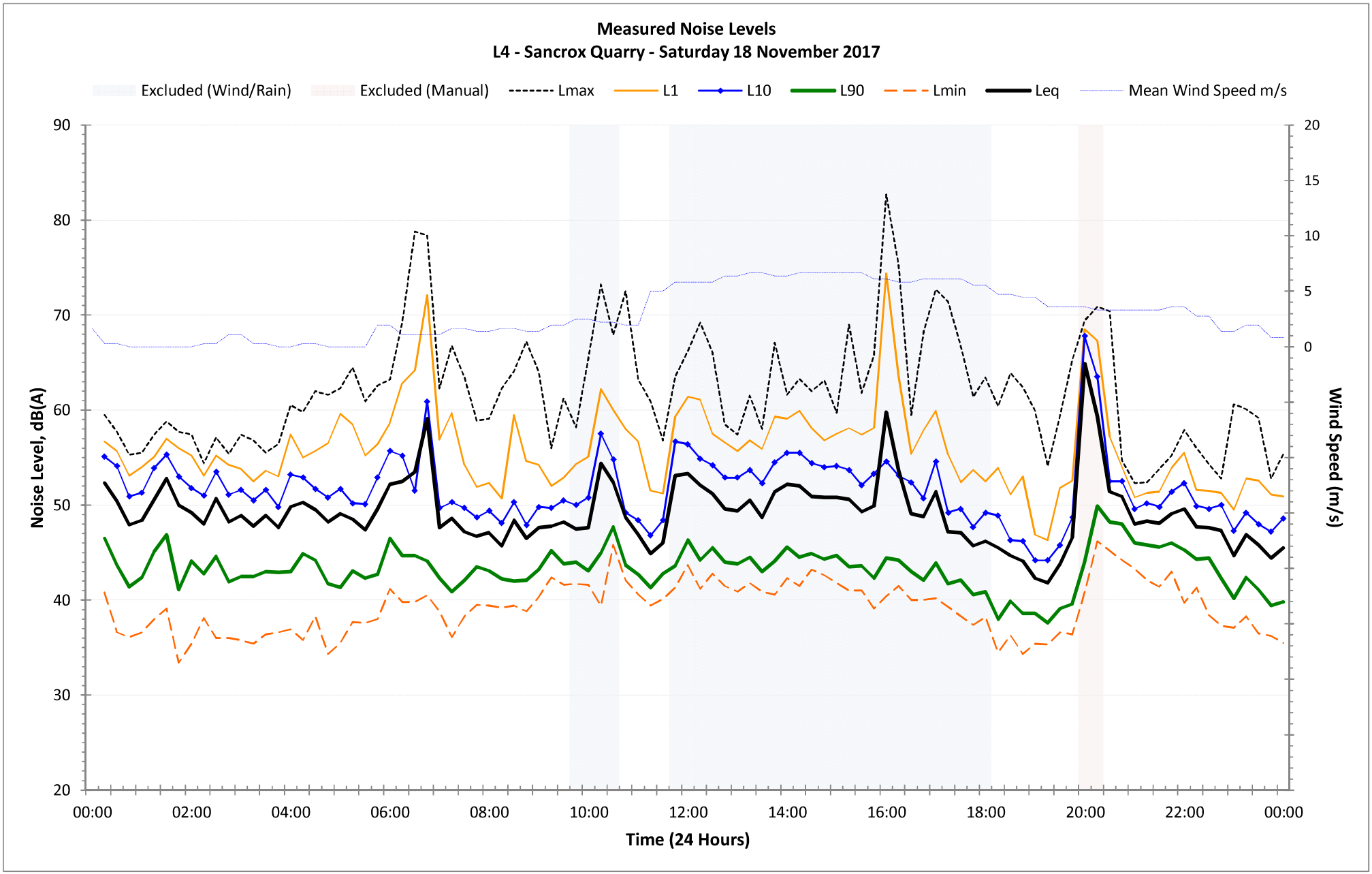

Measured Noise Levels
L4 - Sancrox Quarry - Monday 13 November 2017
Excluded (Wind/Rain)
Excluded (Manual)
Lmax
L1
L10
L90
Lmin
Leq
Mean Wind Speed m/s
Noise Level, dB(A)
Wind Speed (m/s)
Time (24 Hours)
90
80
70
60
50
40
30
20
20
15
10
5
0
00:00
02:00
04:00
06:00
08:00
10:00
12:00
14:00
16:00
18:00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

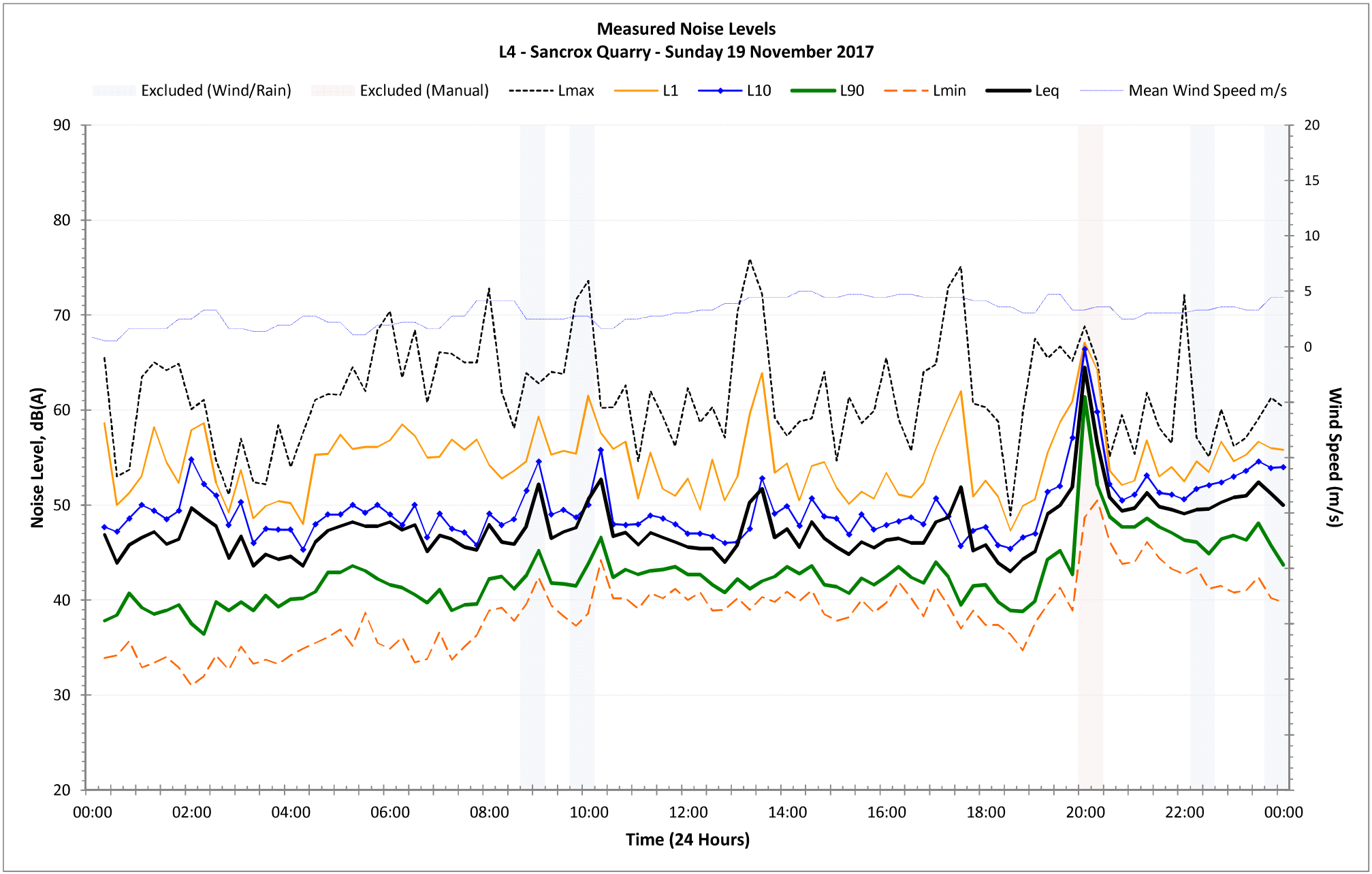

Measured Noise Levels
L4 - Sancrox Quarry - Tuesday 14 November 2017
Excluded (Wind/Rain)
Excluded (Manual)
Lmax
L1
L10
L90
Lmin
Leq
Mean Wind Speed m/s
Noise Level, dB(A)
Wind Speed (m/s)
Time (24 Hours)
90
80
70
60
50
40
30
20
20
15
10
5
0
00:00
02:00
04:00
06:00
08:00
10:00
12:00
14:00
16:00
18:00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

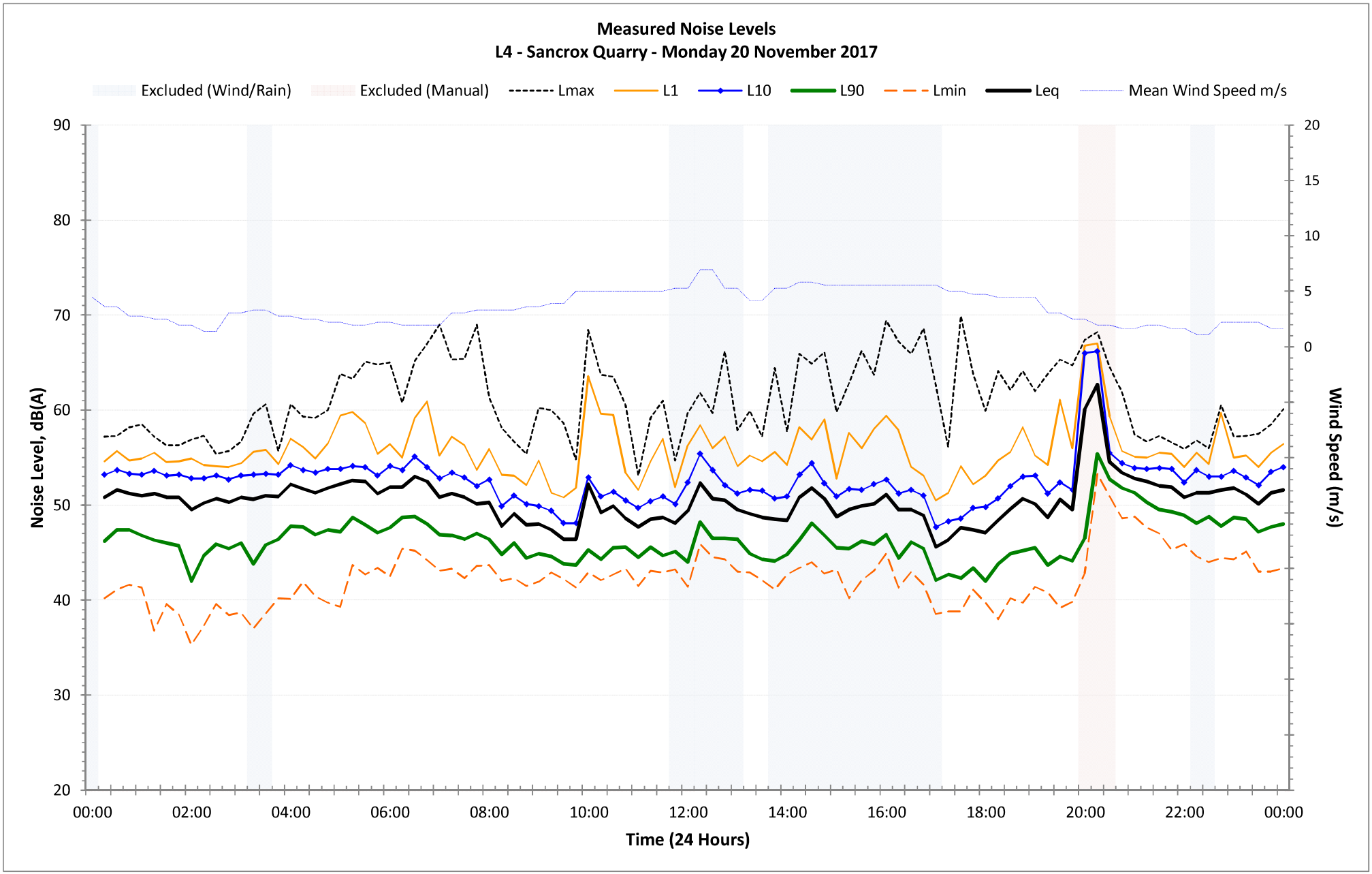

Measured Noise Levels
L4 - Sancrox Quarry - Wednesday 15 November 2017
Excluded (Wind/Rain)
Excluded (Manual)
Lmax
L1
L10
L90
Lmin
Leq
Mean Wind Speed m/s
Noise Level, dB(A)
Wind Speed (m/s)
Time (24 Hours)
90
80
70
60
50
40
30
20
20
15
10
5
0
00:00
02:00
04:00
06:00
08:00
10:00
12:00
14:00
16:00
18:00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

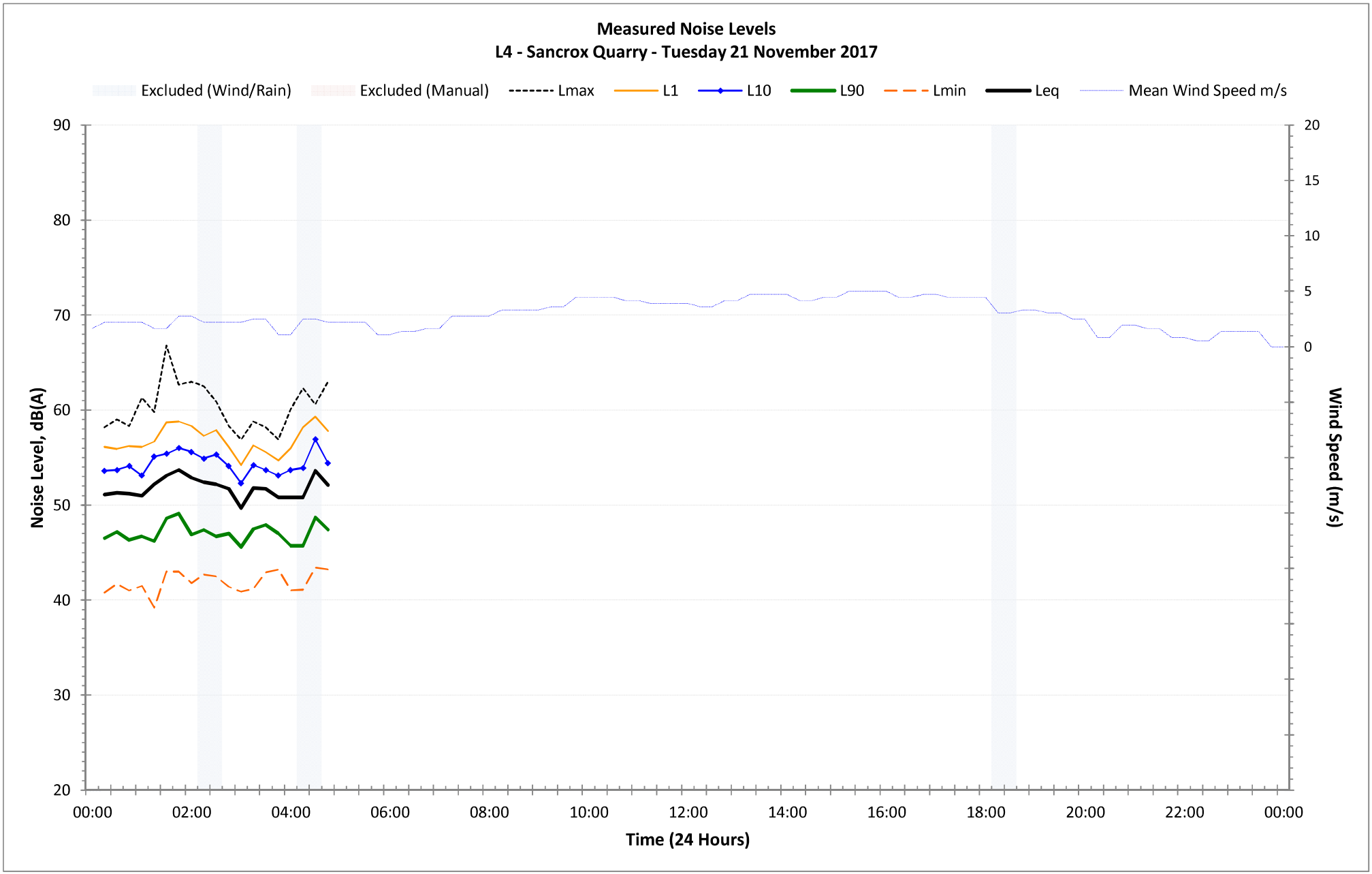

Measured Noise Levels
L4 - Sancrox Quarry - Thursday 16 November 2017
Excluded (Wind/Rain)
Excluded (Manual)
Lmax
L1
L10
L90
Lmin
Leq
Mean Wind Speed m/s
Noise Level, dB(A)
Wind Speed (m/s)
Time (24 Hours)
90
80
70
60
50
40
30
20
20
15
10
5
0
00:00
02:00
04:00
06:00
08:00
10:00
12:00
14:00
16:00
18:00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

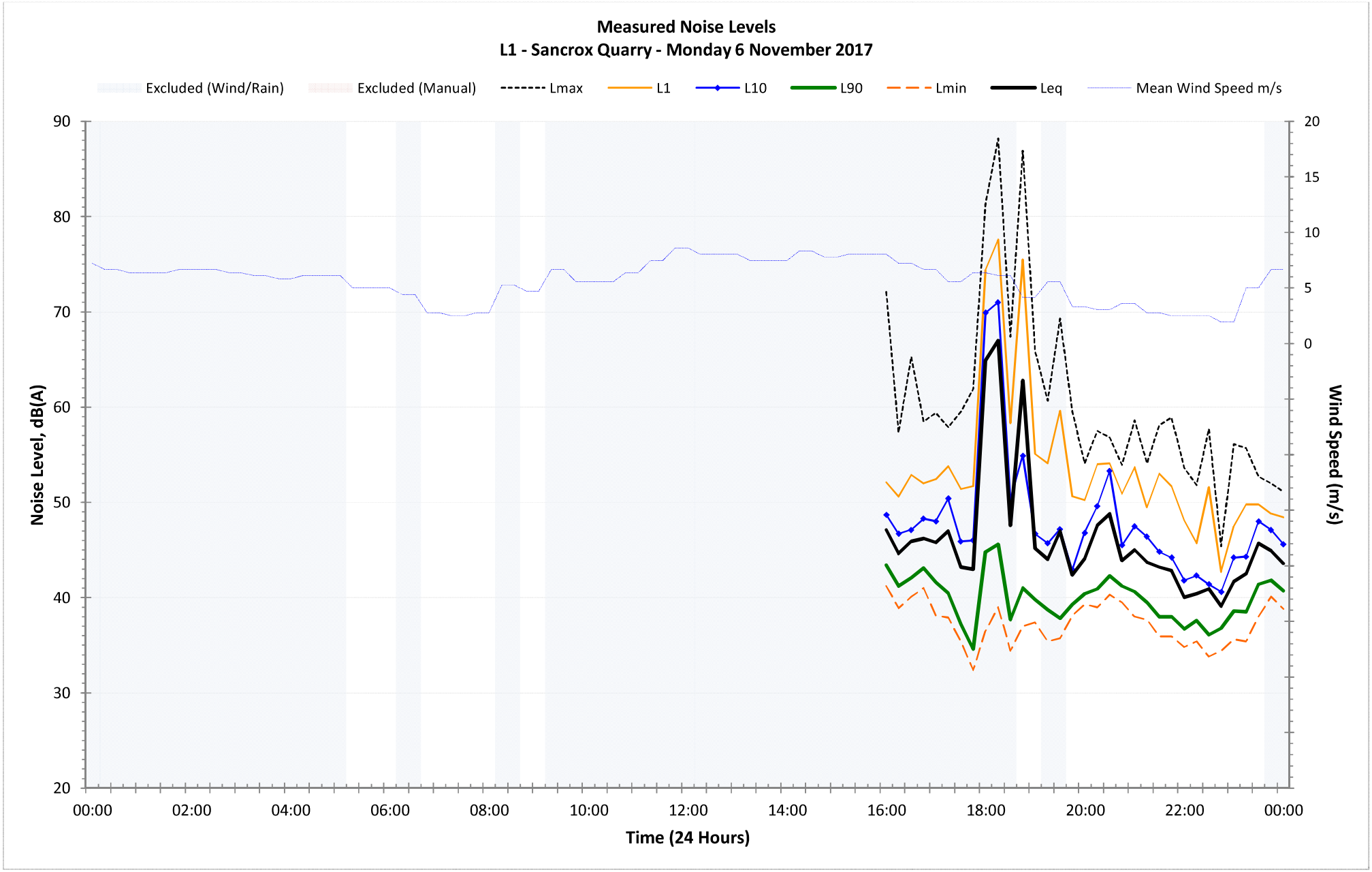

Measured Noise Levels
L4 - Sancrox Quarry - Friday 17 November 2017
Excluded (Wind/Rain)
Excluded (Manual)
Lmax
L1
L10
L90
Lmin
Leq
Mean Wind Speed m/s
Noise Level, dB(A)
Wind Speed (m/s)
Time (24 Hours)
90
80
70
60
50
40
30
20
20
15
10
5
0
00:00
02:00
04:00
06:00
08:00
10:00
12:00
14:00
16:00
18:00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

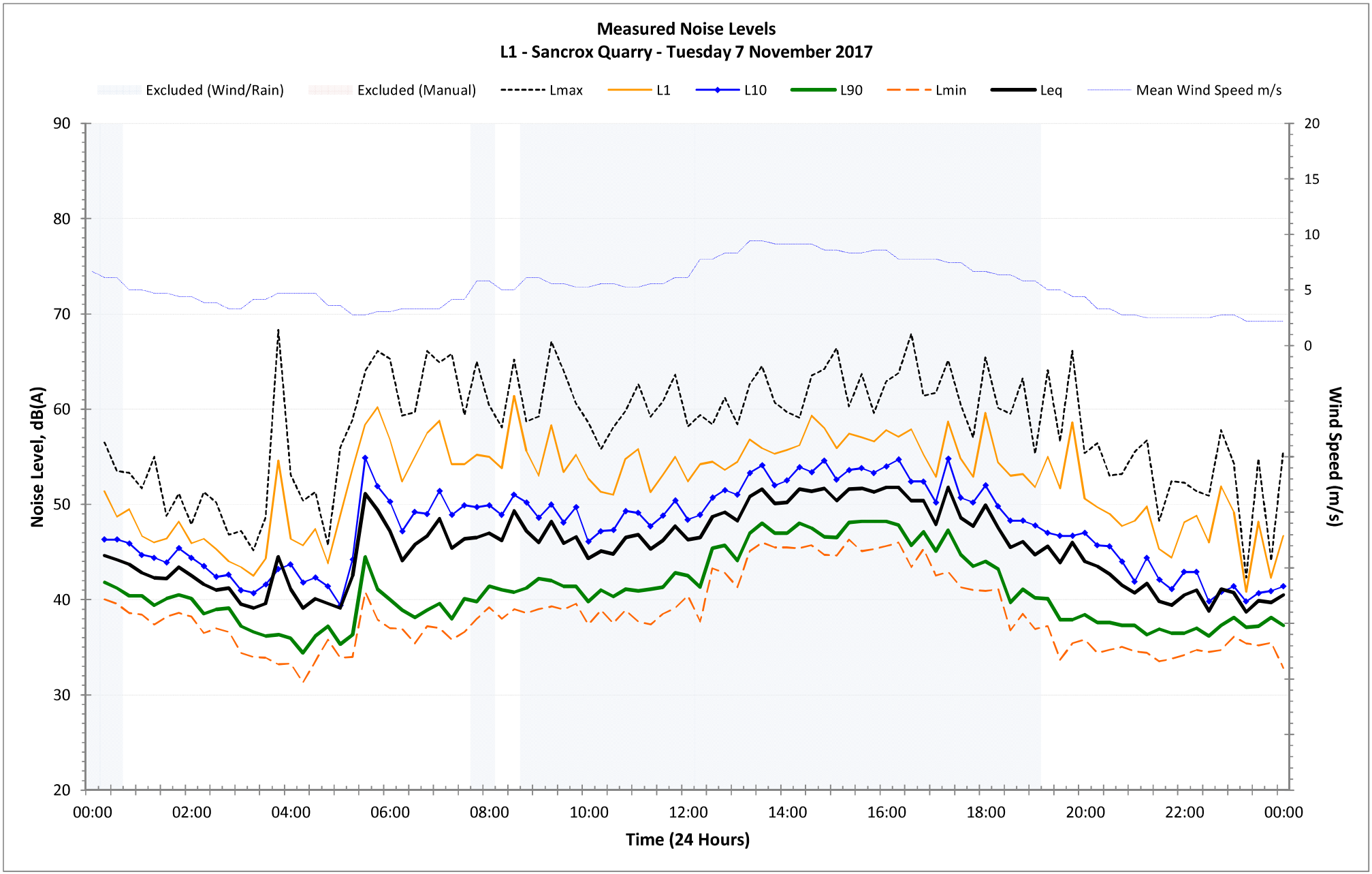

Measured Noise Levels
L4 - Sancrox Quarry - Saturday 18 November 2017
Excluded (Wind/Rain)
Excluded (Manual)
Lmax
L1
L10
L90
Lmin
Leq
Mean Wind Speed m/s
Noise Level, dB(A)
Wind Speed (m/s)
Time (24 Hours)
90
80
70
60
50
40
30
20
20
15
10
5
0
00:00
02:00
04:00
06:00
08:00
10:00
12:00
14:00
16:00
18:00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

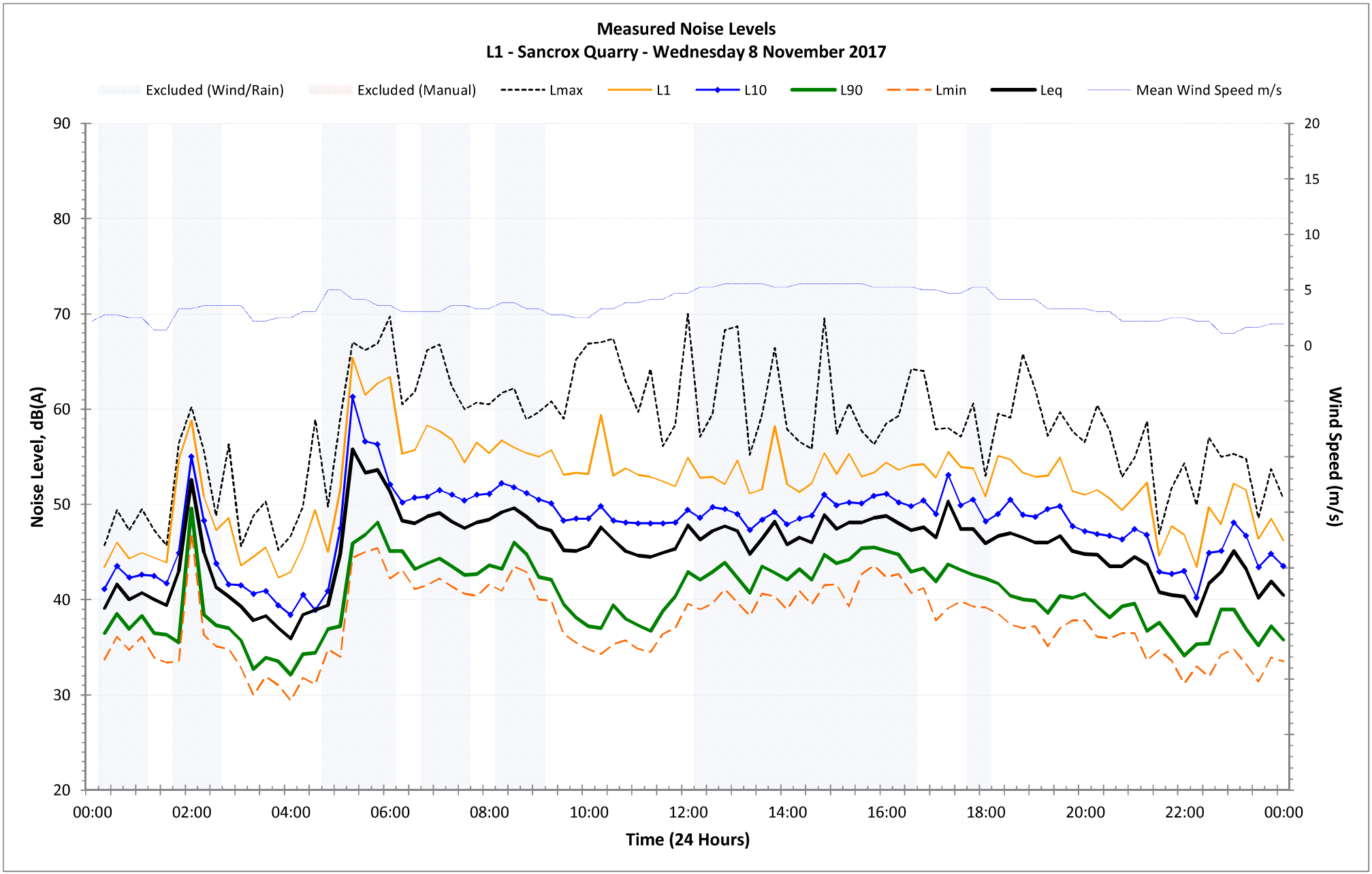

Measured Noise Levels
L4 - Sancrox Quarry - Sunday 19 November 2017
Excluded (Wind/Rain)
Excluded (Manual)
Lmax
L1
L10
L90
Lmin
Leq
Mean Wind Speed m/s
Noise Level, dB(A)
Wind Speed (m/s)
Time (24 Hours)
90
80
70
60
50
40
30
20
20
15
10
5
0
00:00
02:00
04:00
06:00
08:00
10:00
12:00
14:00
16:00
18:00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

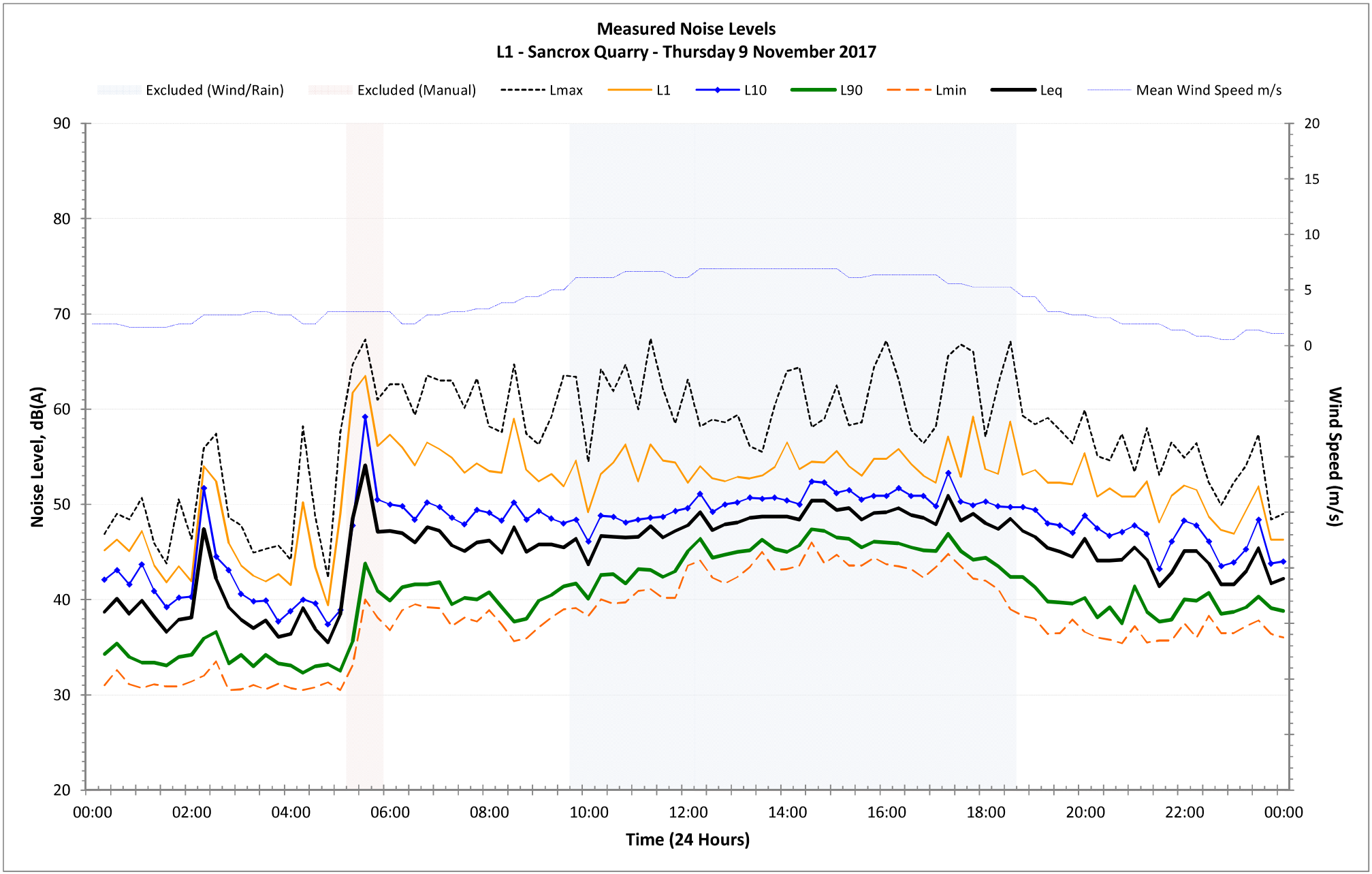

Measured Noise Levels
L4 - Sancrox Quarry - Monday 20 November 2017
Excluded (Wind/Rain)
Excluded (Manual)
Lmax
L1
L10
L90
Lmin
Leq
Mean Wind Speed m/s
Noise Level, dB(A)
Wind Speed (m/s)
Time (24 Hours)
90
80
70
60
50
40
30
20
20
15
10
5
0
00:00
02:00
04:00
06:00
08:00
10:00
12:00
14:00
16:00
18:00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

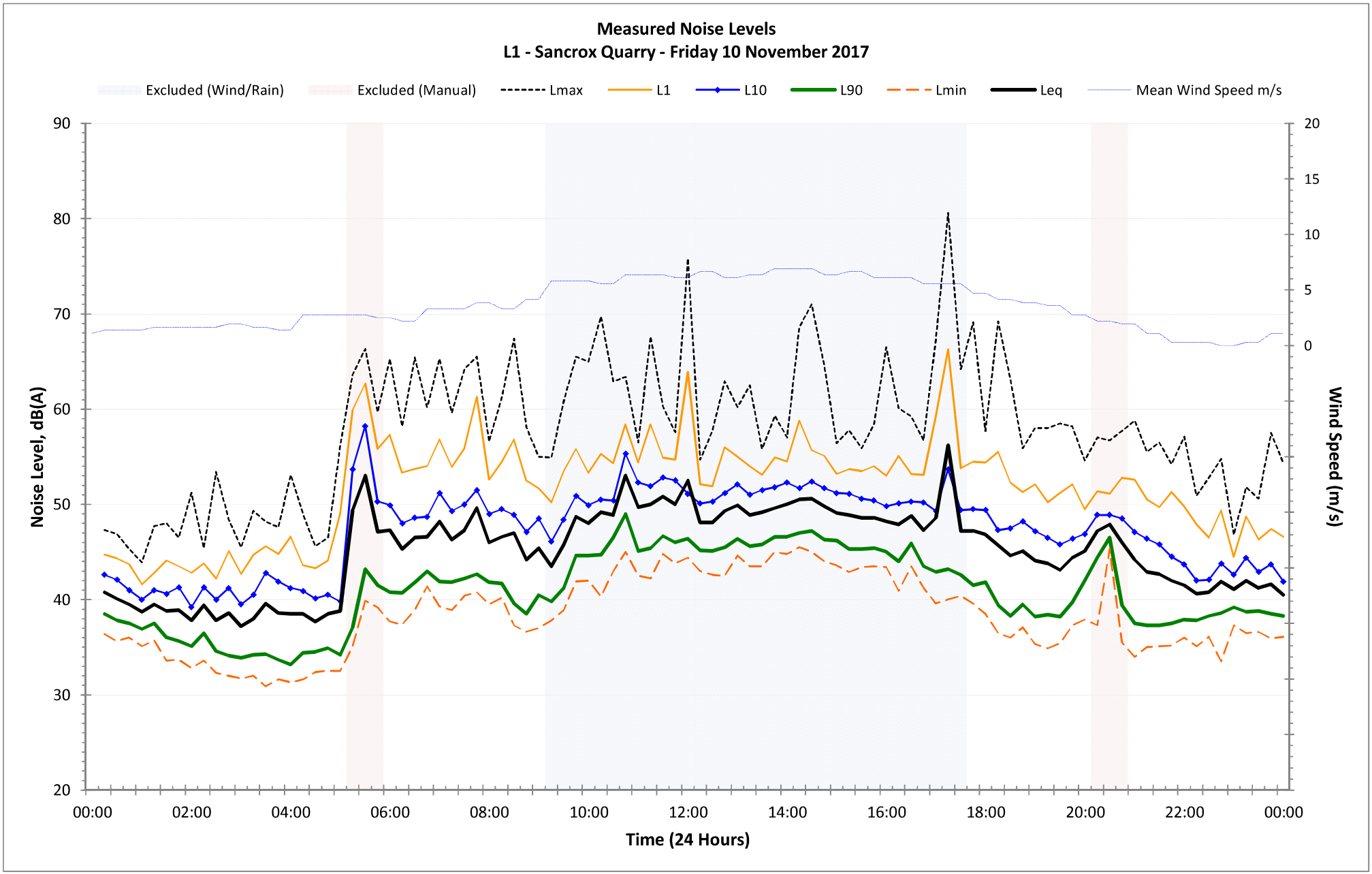

Measured Noise Levels
L4 - Sancrox Quarry - Tuesday 21 November 2017
Excluded (Wind/Rain)
Excluded (Manual)
Lmax
L1
L10
L90
Lmin
Leq
Mean Wind Speed m/s
Noise Level, dB(A)
Wind Speed (m/s)
Time (24 Hours)
90
80
70
60
50
40
30
20
20
15
10
5
0
00:00
02:00
04:00
06:00
08:00
10:00
12:00
14:00
16:00
18:00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

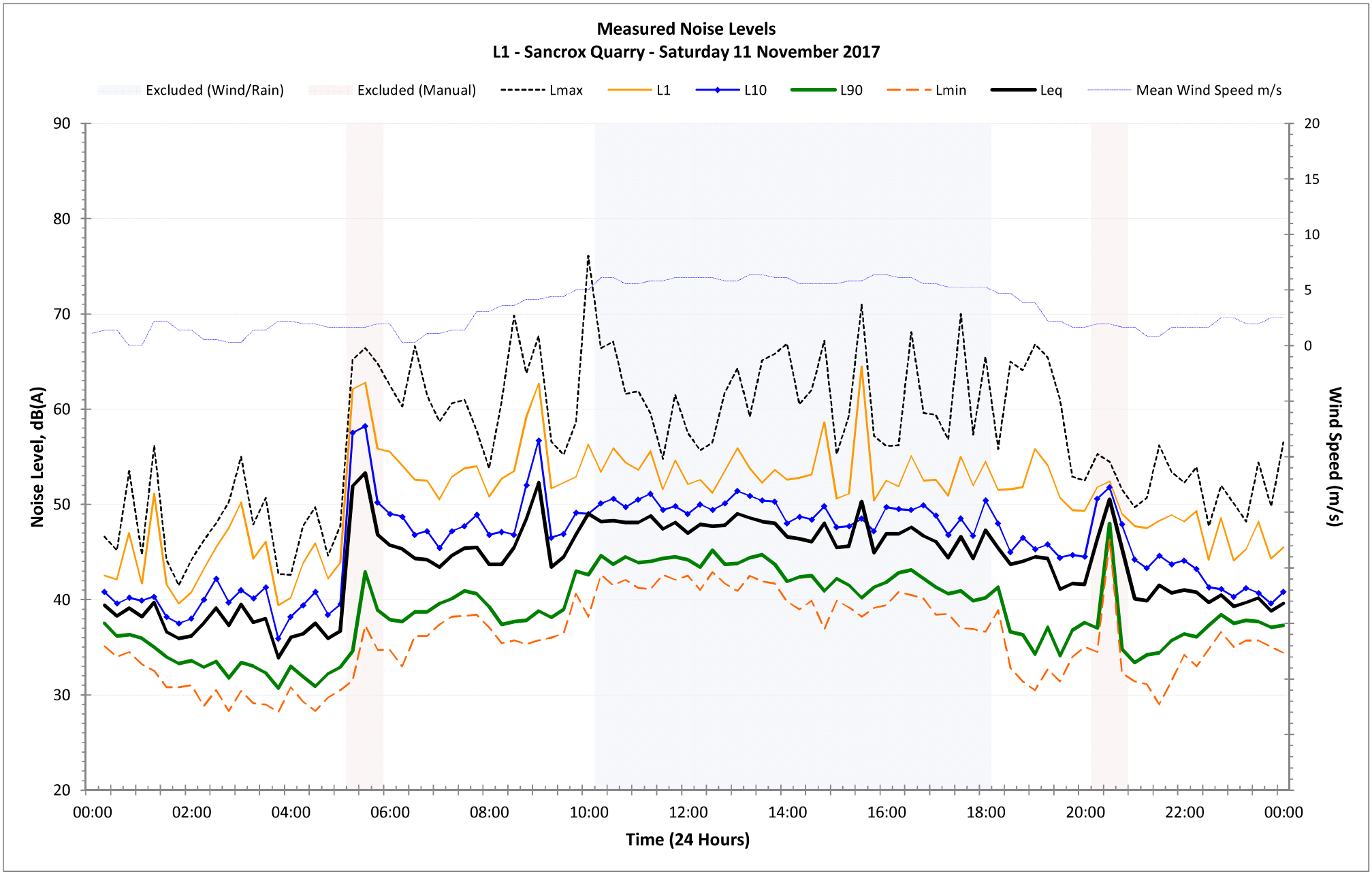

Measured Noise Levels
L1 - Sancrox Quarry - Monday 6 November 2017
Excluded (Wind/Rain)
Excluded (Manual)
Lmax
L1
L10
L90
Lmin
Leq
Mean Wind Speed m/s
Noise Level, dB(A)
Wind Speed (m/s)
Time (24 Hours)
90
80
70
60
50
40
30
20
20
15
10
5
0
00:00
02:00
04:00
06:00
08:00
10:00
12:00
14:00
16:00
18:00
20:00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

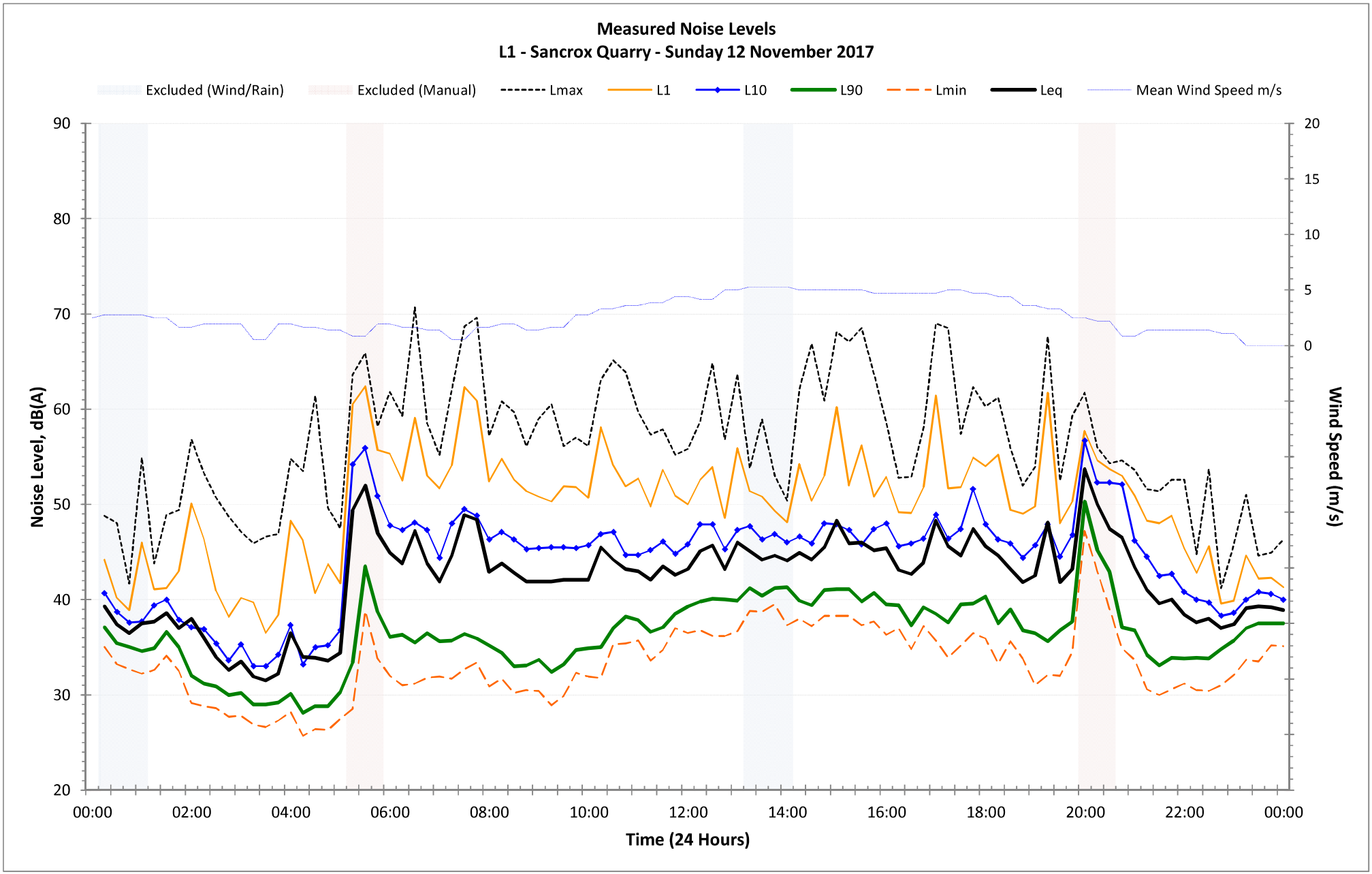

Measured Noise Levels
L1 - Sancrox Quarry - Tuesday 7 November 2017
Excluded (Wind/Rain)
Excluded (Manual)
Lmax
L1
L10
L90
Lmin
Leq
Mean Wind Speed m/s
Noise Level, dB(A)
Wind Speed (m/s)
Time (24 Hours)
90
80
70
60
50
40
30
20
20
15
10
5
0
00:00
02:00
04:00
06:00
08:00
10:00
12:00
14:00
16:00
18:00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

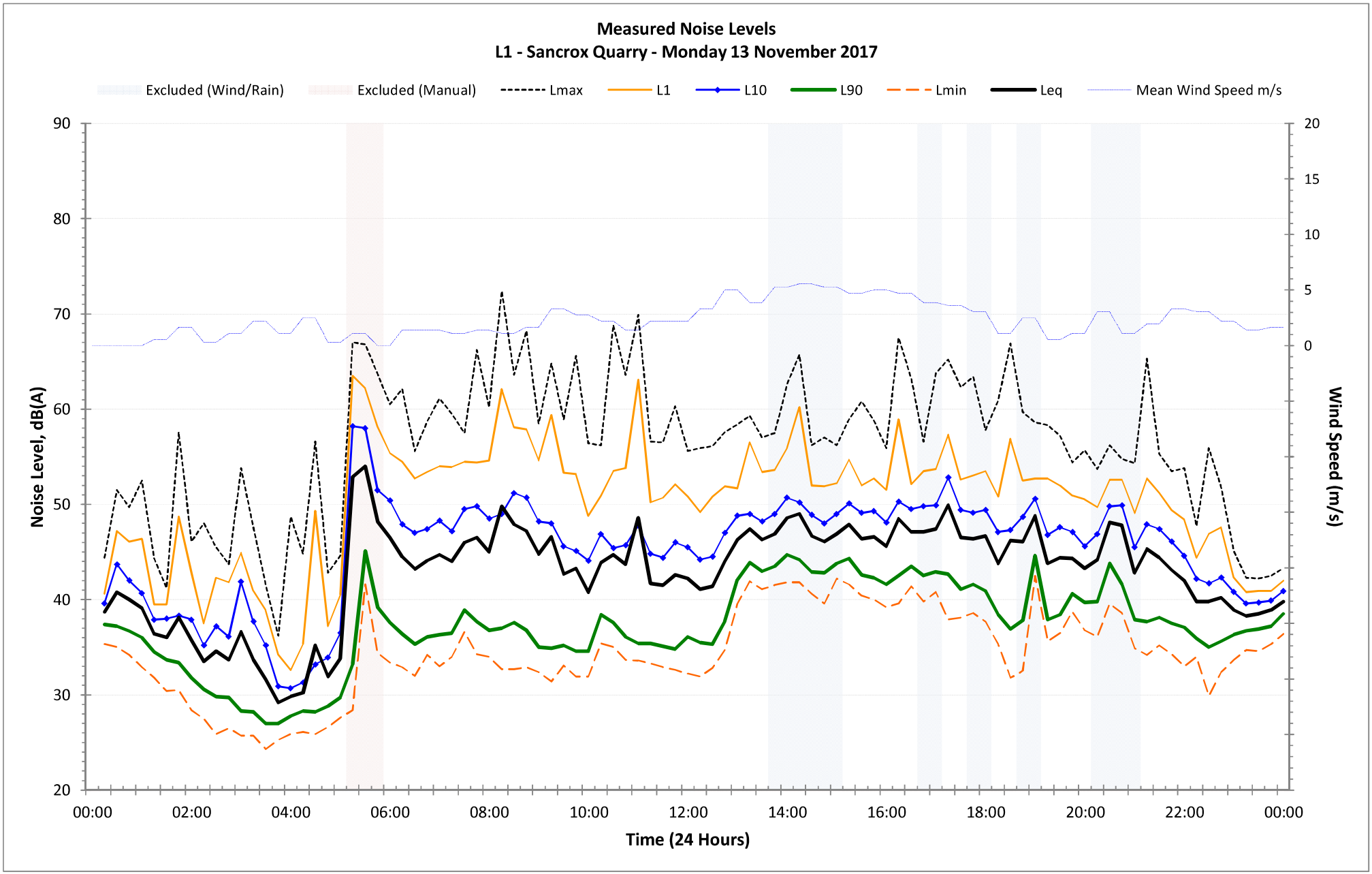

Measured Noise Levels
L1 - Sancrox Quarry - Wednesday 8 November 2017
Excluded (Wind/Rain)
Excluded (Manual)
Lmax
L1
L10
L90
Lmin
Leq
Mean Wind Speed m/s
Noise Level, dB(A)
Wind Speed (m/s)
Time (24 Hours)
90
80
70
60
50
40
30
20
20
15
10
5
0
00:00
02:00
04:00
06:00
08:00
10:00
12:00
14:00
16:00
18:00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

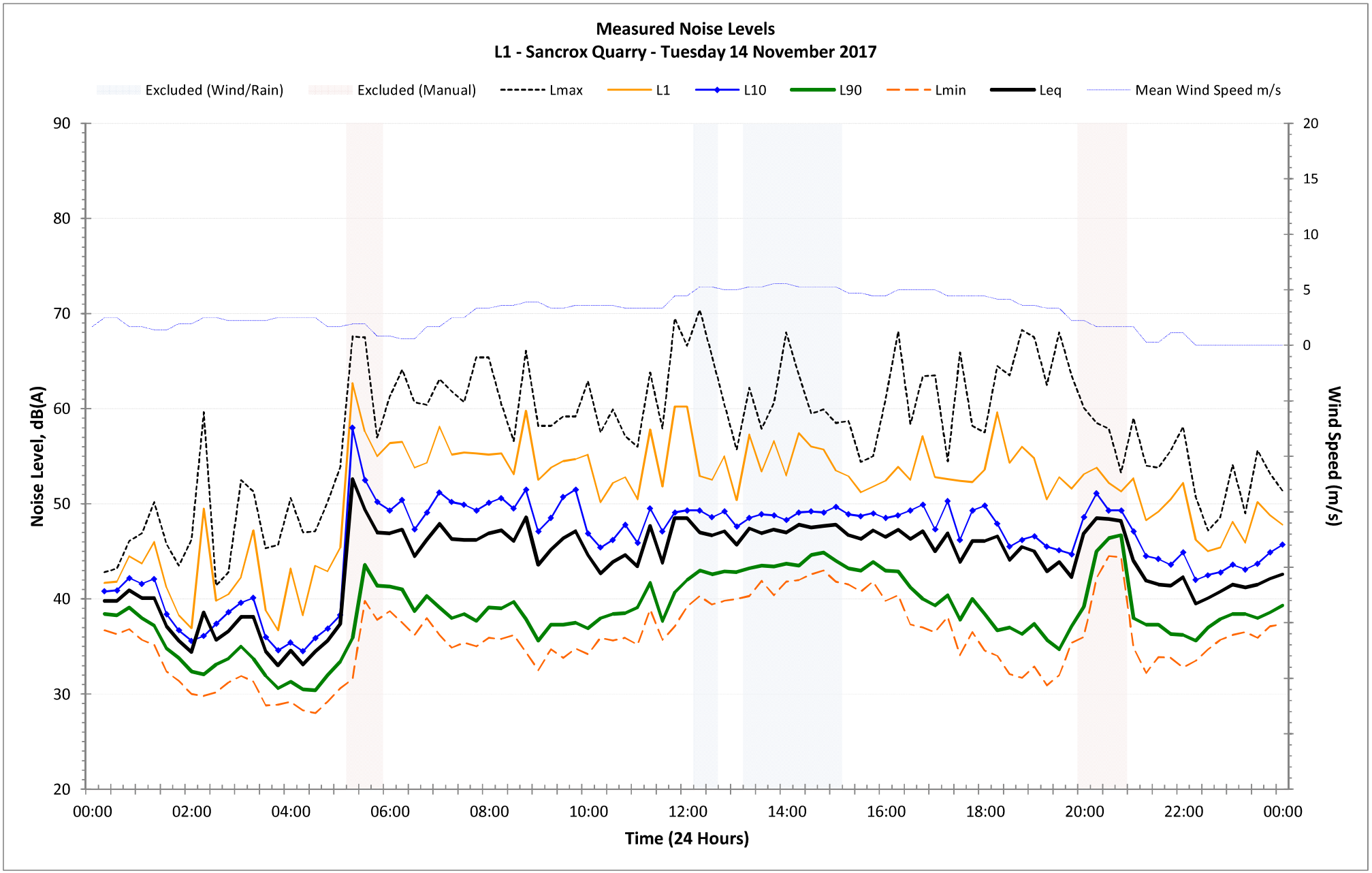

Measured Noise Levels
L1 - Sancrox Quarry - Thursday 9 November 2017
Excluded (Wind/Rain)
Excluded (Manual)
Lmax
L1
L10
L90
Lmin
Leq
Mean Wind Speed m/s
Noise Level, dB(A)
Wind Speed (m/s)
Time (24 Hours)
90
80
70
60
50
40
30
20
20
15
10
5
0
00:00
02:00
04:00
06:00
08:00
10:00
12:00
14:00
16:00
18:00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

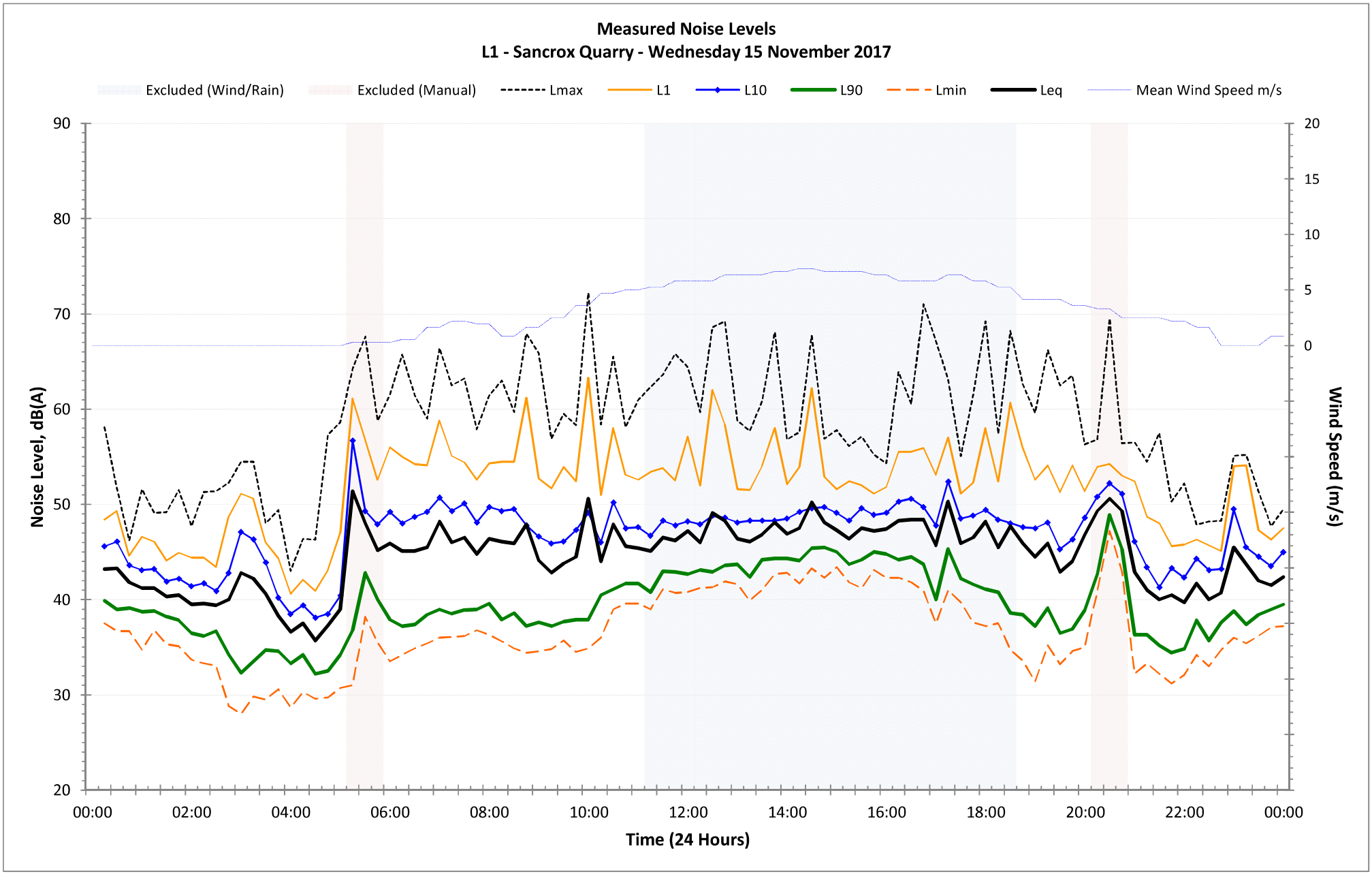

Measured Noise Levels
L1 - Sancrox Quarry - Friday 10 November 2017
Excluded (Wind/Rain)
Excluded (Manual)
Lmax
L1
L10
L90
Lmin
Leq
Mean Wind Speed m/s
Noise Level, dB(A)
Wind Speed (m/s)
Time (24 Hours)
90
80
70
60
50
40
30
20
20
15
10
5
0
00:00
02:00
04:00
06:00
08:00
10:00
12:00
14:00
16:00
18:00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

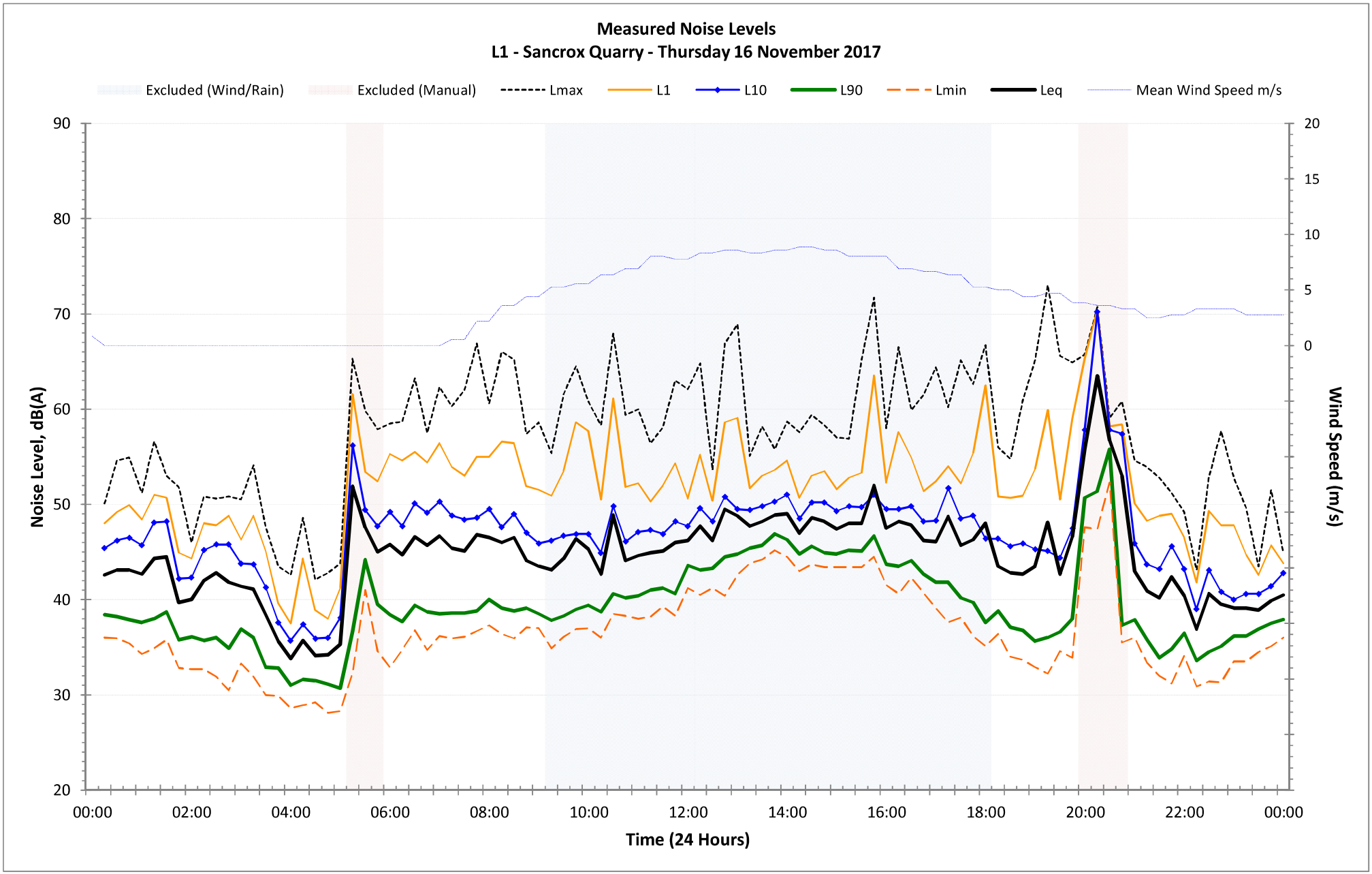

Measured Noise Levels
L1 - Sancrox Quarry - Saturday 11 November 2017
Excluded (Wind/Rain)
Excluded (Manual)
Lmax
L1
L10
L90
Lmin
Leq
Mean Wind Speed m/s
Noise Level, dB(A)
Wind Speed (m/s)
Time (24 Hours)
90
80
70
60
50
40
30
20
20
15
10
5
0
00:00
02:00
04:00
06:00
08:00
10:00
12:00
14:00
16:00
18:00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

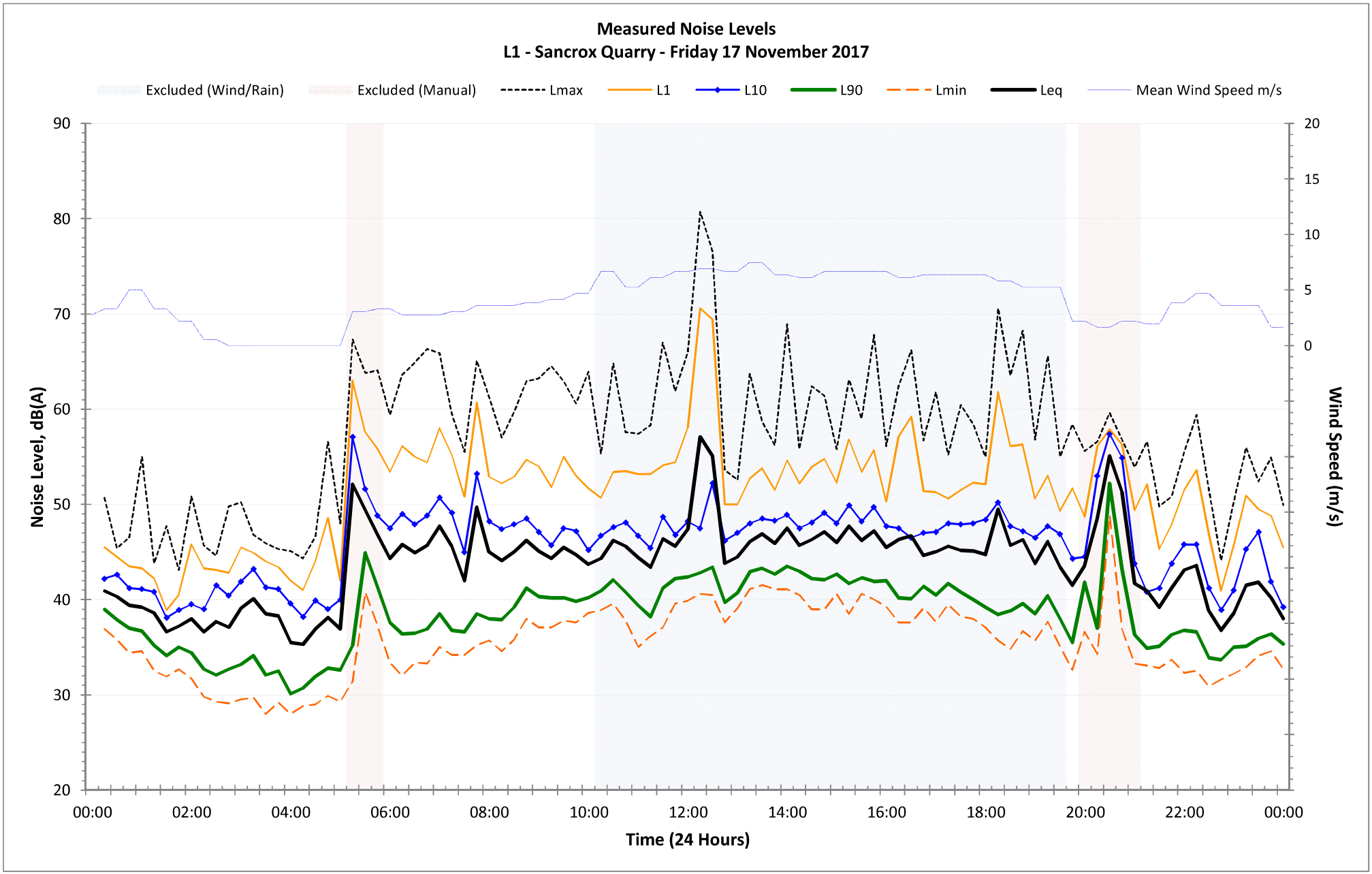

Measured Noise Levels
L1 - Sancrox Quarry - Sunday 12 November 2017
Excluded (Wind/Rain)
Excluded (Manual)
Lmax
L1
L10
L90
Lmin
Leq
Mean Wind Speed m/s
Noise Level, dB(A)
Wind Speed (m/s)
Time (24 Hours)
90
80
70
60
50
40
30
20
20
15
10
5
0
00:00
02:00
04:00
06:00
08:00
10:00
12:00
14:00
16:00
18:00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

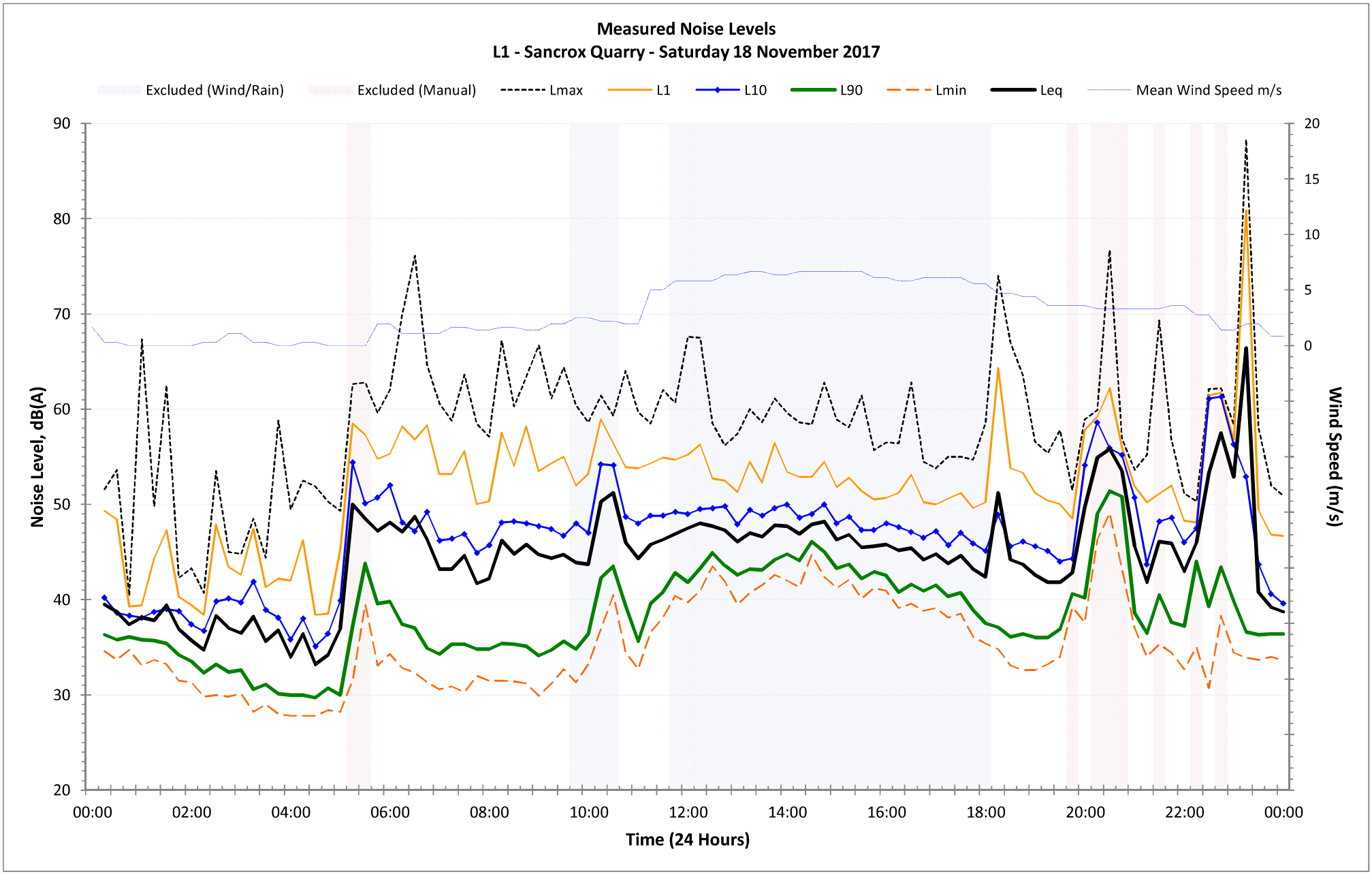

Measured Noise Levels
L1 - Sancrox Quarry - Monday 13 November 2017
Excluded (Wind/Rain)
Excluded (Manual)
Lmax
L1
L10
L90
Lmin
Leq
Mean Wind Speed m/s
Noise Level, dB(A)
Wind Speed (m/s)
Time (24 Hours)
90
80
70
60
50
40
30
20
20
15
10
5
0
00:00
02:00
04:00
06:00
08:00
10:00
12:00
14:00
16:00
18:00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

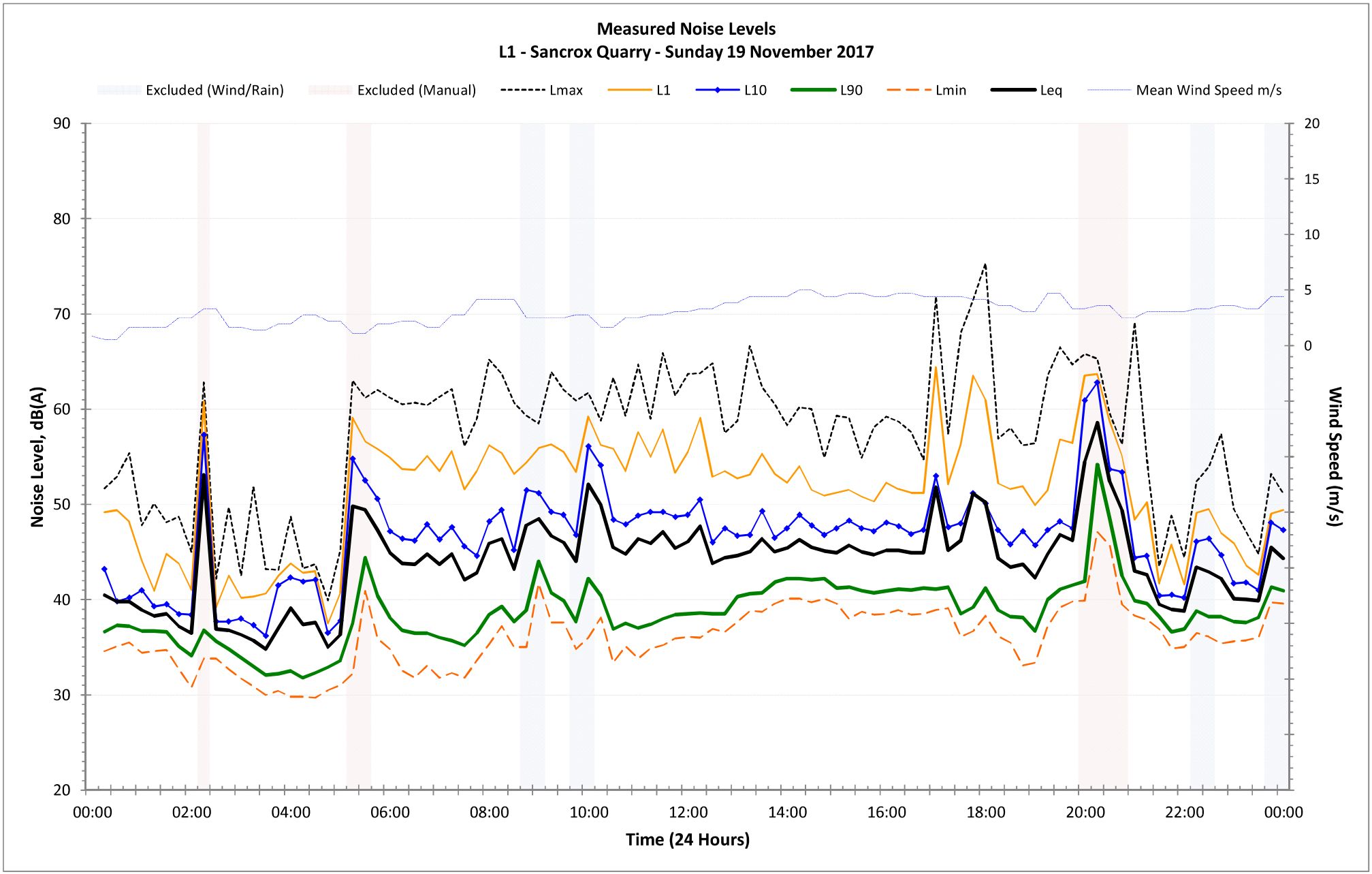

Measured Noise Levels
L1 - Sancrox Quarry - Tuesday 14 November 2017
Excluded (Wind/Rain)
Excluded (Manual)
Lmax
L1
L10
L90
Lmin
Leq
Mean Wind Speed m/s
Noise Level, dB(A)
Wind Speed (m/s)
Time (24 Hours)
90
80
70
60
50
40
30
20
20
15
10
5
0
00:00
02:00
04:00
06:00
08:00
10:00
12:00
14:00
16:00
18:00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

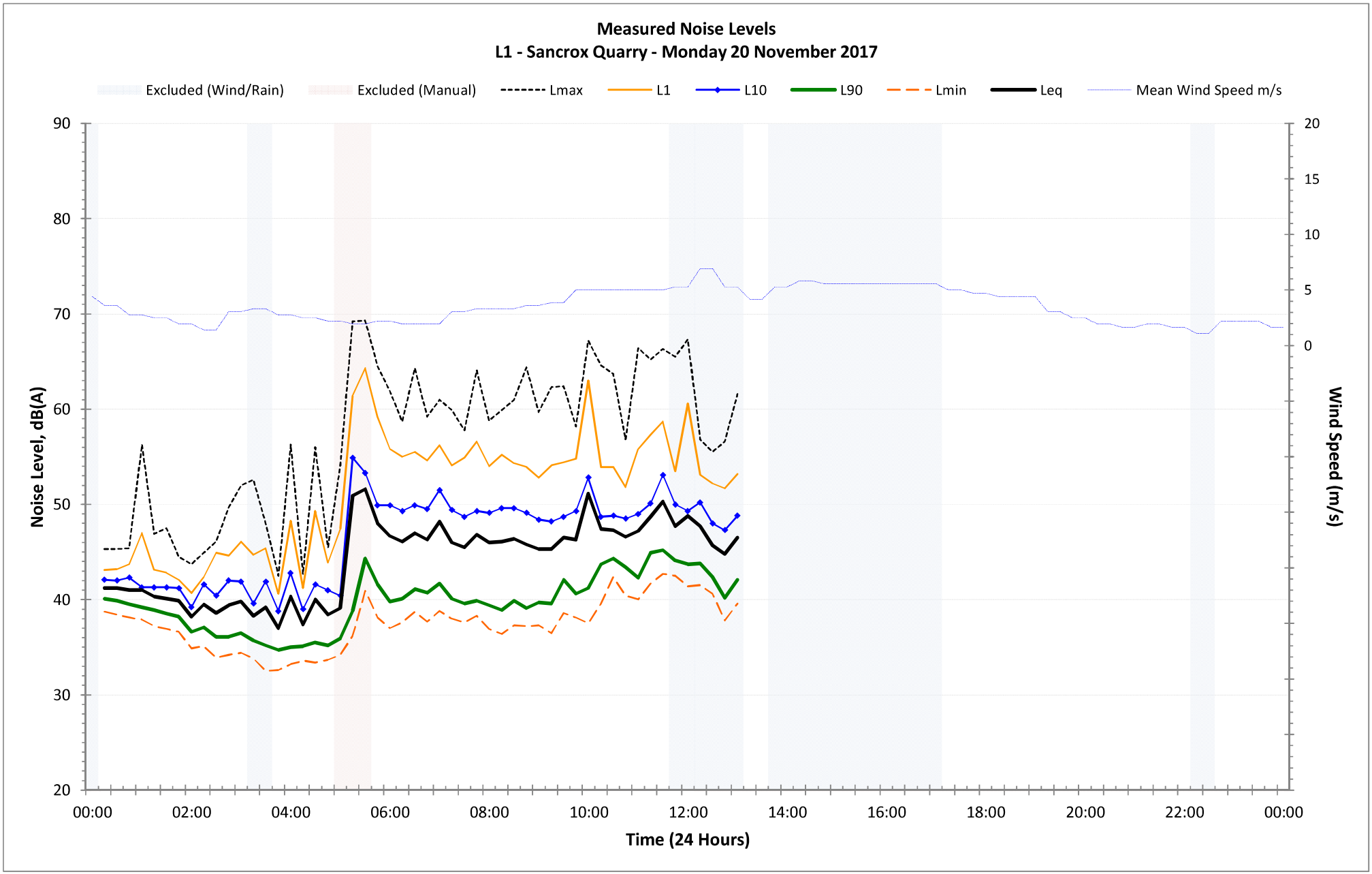

Measured Noise Levels
L1 - Sancrox Quarry - Wednesday 15 November 2017
Excluded (Wind/Rain)
Excluded (Manual)
Lmax
L1
L10
L90
Lmin
Leq
Mean Wind Speed m/s
Noise Level, dB(A)
Wind Speed (m/s)
Time (24 Hours)
90
80
70
60
50
40
30
20
20
15
10
5
0
00:00
02:00
04:00
06:00
08:00
10:00
12:00
14:00
16:00
18:00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

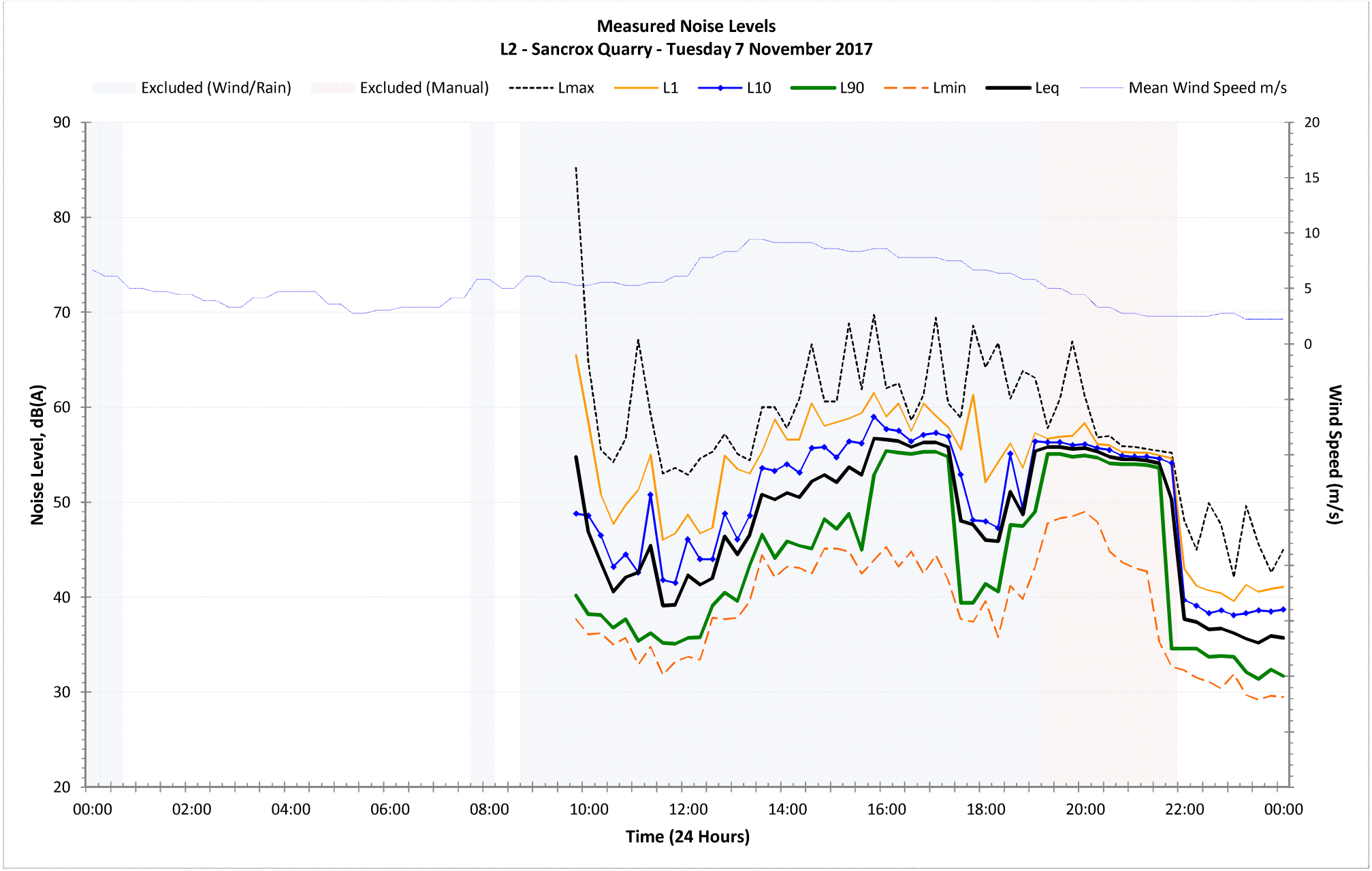

Measured Noise Levels
L1 - Sancrox Quarry - Thursday 16 November 2017
Excluded (Wind/Rain)
Excluded (Manual)
Lmax
L1
L10
L90
Lmin
Leq
Mean Wind Speed m/s
Noise Level, dB(A)
Wind Speed (m/s)
Time (24 Hours)
90
80
70
60
50
40
30
20
20
15
10
5
0
00:00
02:00
04:00
06:00
08:00
10:00
12:00
14:00
16:00
18:00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

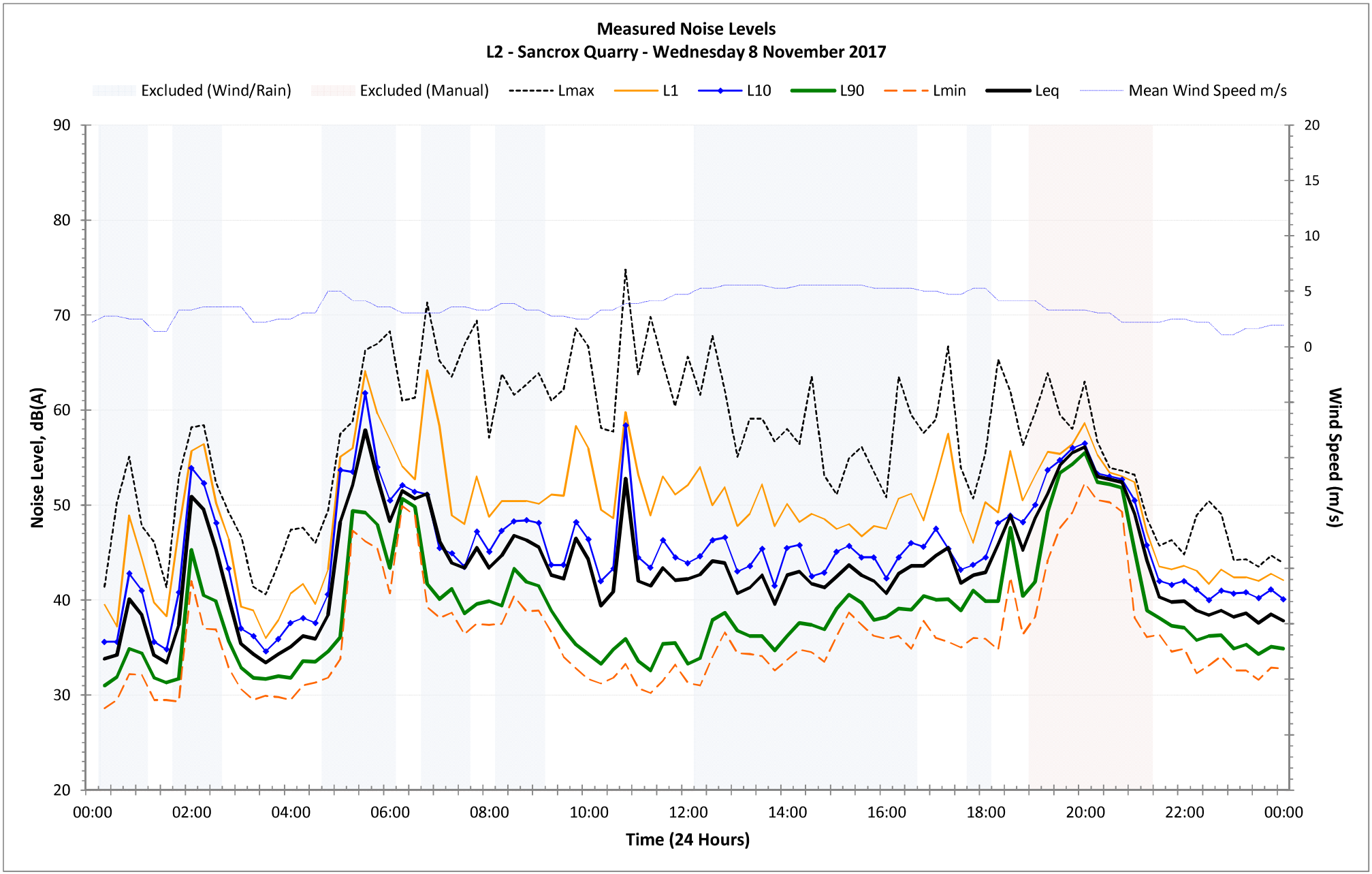

Measured Noise Levels
L1 - Sancrox Quarry - Friday 17 November 2017
Excluded (Wind/Rain)
Excluded (Manual)
Lmax
L1
L10
L90
Lmin
Leq
Mean Wind Speed m/s
Noise Level, dB(A)
Wind Speed (m/s)
Time (24 Hours)
90
80
70
60
50
40
30
20
20
15
10
5
0
00:00
02:00
04:00
06:00
08:00
10:00
12:00
14:00
16:00
18:00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

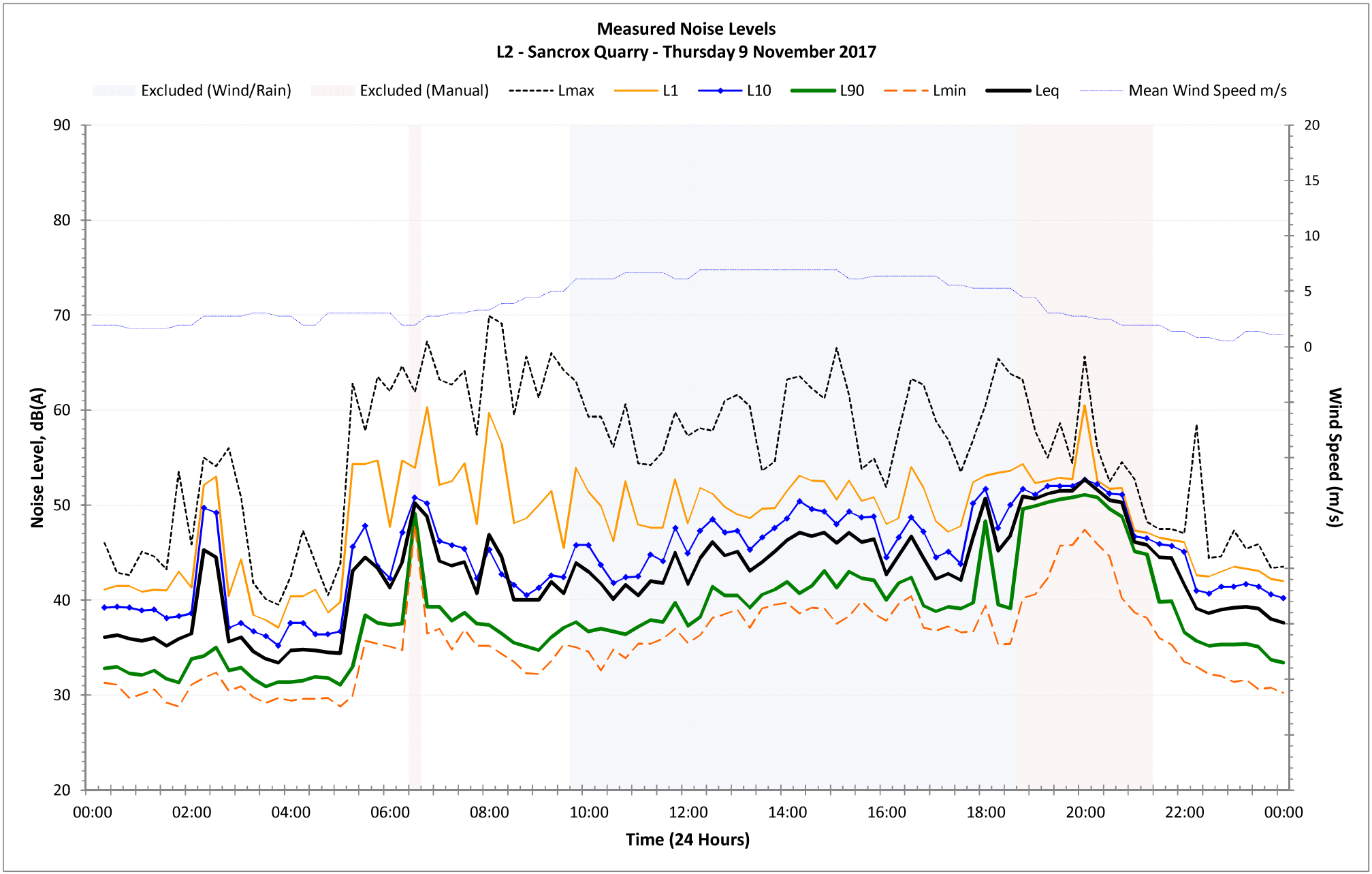

Measured Noise Levels
L1 - Sancrox Quarry - Saturday 18 November 2017
Excluded (Wind/Rain)
Excluded (Manual)
Lmax
L1
L10
L90
Lmin
Leq
Mean Wind Speed m/s
Noise Level, dB(A)
Wind Speed (m/s)
Time (24 Hours)
90
80
70
60
50
40
30
20
20
15
10
5
0
00:00
02:00
04:00
06:00
08:00
10:00
12:00
14:00
16:00
18:00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

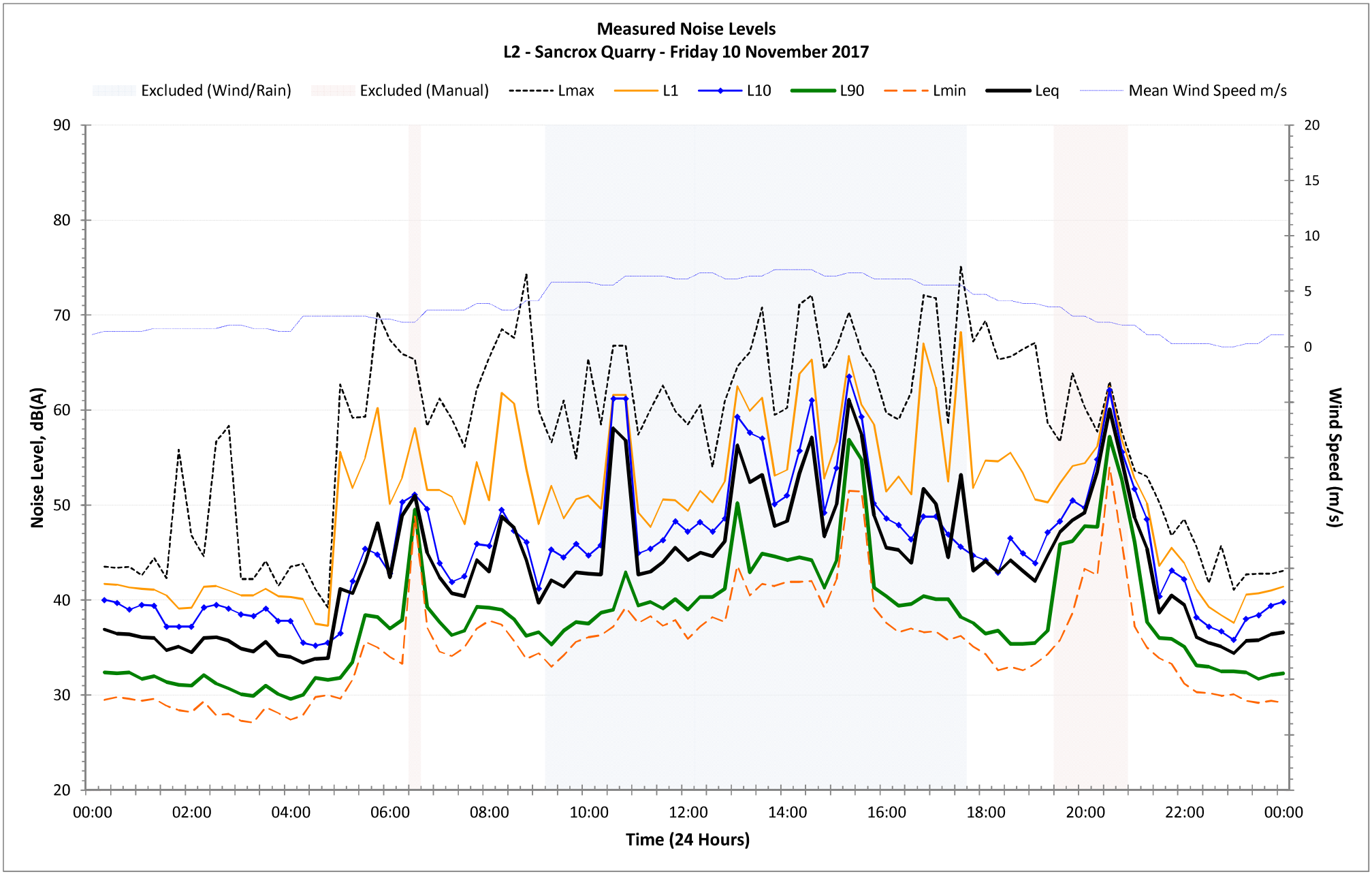

Measured Noise Levels
L1 - Sancrox Quarry - Sunday 19 November 2017
Excluded (Wind/Rain)
Excluded (Manual)
Lmax
L1
L10
L90
Lmin
Leq
Mean Wind Speed m/s
Noise Level, dB(A)
Wind Speed (m/s)
Time (24 Hours)
90
80
70
60
50
40
30
20
20
15
10
5
0
00:00
02:00
04:00
06:00
08:00
10:00
12:00
14:00
16:00
18:00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

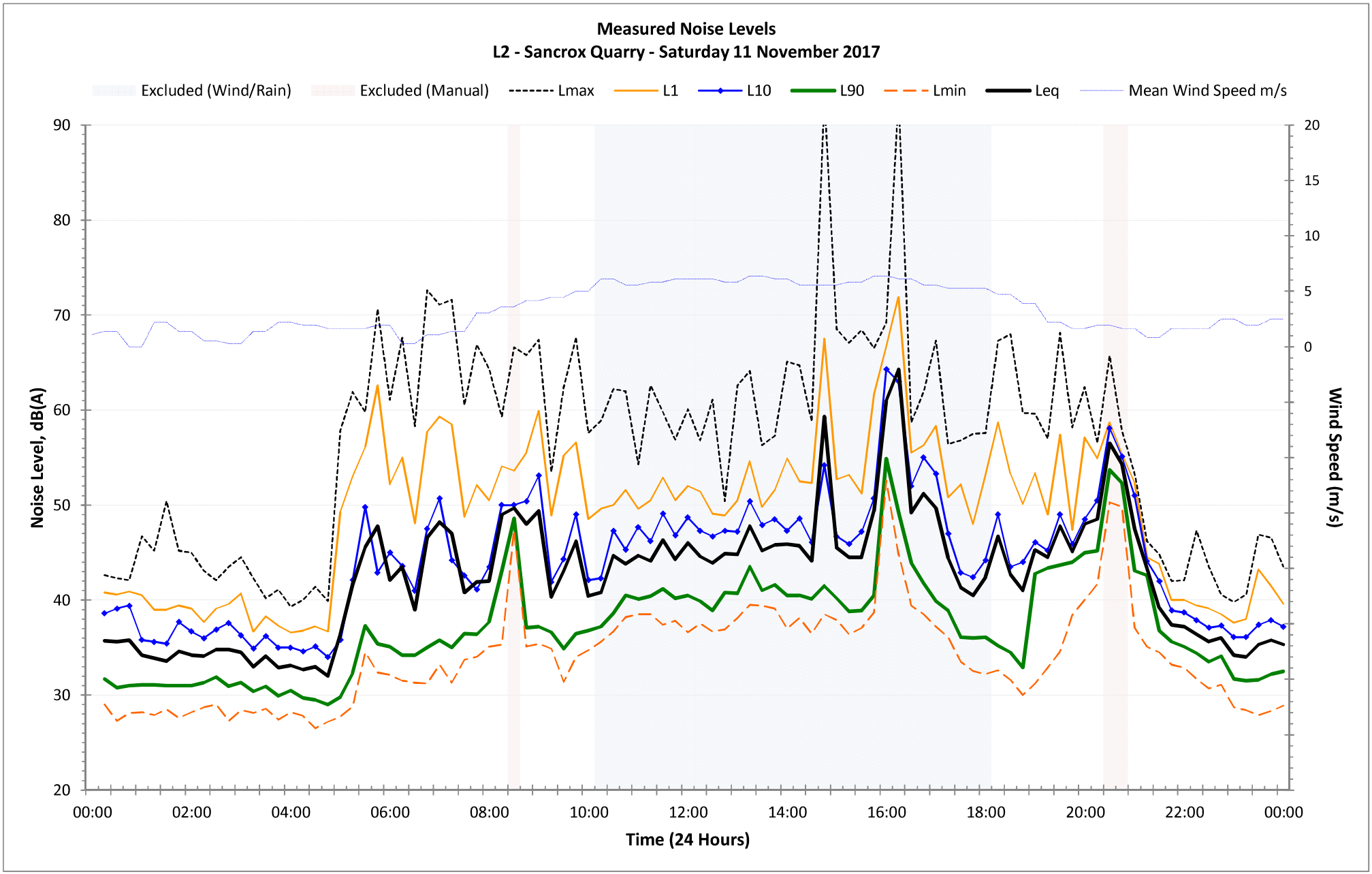

Measured Noise Levels
L1 - Sancrox Quarry - Monday 20 November 2017
Excluded (Wind/Rain)
Excluded (Manual)
Lmax
L1
L10
L90
Lmin
Leq
Mean Wind Speed m/s
Noise Level, dB(A)
Wind Speed (m/s)
Time (24 Hours)
90
80
70
60
50
40
30
20
20
15
10
5
0
00:00
02:00
04:00
06:00
08:00
10:00
12:00
14:00
16:00
18:00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

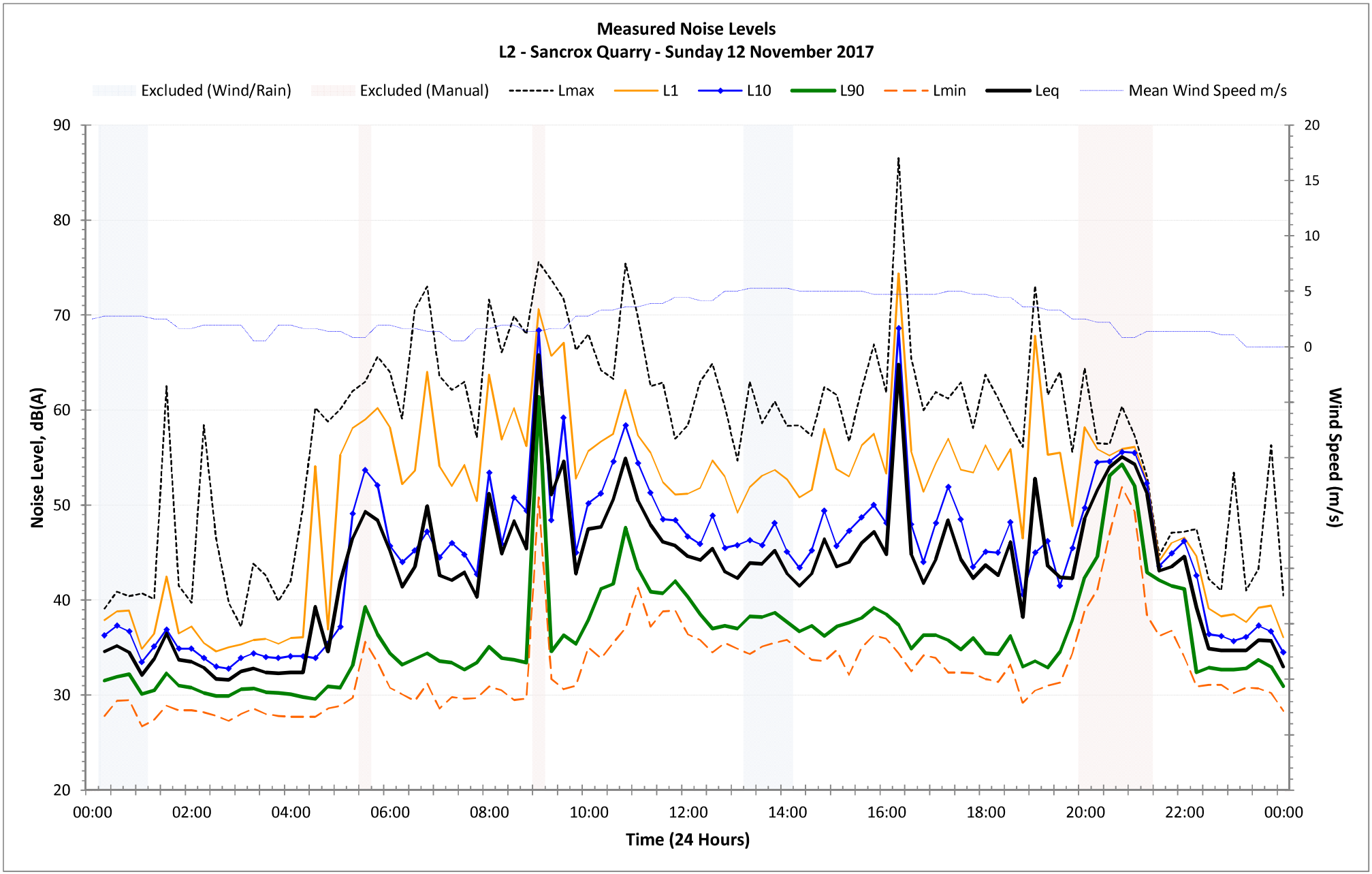

Measured Noise Levels
L2 - Sancrox Quarry - Tuesday 7 November 2017
Excluded (Wind/Rain)
Excluded (Manual)
Lmax
L1
L10
L90
Lmin
Leq
Mean Wind Speed m/s
Noise Level, dB(A)
Wind Speed (m/s)
Time (24 Hours)
90
80
70
60
50
40
30
20
20
15
10
5
0
00:00
02:00
04:00
06:00
08:00
10:00
12:00
14:00
16:00
18:00
20:00
22:00
00:00

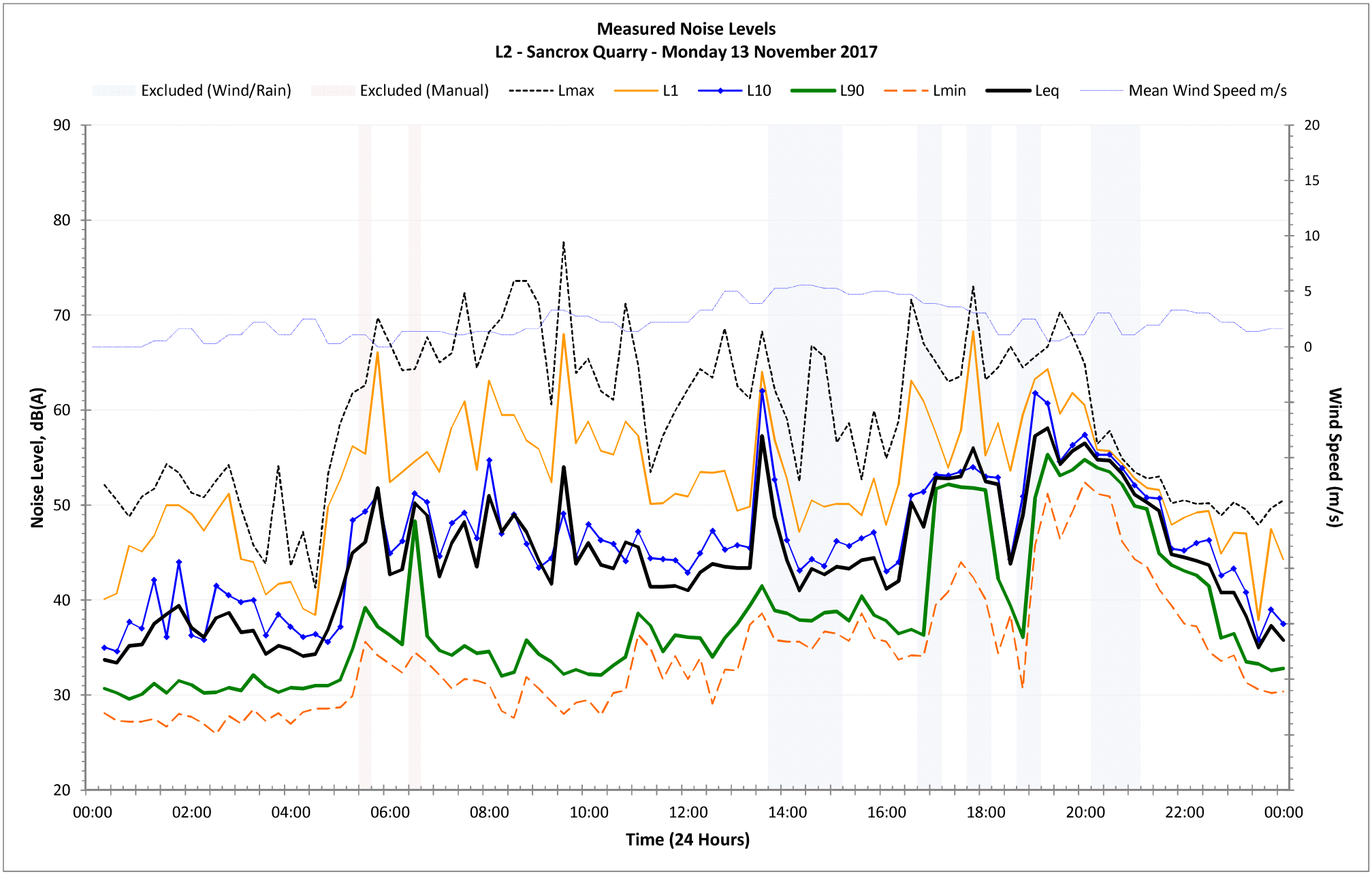

Measured Noise Levels
L2 - Sancrox Quarry - Wednesday 8 November 2017
Excluded (Wind/Rain)
Excluded (Manual)
Lmax
L1
L10
L90
Lmin
Leq
Mean Wind Speed m/s
Noise Level, dB(A)
Wind Speed (m/s)
Time (24 Hours)
90
80
70
60
50
40
30
20
20
15
10
5
0
00:00
02:00
04:00
06:00
08:00
10:00
12:00
14:00
16:00
18:00
20:00
22:00
00:00

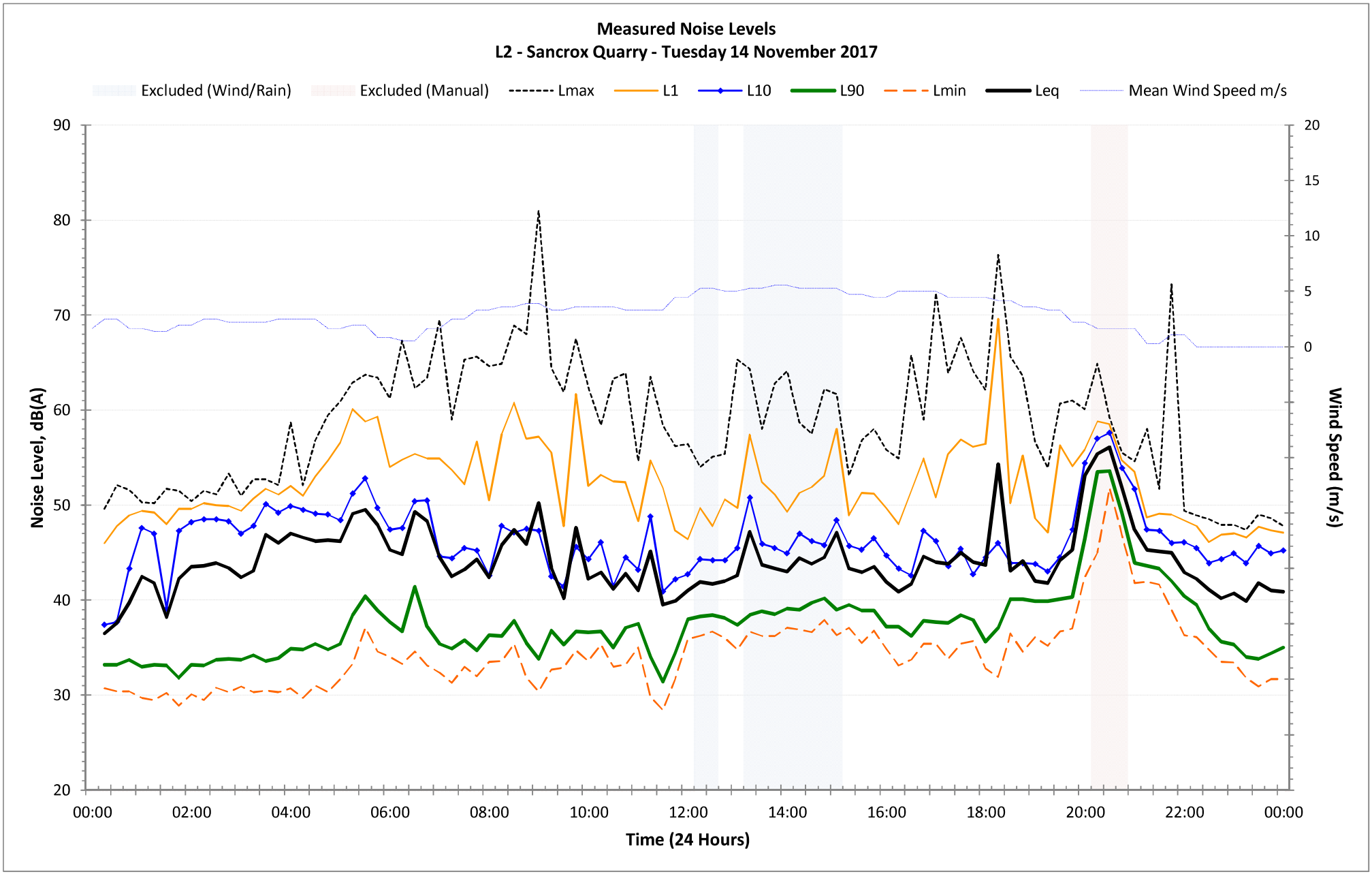

Measured Noise Levels
L2 - Sancrox Quarry - Thursday 9 November 2017
Excluded (Wind/Rain)
Excluded (Manual)
Lmax
L1
L10
L90
Lmin
Leq
Mean Wind Speed m/s
Noise Level, dB(A)
Wind Speed (m/s)
Time (24 Hours)
90
80
70
60
50
40
30
20
20
15
10
5
0
00:00
02:00
04:00
06:00
08:00
10:00
12:00
14:00
16:00
18:00
20:00
22:00
00:00

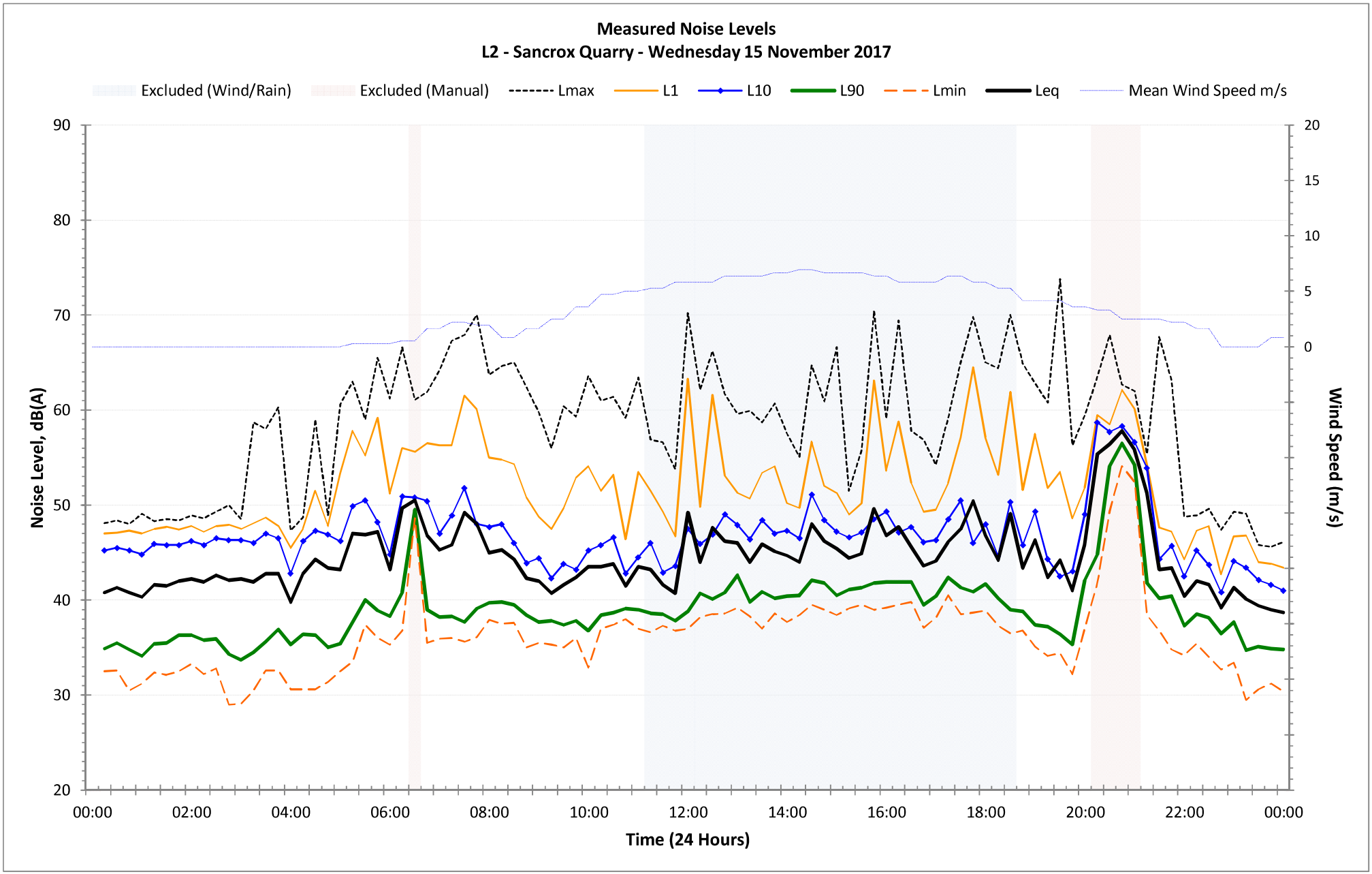

Measured Noise Levels
L2 - Sancrox Quarry - Friday 10 November 2017
Excluded (Wind/Rain)
Excluded (Manual)
Lmax
L1
L10
L90
Lmin
Leq
Mean Wind Speed m/s
Noise Level, dB(A)
Wind Speed (m/s)
Time (24 Hours)
90
80
70
60
50
40
30
20
20
15
10
5
0
00:00
02:00
04:00
06:00
08:00
10:00
12:00
14:00
16:00
18:00
20:00
22:00
00:00

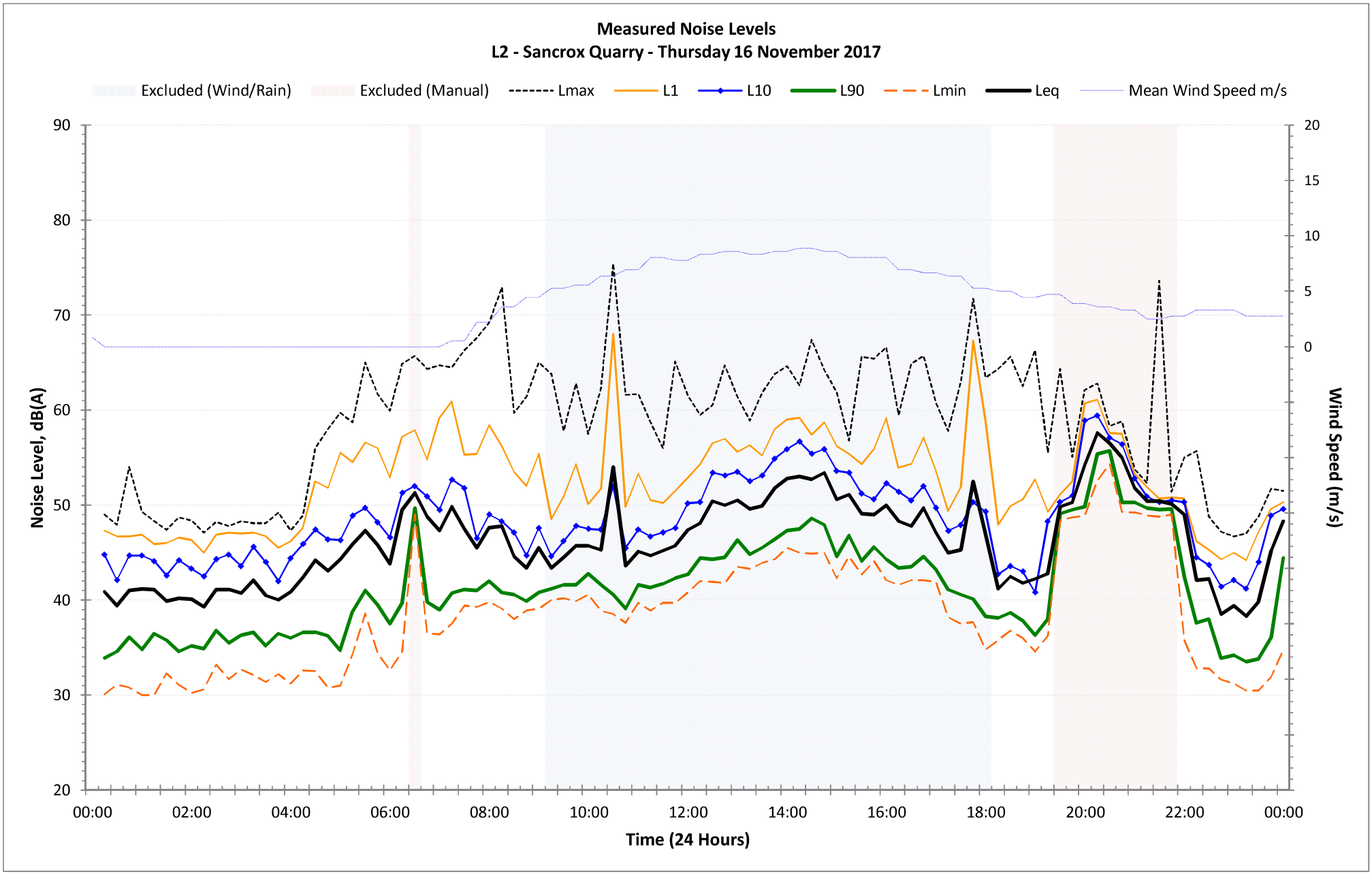

Measured Noise Levels
L2 - Sancrox Quarry - Saturday 11 November 2017
Excluded (Wind/Rain)
Excluded (Manual)
Lmax
L1
L10
L90
Lmin
Leq
Mean Wind Speed m/s
Noise Level, dB(A)
Wind Speed (m/s)
Time (24 Hours)
90
80
70
60
50
40
30
20
20
15
10
5
0
00:00
02:00
04:00
06:00
08:00
10:00
12:00
14:00
16:00
18:00
20:00
22:00
00:00

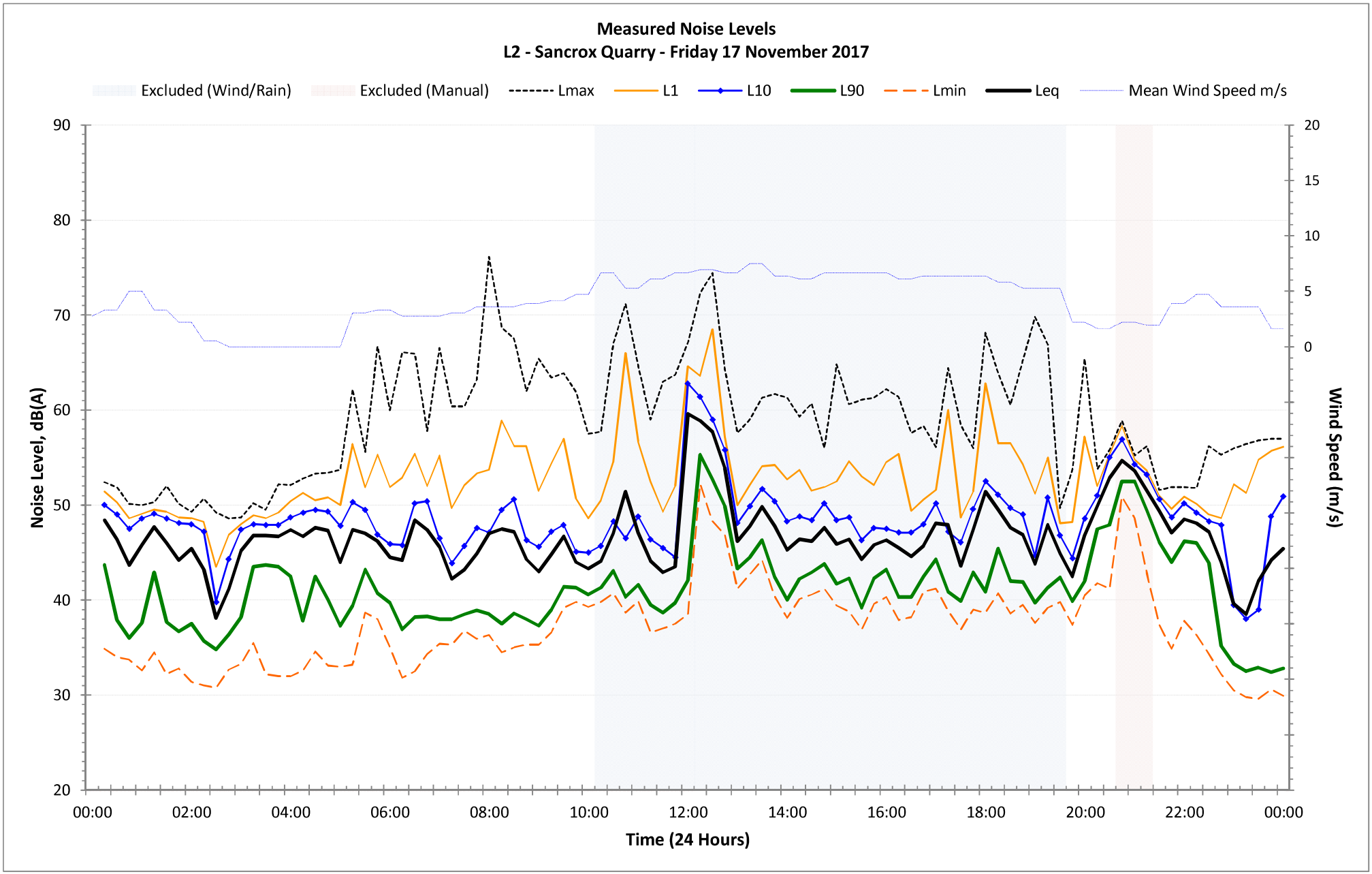

Measured Noise Levels
L2 - Sancrox Quarry - Sunday 12 November 2017
Excluded (Wind/Rain)
Excluded (Manual)
Lmax
L1
L10
L90
Lmin
Leq
Mean Wind Speed m/s
Noise Level, dB(A)
Wind Speed (m/s)
Time (24 Hours)
90
80
70
60
50
40
30
20
20
15
10
5
0
00:00
02:00
04:00
06:00
08:00
10:00
12:00
14:00
16:00
18:00
20:00
22:00
00:00

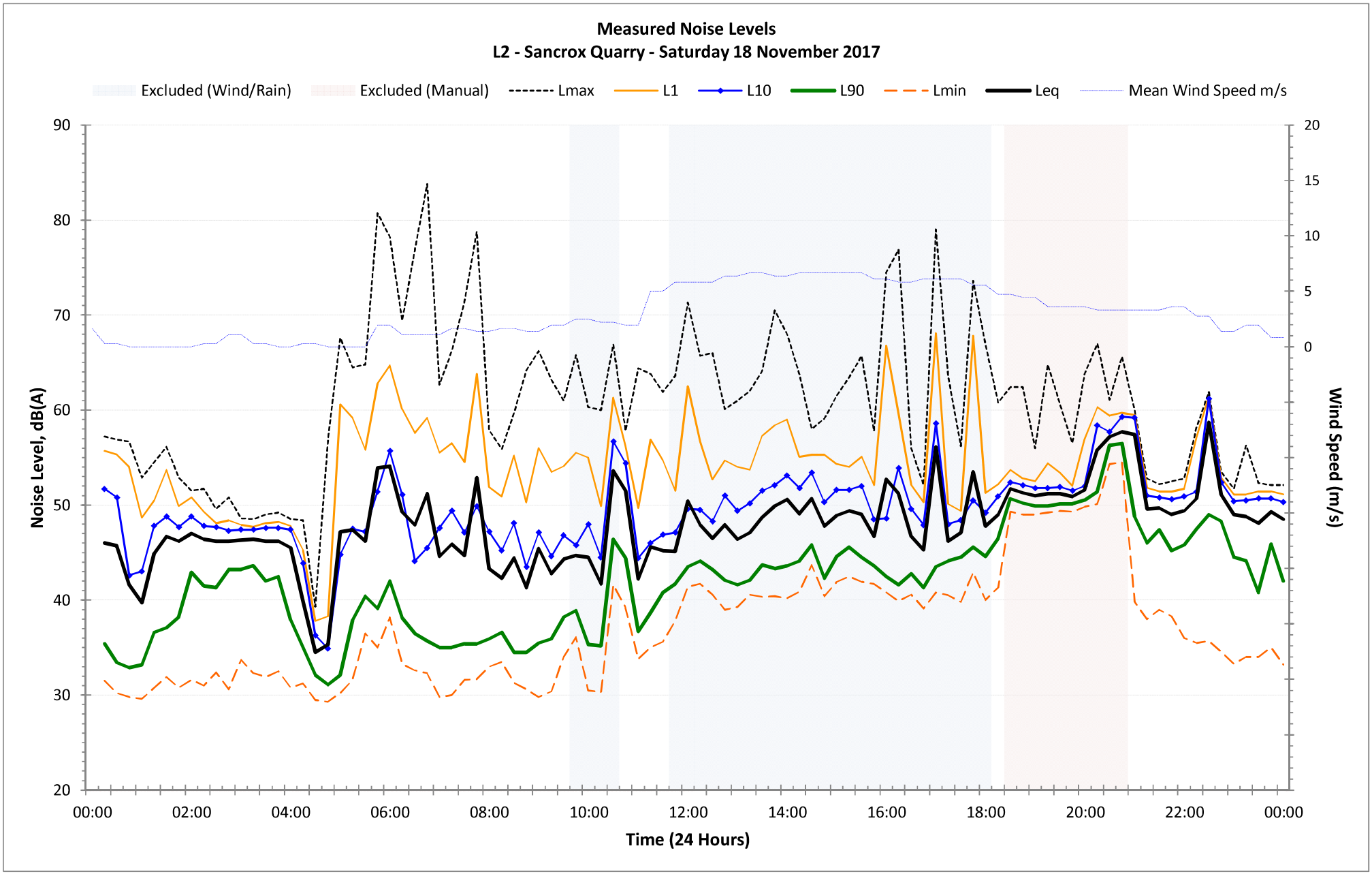

Measured Noise Levels
L2 - Sancrox Quarry - Monday 13 November 2017
Excluded (Wind/Rain)
Excluded (Manual)
Lmax
L1
L10
L90
Lmin
Leq
Mean Wind Speed m/s
Noise Level, dB(A)
Wind Speed (m/s)
Time (24 Hours)
90
80
70
60
50
40
30
20
20
15
10
5
0
00:00
02:00
04:00
06:00
08:00
10:00
12:00
14:00
16:00
18:00
20:00
22:00
00:00

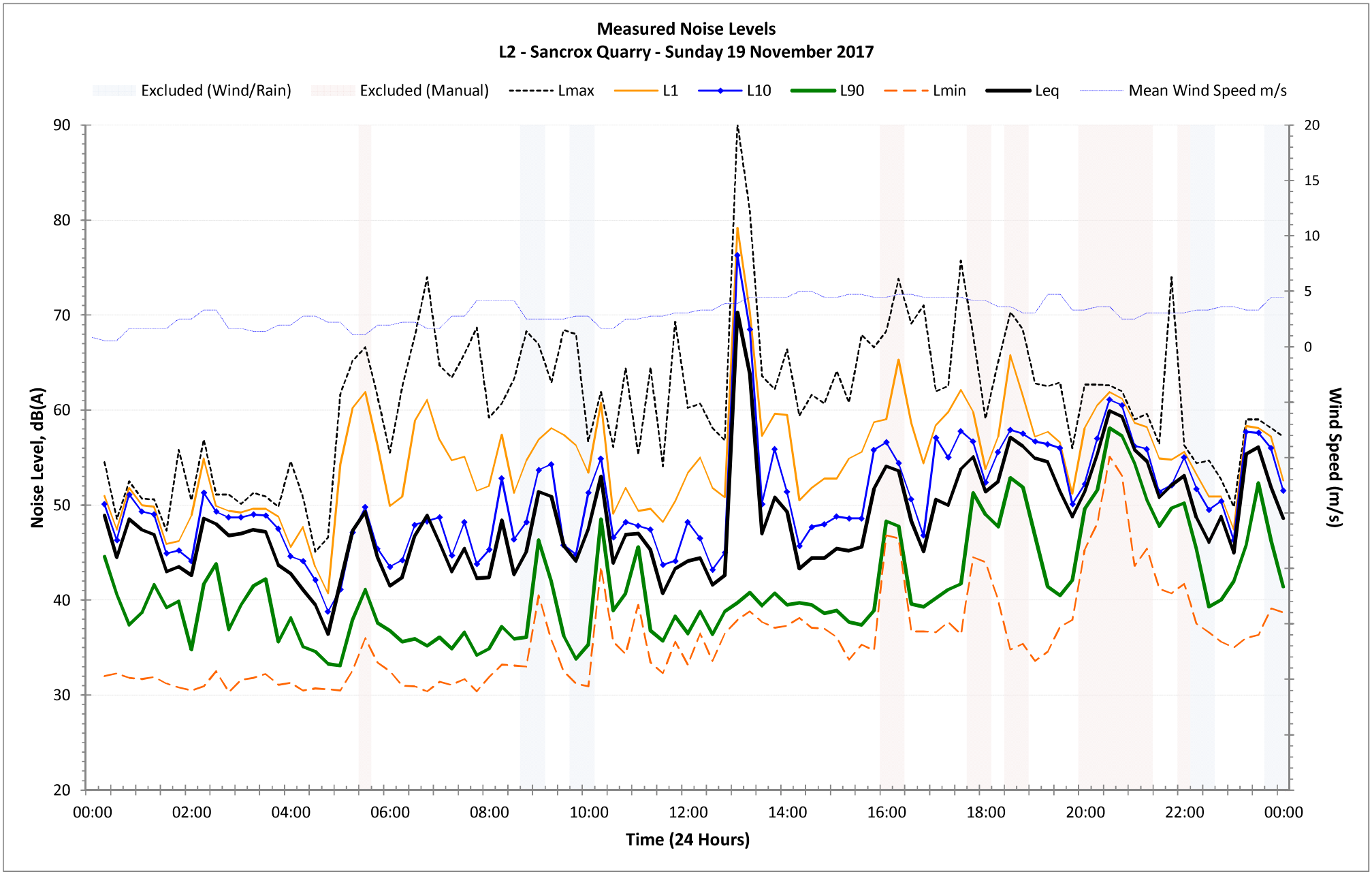

Measured Noise Levels
L2 - Sancrox Quarry - Tuesday 14 November 2017
Excluded (Wind/Rain)
Excluded (Manual)
Lmax
L1
L10
L90
Lmin
Leq
Mean Wind Speed m/s
Noise Level, dB(A)
Wind Speed (m/s)
Time (24 Hours)
90
80
70
60
50
40
30
20
20
15
10
5
0
00:00
02:00
04:00
06:00
08:00
10:00
12:00
14:00
16:00
18:00
20:00
22:00
00:00

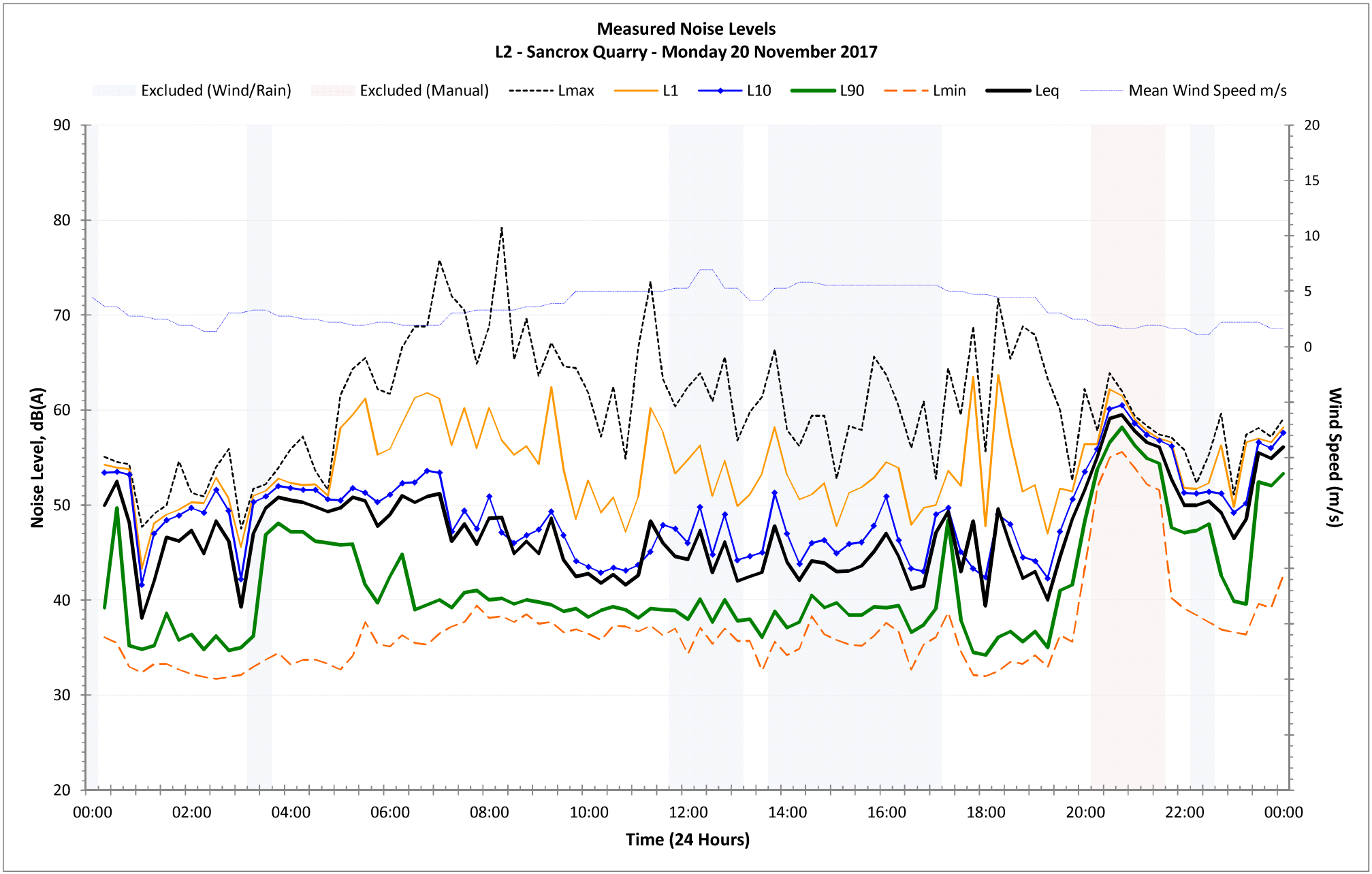

Measured Noise Levels
L2 - Sancrox Quarry - Wednesday 15 November 2017
Excluded (Wind/Rain)
Excluded (Manual)
Lmax
L1
L10
L90
Lmin
Leq
Mean Wind Speed m/s
Noise Level, dB(A)
Wind Speed (m/s)
Time (24 Hours)
90
80
70
60
50
40
30
20
20
15
10
5
0
00:00
02:00
04:00
06:00
08:00
10:00
12:00
14:00
16:00
18:00
20:00
22:00
00:00

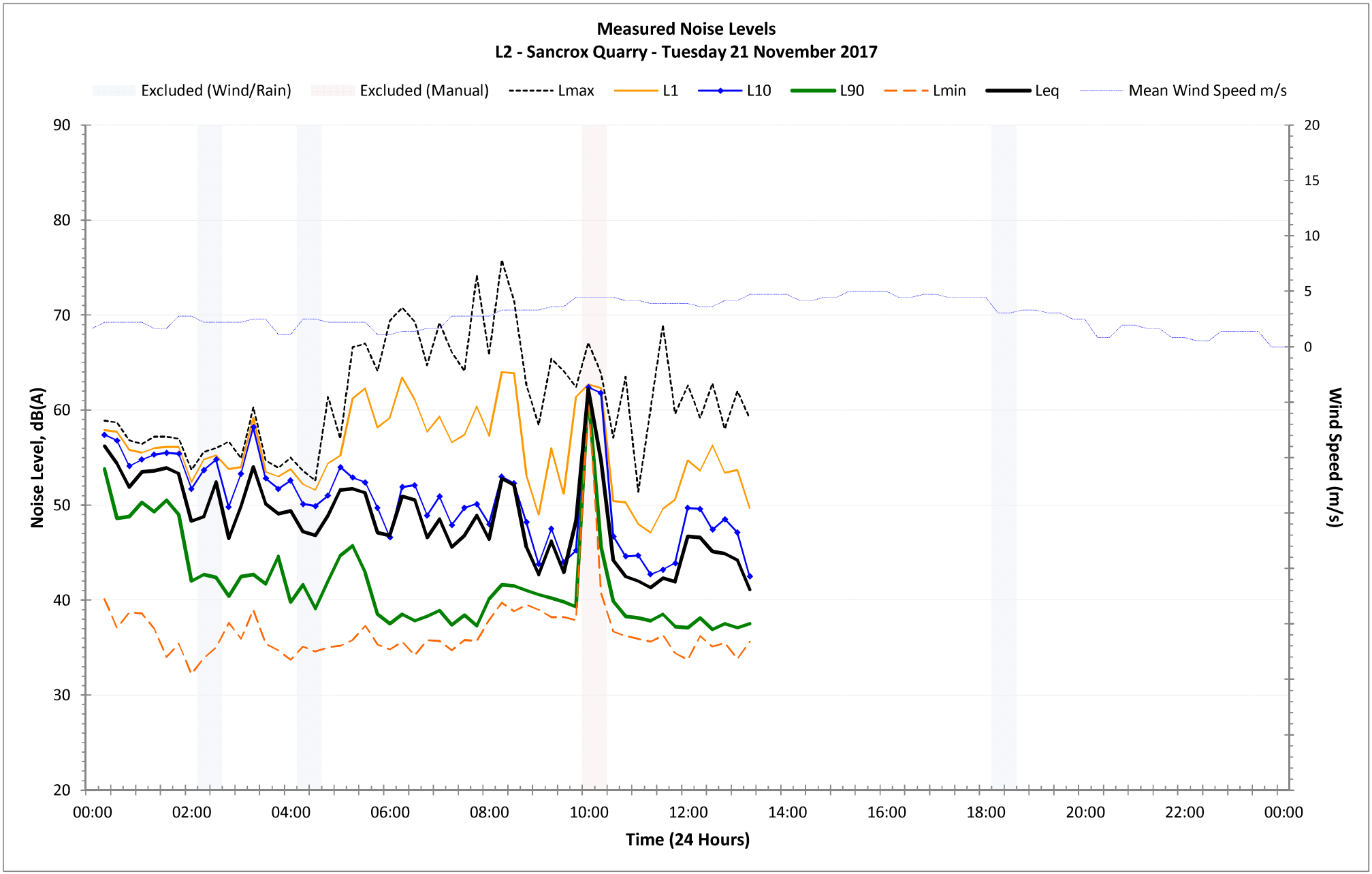

Measured Noise Levels
L2 - Sancrox Quarry - Thursday 16 November 2017
Excluded (Wind/Rain)
Excluded (Manual)
Lmax
L1
L10
L90
Lmin
Leq
Mean Wind Speed m/s
Noise Level, dB(A)
Wind Speed (m/s)
Time (24 Hours)
90
80
70
60
50
40
30
20
20
15
10
5
0
00:00
02:00
04:00
06:00
08:00
10:00
12:00
14:00
16:00
18:00
20:00
22:00
00:00

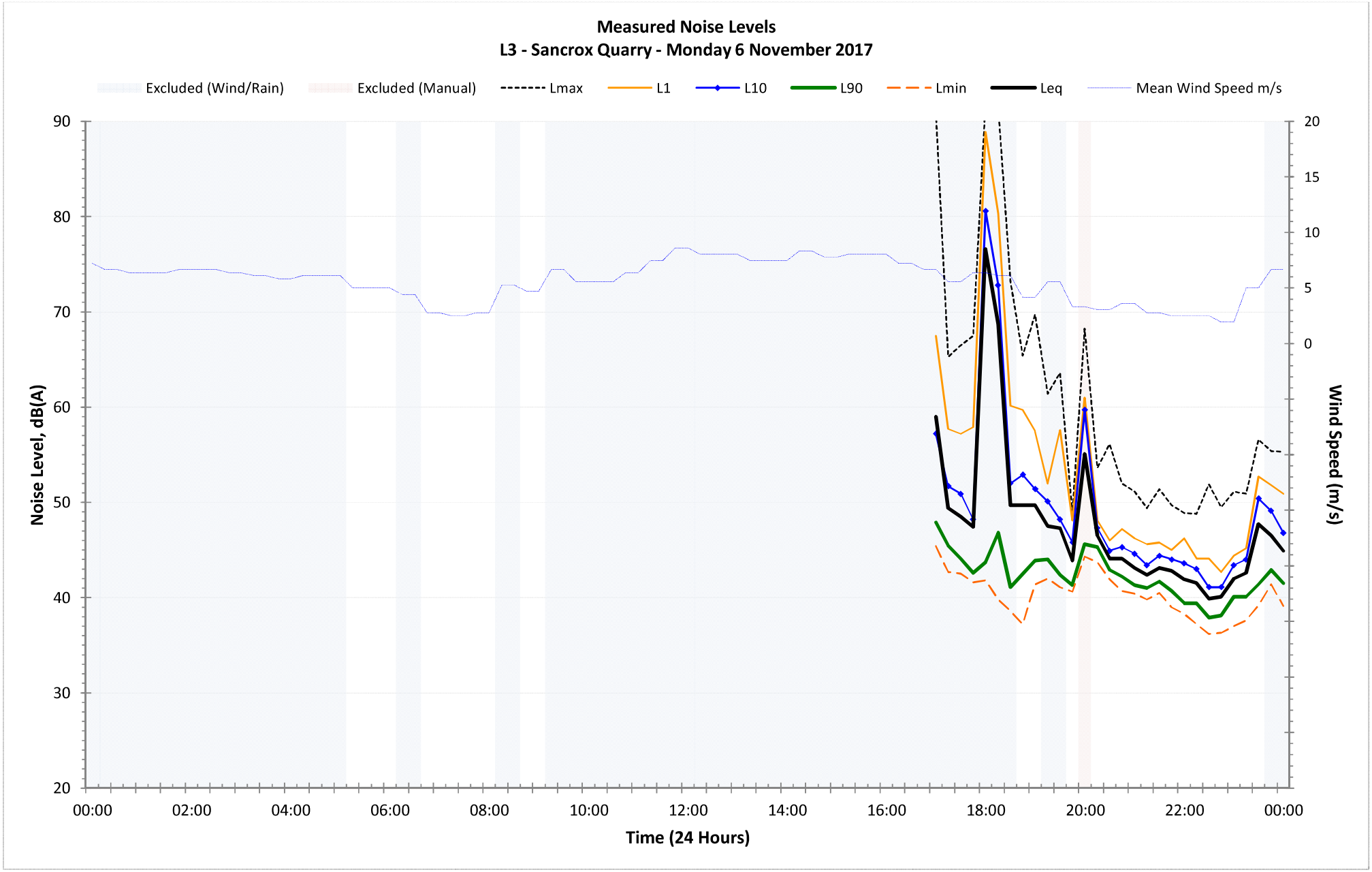

Measured Noise Levels
L2 - Sancrox Quarry - Friday 17 November 2017
Excluded (Wind/Rain)
Excluded (Manual)
Lmax
L1
L10
L90
Lmin
Leq
Mean Wind Speed m/s
Noise Level, dB(A)
Wind Speed (m/s)
Time (24 Hours)
90
80
70
60
50
40
30
20
20
15
10
5
0
00:00
02:00
04:00
06:00
08:00
10:00
12:00
14:00
16:00
18:00
20:00
22:00
00:00

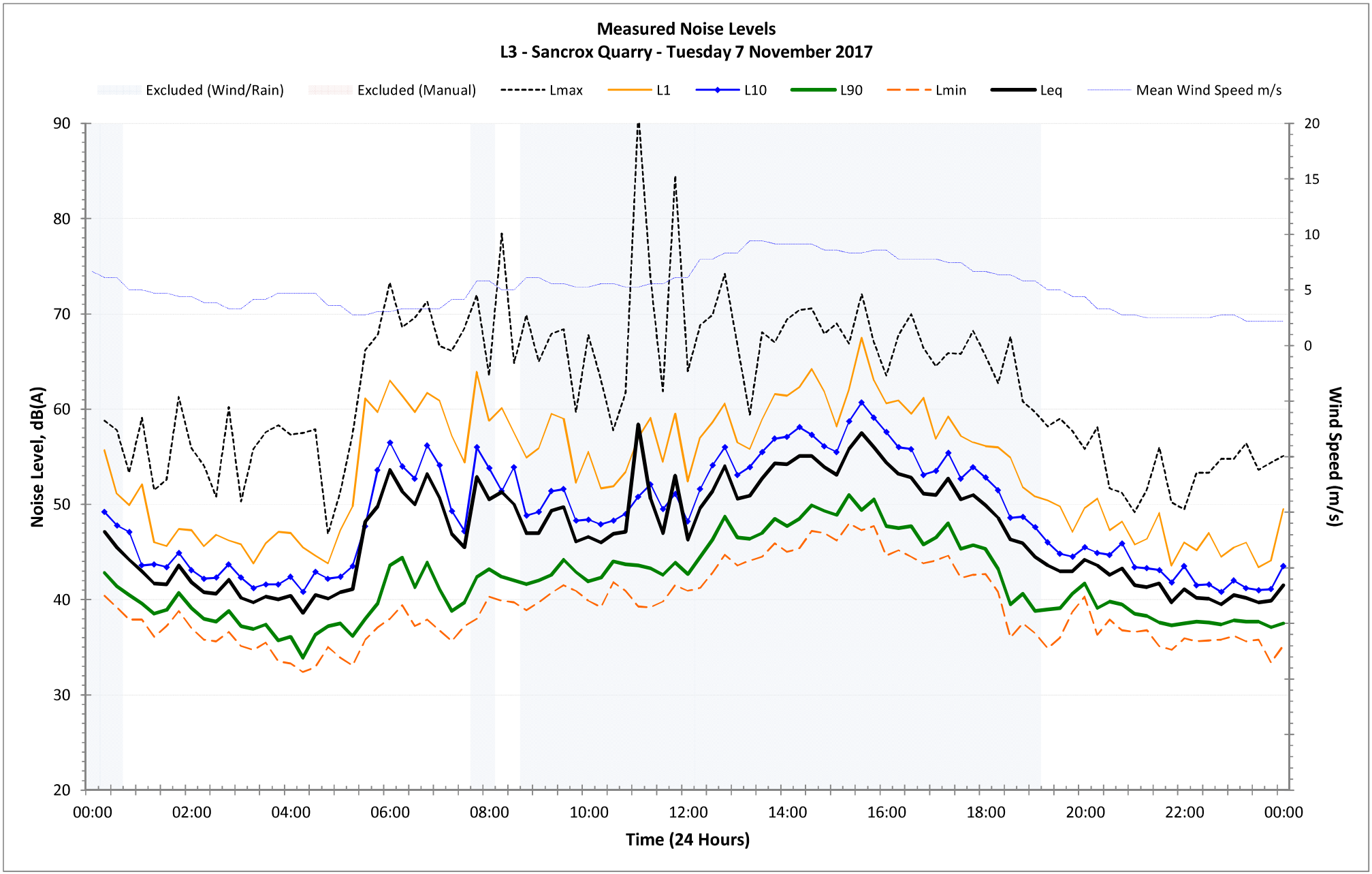

Measured Noise Levels
L2 - Sancrox Quarry - Saturday 18 November 2017
Excluded (Wind/Rain)
Excluded (Manual)
Lmax
L1
L10
L90
Lmin
Leq
Mean Wind Speed m/s
Noise Level, dB(A)
Wind Speed (m/s)
Time (24 Hours)
90
80
70
60
50
40
30
20
20
15
10
5
0
00:00
02:00
04:00
06:00
08:00
10:00
12:00
14:00
16:00
18:00
20:00
22:00
00:00

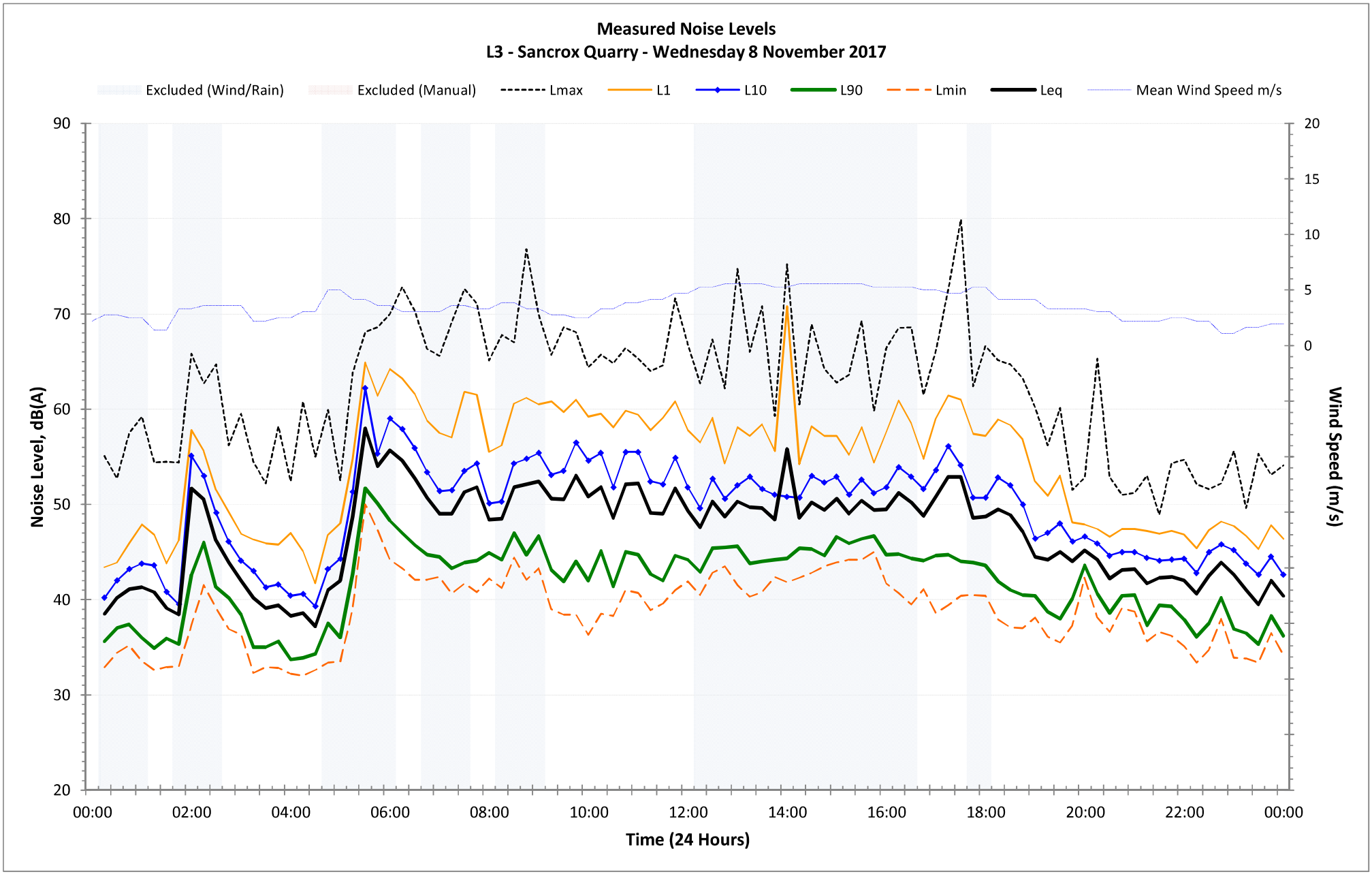

Measured Noise Levels
L2 - Sancrox Quarry - Sunday 19 November 2017
Excluded (Wind/Rain)
Excluded (Manual)
Lmax
L1
L10
L90
Lmin
Leq
Mean Wind Speed m/s
Noise Level, dB(A)
Wind Speed (m/s)
Time (24 Hours)
90
80
70
60
50
40
30
20
20
15
10
5
0
00:00
02:00
04:00
06:00
08:00
10:00
12:00
14:00
16:00
18:00
20:00
22:00
00:00

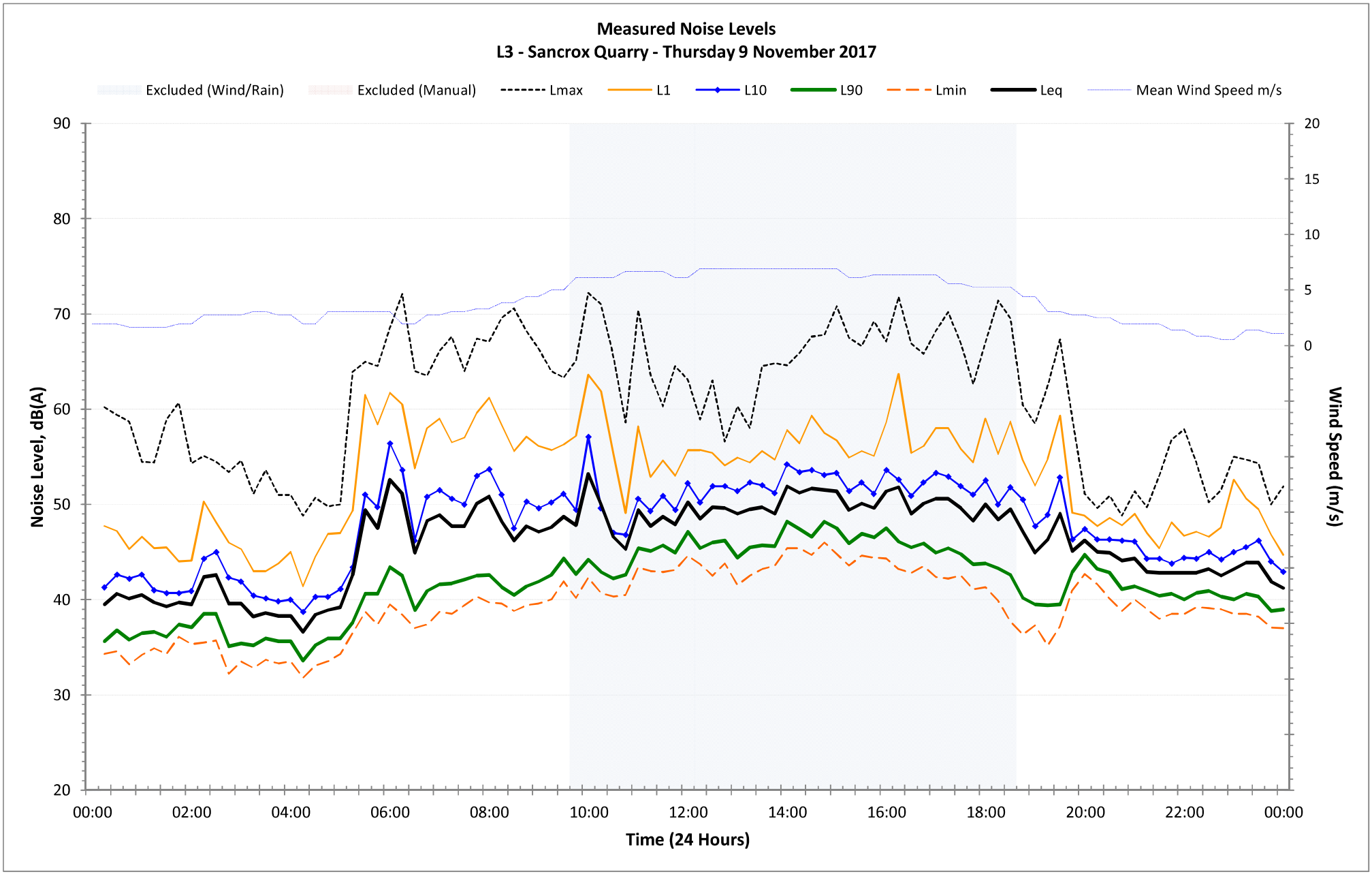

Measured Noise Levels
L2 - Sancrox Quarry - Monday 20 November 2017
Excluded (Wind/Rain)
Excluded (Manual)
Lmax
L1
L10
L90
Lmin
Leq
Mean Wind Speed m/s
Noise Level, dB(A)
Wind Speed (m/s)
Time (24 Hours)
90
80
70
60
50
40
30
20
20
15
10
5
0
00:00
02:00
04:00
06:00
08:00
10:00
12:00
14:00
16:00
18:00
20:00
22:00
00:00

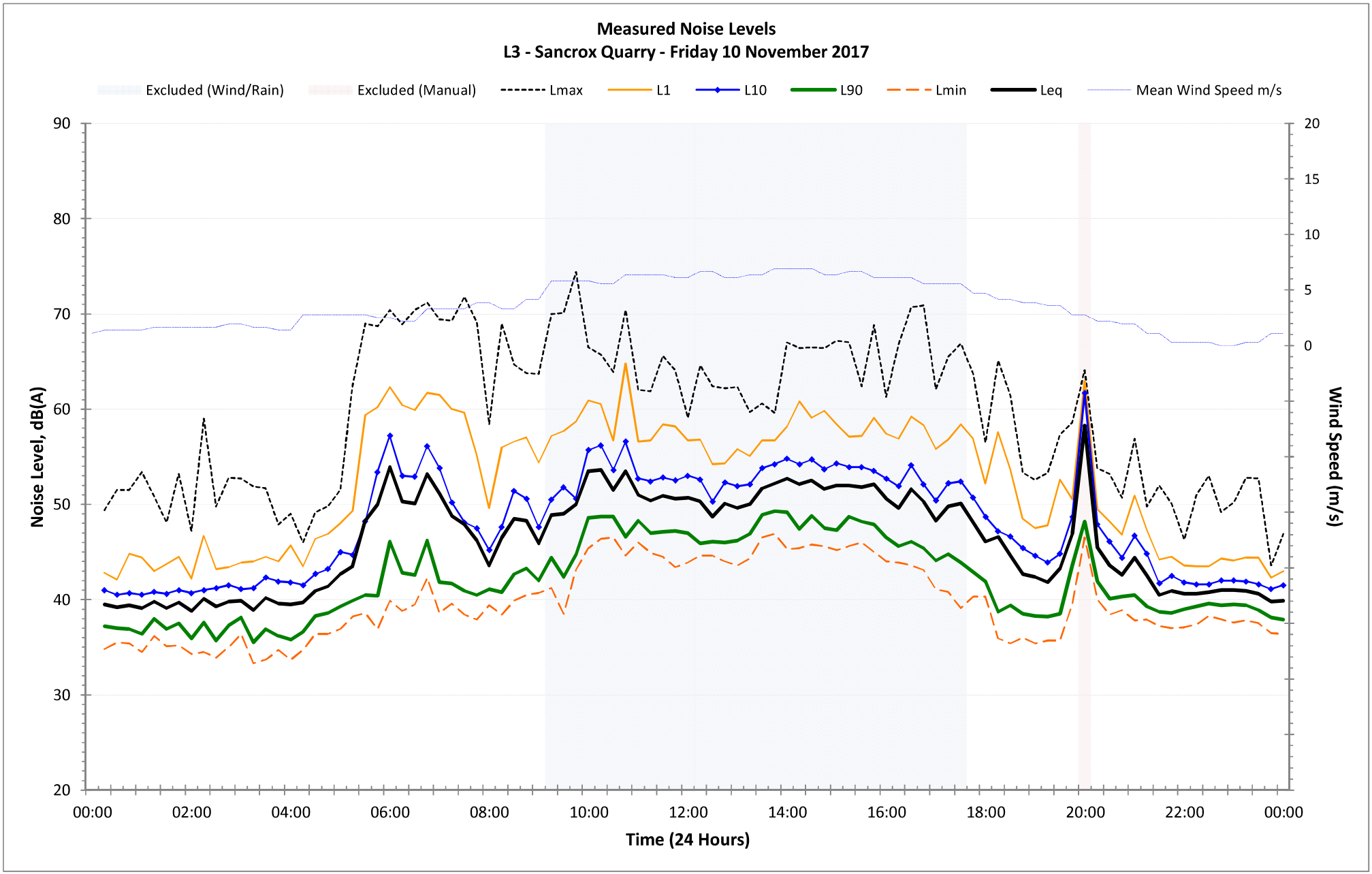

Measured Noise Levels
L2 - Sancrox Quarry - Tuesday 21 November 2017
Excluded (Wind/Rain)
Excluded (Manual)
Lmax
L1
L10
L90
Lmin
Leq
Mean Wind Speed m/s
Noise Level, dB(A)
Wind Speed (m/s)
Time (24 Hours)
90
80
70
60
50
40
30
20
20
15
10
5
0
00:00
02:00
04:00
06:00
08:00
10:00
12:00
14:00
16:00
18:00
20:00
22:00
00:00

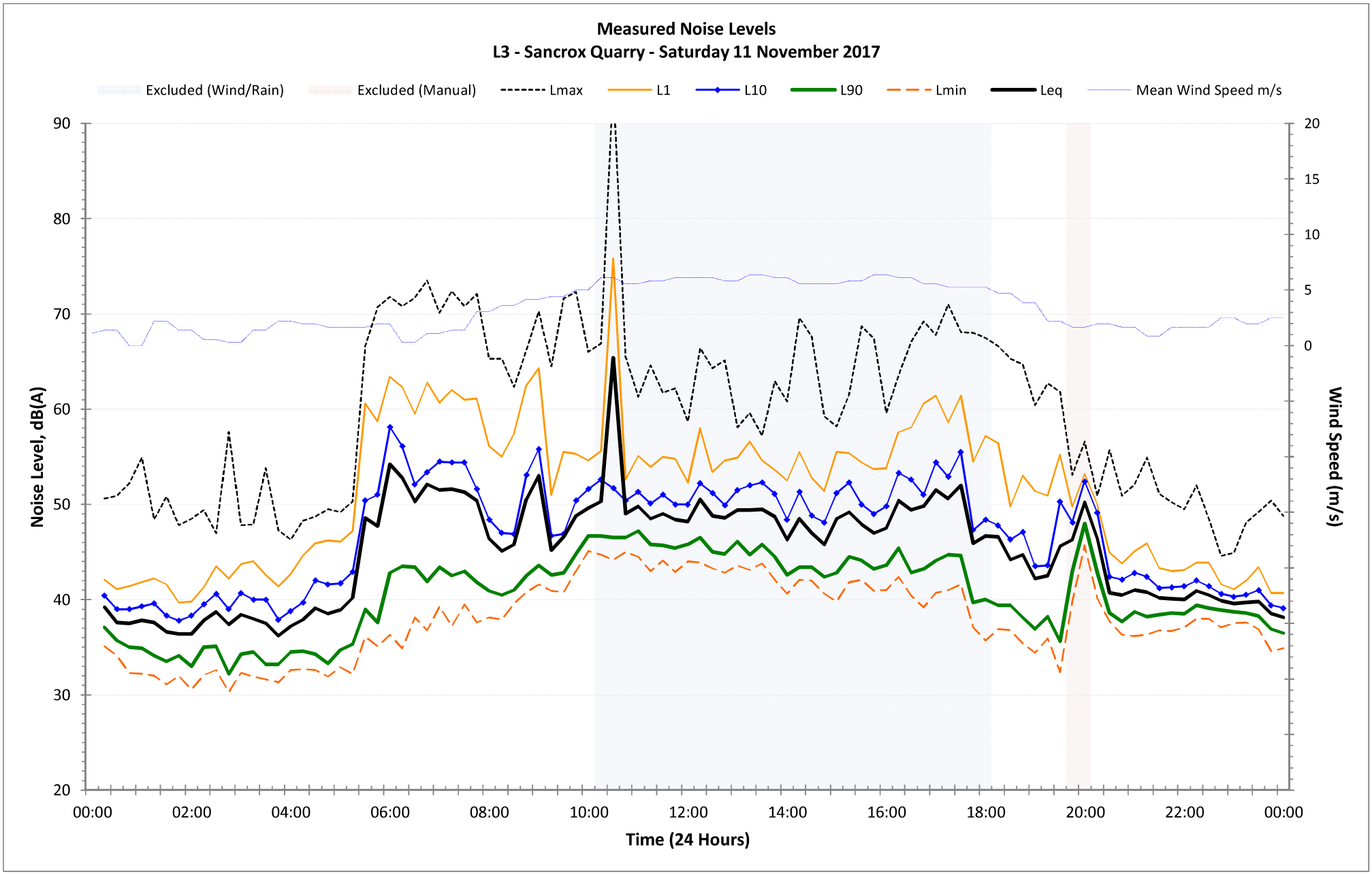

Measured Noise Levels
L3 - Sancrox Quarry - Monday 6 November 2017
Excluded (Wind/Rain)
Excluded (Manual)
Lmax
L1
L10
L90
Lmin
Leq
Mean Wind Speed m/s
Noise Level, dB(A)
Wind Speed (m/s)
Time (24 Hours)
90
80
70
60
50
40
30
20
20
15
10
5
0
00:00
02:00
04:00
06:00
08:00
10:00
12:00
14:00
16:00
18:00
20:00
22:00
00:00

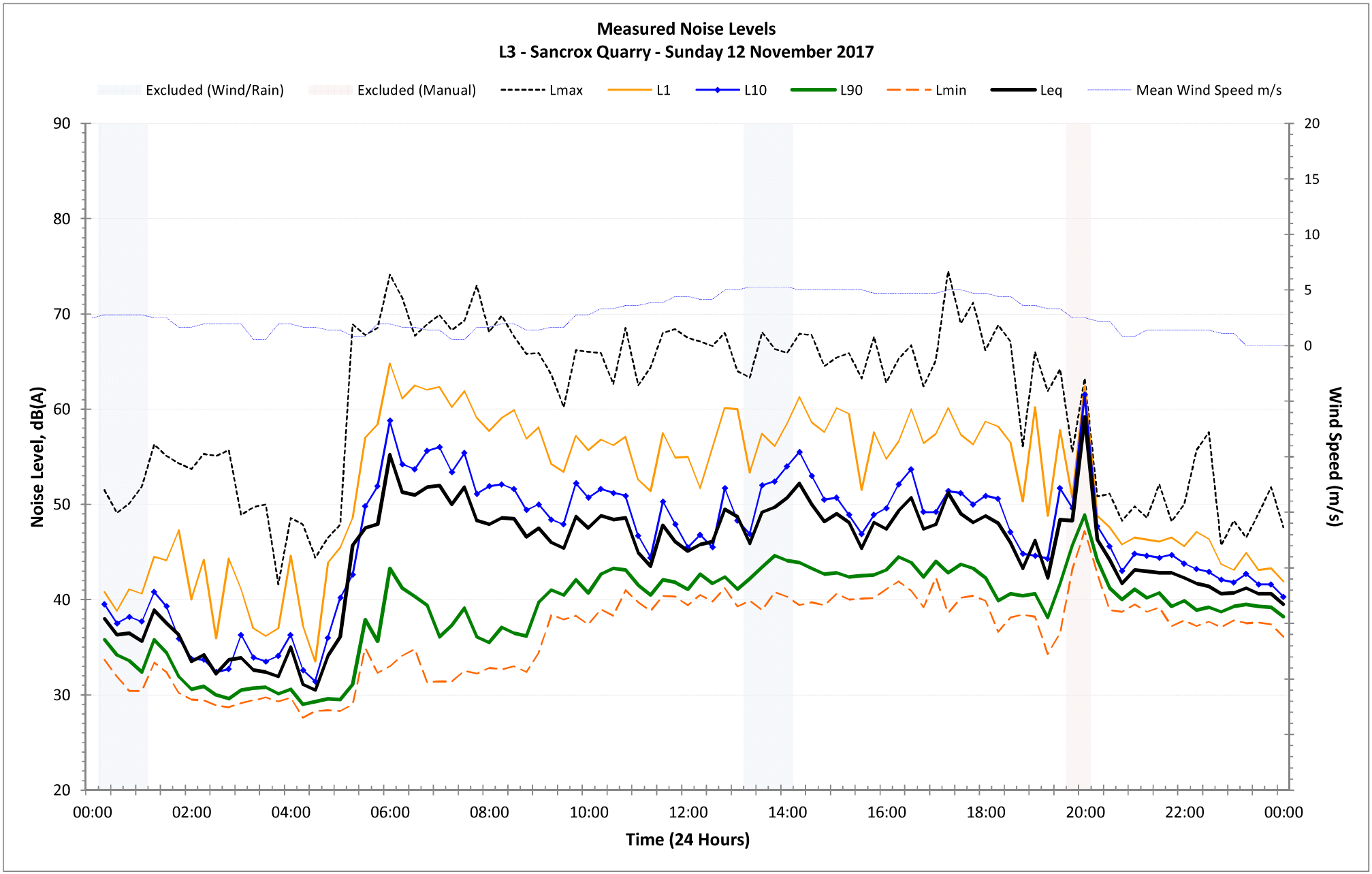

Measured Noise Levels
L3 - Sancrox Quarry - Tuesday 7 November 2017
Excluded (Wind/Rain)
Excluded (Manual)
Lmax
L1
L10
L90
Lmin
Leq
Mean Wind Speed m/s
Noise Level, dB(A)
Wind Speed (m/s)
Time (24 Hours)
90
80
70
60
50
40
30
20
20
15
10
5
0
00:00
02:00
04:00
06:00
08:00
10:00
12:00
14:00
16:00
18:00
20:00
22:00
00:00

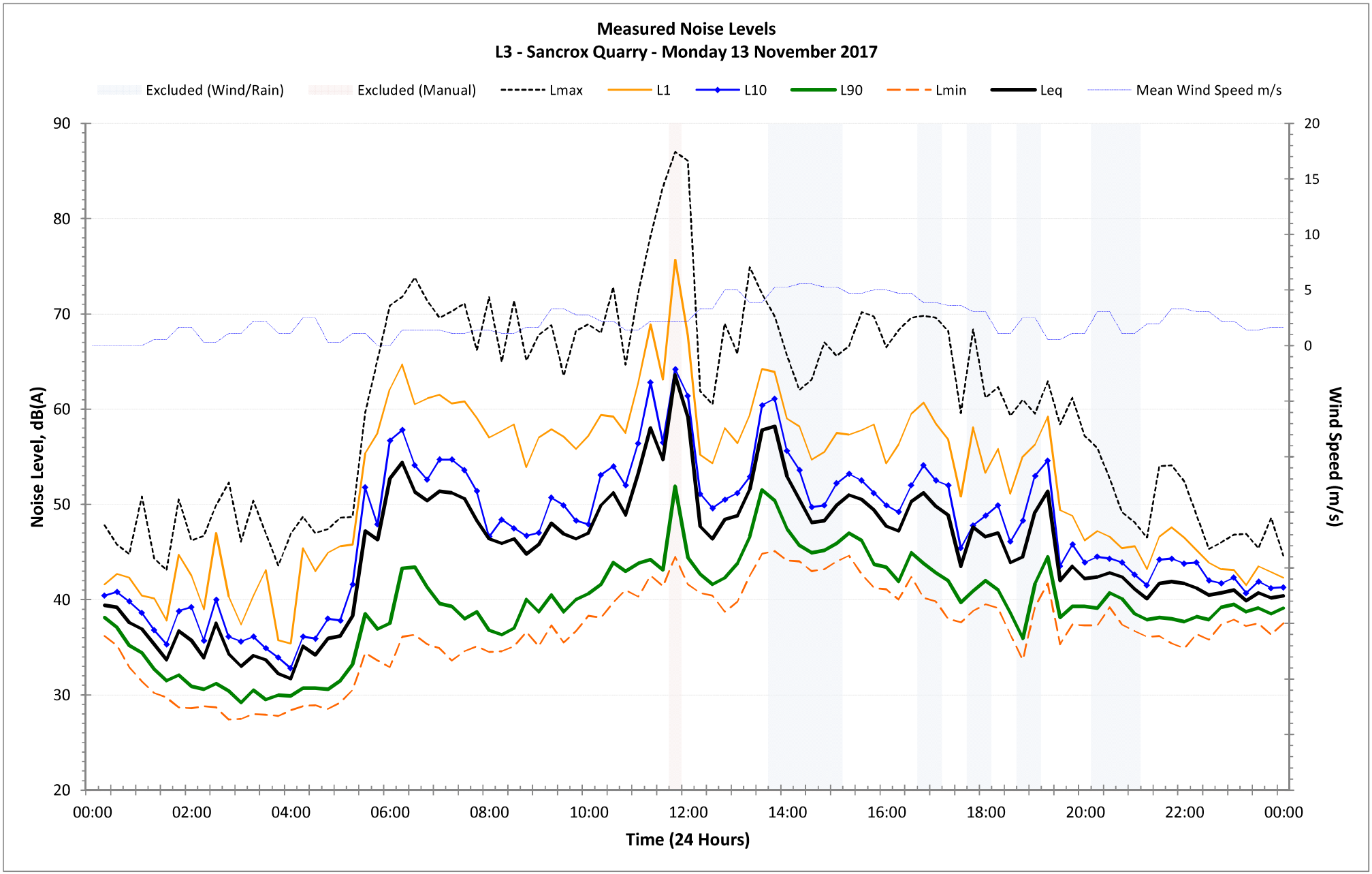

Measured Noise Levels
L3 - Sancrox Quarry - Wednesday 8 November 2017
Excluded (Wind/Rain)
Excluded (Manual)
Lmax
L1
L10
L90
Lmin
Leq
Mean Wind Speed m/s
Noise Level, dB(A)
Wind Speed (m/s)
Time (24 Hours)
90
80
70
60
50
40
30
20
20
15
10
5
0
00:00
02:00
04:00
06:00
08:00
10:00
12:00
14:00
16:00
18:00
20:00
22:00
00:00

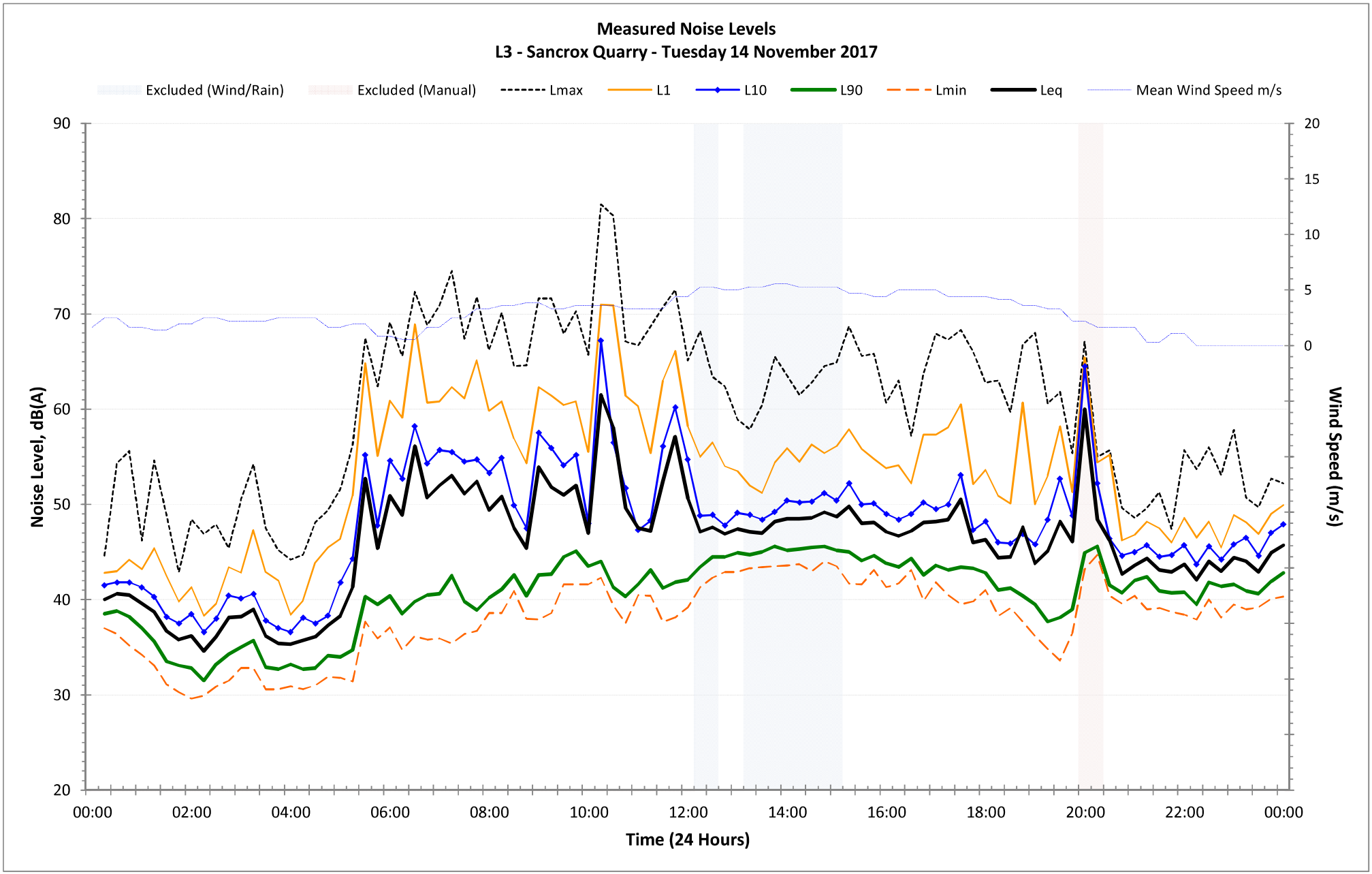

Measured Noise Levels
L3 - Sancrox Quarry - Thursday 9 November 2017
Excluded (Wind/Rain)
Excluded (Manual)
Lmax
L1
L10
L90
Lmin
Leq
Mean Wind Speed m/s
Noise Level, dB(A)
Wind Speed (m/s)
Time (24 Hours)
90
80
70
60
50
40
30
20
20
15
10
5
0
00:00
02:00
04:00
06:00
08:00
10:00
12:00
14:00
16:00
18:00
20:00
22:00
00:00

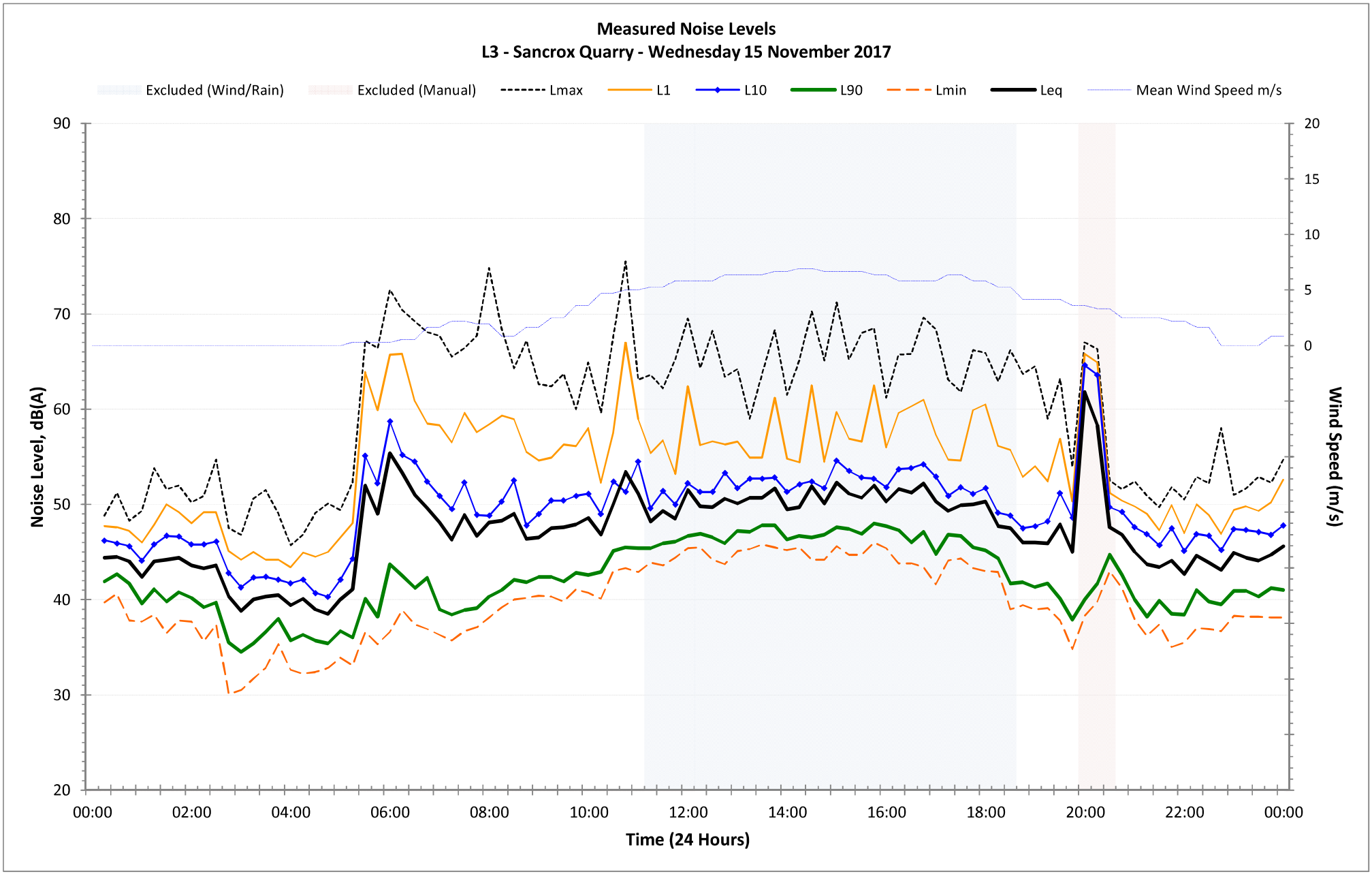

Measured Noise Levels
L3 - Sancrox Quarry - Friday 10 November 2017
Excluded (Wind/Rain)
Excluded (Manual)
Lmax
L1
L10
L90
Lmin
Leq
Mean Wind Speed m/s
Noise Level, dB(A)
Wind Speed (m/s)
Time (24 Hours)
90
80
70
60
50
40
30
20
20
15
10
5
0
00:00
02:00
04:00
06:00
08:00
10:00
12:00
14:00
16:00
18:00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

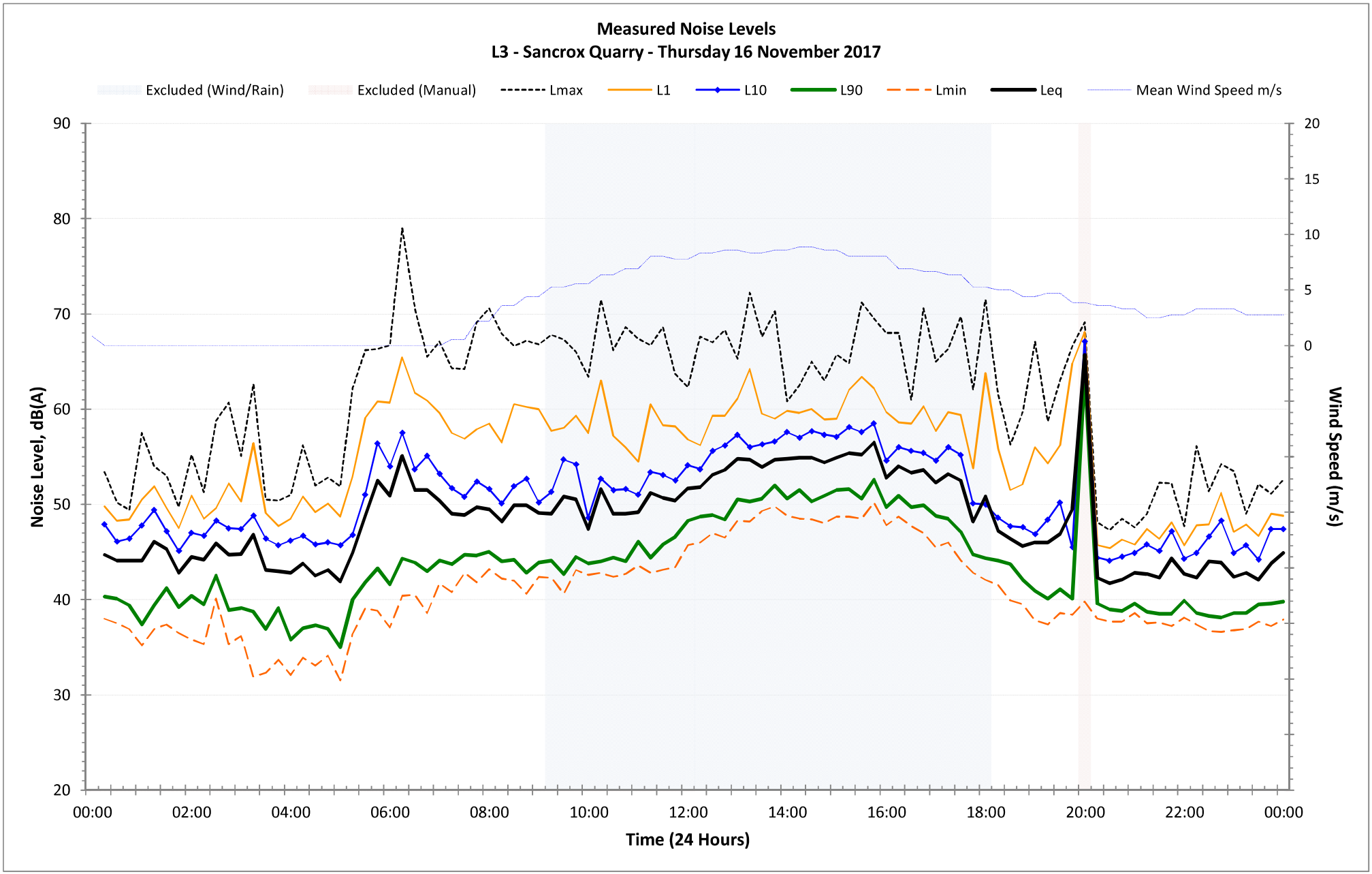

Measured Noise Levels
L3 - Sancrox Quarry - Saturday 11 November 2017
Excluded (Wind/Rain)
Excluded (Manual)
Lmax
L1
L10
L90
Lmin
Leq
Mean Wind Speed m/s
Noise Level, dB(A)
Wind Speed (m/s)
Time (24 Hours)
90
80
70
60
50
40
30
20
20
15
10
5
0
00:00
02:00
04:00
06:00
08:00
10:00
12:00
14:00
16:00
18:00
20:00
22:00
00:00

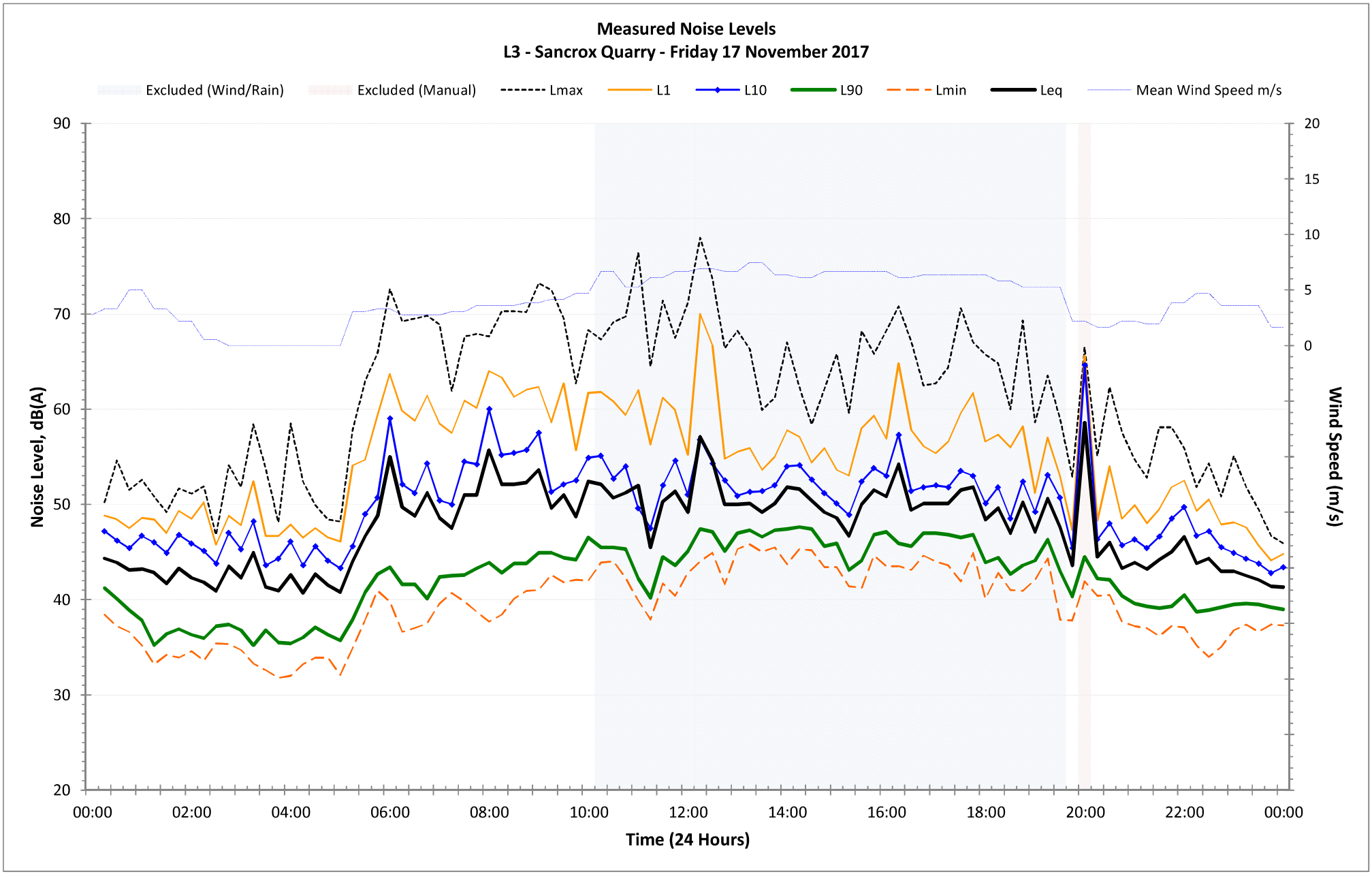

Measured Noise Levels
L3 - Sancrox Quarry - Sunday 12 November 2017
Excluded (Wind/Rain)
Excluded (Manual)
Lmax
L1
L10
L90
Lmin
Leq
Mean Wind Speed m/s
Noise Level, dB(A)
Wind Speed (m/s)
Time (24 Hours)
90
80
70
60
50
40
30
20
20
15
10
5
0
00:00
02:00
04:00
06:00
08:00
10:00
12:00
14:00
16:00
18:00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

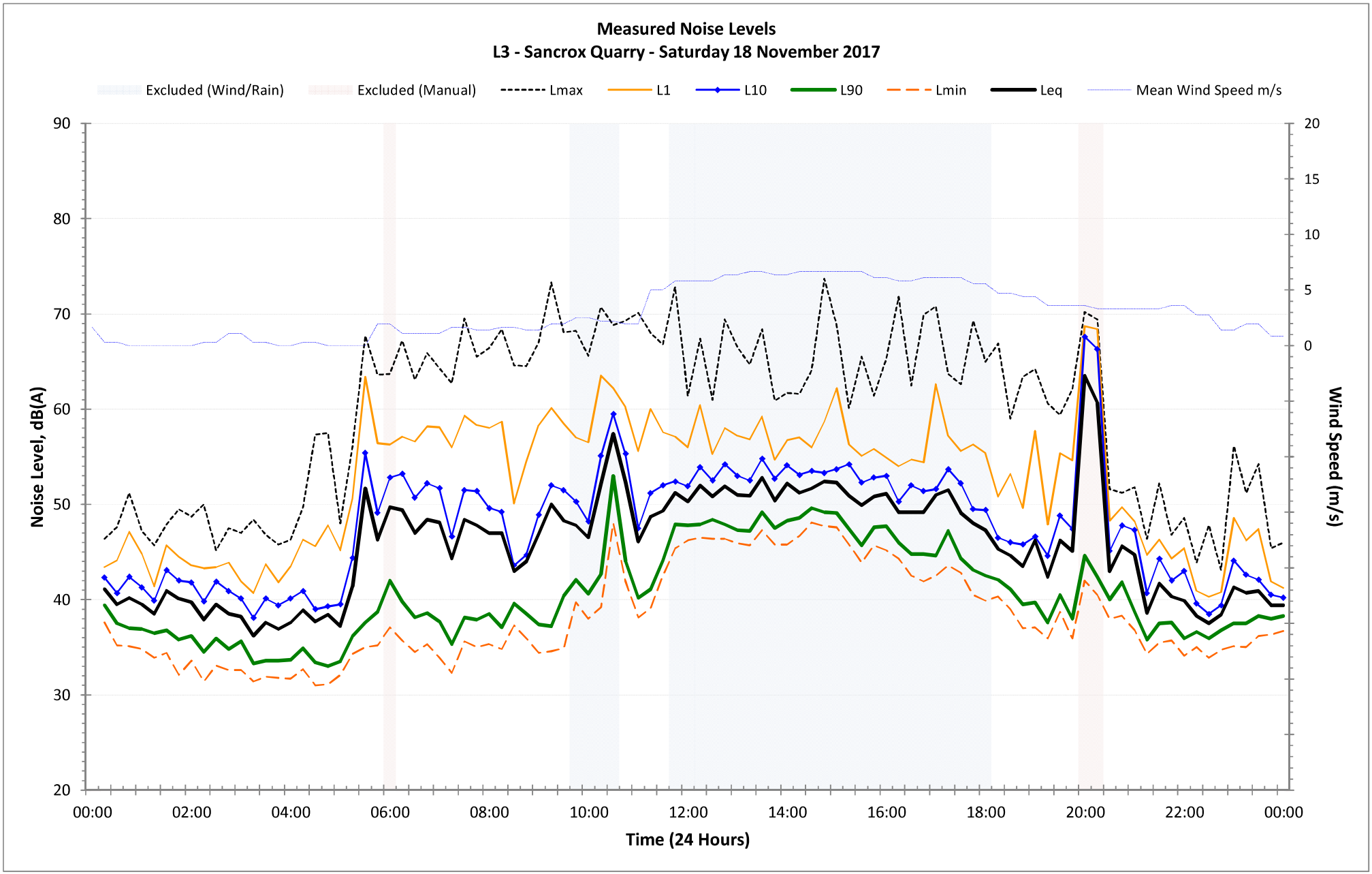

Measured Noise Levels
L3 - Sancrox Quarry - Monday 13 November 2017
Excluded (Wind/Rain)
Excluded (Manual)
Lmax
L1
L10
L90
Lmin
Leq
Mean Wind Speed m/s
Noise Level, dB(A)
Wind Speed (m/s)
Time (24 Hours)
90
80
70
60
50
40
30
20
20
15
10
5
0
00:00
02:00
04:00
06:00
08:00
10:00
12:00
14:00
16:00
18:00
20:00
22:00
00:00

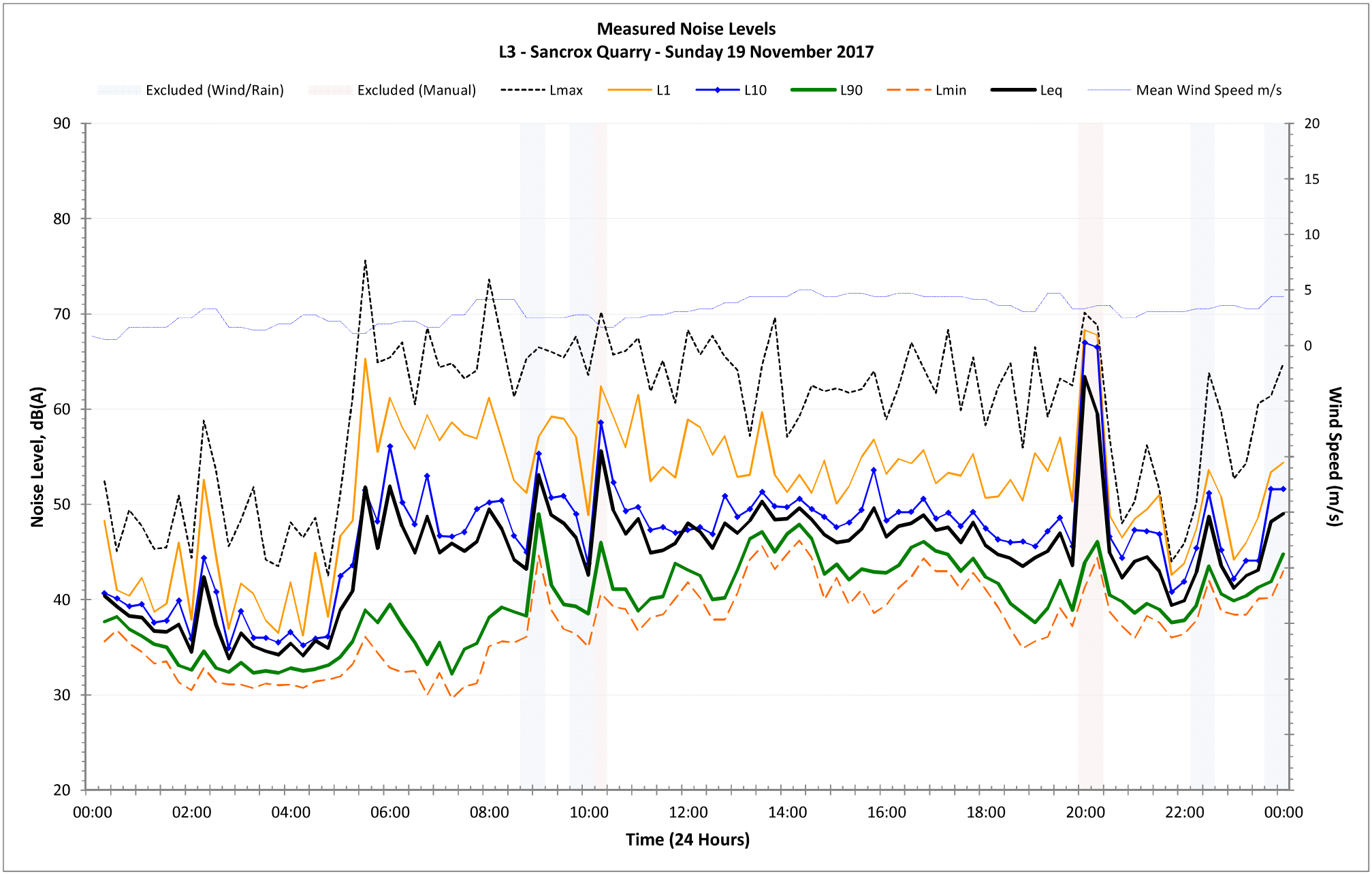

Measured Noise Levels
L3 - Sancrox Quarry - Tuesday 14 November 2017
Excluded (Wind/Rain)
Excluded (Manual)
Lmax
L1
L10
L90
Lmin
Leq
Mean Wind Speed m/s
Noise Level, dB(A)
Wind Speed (m/s)
Time (24 Hours)
90
80
70
60
50
40
30
20
20
15
10
5
0
00:00
02:00
04:00
06:00
08:00
10:00
12:00
14:00
16:00
18:00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

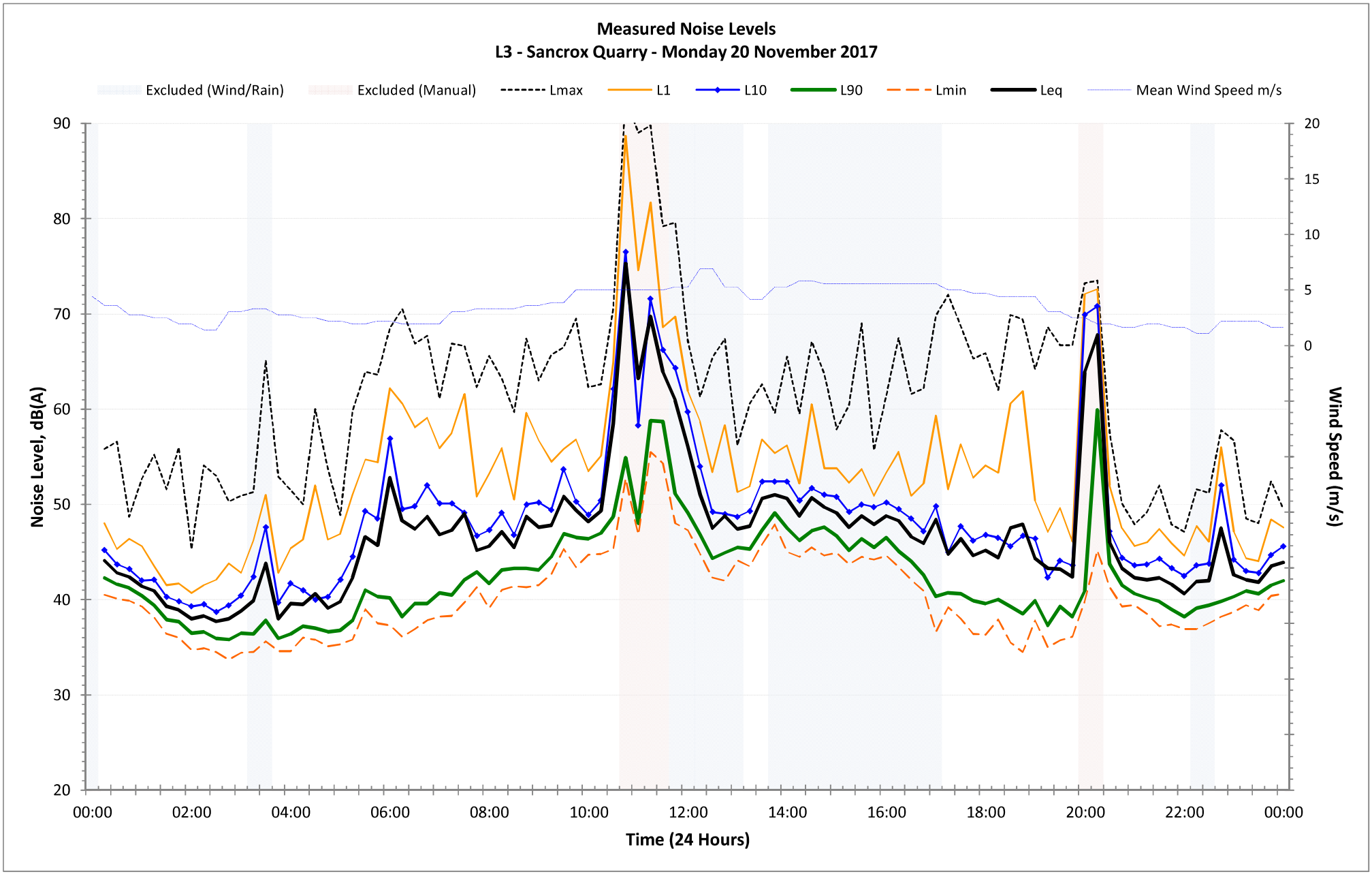

Measured Noise Levels
L3 - Sancrox Quarry - Wednesday 15 November 2017
Excluded (Wind/Rain)
Excluded (Manual)
Lmax
L1
L10
L90
Lmin
Leq
Mean Wind Speed m/s
Noise Level, dB(A)
Wind Speed (m/s)
Time (24 Hours)
90
80
70
60
50
40
30
20
20
15
10
5
0
00:00
02:00
04:00
06:00
08:00
10:00
12:00
14:00
16:00
18:00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

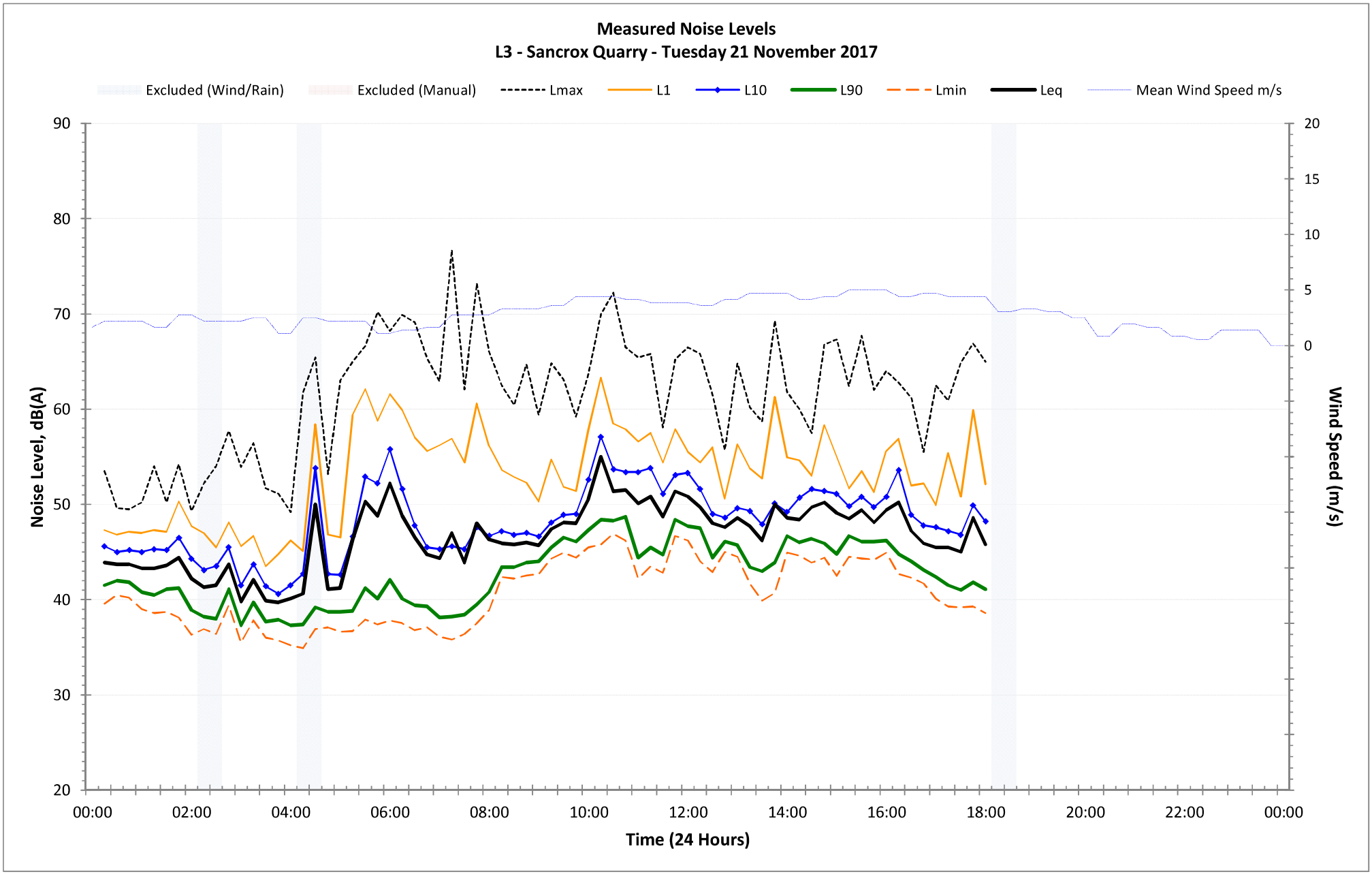

Measured Noise Levels
L3 - Sancrox Quarry - Thursday 16 November 2017
Excluded (Wind/Rain)
Excluded (Manual)
Lmax
L1
L10
L90
Lmin
Leq
Mean Wind Speed m/s
Noise Level, dB(A)
Wind Speed (m/s)
Time (24 Hours)
90
80
70
60
50
40
30
20
20
15
10
5
0
00:00
02:00
04:00
06:00
08:00
10:00
12:00
14:00
16:00
18:00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

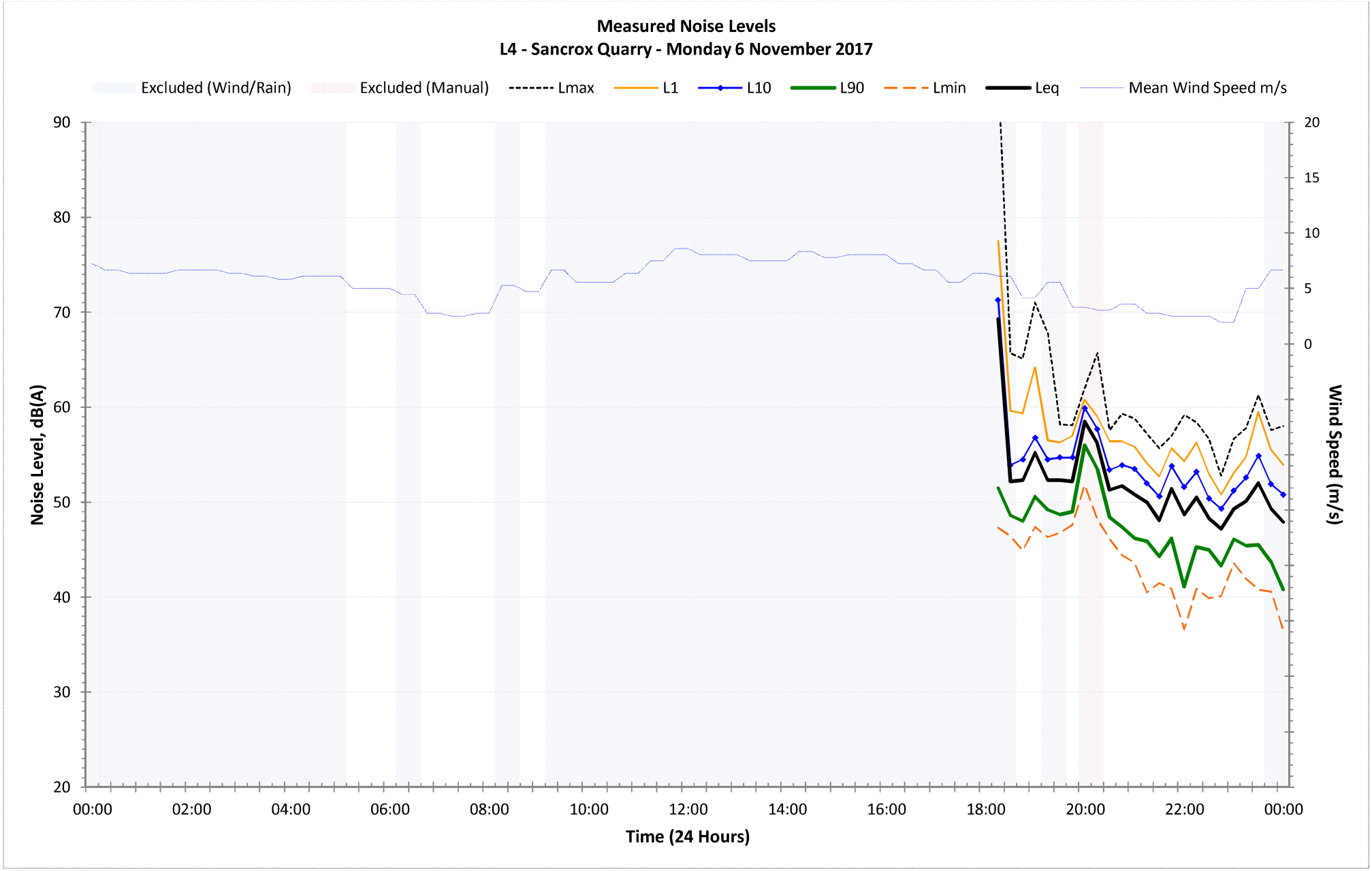

Measured Noise Levels
L3 - Sancrox Quarry - Friday 17 November 2017
Excluded (Wind/Rain)
Excluded (Manual)
Lmax
L1
L10
L90
Lmin
Leq
Mean Wind Speed m/s
Noise Level, dB(A)
Wind Speed (m/s)
Time (24 Hours)
90
80
70
60
50
40
30
20
20
15
10
5
0
00:00
02:00
04:00
06:00
08:00
10:00
12:00
14:00
16:00
18:00
20:00
22:00
00:00

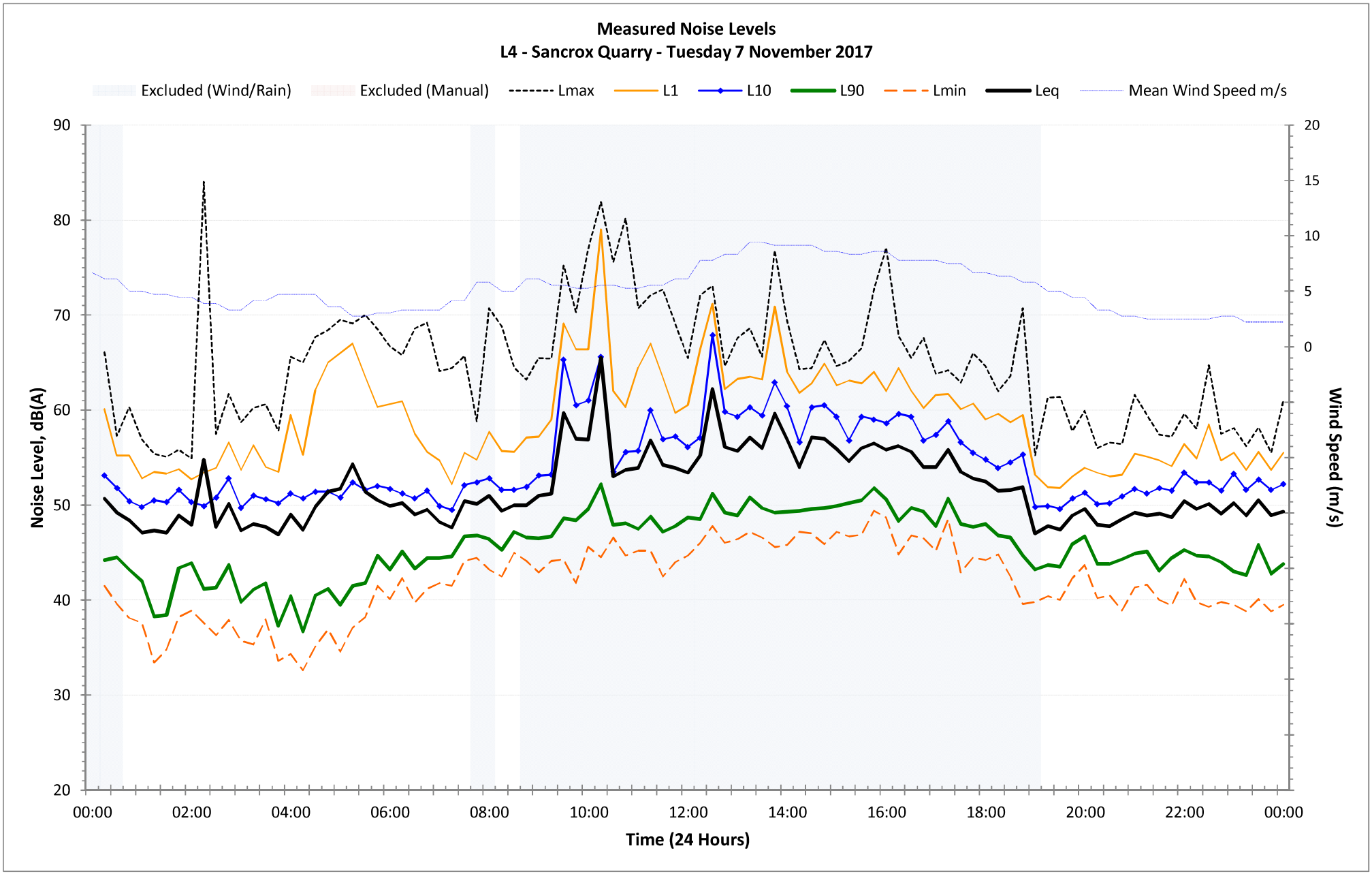

Measured Noise Levels
L3 - Sancrox Quarry - Saturday 18 November 2017
Excluded (Wind/Rain)
Excluded (Manual)
Lmax
L1
L10
L90
Lmin
Leq
Mean Wind Speed m/s
Noise Level, dB(A)
Wind Speed (m/s)
Time (24 Hours)
90
80
70
60
50
40
30
20
20
15
10
5
0
00:00
02:00
04:00
06:00
08:00
10:00
12:00
14:00
16:00
18:00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

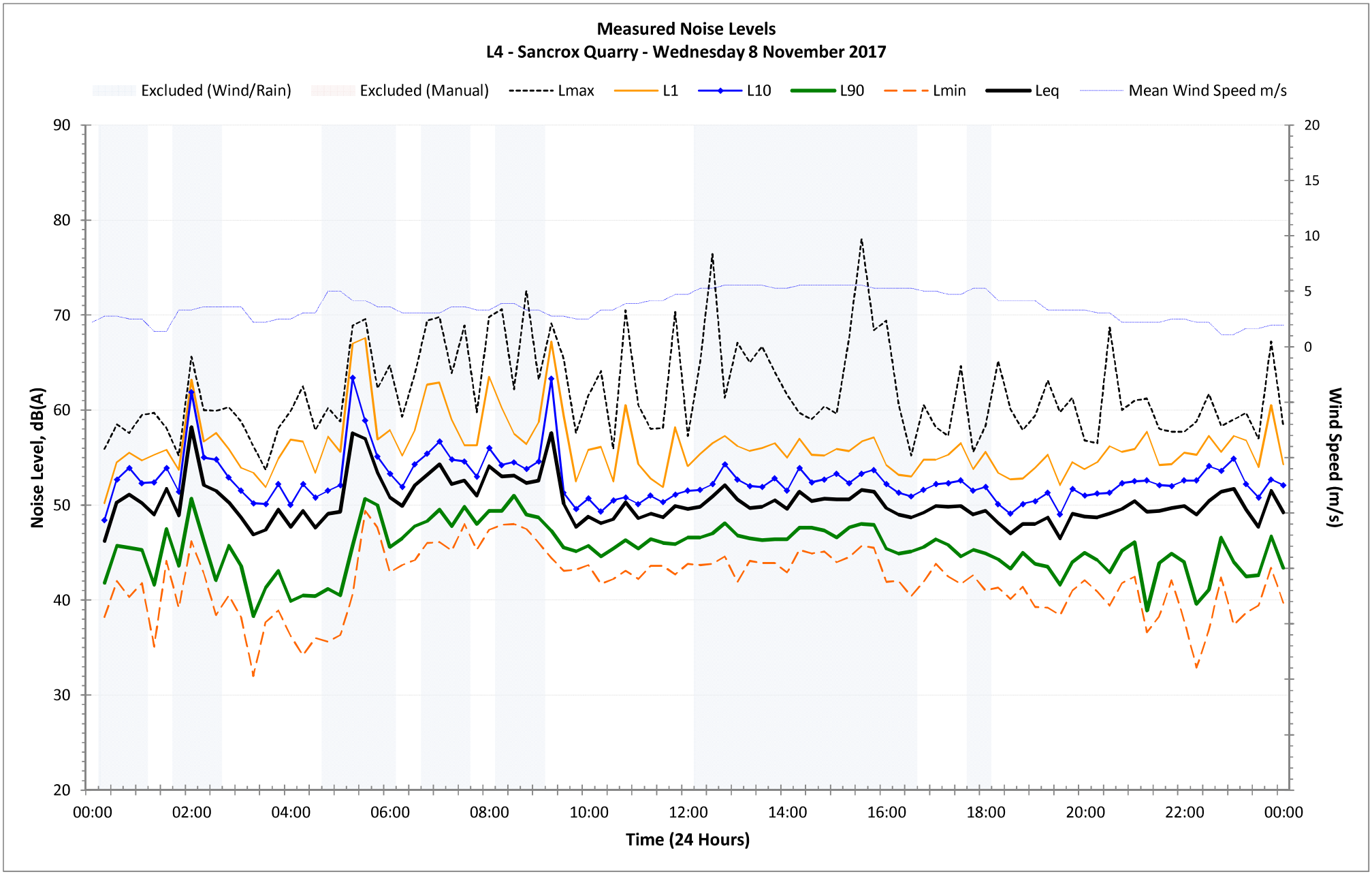

Measured Noise Levels
L3 - Sancrox Quarry - Sunday 19 November 2017
Excluded (Wind/Rain)
Excluded (Manual)
Lmax
L1
L10
L90
Lmin
Leq
Mean Wind Speed m/s
Noise Level, dB(A)
Wind Speed (m/s)
Time (24 Hours)
90
80
70
60
50
40
30
20
20
15
10
5
0
00:00
02:00
04:00
06:00
08:00
10:00
12:00
14:00
16:00
18:00
20:00
22:00
00:00

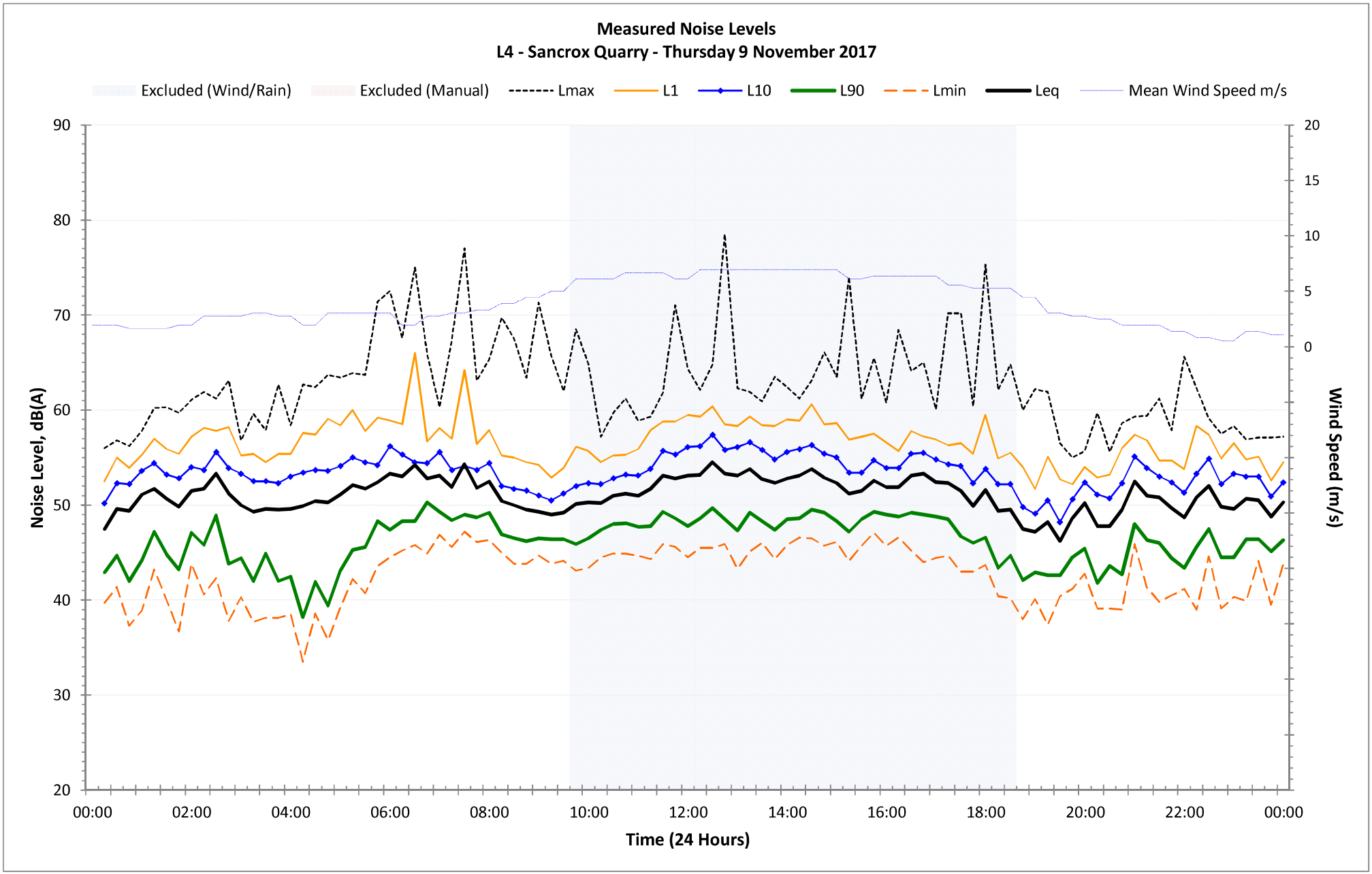

Measured Noise Levels
L3 - Sancrox Quarry - Monday 20 November 2017
Excluded (Wind/Rain)
Excluded (Manual)
Lmax
L1
L10
L90
Lmin
Leq
Mean Wind Speed m/s
Noise Level, dB(A)
Wind Speed (m/s)
Time (24 Hours)
90
80
70
60
50
40
30
20
20
15
10
5
0
00:00
02:00
04:00
06:00
08:00
10:00
12:00
14:00
16:00
18:00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

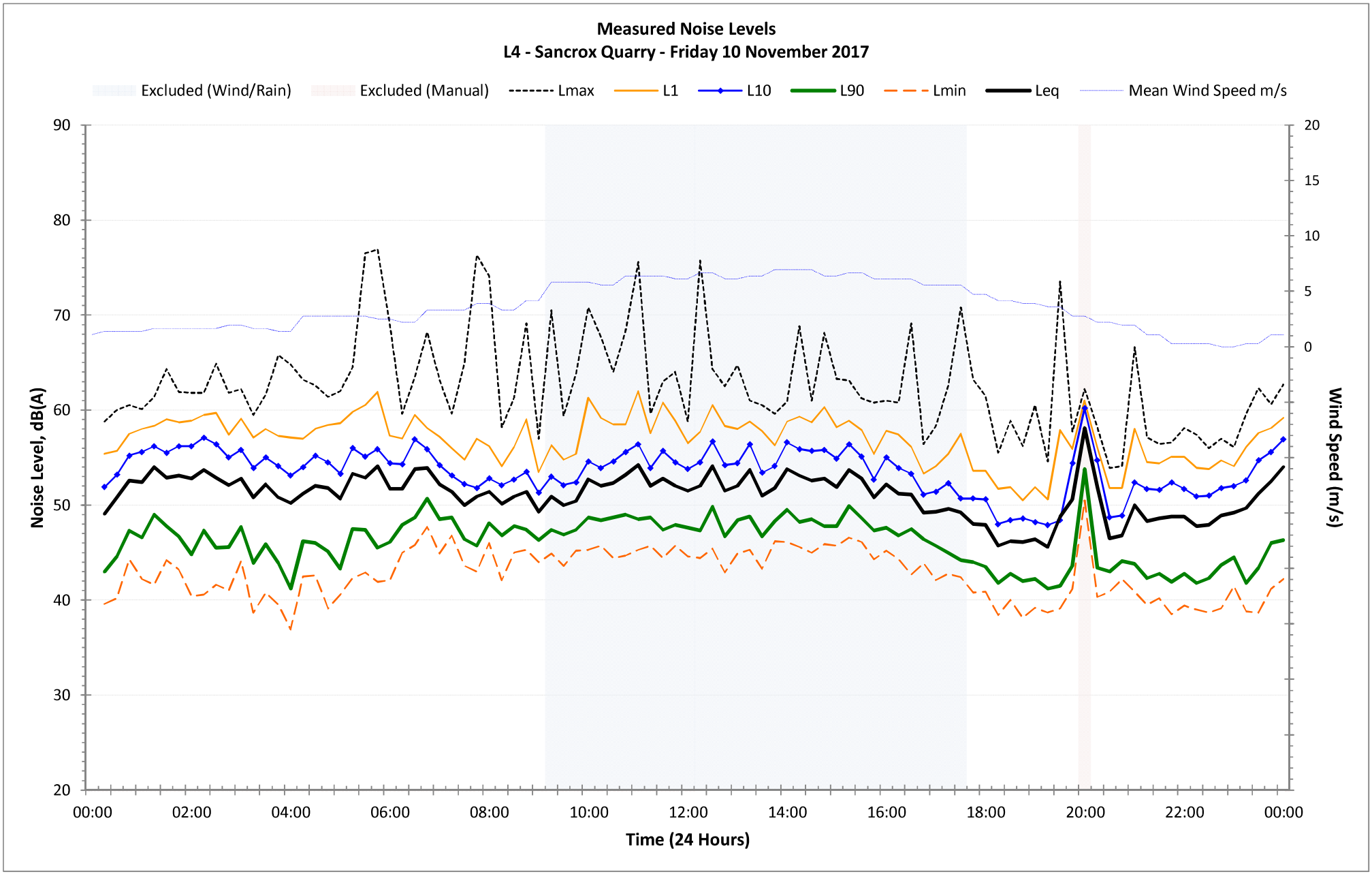

Measured Noise Levels
L3 - Sancrox Quarry - Tuesday 21 November 2017
Excluded (Wind/Rain)
Excluded (Manual)
Lmax
L1
L10
L90
Lmin
Leq
Mean Wind Speed m/s
Noise Level, dB(A)
Wind Speed (m/s)
Time (24 Hours)
90
80
70
60
50
40
30
20
20
15
10
5
0
00:00
02:00
04:00
06:00
08:00
10:00
12:00
14:00
16:00
18:00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

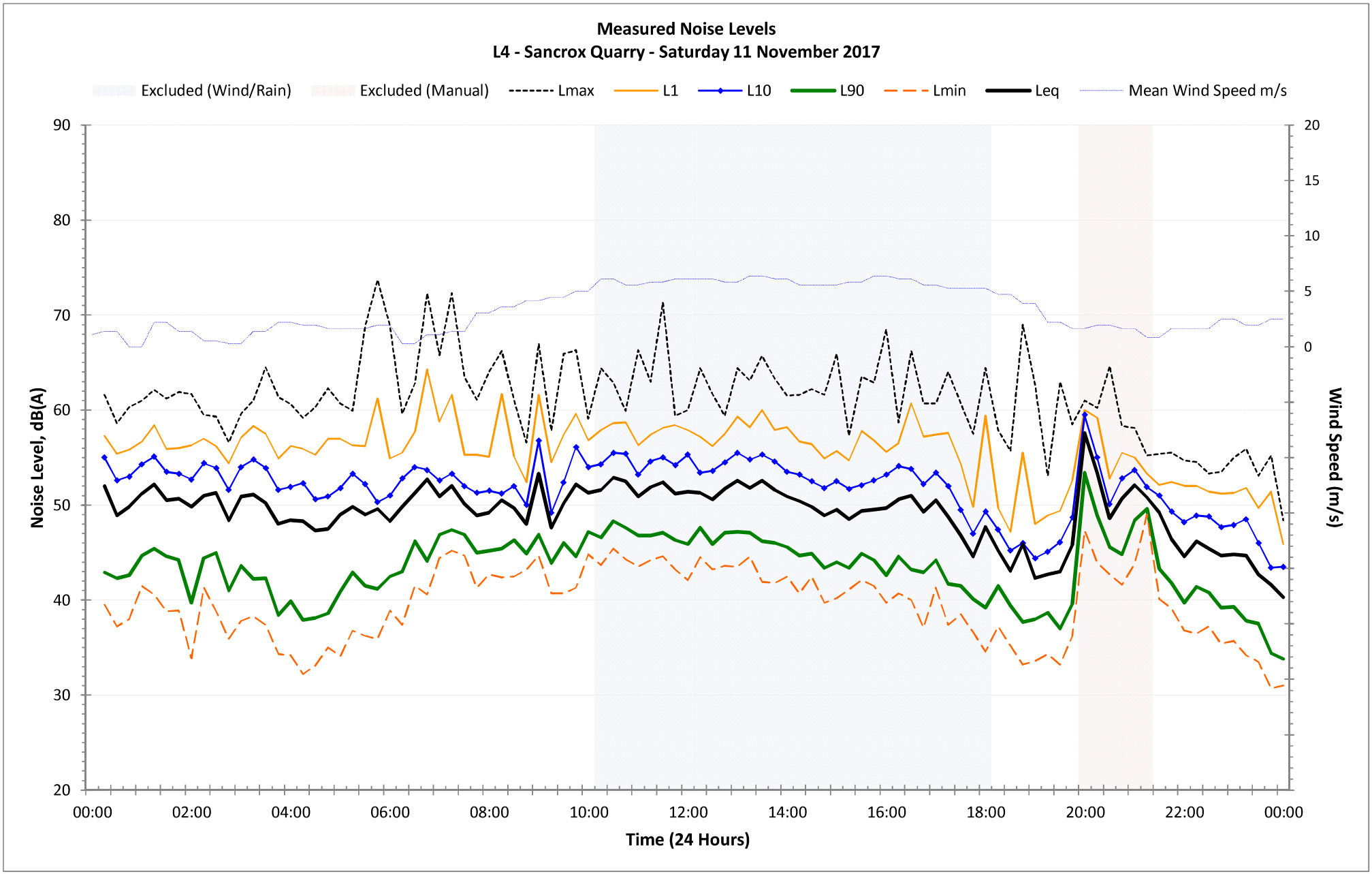

Measured Noise Levels
L4 - Sancrox Quarry - Monday 6 November 2017
Excluded (Wind/Rain)
Excluded (Manual)
Lmax
L1
L10
L90
Lmin
Leq
Mean Wind Speed m/s
Noise Level, dB(A)
Wind Speed (m/s)
Time (24 Hours)
90
80
70
60
50
40
30
20
20
15
10
5
0
00:00
02:00
04:00
06:00
08:00
10:00
12:00
14:00
16:00
18:00
20:00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

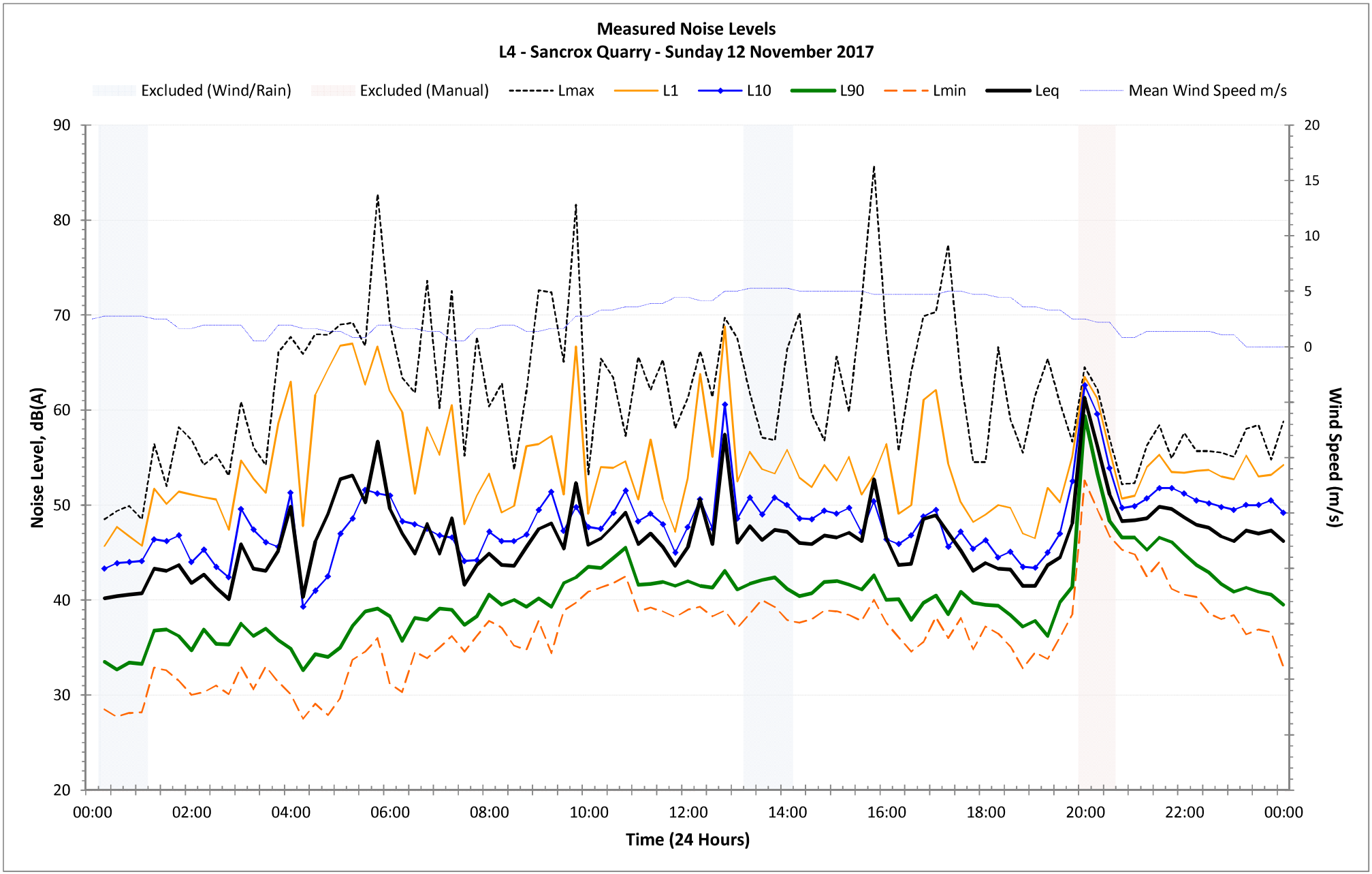

Measured Noise Levels
L4 - Sancrox Quarry - Tuesday 7 November 2017
Excluded (Wind/Rain)
Excluded (Manual)
Lmax
L1
L10
L90
Lmin
Leq
Mean Wind Speed m/s
Noise Level, dB(A)
Wind Speed (m/s)
Time (24 Hours)
90
80
70
60
50
40
30
20
20
15
10
5
0
00:00
02:00
04:00
06:00
08:00
10:00
12:00
14:00
16:00
18:00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

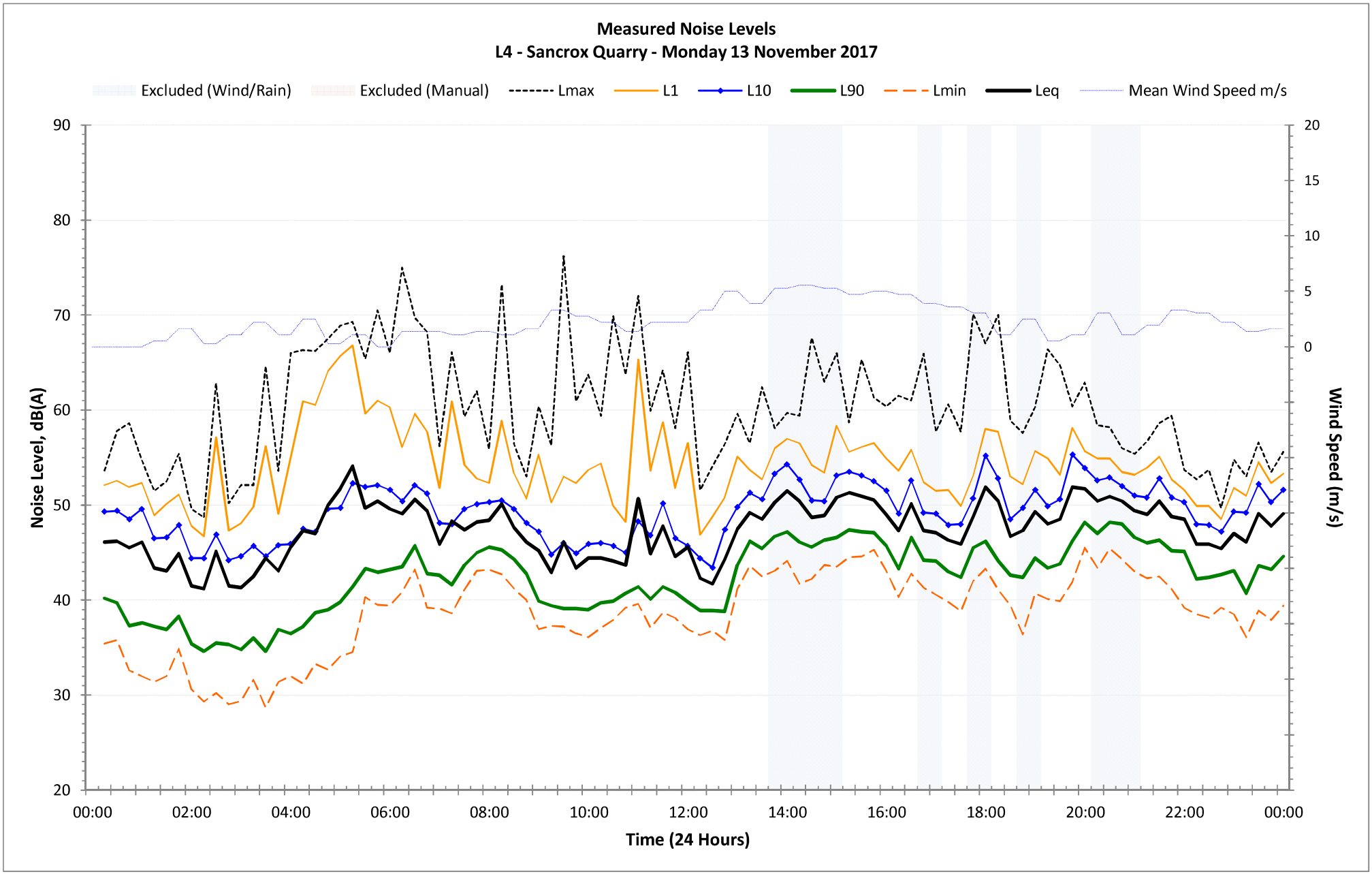

Measured Noise Levels
L4 - Sancrox Quarry - Wednesday 8 November 2017
Excluded (Wind/Rain)
Excluded (Manual)
Lmax
L1
L10
L90
Lmin
Leq
Mean Wind Speed m/s
Noise Level, dB(A)
Wind Speed (m/s)
Time (24 Hours)
90
80
70
60
50
40
30
20
20
15
10
5
0
00:00
02:00
04:00
06:00
08:00
10:00
12:00
14:00
16:00
18:00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

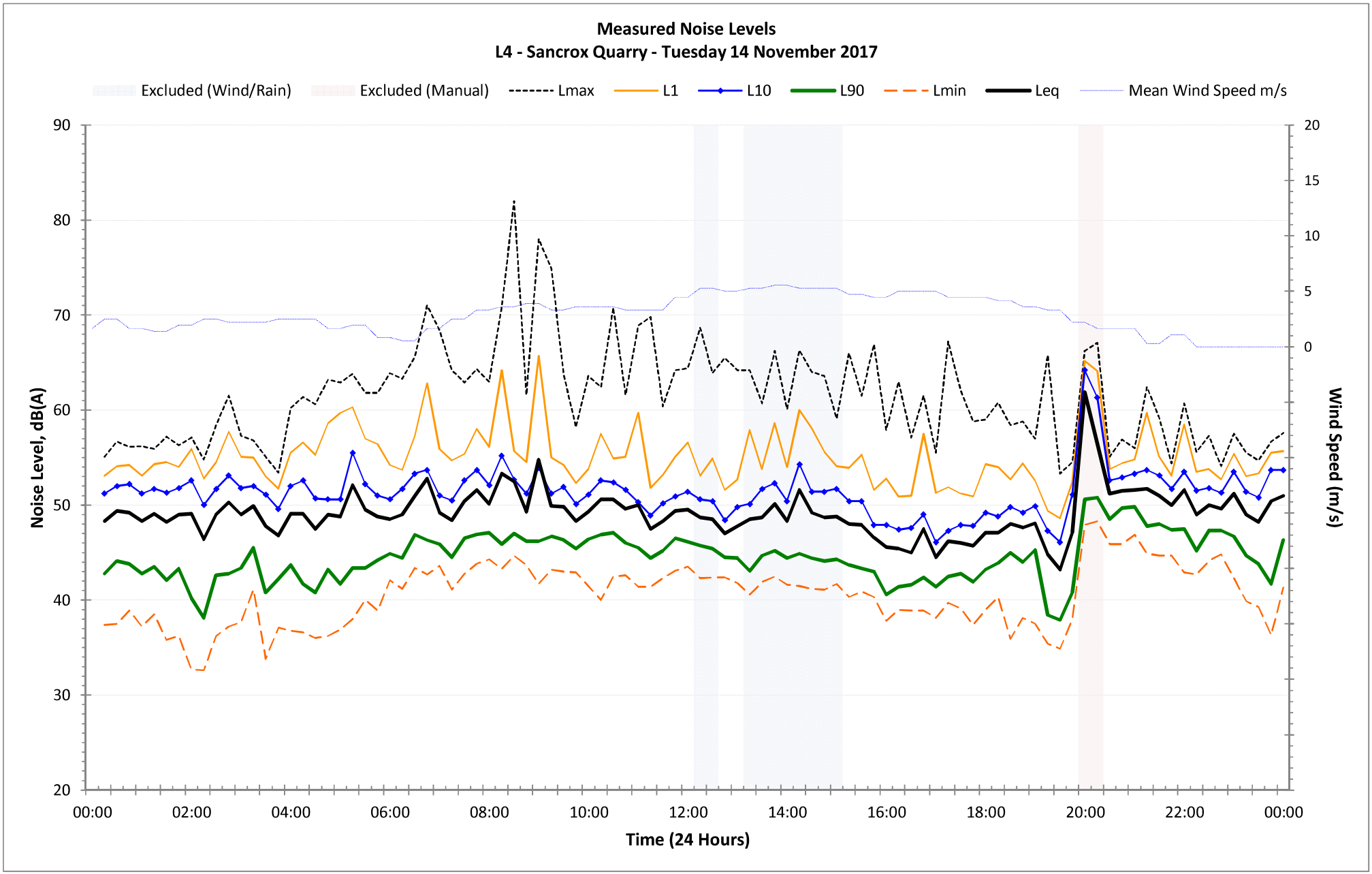

Measured Noise Levels
L4 - Sancrox Quarry - Thursday 9 November 2017
Excluded (Wind/Rain)
Excluded (Manual)
Lmax
L1
L10
L90
Lmin
Leq
Mean Wind Speed m/s
Noise Level, dB(A)
Wind Speed (m/s)
Time (24 Hours)
90
80
70
60
50
40
30
20
20
15
10
5
0
00:00
02:00
04:00
06:00
08:00
10:00
12:00
14:00
16:00
18:00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

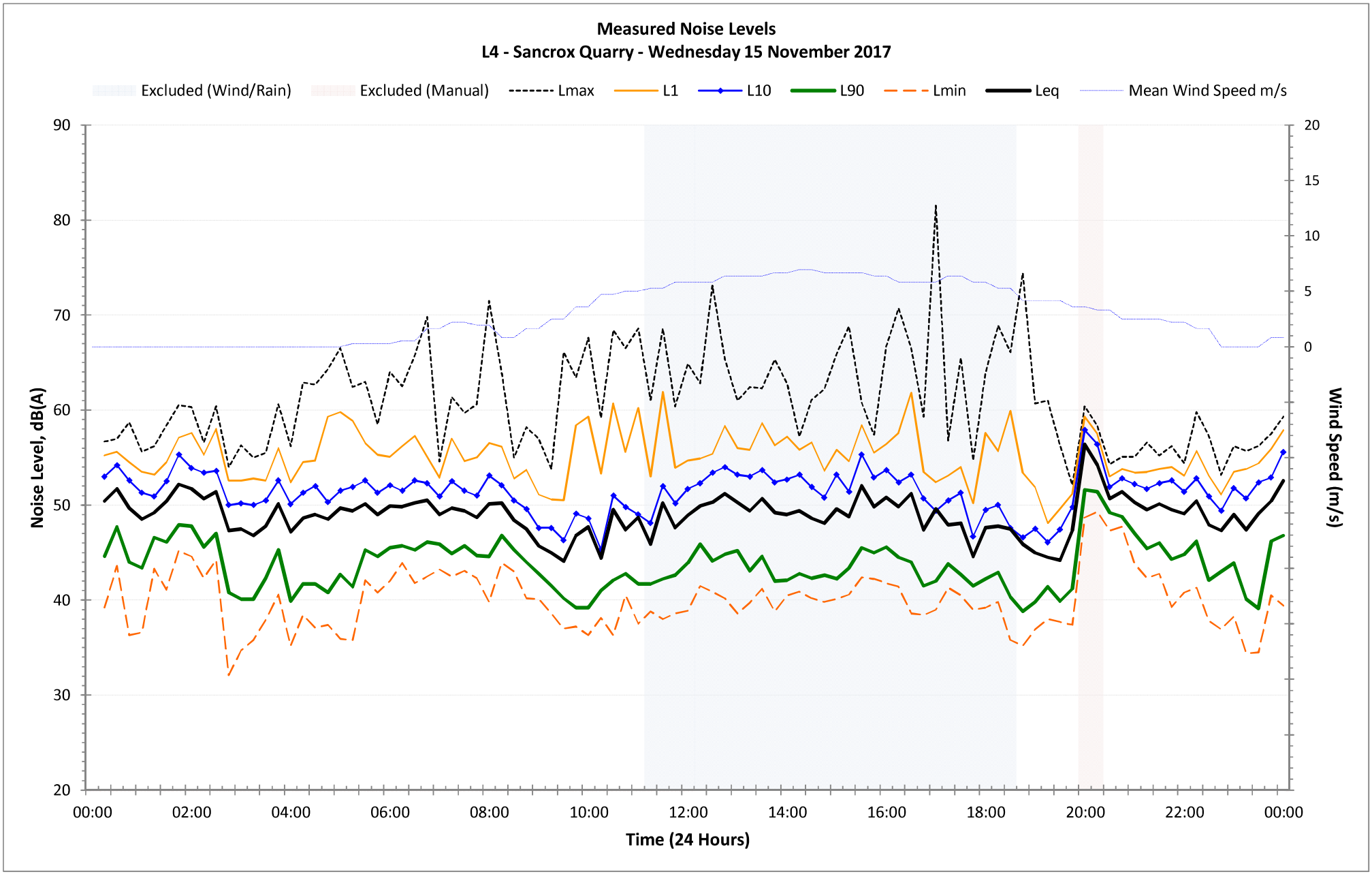

Measured Noise Levels
L4 - Sancrox Quarry - Friday 10 November 2017
Excluded (Wind/Rain)
Excluded (Manual)
Lmax
L1
L10
L90
Lmin
Leq
Mean Wind Speed m/s
Noise Level, dB(A)
Wind Speed (m/s)
Time (24 Hours)
90
80
70
60
50
40
30
20
20
15
10
5
0
00:00
02:00
04:00
06:00
08:00
10:00
12:00
14:00
16:00
18:00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

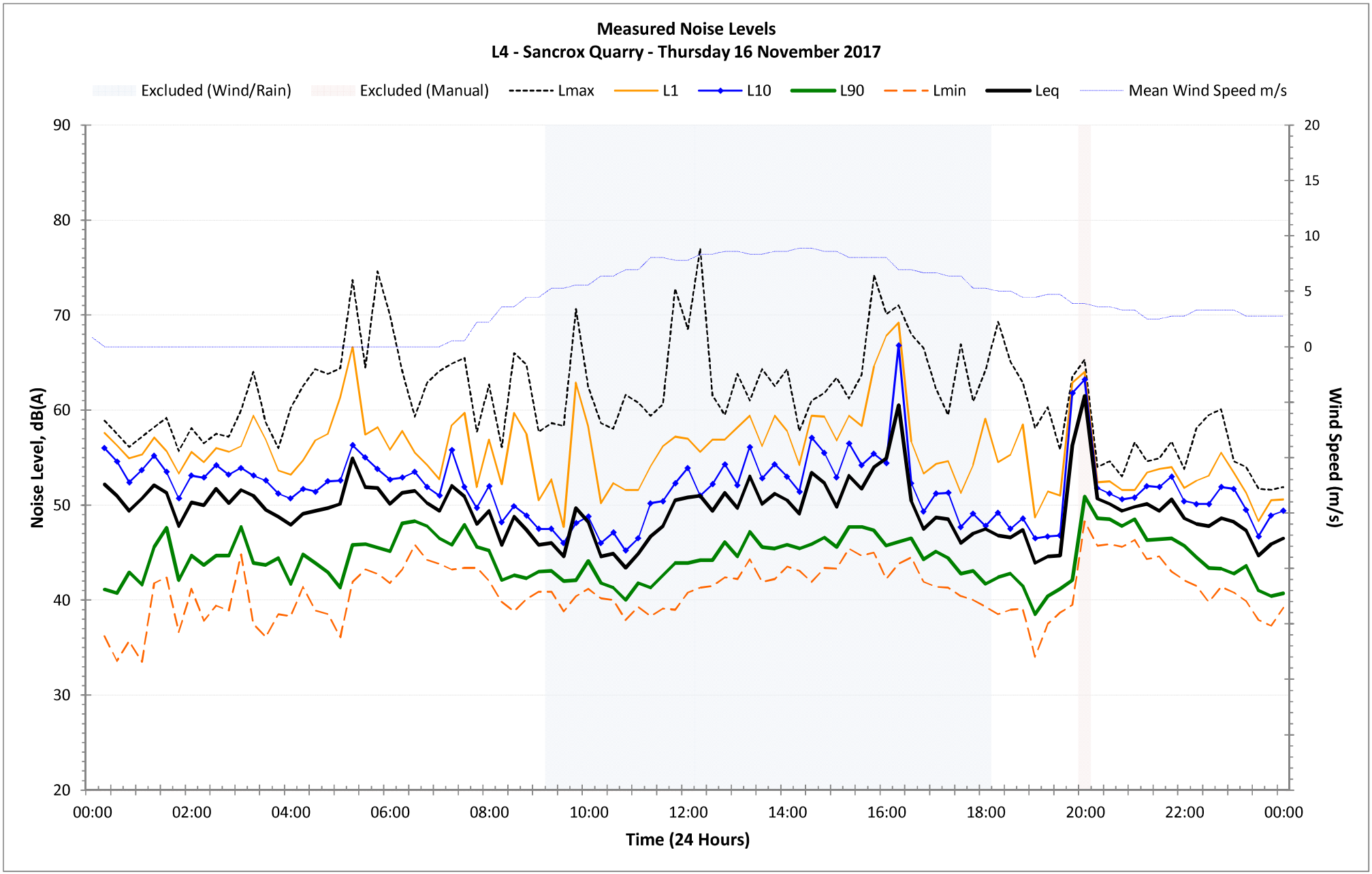

Measured Noise Levels
L4 - Sancrox Quarry - Saturday 11 November 2017
Excluded (Wind/Rain)
Excluded (Manual)
Lmax
L1
L10
L90
Lmin
Leq
Mean Wind Speed m/s
Noise Level, dB(A)
Wind Speed (m/s)
Time (24 Hours)
90
80
70
60
50
40
30
20
20
15
10
5
0
00:00
02:00
04:00
06:00
08:00
10:00
12:00
14:00
16:00
18:00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

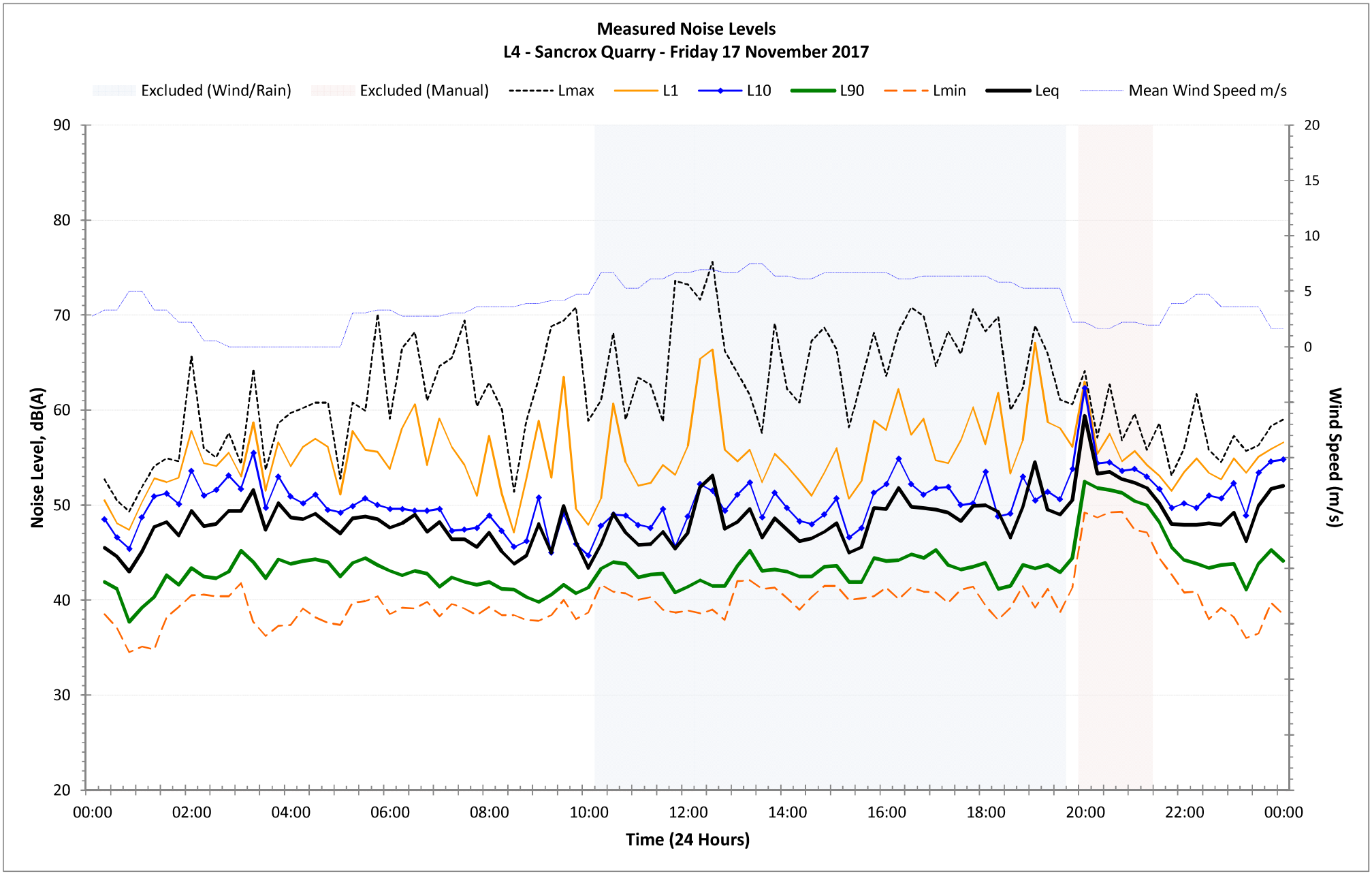

Measured Noise Levels
L4 - Sancrox Quarry - Sunday 12 November 2017
Excluded (Wind/Rain)
Excluded (Manual)
Lmax
L1
L10
L90
Lmin
Leq
Mean Wind Speed m/s
Noise Level, dB(A)
Wind Speed (m/s)
Time (24 Hours)
90
80
70
60
50
40
30
20
20
15
10
5
0
00:00
02:00
04:00
06:00
08:00
10:00
12:00
14:00
16:00
18:00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

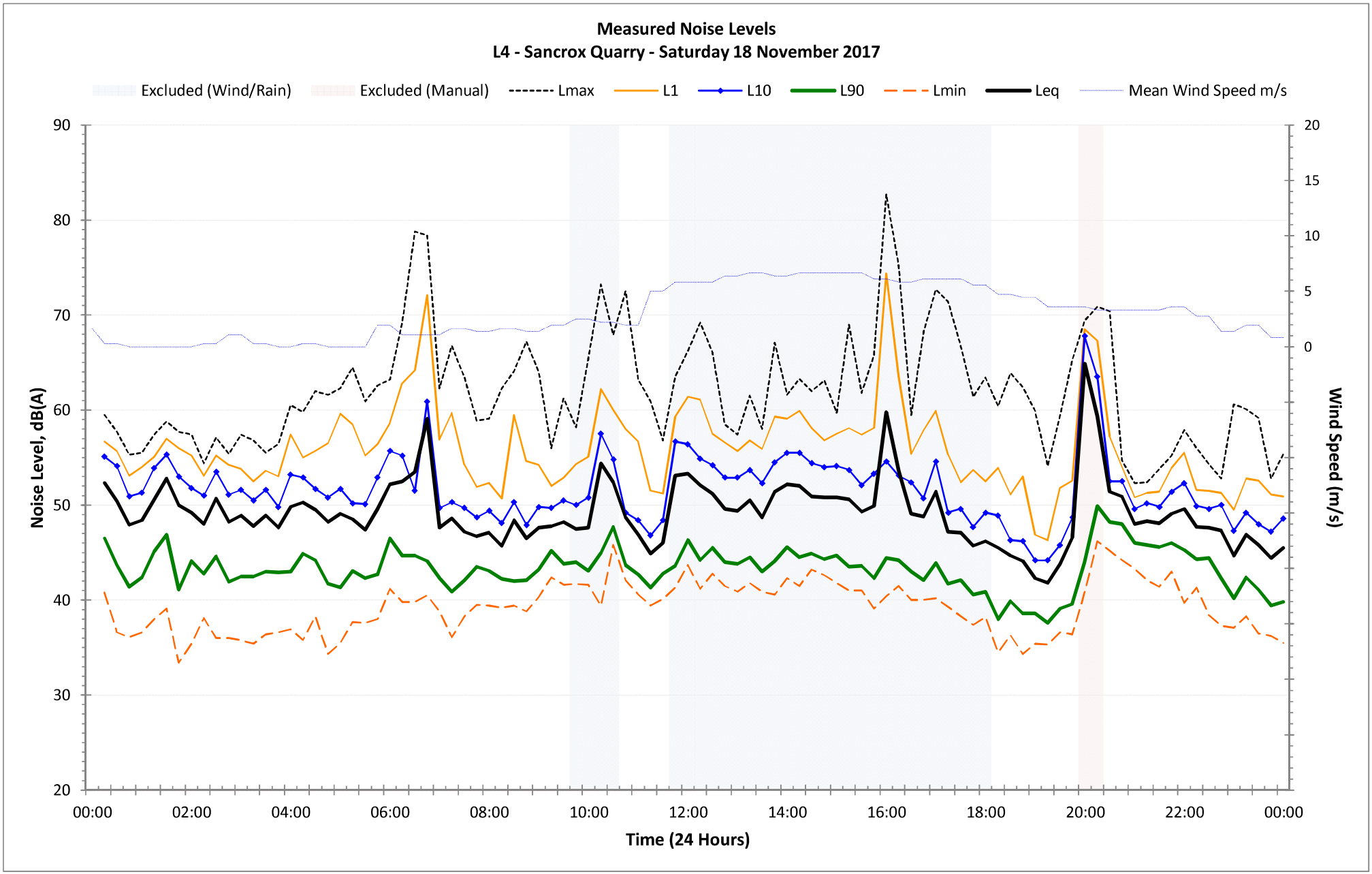

Measured Noise Levels
L4 - Sancrox Quarry - Monday 13 November 2017
Excluded (Wind/Rain)
Excluded (Manual)
Lmax
L1
L10
L90
Lmin
Leq
Mean Wind Speed m/s
Noise Level, dB(A)
Wind Speed (m/s)
Time (24 Hours)
90
80
70
60
50
40
30
20
20
15
10
5
0
00:00
02:00
04:00
06:00
08:00
10:00
12:00
14:00
16:00
18:00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

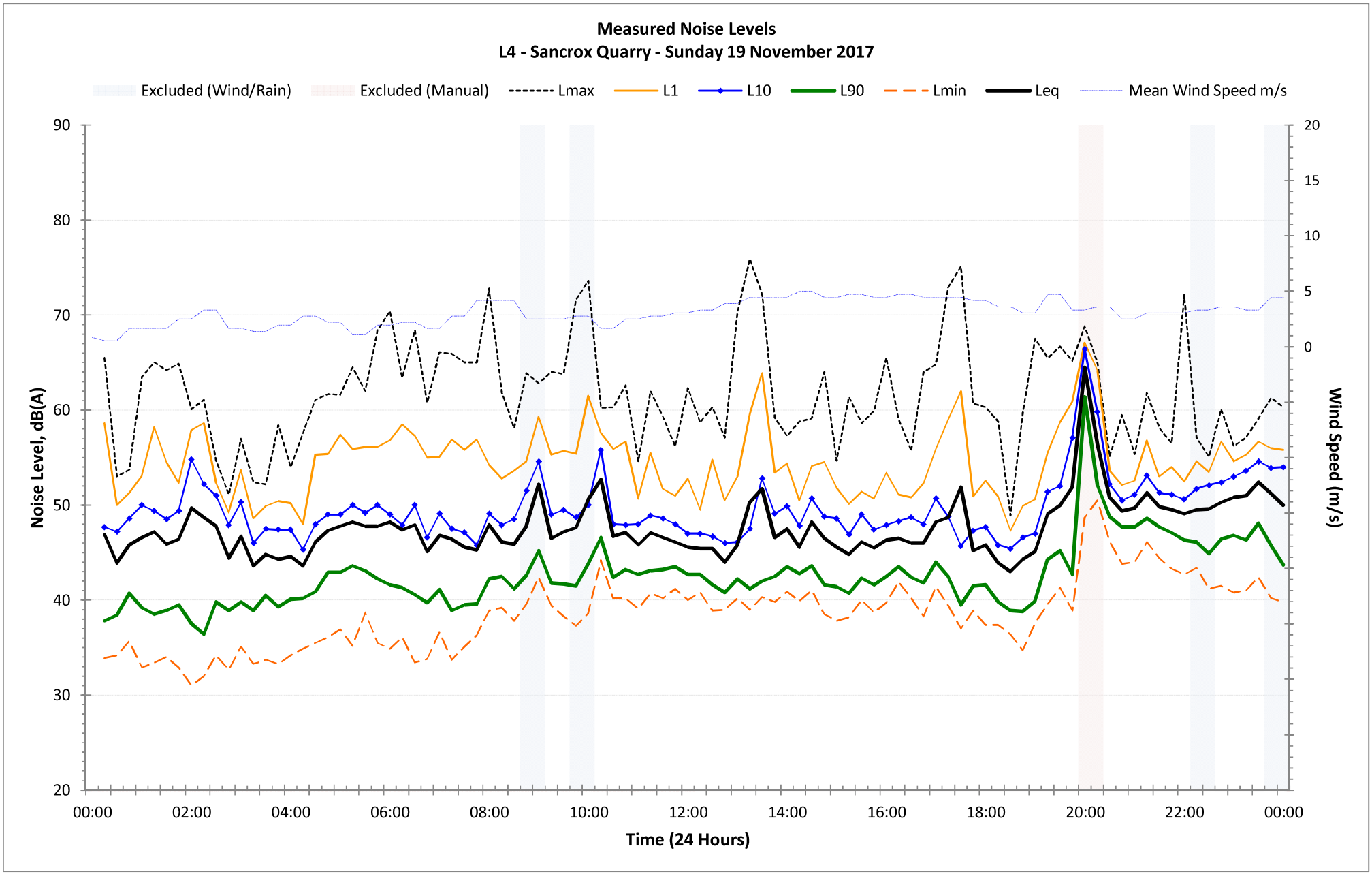

Measured Noise Levels
L4 - Sancrox Quarry - Tuesday 14 November 2017
Excluded (Wind/Rain)
Excluded (Manual)
Lmax
L1
L10
L90
Lmin
Leq
Mean Wind Speed m/s
Noise Level, dB(A)
Wind Speed (m/s)
Time (24 Hours)
90
80
70
60
50
40
30
20
20
15
10
5
0
00:00
02:00
04:00
06:00
08:00
10:00
12:00
14:00
16:00
18:00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

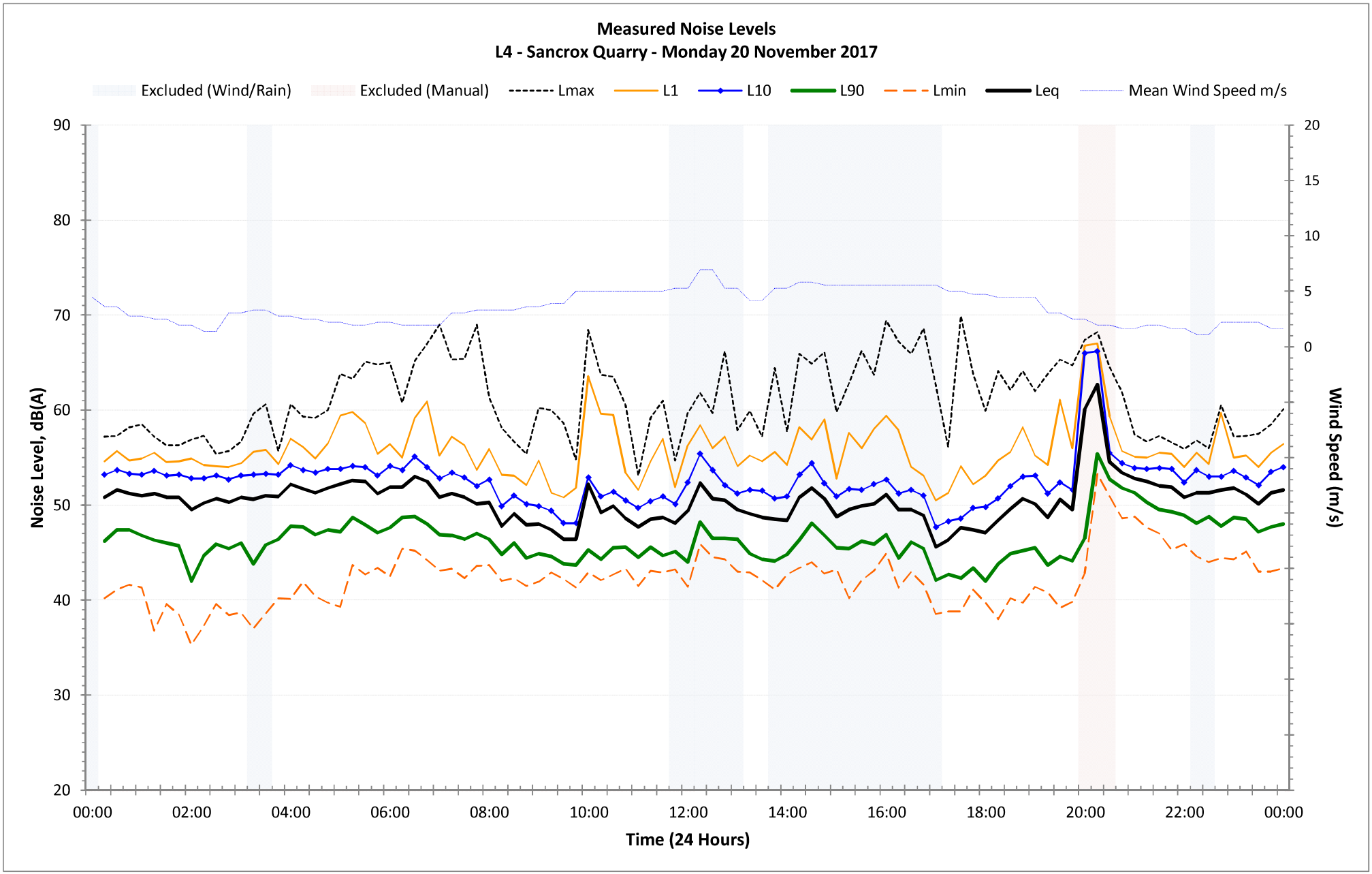

Measured Noise Levels
L4 - Sancrox Quarry - Wednesday 15 November 2017
Excluded (Wind/Rain)
Excluded (Manual)
Lmax
L1
L10
L90
Lmin
Leq
Mean Wind Speed m/s
Noise Level, dB(A)
Wind Speed (m/s)
Time (24 Hours)
90
80
70
60
50
40
30
20
20
15
10
5
0
00:00
02:00
04:00
06:00
08:00
10:00
12:00
14:00
16:00
18:00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

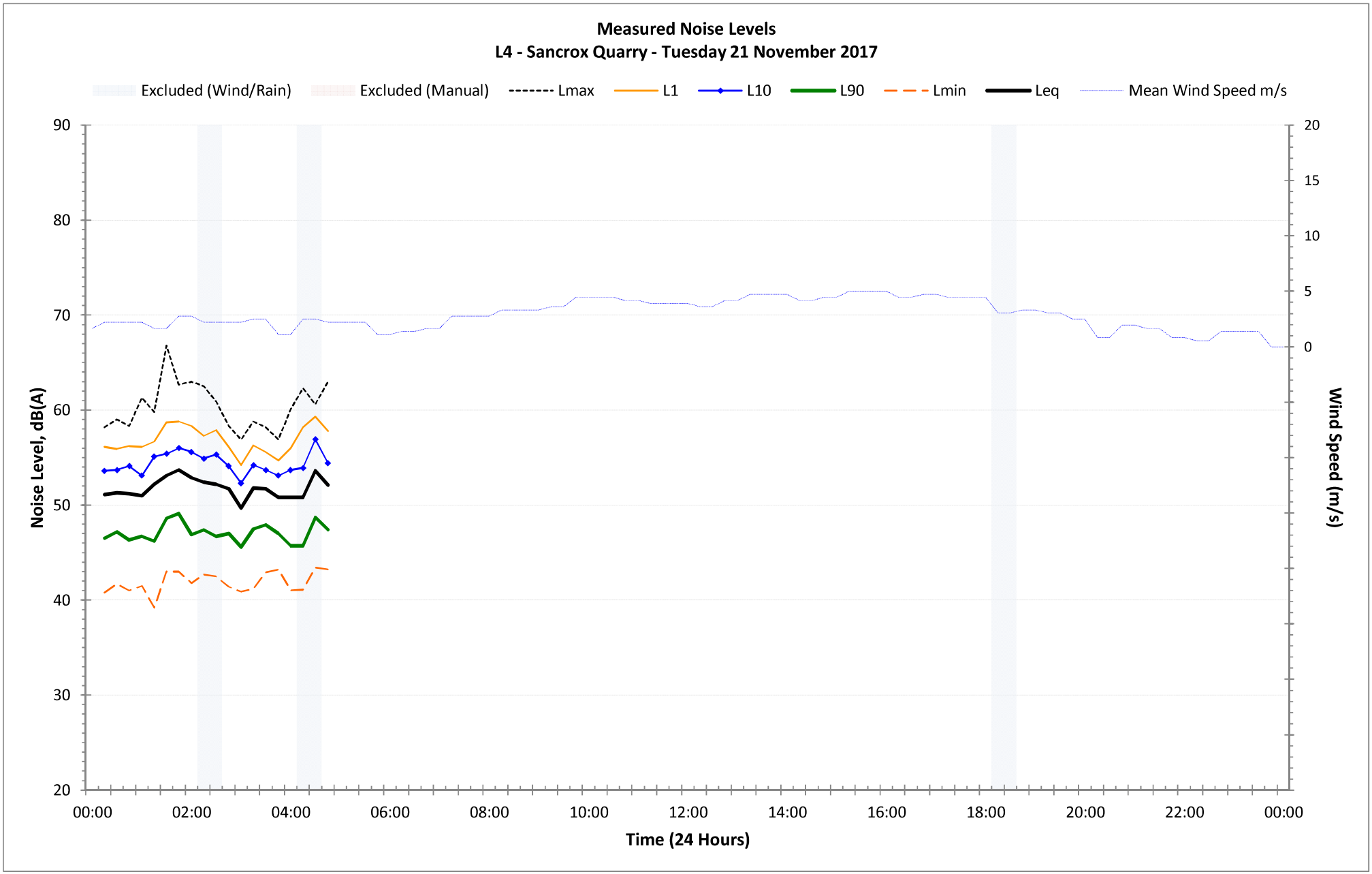

Measured Noise Levels
L4 - Sancrox Quarry - Thursday 16 November 2017
Excluded (Wind/Rain)
Excluded (Manual)
Lmax
L1
L10
L90
Lmin
Leq
Mean Wind Speed m/s
Noise Level, dB(A)
Wind Speed (m/s)
Time (24 Hours)
90
80
70
60
50
40
30
20
20
15
10
5
0
00:00
02:00
04:00
06:00
08:00
10:00
12:00
14:00
16:00
18:00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


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.

ERM has over 160 offices across the following countries and territories worldwide

Argentina
Australia
Belgium
Brazil
Canada
Chile
China
Colombia
France
Germany
Hong Kong
India
Indonesia
Ireland
Italy
Japan
Kazakhstan
Kenya
Malaysia
Mexico
Mozambique
Myanmar
The Netherlands
New Zealand
Norway
Panama
Peru
Poland
Portugal
Puerto Rico
Romania
Russia
Singapore
South Africa
South Korea
Spain
Sweden
Switzerland
Taiwan
Thailand
UAE
UK
US
Vietnam

ERM's Sydney Office
Level 15, 309 Kent Street
Sydney NSW 2000 Australia

Telephone +61 2 8584 8888
Facsimile +61 2 9299 7502

www.erm.com

The business of sustainability

ERM

Appendix F

Revised Air Quality Assessment Report

Air Quality Assessment Report

Sancrox Quarry Expansion Project

2 December 2020

Project No.: 0418291

The business of sustainability

Document details	
Document title	Air Quality Assessment Report
Document subtitle	Sancrox Quarry Expansion Project
Project No.	0418291
Date	2 December 2020
Version	Revision 1.0
Author	Justine Firth
Client Name	Hanson Construction Materials Pty Ltd

Document history

				ERM approval to issue		
Version	Revision	Author	Reviewed by	Name	Date	Comments
Revision	01	J. Firth	D. Roddis	D. Roddis	17.09.20	Revision responding to EPA submissions
Final	01	J. Firth	D. Roddis	D. Roddis	02.12.2020	Incorporation of client comments

Signature Page

2 December 2020

Air Quality Assessment Report

Sancrox Quarry Expansion Project

Justine Firth	Damon Roddis
Senior Air Quality Consultant	Partner

Environmental Resources Management Australia Pty Ltd

Level 15, 309 Kent Street

Sydney NSW 2000

© Copyright 2020 by ERM Worldwide Group Ltd and/or its affiliates ("ERM").
All rights reserved. No part of this work may be reproduced or transmitted in any form, or by any means, without the prior written permission of ERM.

CONTENTS

EXECUTIVE SUMMARY I

1. INTRODUCTION 1
   1.1 Background 1
   1.2 Secretary Environmental Assessment Requirements (SEARS) 1
   1.3 Scope of Works 2

2. SITE AND PROCESS DESCRIPTION 3
   2.1 Site Location 3
      2.1.1 Site Layout 3
      2.1.2 Sensitive Receptors 7
   2.2 Process Description 10
      2.2.1 Quarry Operations 10
      2.2.2 Concrete Recycling Plant 10
      2.2.3 Concrete Batching Plant 10
      2.2.4 Asphalt Plant 10

3. LEGISLATION AND GUIDELINES 11
   3.1 Air Quality 11
      3.1.1 POEO Clean Air Regulation 2010 11
      3.1.2 Approved Methods for the Assessment of Air Pollutants in NSW 12
      3.1.3 Other Legislation 14
      3.1.4 Protocol for Environmental Management Mining and Extractive Industries 14

4. EXISTING ENVIRONMENT 15
   4.1 General Meteorological Conditions 15
   4.2 Climate 15
   4.3 Typical Wind Conditions 15
   4.4 Atmospheric Stability 18
   4.5 Existing Ambient Air Quality 18
      4.5.1 Particulate Matter 19
      4.5.2 Total Suspended Particulate 21
      4.5.3 Dust Deposition 21
      4.5.4 Nitrogen Dioxide 21

5. ATMOSPHERIC EMISSIONS INVENTORY 22
   5.1 Particle size categories 22
   5.2 Particulate matter emissions 22
   5.3 Other emissions 25
   5.4 Screening Assessment 27

6. DISPERSION MODELLING ASSESSMENT 28
   6.1 Modelling Methodology 28
   6.2 Metrological Modelling 28
      6.2.1 TAPM 28
      6.2.2 CALMET 28
   6.3 Dispersion Model Receptors 30
   6.4 Emission Parameters 30
      6.4.1 Respirable Crystalline Silica 30
      6.4.2 Odour 30

7. MODELLING RESULTS 31
   7.1 Introduction 31
   7.2 Predicted PM_{10} Concentrations 31
   7.3 Predicted $PM_{2.5}$ Concentrations 33
   7.4 Predicted Concentrations for all Other Species 35

8. MITIGATION MEASURES 40
9. MONITORING AND MANAGEMENT MEASURES 41
10. CONCLUSIONS 44
11. REFERENCES 45
B1 SCREENING ASSESSMENT 1

APPENDIX A AIR QUALITY EMISSION ESTIMATION
APPENDIX B SCREENING ASSESSMENT
APPENDIX C CONTOUR PLOTS

List of Tables

Table 2-1: Modelled specific sensitive receptors surrounding the Site (MGA Zone 55S) 7
Table 3-1: Emission limits for bag filters at the concrete batching plant adopted from the Schedule 3, POEO Clean Air Regulation (New South Wales Government, 2017) 11
Table 3-2: Emission limits for asphalt plant adopted from the Schedule 4, POEO Clean Air Regulation (New South Wales Government, 2017) 12
Table 3-3: Impact Assessment Criteria for particulate matter (NSW DPIE, 2016) 12
Table 3-4: Approved methods criteria for other species considered in this assessment 13
Table 3-5: Acceptable Impact Assessment Criteria for Complex Mixtures of Air Pollutants (OU) for Various Population Sizes 14
Table 3-6: Criteria sourced from Ontario Regulation 419/06 (Government of Ontario, 2017) 14
Table 4-1: Climate Data for Port Macquarie Station obtained from Bureau of Meteorology 16
Table 4-2: Maximum measured 24 hour average and annual mean concentrations for PM_{10} and $PM_{2.5}$ at Port Macquarie 19
Table 4-3: Maximum measured 24 hour average and annual mean concentrations (µg/m^3) for PM_{10} and $PM_{2.5}$, as measured at Wyong for 2012 to 2016 20
Table 4-4: Maximum measured 1 hour average and annual mean NO_2 concentrations NO_2 as measured at Wyong for 2012 to 2016 21
Table 5-1: Estimated TSP, PM_{10} and $PM_{2.5}$ emissions for the Proposed Project 23
Table 5-2: Emission rates for other species considered in this assessment 26
Table 6-1: 29
Table 6-3: Emission source parameters for point sources used in the dispersion modelling 30
Table 7-1: Predicted cumulative PM_{10} concentrations 31
Table 7-2: Level 2 Assessment of PM_{10} at R13 for maximum day, 24-hour operations 33
Table 7-3: Predicted $PM_{2.5}$ concentrations 34
Table 7-4: Predicted concentrations for all species included in the dispersion modelling 36
Table 9-1 Recommendations for the environmental management plan 42

List of Figures

Figure 2-1: Project Location, including Proposed Sealed and Unsealed Roads 4
Figure 2-2: Site layout 5
Figure 2-3: Quarry Staging 6
Figure 2-4: Location of sensitive receptors 9
Figure 4-1: Site-Specific annual wind roses (2012-2016) 17
Figure 4-2: Frequency of Atmospheric Stability Categories predicted for the Site 18
Figure 4-3: Box and whisker plot of Wyong and Port Macquarie annual monitoring data 20

EXECUTIVE SUMMARY

Environmental Resources Management Australia Pty Ltd (ERM) has been commissioned by Hanson Construction Materials Pty Ltd (Hanson) to undertake specialist air quality assessment (AQIA) to inform the Environmental Impact Statement (EIS) for the proposed Sancrox Quarry Extension Project (the 'Proposed Project').

This revised AQIA has been produced to address comments provided by the NSW EPA on the original AQIA as part of regulatory submissions during public exhibition. The AQIA approach, as well as the Proposed Project, has been altered accordingly. The greenhouse gas component of the assessment has not been updated since the original AQIA and as such is not included within this revised document.

The site is located on Lot 2 DP 574308, Lot 353 DP 754434, Lot 1 DP 704890 and Lot 1 DP 720807, Sancrox Road, Sancrox, 8km west of Port Macquarie, within the Port Macquarie Hastings Council (PMHC) Local Government Area (LGA) on the Mid North Coast of New South Wales (NSW).

Current operations at the site primarily include the extraction and crushing of high quality aggregate materials (rhyolite) for concrete and asphalt, sealing aggregates, road bases and select fill to both the private and government sectors. Current extraction rate at the site is 185,000 tonnes per annum (tpa).

The Proposed Project involves the following:

- Extending the approved extraction boundary by approximately 52 hectares;
- Extending the quarry life by ten years (from 20 to 30 years);
- Increasing the annual production limit from 185,000 tpa to 530,000 tpa;
- Introducing a maximum daily limit of 2,600 tonnes per day (tpd);
- Constructing and operating a concrete batching plant producing 20,000m^3 of concrete product per annum;
- Constructing and operating a concrete recycling facility processing 20,000 tpa;
- Typical operations will be between 5am and 10pm;
- Increasing quarry operations to 24 hours per day, 7 days per week for a maximum of 20 days per year;
- Transporting material off-site via public roads; and
- Constructing and operating an asphalt plant producing 50,000 tpa.

This updated AQIA is to accompany the Response to Submission report that includes a revised quarry plan including staging.

The following scope of works has been undertaken:

- Assessment of potential for ambient air quality impacts and greenhouse gas emissions from construction and operation of the Proposed Project;
- Provision of mitigation measures to minimise impacts to the surrounding land use; and
- Recommendations for ambient monitoring to ensure compliance with legislation.

It should be noted that the estimation of GHG emissions from the Project was limited to Scope 1 and Scope 2 emissions. The GHG inventory stated within the original AQIA is anticipated to reduce as a result of the reduced throughput now sought within the Proposed Project.

The primary emissions from the sources considered in this assessment are total suspended particulate (TSP), particulate matter less than 10 and 2.5 micrometres in aerodynamic diameter (PM_{10} and $PM_{2.5}$ respectively) and deposited dust.

Concrete batching and asphalt plants have the potential to emit additional species. All potential species emitted to atmosphere from these sources were identified through consideration of published emission factor databases for these sources.

The criteria for all the emitted species were established through consideration of the following legislation and guidelines:

- POEO Clean Air Regulation 2010 (New South Wales Government, 2017);
- Approved Methods for the Assessment of Air Pollutants in NSW (State of NSW and Environment Protection Authority, 2016);
- National Environment Protection Measures (Australian Government, 2016);
- Other international legislations:
  - Ontario Regulation 419/06: Air Pollution – Local Air Quality (Government of Ontario, 2017);
- Protocol for Environmental Management: Mining and Extractive Industries (Environment Protection Authority Victoria, 2007).

Initially, a screening assessment was undertaken for the species other than particulate matter, using the 'UK Air emissions risk assessment for your environmental permit' guidance (UK Guidance). The species that could not be screened out using the criteria provided in the UK Guidance were further considered through the use of atmospheric dispersion modelling.

Atmospheric dispersion modelling was undertaken using the CALPUFF dispersion model for a representative year (2014). The dispersion modelling was completed using site-specific meteorology predicted using a two-step process:

- Prognostic modelling using TAPM (developed by CSIRO); and
- Diagnostic modelling using CALMET (the meteorological pre-processor for the CALPUFF dispersion model).

The configuration of the emission sources within the CALPUFF dispersion model comprised a combination of volume, point and road sources.

The assessment of ambient air quality impacts identified that:

- The cumulative annual mean concentrations of PM_{10} are below the Approved Methods criterion at all sensitive receptors;
- Contemporaneous analysis identified that the cumulative (background plus Proposed Project contributions) 24-hour average PM_{10} concentrations predict an exceedance of the Approved Methods Criterion at receptor R13 when operating under maximum daily throughput scenario over a 24-hour period. However, when the hours are reduced to operate between 5am and 10pm with the same maximum daily throughput compliance is demonstrated at R13.
- It is anticipated that the probability of meteorological conditions conducive to causing an exceedance at receptor R13 occurring during the proposed 20 days of 24-hour operations is low. It is thus considered that this risk may be mitigated by provision of additional dust management planning and controls prior to 24-hour operations, as documented within the site Air Quality Management Plan.
- The cumulative annual mean concentrations of $PM_{2.5}$ are below the Approved Methods criterion at all sensitive receptors;
- The predicted concentrations for all other species are below the adopted criteria at all sensitive receptor locations.

This assessment considered reasonable and feasible mitigation measures to minimise the emissions from the proposed activities at the site and provided recommendations for ambient monitoring to ensure compliance with legislation.

The following mitigation measures have been included to minimise the emissions from the proposed activities:

- Roads which are likely to remain unchanged throughout the Project stages and to be frequently used by machinery, will be sealed using asphalt and swept daily to minimise wheel-generated dust emissions;
- Full dust extraction system for drilling;
- Utilisation of water sprays during truck rear dumping;
- The use of mobile sprinkler systems during the operation of front end loaders (FELs);
- Dust suppression measures such as water sprays in place at the crushers and screeners;
- Water sprays used on all conveyor transfer points;
- The conveyor loading to be enclosed by a shroud;
- Unsealed haul roads are to apply a dust suppressant;
- Water sprays to be utilised to minimise wind erosion from stockpiles, as required;
- The dry product delivered to the concrete batching, concrete recycling and asphalt plants to be stored in aggregate storage bins enclosed on three sides. The aggregate storage bins to be fitted with water sprays;
- Cement and cement supplement to be delivered to the concrete batching plant and pneumatically fed;
- Concrete batching loading point to be enclosed with all particulate matter emissions generated by the facility captured by one bag filter located above the pan mixer;
- Concrete recycling facility out-loading to be directly to processed material storage bins enclosed on three sides. The recycled concrete storage bins to be fitted with water sprays;
- Vapour balancing system to be installed for the delivery of bitumen at the asphalt plant;
- Asphalt plant will be totally enclosed. All particulate matter emissions generated at the plant will be captured by one fabric filter associated with the natural-gas fired dryer; and
- Vapour recovery system to be employed for transfer of asphalt to trucks.

It is recommended that the Site additionally employs real-time ambient air quality monitoring system. This will allow staff to identify when additional mitigation measures are to be implemented to minimise impact from the onsite activities.

1. INTRODUCTION

1.1 Background

Environmental Resources Management Australia Pty Ltd (ERM) has been commissioned by Hanson Construction Materials Pty Ltd (Hanson) to undertake specialist air quality assessment (AQIA) to inform the Environmental Impact Statement (EIS) for the proposed Sancrox Quarry Extension Project (the 'Proposed Project'). The site is located on Lot 2 DP 574308, Lot 353 DP 754434, Lot 1 DP 704890 and Lot 1 DP 720807, Sancrox Road, Sancrox, 8km west of Port Macquarie, within the Port Macquarie Hastings Council (PMHC) Local Government Area (LGA) on the Mid North Coast of New South Wales (NSW).

Current operations at the site primarily include the extraction and crushing of high quality aggregate materials (rhyolite) for concrete and asphalt, sealing aggregates, road bases and select fill to both the private and government sectors. Current extraction rate at the site is 185,000 tonnes per annum (tpa).

The Proposed Project involves the following:

- Extending the approved extraction boundary by approximately 52 hectares;
- Extending the quarry life by ten years (from 20 to 30 years);
- Increasing the annual production limit from 185,000 tpa to 530,000 tpa;
- Introducing a maximum daily limit of 2,600 tonnes per day (tpd);
- Constructing and operating a concrete batching plant producing 20,000m3 per annum;
- Constructing and operating a concrete recycling facility processing 20,000 tpa;
- Typical operations will be between 5am and 10pm;
- Increasing truck movements and equipment loading to 24 hours per day, 7 days per week for a maximum of 20 days per year;
- Increasing quarry operations to 24 hours per day, 7 days per week for a maximum of 20 days per year;
- Transporting material off-site via public roads; and
- Constructing and operating an asphalt plant producing 50,000 tpa.

This updated AQIA is to accompany the Response to Submission report that includes a revised quarry plan including staging.

1.2 Secretary Environmental Assessment Requirements (SEARS)

This AQIA has been prepared in accordance with the latest version of the Secretary's Environmental Assessment Requirements (SEARs) for the preparation of an EIS for the Sancrox Quarry Extension Project (Department of Planning and Environment, 2017). In relation to air quality the following has been required:

- A detailed assessment of potential construction and operational impacts, in accordance with the Approved Methods for the Modelling and Assessment of Air Pollutants in NSW (State of NSW and Environment Protection Authority, 2016), and with a particular focus on dust emissions including $PM_{2.5}$ and PM_{10}, and having regard to the Voluntary Land Acquisition and Mitigation Policy (NSW Government, 2018);
- An assessment of potential dust and other emissions generated from processing, operational activities and transportation of quarry products;
- Reasonable and feasible mitigation measures to minimise dust and emissions; and

- Monitoring and management measures, in particular, real-time air quality monitoring.

1.3 Scope of Works

To address the SEARs for the preparation of an EIS for the Sancrox Quarry Extension Project (Department of Planning and Environment, 2017), ERM undertook the following scope of works:

- Assessment of potential for ambient air quality impacts and greenhouse gas emissions from construction and operation of the Proposed Project;
- Provision of mitigation measures to minimise impacts to the surrounding land use; and
- Recommendations for ambient monitoring to ensure compliance with legislations.

2. SITE AND PROCESS DESCRIPTION

2.1 Site Location

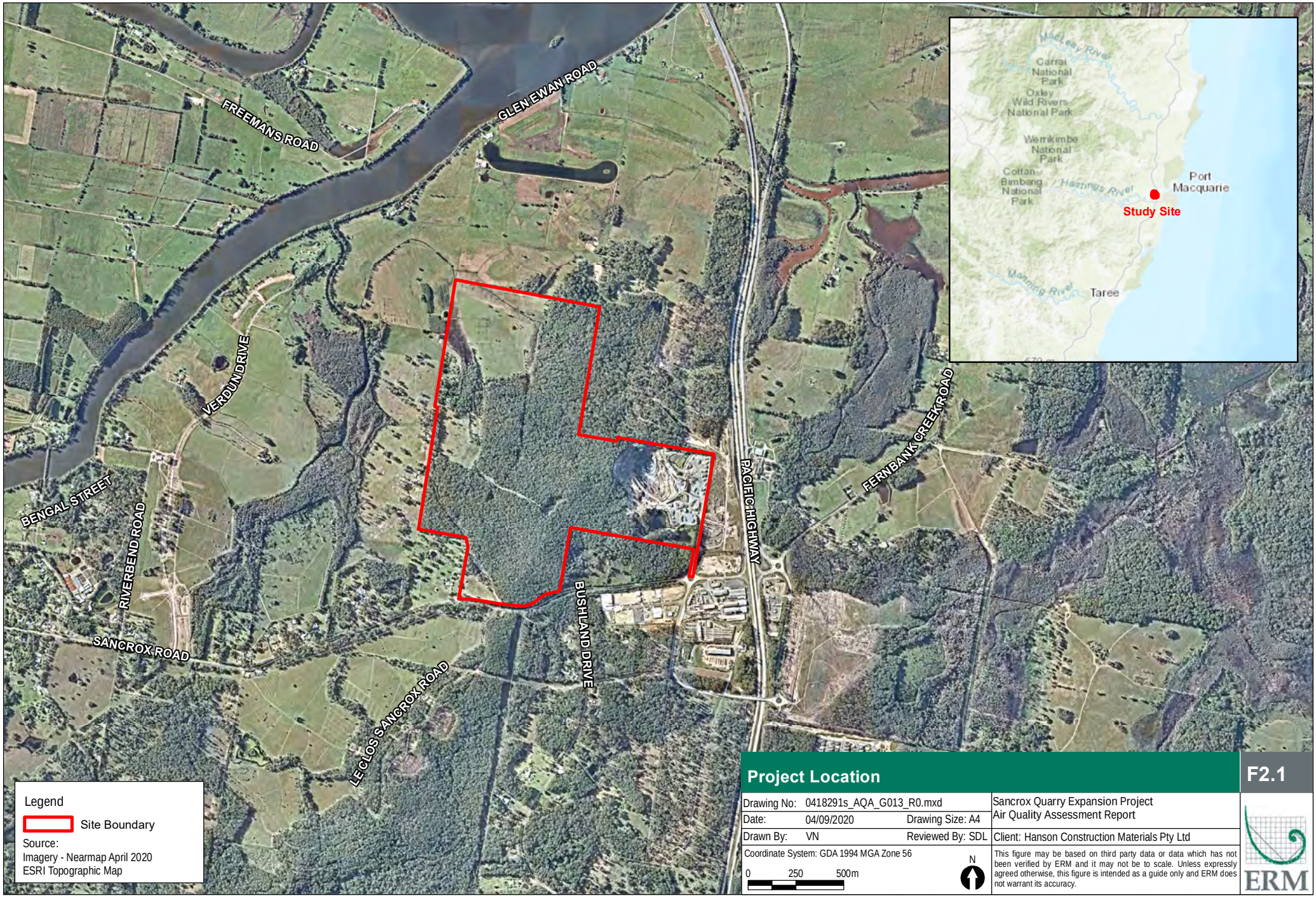
The Proposed Project is located on Sancrox Road, Sancrox, approximately 8km west of Port Macquarie, within the PMHC LGA on the NSW Mid North Coast (refer Figure 2.1) (the site). Access to the site is gained via a sealed road which runs off Sancrox Road located to the southeast of the site. The total area of the Project is approximately 52 hectares. The closest residences to the site are located approximately 50m to the western boundary and 130 metres to the northern boundary of the Site.

2.1.1 Site Layout

The building west of the main access road serves as the site office and staff amenities block. A workshop and materials storage shed is located next to the site office. The weighbridge is also located on the access road near the site office.

The processing plant is proposed to be relocated approximately 300 metres south-west of the current location. A new stockpile area is proposed to be located to the west of the new processing plant location. A concrete recycling facility is proposed to be located immediately west of the new processing plant location and immediately east of the new stockpile area. Concrete batching facility is proposed to be located to the north of the old processing plant location, and asphalt plant is proposed to be located to the east of the new processing plant location.

It is proposed that roads which are likely to remain unchanged throughout the stages of the Project and to be frequently used by machinery, are sealed using asphalt and swept daily to minimise wheel-generated dust emissions. Figure 2-2 presents the site layout and both sealed and unsealed roads. Figure 2-3 shows the Quarry staging over the operational period.

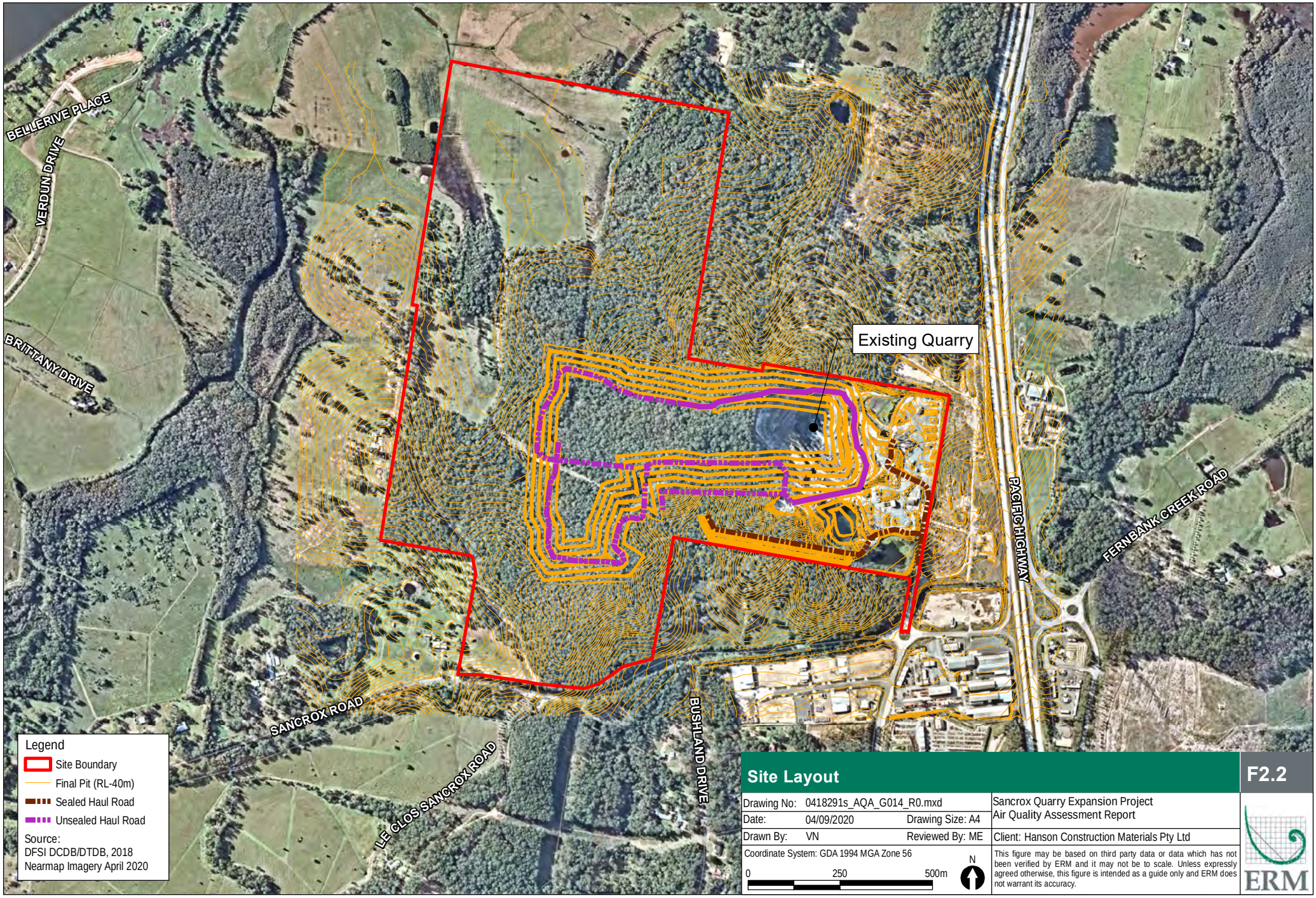


Project Location

F2.1

Drawing No:	0418291s_AQA_G013_R0.mxd		Sancrox Quarry Expansion Project Air Quality Assessment Report
Date:	04/09/2020	Drawing Size: A4	
Drawn By:	VN	Reviewed By: SDL	Client: Hanson Construction Materials Pty Ltd
Coordinate System: GDA 1994 MGA Zone 56			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



Site Layout

F2.2

Drawing No: 0418291s_AQA_G014_R0.mxd		Sancrox Quarry Expansion Project Air Quality Assessment Report
Date: 04/09/2020	Drawing Size: A4	
Drawn By: VN	Reviewed By: ME	Client: Hanson Construction Materials Pty Ltd
Coordinate System: GDA 1994 MGA Zone 56		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 2.3

Drawing No: 0418291s_AQA_G012_R1.mxd		Sancrox Quarry Expansion Project Air Quality Assessment Report
Date: 04/09/2020	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

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

2.1.2 Sensitive Receptors

Sensitive receptors are locations where the general population is likely to be exposed to the resultant ground level concentrations from the atmospheric emissions. The Approved Methods defines these as:

> "A location where people are likely to work or reside; this may include a dwelling, school, hospital, office or public recreational area" (State of NSW and Environment Protection Authority, 2016).

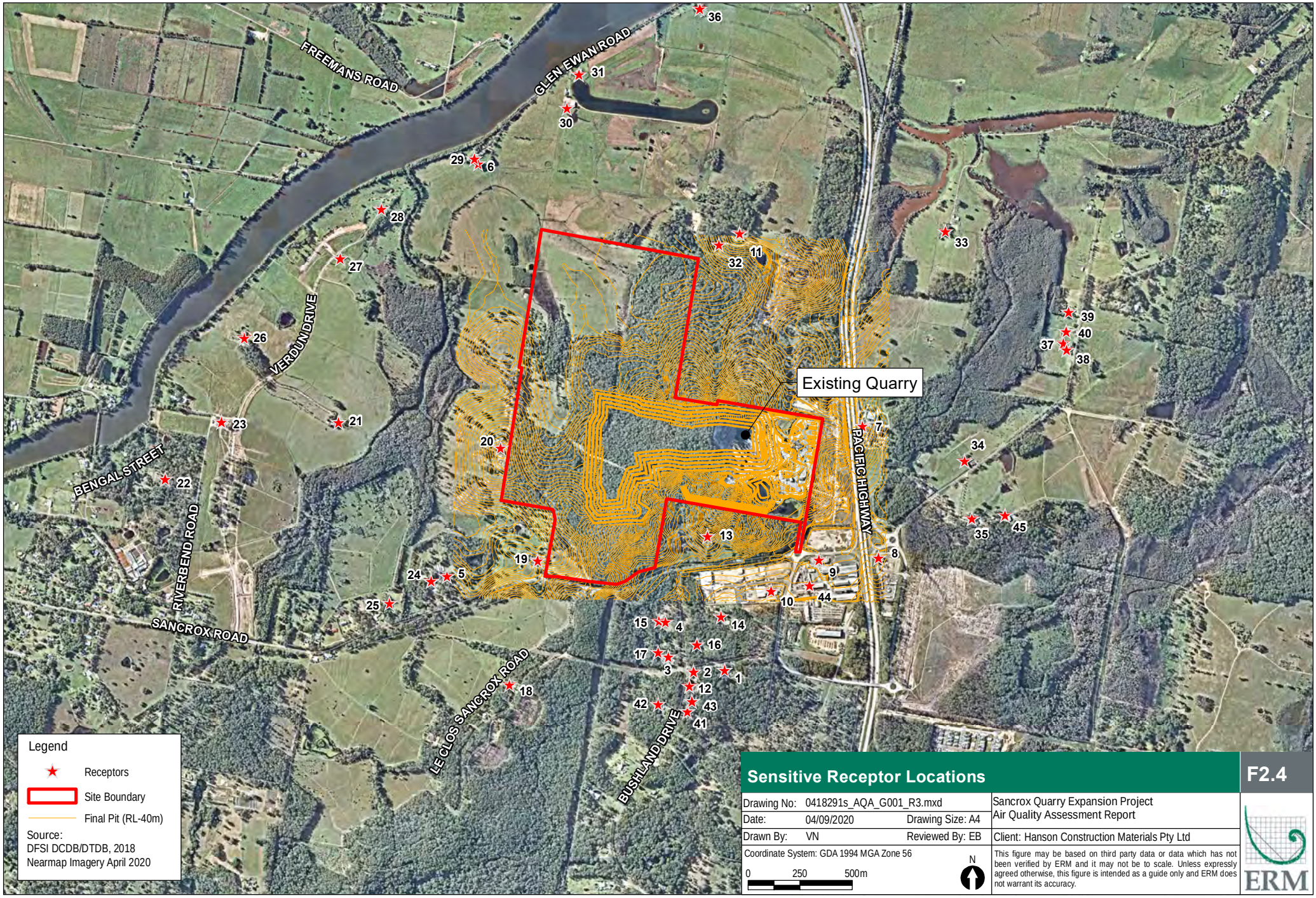
Forty five sensitive receptors have been identified on the basis of proximity to Site from all directions. In addition, the assessment has undertaken atmospheric dispersion modelling over a grid of 12 km by 12 km with a spatial resolution of 150 m. The results on the modelled grid are then interpolated and contoured to provide predicted concentrations for all other sensitive receptors not specifically included in the dispersion model, but within the modelled area. The locations of the specific sensitive receptors included in the model are provided in Table 2-1 and Figure 2-4.

A review of the location of all sensitive receptors was completed to identify if any additional receptors are required to be added to address locations of any future receptors. The spatial distribution of the current 45 receptors is considered to appropriately reflect the existing and potential future sensitive receptors in the vicinity. Potential future sensitive receptors located further afield, in particular to the southeast, than the existing sensitive receptor list are anticipated to be exposed to reduced air quality impacts compared to the existing receptor located closer to the Proposed Project.

Table 2-1: Modelled specific sensitive receptors surrounding the Site (MGA Zone 55S)

Sensitive receptor	X (m)	Y (m)
1	482552	6520977
2	482404	6520969
3	482281	6521042
4	482236	6521212
5	481222	6521428
6	481371	6523402
7	483212	6522146
8	483289	6521515
9	483004	6521505
10	482775	6521355
11	482624	6523068
12	482382	6520901
13	482469	6521618
14	482535	6521234
15	482268	6521208
16	482420	6521099
17	482233	6521062
18	481521	6520908
19	481656	6521502

Sensitive receptor	X (m)	Y (m)
20	481477	6522042
21	480704	6522163
22	479872	6521891
23	480141	6522165
24	481146	6521405
25	480946	6521299
26	480251	6522566
27	480711	6522947
28	480906	6523185
29	481353	6523426
30	481795	6523669
31	481855	6523829
32	482524	6523013
33	483609	6523077
34	483701	6521979
35	483736	6521703
36	482434	6524144
37	484174	6522543
38	484191	6522511
39	484200	6522692
40	484189	6522599
41	482372	6520779
42	482234	6520814
43	482395	6520827
44	482960	6521383
45	483894	6521719


FREEMANS ROAD
GLEN EWAN ROAD
VERDUN DRIVE
BENGAL STREET
RIVERBEND ROAD
SANCROX ROAD
LE CLOS SANCROX ROAD
BUSHLAND DRIVE
PACIFIC HIGHWAY
Existing Quarry
Legend
Receptors
Site Boundary
Final Pit (RL-40m)
Source:
DFSI DCDB/DTDB, 2018
Nearmap Imagery April 2020
Sensitive Receptor Locations
F2.4
Drawing No: 0418291s_AQA_G001_R3.mxd
Date: 04/09/2020
Drawing Size: A4
Drawn By: VN
Reviewed By: EB
Coordinate System: GDA 1994 MGA Zone 56
0 250 500m
N
Sancrox Quarry Expansion Project
Air Quality Assessment Report
Client: Hanson Construction Materials Pty Ltd
This figure may be based on third party data or data which has not been verified by ERM and it may not be to scale. Unless expressly agreed otherwise, this figure is intended as a guide only and ERM does not warrant its accuracy.
ERM

2.2 Process Description

2.2.1 Quarry Operations

Benches are developed by ripping, drilling and blasting. Ripped or blasted rock is loaded and then transported to either the processing plant, or transported directly off-site to market. The approximate split of material transported directly off-site is reportedly 10% with 90% transported to the processing area. The 90% of material to be taken to the processing plant is loaded to trucks using two excavators and hauled from the working face to the processing plant.

The processing plant reduces the size of feed rock by crushing. Screens are used to separate the material into various sizes and product types. Blending of materials will be undertaken to achieve required product specifications and quality control. It has been assumed in the AQIA that rock delivered to the processing plant is placed directly in to the feed hopper for processing. Conveyors transfer product from the screening area to stockpiles of various sizes.

The processed product is either loaded directly from stockpiles to delivery trucks by front-end loaders (FEL) or moved to a stockpile storage area to the west of the processing plant. It was considered that the proposed quantity of the material will require operation of two FELs around processing plant and stockpile area. The delivery trucks, loaded using FELs, leave the site via the weighbridge.

2.2.2 Concrete Recycling Plant

Concrete for recycling will be delivered from offsite using truck-and-dog type trucks to the aggregate storage bins located at the concrete recycling facility. The delivered concrete will be fed to a mobile primary crusher using one of the FELs in the vicinity of the processing plant and stockpile area. The concrete will be processed to the desired size and outloaded directly to the product storage bins prior to be taken offsite for the use as a recycled road base.

2.2.3 Concrete Batching Plant

Operations of the concrete batching plant require materials including coarse aggregate, sand, cement and cement supplement. The coarse aggregate component will be obtained from the rock processed at the processing plant, and will be delivered to the concrete batching plant from the stockpile area using the same trucks used to move material from the quarry floor. Sand will be delivered from offsite to the concrete batching plant using road trucks. Cement and cement supplement will be delivered to the concrete batching plant and pneumatically fed. The central mix concrete product will be loaded to the agitator trucks, which will take the concrete offsite for application. The concrete batching plant will be enclosed with one bag filter fitted above the pan mixer to mitigate particulate matter emissions from the facility.

2.2.4 Asphalt Plant

Operations of the asphalt plant require high quality aggregate and bitumen. The aggregate for asphalt production will be obtained from the processing plant and will be delivered directly to the aggregate storage bins at the asphalt plant. The produced asphalt will be loaded in truck-and-dog-type trucks and taken offsite via the weighbridge. As part of asphalt plant, one fully enclosed pug mill will be located on site. It is understood that vapour balancing system will be installed for the delivery of bitumen on site and vapour recovery system will be employed for transfer of asphalt to trucks to minimise odour and dust emissions. Moreover, the asphalt plant will be totally enclosed and particulate matter emissions will be mitigated using one fabric filter associated with the natural-gas fired dryer.

3. LEGISLATION AND GUIDELINES

3.1 Air Quality

Within New South Wales (NSW), the protection of local air quality standards is considered in the following policy documents:

- Protection of the Environment Operations (Clean Air) Regulation 2010 (New South Wales Government, 2017);
- Approved Methods and Guidance for the Modelling and Assessment of Air Pollutants in New South Wales (State of NSW and Environment Protection Authority, 2016); and

In addition, NSW has committed to complying with the National Environment Protection (Ambient Air Quality) Measure (Australian Government, 2016).

3.1.1 POEO Clean Air Regulation 2010

The Protection of the Environment Operations (Clean Air) Regulation (2010) (the POEO Clean Air) (New South Wales Government, 2017) is the main legislative and regulatory instrument for air quality in NSW. With respect to industrial emissions, the POEO Clean Air defines:

- the meaning of a scheduled premises;
- groupings of activities and plant, based on commencement date of operation;
- allowable stack emission concentrations for a variety of industries based on the defined group; and
- requirements for the testing and assessment of emissions from existing and proposed industry.

The POEO Clean Air provides emission limits for point (stack) sources only. In relation to the proposed development, the concrete batching plant and the asphalt plant will have associated stacks. The remainder of operations at the facility will result in fugitive emissions not controlled under emission standards within the POEO Clean Air.

Table 3 1 provides the emission limits adopted in this assessment for the bag filter at the concrete batching plant.

Table 3-1: Emission limits for bag filters at the concrete batching plant adopted from the Schedule 3, POEO Clean Air Regulation (New South Wales Government, 2017)

Emitted Species	Concentration	Reference conditions
Solid Particles	20 mg/m^3	Dry, 273 K, 101.3 kPa
Type 1 substances and Type 2 substances (in aggregate)	1 mg/m^3	Dry, 273 K, 101.3 kPa
Cadmium individually	0.2 mg/m^3	Dry, 273 K, 101.3 kPa

Note: Type 1 substance means the elements antimony, arsenic, cadmium, lead or mercury or any compound containing one or more of those elements. Type 2 substance means the elements beryllium, chromium, cobalt, manganese, nickel, selenium, tin or vanadium or any compound containing one or more of those elements.

No specific emission limits are set by the POEO Regulation for asphalt plants, therefore this assessment considered emission limits set in Schedule 4 for general activities and plant. Table 3 2 provides the emission limits adopted in this assessment for the bag filter at the asphalt plant.

Table 3-2: Emission limits for asphalt plant adopted from the Schedule 4, POEO Clean Air Regulation (New South Wales Government, 2017)

Emitted Species	Concentration	Reference conditions[1]
Solid Particles	20 mg/m^3	Dry, 273 K, 101.3 kPa, 3% O_2
NO_2	350 mg/m^3	Dry, 273 K, 101.3 kPa, 3% O_2
Type 1 substances and Type 2 substances (in aggregate)	1 mg/m^3	Dry, 273 K, 101.3 kPa, 3% O_2
Cadmium or mercury individually	0.2 mg/m^3	Dry, 273 K, 101.3 kPa, 3% O_2
Volatile organic compounds, as n-propane	40 mg/m^3 VOCs or 125 mg/m^3 CO	Dry, 273 K, 101.3 kPa, 3% O_2

1 Reference conditions are based on fuel burning equipment using gas

Note: Type 1 substance means the elements antimony, arsenic, cadmium, lead or mercury or any compound containing one or more of those elements. Type 2 substance means the elements beryllium, chromium, cobalt, manganese, nickel, selenium, tin or vanadium or any compound containing one or more of those elements. Volatile organic compound (VOC) means any chemical compound that: (a) is based on carbon chains or rings, and (b) contains hydrogen, and (c) has a vapour pressure greater than 2mm of mercury (0.27 kPa) at 25°C and 101.3 kPa, and includes any such compound containing oxygen, nitrogen or other elements, but does not include methane, carbon monoxide, carbon dioxide, carbonic acid, metallic carbides and carbonate salts.

3.1.2 Approved Methods for the Assessment of Air Pollutants in NSW

The Approved Methods and Guidance for the Modelling and Assessment of Air Pollutants in New South Wales (Approved Methods) (NSW Department of Primary Industry and Environment (DPIE), 2016) is referred to in Part 5 of the POEO Regulation 2010. The Approved Methods provides the statutory methods for modelling and assessing emissions to atmosphere from stationary sources in the state.

The regulation also provides ground level assessment criteria against which results of dispersion modelling are assessed. Table 3-3 shows the criteria for particulate matter considered in this assessment.

Table 3-3: Impact Assessment Criteria for particulate matter (NSW DPIE, 2016)

Species	Averaging Period	Criterion
TSP	Annual	90 µg/m^3
PM_{10}	24 hour	50 µg/m^3
	Annual	25 µg/m^3
$PM_{2.5}$	24 hour	25 µg/m^3
	Annual	8 µg/m^3
Deposited Dust	Annual	2[1] g/m^2/month 4[2] g/m^2/month

1. Maximum increase in deposited dust level
2. Maximum total deposited dust level

In addition to particulate matter the concrete batching plant emissions include metals as specified in AP-42 Section 11.12 (United States Environmental Protection Agency, 2006). Emissions from the dryer at the asphalt plant in addition to particulate matter emissions also include carbon monoxide (CO), Nitrogen dioxide (NO_2), sulfur dioxide (SO_2), organic species, metals and general odour (United States Environmental Protection Agency, 2004). Table 3-4 presents the criteria for these additional species as contained in the Approved Methods.

Table 3-4: Approved methods criteria for other species considered in this assessment

Species	Averaging period	Criterion (µg/m³)
NO2	1 hour	246
	Annual	62
CO	15 min	100,000
	1 hour	30,000
	8 hour	10,000
SO2	10 min	712
	1 hour	570
	24 hour	228
	Annual	60
Benzene	1 hour	29
Ethylbenzene	1 hour	8,000
Formaldehyde	1 hour	20
n-Hexane	1 hour	3200
Methyl chloroform	1 hour	12,500
Polycyclic aromatic hydrocarbon (PAH) as benzo[a]pyrene	1 hour	0.4
Toluene	1 hour	360
Xylene	1 hour	190
n-Pentane	1 hour	33,000
Asphalt petroleum fumes	1 hour	90
Antimony and compounds	1 hour	9
Arsenic and compounds	1 hour	0.09
Barium (soluble compound)	1 hour	9
Cadmium and cadmium compounds	1 hour	0.018
Chromium III compounds	1 hour	9
Copper fumes	1 hour	3.7
Chromium VI compounds	1 hour	0.09
Lead	Annual	0.5
Manganese and compounds	1 hour	18
Mercury organic	1 hour	0.18
Nickel and nickel compounds	1 hour	0.18
Silver soluble compounds (as Ag)	1 hour	0.18

For the assessment of complex mixtures of odours, the Approved Methods adopts a statistical approach, dependent on the population size. As the population increases the proportion of sensitive individuals is also likely to increase, indicating that more stringent criterion is required. The Approved Methods use an equation to provide acceptable odour criteria as a function of affected population (Table 3-5).

Table 3-5: Acceptable Impact Assessment Criteria for Complex Mixtures of Air Pollutants (OU) for Various Population Sizes

Population of Affected Community	Impact Assessment Criteria for Complex Mixtures of Air Pollutants (OU)
Urban (>2000) and/or schools and hospitals	2.0
~500	3.0
~125	4.0
~30	5.0
~10	6.0
~2 (Single Rural Residence)	7.0

1. *(State of NSW and Environment Protection Authority, 2016)*

Given that there will be very few residences potentially impacted by odour, an assessment criterion of 6 OU has been selected in this instance.

3.1.3 Other Legislation

For species considered in this AQIA and not included in Approved Methods, the criteria were sourced from Ontario Regulation 419/06: Air Pollution – Local Air Quality (Government of Ontario, 2017) as provided in Table 3-6.

Table 3-6: Criteria sourced from Ontario Regulation 419/06 (Government of Ontario, 2017)

Species	Averaging period	Criterion (µg/m3)
n-Heptane	30 minutes	33,000
	24 hour	11,000
Zinc	30 minutes	100
	24 hour	120

3.1.4 Protocol for Environmental Management Mining and Extractive Industries

Ryolite is an igneous, volcanic rock, which is typically silica rich. During blasting, crushing and mechanical handling of material, there is potential that a portion of the particulate matter released will be comprised of crystalline silica. Respirable crystalline silica has the potential to cause silicosis.

The Approved Methods does not contain standards for respirable crystalline silica. ERM has therefore adopted the approach outlined by the Victorian Protocol for Environmental Management for the Mining and Extractive Industries (Mining PEM), which is an incorporated document to Victoria's State Environment Protection Policy for Air Quality Management.

The Mining PEM provides an assessment criterion for respirable crystalline silica (expressed as $PM_{2.5}$ of 3 µg/m^3 as an annual average). This criterion was adopted in this assessment.

4. EXISTING ENVIRONMENT

4.1 General Meteorological Conditions

Local meteorology plays a major role in determining the location and the degree of off-site impacts of activities proposed to be carried out at the site. Air dispersion modelling requires information about the dispersion characteristics of the area. In particular, data is required on wind direction, wind speed, temperature, atmospheric stability and mixing height. This meteorological data is outlined in the following Sections.

4.2 Climate

Long-term climate data is available from the Bureau of Meteorology (BoM) weather station located in Port Macquarie (Airport), approximately 3.5 km east of the site. Table 4-1 presents temperature, humidity and rainfall statistics from this weather station for the period 1995 to 2018, which consists of monthly average 9am and 3pm readings. Monthly averages of maximum and minimum temperatures are also presented. Rainfall data consists of mean monthly rainfall and the average number of rain days per month. Overall, the local area is characterised by:

- Annual average rainfall of 1,428.2 mm;
- Average maximum temperature of 27.7°C in January;
- Average minimum temperature of 6.4°C in July;
- Average maximum 9am humidity of 83% in March; and
- Average minimum 3pm humidity of 52% in August.

4.3 Typical Wind Conditions

Figure 4-1 provides the predicted wind roses (see Section 7.2) showing the frequency of strength and direction of winds for five recent years (2012 to 2016 inclusive) at the Site. The data has been divided to show annual trends.

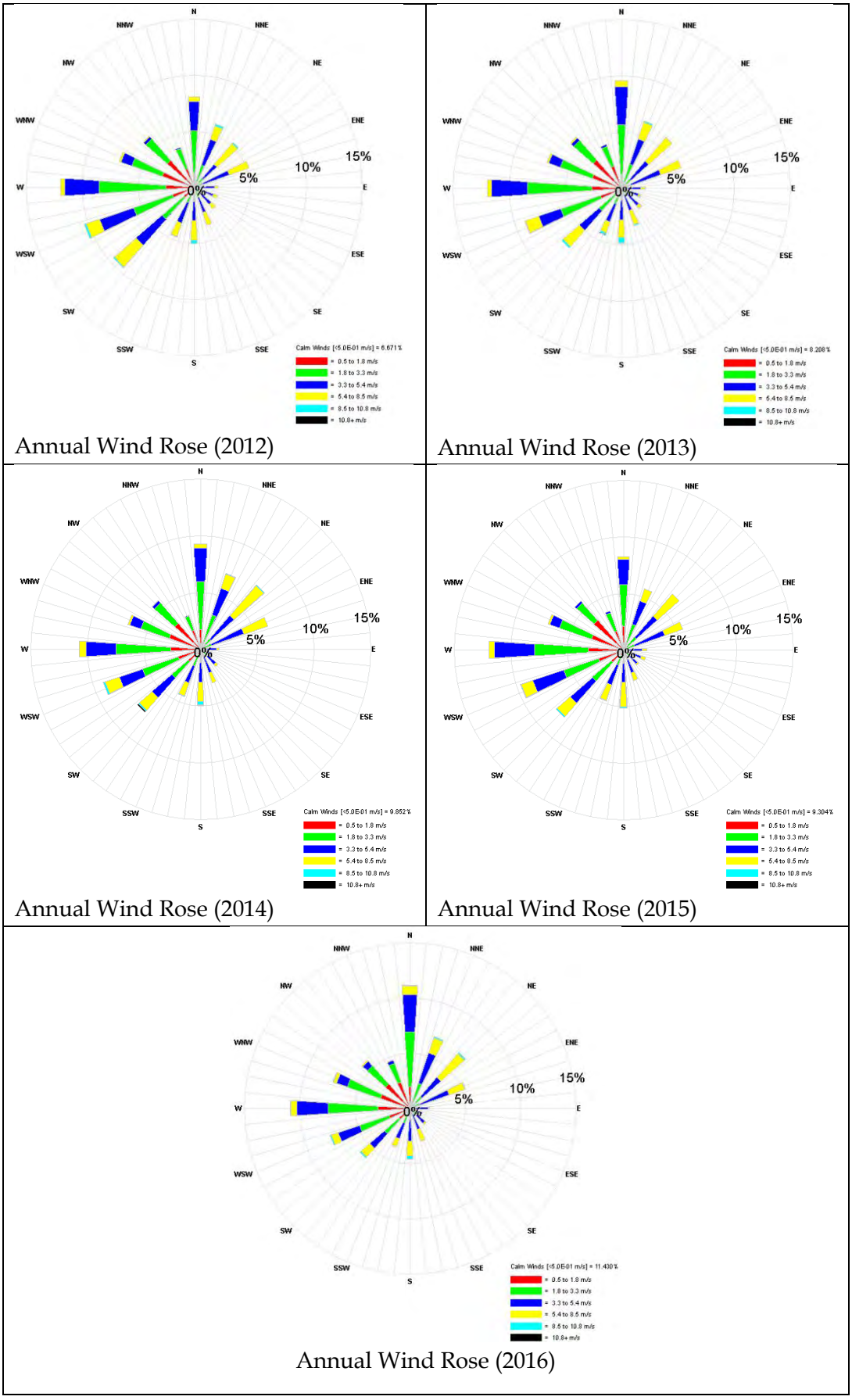
The wind roses indicate that typically winds at the subject Site are:

- Most frequently westerly, south-westerly and northerly;
- Occur moderately from the north-western and north-eastern directions;
- Low percentage of winds from the southern direction;
- Rarely from the east; and
- From approximately 6.7% to 11.4% calm conditions (less than 0.5 m/sec).

Based on the available meteorological data from the Port Macquarie (Airport) BoM station, 2014 was selected as a representative year for dispersion modelling.

Table 4-1: Climate Data for Port Macquarie Station obtained from Bureau of Meteorology

Statistic Element	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual	Start Year	End Year
Mean maximum temperature (°C)	27.7	27.6	26.4	24.2	21.6	19.5	18.8	20.3	22.7	24.1	25.2	26.8	23.7	1995	2018
Mean minimum temperature (°C)	18.4	18.4	17.0	13.9	10.4	8.3	6.4	6.7	9.4	12.0	15.2	16.9	12.8	1995	2018
Mean rainfall (mm)	150.8	165.5	176.0	139.0	114.4	140.6	61.9	66.6	59.3	75.1	153.9	114.7	1428.2	1995	2018
Mean 9am temperature (°C)	23.3	22.6	20.8	19.5	16.1	13.3	12.3	14.0	17.7	20.1	20.7	22.6	18.6	1995	2010
Mean 9am relative humidity (%)	76	82	83	76	76	78	75	68	64	64	73	72	74	1995	2010
Mean 9am wind speed (km/h)	13.0	12.3	11.5	12.3	12.5	11.5	11.9	12.6	13.6	14.7	14.0	13.6	12.8	1995	2010
Mean 3pm temperature (° C)	26.1	26.0	24.9	22.5	20.1	18.2	17.5	18.7	20.5	21.9	23.1	24.9	26.1	1995	2010
Mean 3pm relative humidity (%)	65	66	65	64	61	60	55	52	56	59	65	64	61	1995	2010
Mean 3pm wind speed (km/h)	22.4	21.6	20.1	17.3	15.3	14.9	16.0	19.0	21.0	22.2	22.5	22.3	19.6	1995	2010



Annual Wind Rose (2012)

Annual Wind Rose (2013)

Annual Wind Rose (2014)

Annual Wind Rose (2015)

Annual Wind Rose (2016)

Figure 4-1: Site-Specific annual wind roses (2012-2016)

4.4 Atmospheric Stability

Atmospheric stability is one of the key parameters that effects dispersion and dilution of emissions away from source. In essence it describes the degree of thermal and mechanical mixing of the atmosphere that occurs due to wind and thermal heating. Higher stability of the atmosphere typically results in poor dispersion conditions and higher ground level concentrations, whilst unstable atmospheres typically have the opposite impact.

Typically, these atmospheric conditions occur under the following conditions:

- Category A – Very sunny and very windy conditions;
- Category B – Very sunny but less windy conditions;
- Category C – Moderately sunny and moderately windy conditions;
- Category D – The hours around sunrise and sunset in addition to overcast conditions;
- Category E, F and G – Mostly clear or clear night time conditions with decreasing wind speed.

Figure 4-2 shows the predicted frequency of stability categories at the Site. Stability categories have been predicted using the methodology outlined in Section 7.1.

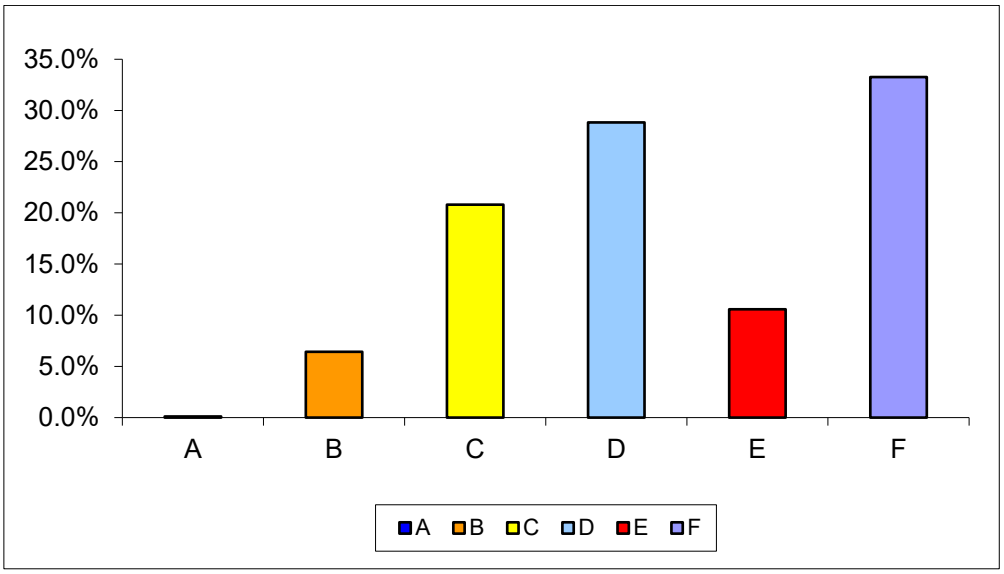


Figure 4-2: Frequency of Atmospheric Stability Categories predicted for the Site

4.5 Existing Ambient Air Quality

Background air quality is a measure of the existing air quality in the absence of the project activity. The background air quality is due to sources (natural or man-made) other than the site. It is important to consider background air quality when considering cumulative impacts on sensitive receptors in the area.

A desktop review of the National Pollutant Inventory (NPI) of reported emissions from fixed and mobile sources in the vicinity of the site was also undertaken to obtain an indication of existing industries in the project area. There are no facilities within the Port Macquarie region reporting emissions of particulate matter under the NPI reporting scheme with the exception of the subject site. The proposed operation of this site and proposed increase in activity is included in this air quality assessment.

In June 2018 an air quality monitoring station was installed by DPIE at Port Macquarie, located approximately 5.5 km to the east of the Site. This monitoring station measures PM_{10}, $PM_{2.5}$, CO, SO_2 and NO_2. However, at the time that the original AQIA (ERM, 2019) sufficient data was not yet available for a suitable background dataset to be determine. For this reason, data was relied upon from Wyong and was considered suitable as it was also from a coastal area and located outside of Newcastle.

A review of the respective monitoring datasets is provided in the following sections.

4.5.1 Particulate Matter

4.5.1.1 Port Macquarie

Table 4-2 provides the maximum measured 24 hour concentrations for PM_{10} and $PM_{2.5}$ as measured at Port Macquarie monitoring station from its installation in June 2018.

An important consideration of particulate matter measurements is the influence of bushfires and dust storms on elevated measurements. A series of severe bushfire impacted the east coast of Australia including the Port Macquarie region during 2019 and early 2020. The data has therefore been presented with and without bushfires influences for the available period (June 2018 to June 2020).

Table 4-2: Maximum measured 24 hour average and annual mean concentrations for PM_{10} and $PM_{2.5}$ at Port Macquarie

Species	Averaging Period	2018		2019		2020		2018 - 2020		Goal
		With fires	Without fires	With fires	Without fires	With fires	Without fires	With fires	Without fires	
PM_{10}	24 Hour Mean	38	38	481	87	250	37	481	87	50
	90th percentile	14	14	79	35	28	28	52	29	n/a
	70th percentile	12	12	47	28	19	18	28	20	n/a
	Annual Mean	9	9	41	22	17	14	26	15	25
$PM_{2.5}$	24 Hour Mean	5	5	443	71	221	22	443	71	25
	90th percentile	8	8	51	21	12	10	33	15	n/a
	70th percentile	6	6	29	15	7	7	13	9	n/a
	Annual Mean	5	5	26	11	8	5	15	7	8

4.5.1.2 Wyong

Table 4-2 provides the maximum measured 24 hour concentrations for PM_{10} and $PM_{2.5}$ as measured at Wyong for the years presented within the original AQIA (2012-2016).

Table 4-3: Maximum measured 24 hour average and annual mean concentrations (µg/m³) for PM_{10} and $PM_{2.5}$, as measured at Wyong for 2012 to 2016

Species	Averaging Period	Year					Criterion
		2012	2013	2014	2015	2016	
PM_{10}	24 Hour Mean	37.4	70.2	41.9	58.6	46.0	50
	Annual Mean	16.6	16.6	15.1	14.9	15.2	25
$PM_{2.5}$	24 Hour Mean	14.7	55.8	19.7	13.2	19.8	25
	Annual Mean	6.7	6.7	5.5	5.2	5.7	8

In view that a contemporaneous, annual data set is not available for Port Macquarie, additional analysis has been completed to demonstrate the Wyong dataset is suitably conservative for the estimation of background PM values.

A box and whisker plot has been prepared in Figure 4-3 for the Wyong 2014 dataset (the modelled year) along with the Wyong data that aligns with the time period available for the Port Macquarie data. When comparing these data sets (and particularly the latter two datasets), it can be seen that the Wyong data is anticipated to provide a conservative estimate of background when compared to data gathered at Port Macquarie.

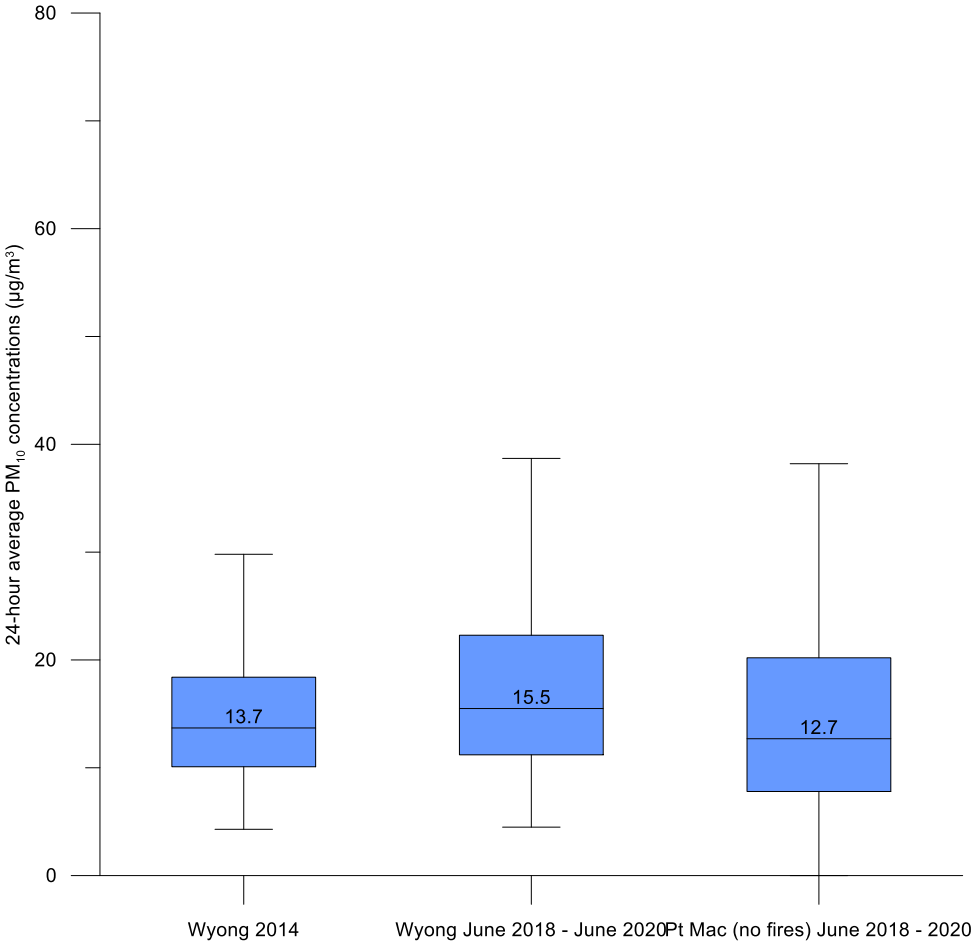


Figure 4-3: Box and whisker plot of Wyong and Port Macquarie annual monitoring data

Note: The centreline of the box indicates the median value. The left side of the box indicates the lower quartile and the right indicates the upper quartile. The far left and far right error bars indicate the minimum and maximum of the values measured.

4.5.2 Total Suspended Particulate

No measurements are taken at Port Macquarie for Total Suspended Particulate (TSP). Consequently, for this assessment, the annual mean TSP concentration has conservatively been assumed to be double the annual mean PM_{10} concentration for the modelled each year.

4.5.3 Dust Deposition

There is no dust deposition monitoring program currently undertaken in the vicinity of the site. No public information regarding background dust deposition rates in the region.

Criteria for dust deposition, specified in the Approved Methods allows an annual mean deposition rate of 4g/m^2/month, with no more than 2g/m^2/month above background.

In the absence of site specific monitoring data, and as shown in Table 3-3, a Porposed Project increment of 2g/m^2/month has been adopted to evaluate this parameter.

4.5.4 Nitrogen Dioxide

Table 4 3 provides the maximum measured 1 hour and annual mean concentrations for NO_2 as measured at Wyong for the modelled years. These values have been used in the Level 1 assessment as described in Section 8.3.

Table 4-4: Maximum measured 1 hour average and annual mean NO_2 concentrations NO_2 as measured at Wyong for 2012 to 2016

Species	Averaging Period	Year					Criterion
		2012	2013	2014	2015	2016	
NO_2	1 Hour Mean	59.5	84.1	69.8	65.7	94.4	246
	Annual Mean	7.8	10.3	10.2	9.3	9.7	62

5. ATMOSPHERIC EMISSIONS INVENTORY

The operations of the Project have been analysed and estimates of particulate matter (PM) emissions for the key PM generating activities have been made. Emissions inventories have been prepared for two scenarios, a typical day and a maximum day.

5.1 Particle size categories

Emission rates of TSP, PM_{10} and $PM_{2.5}$ have been calculated using emission factors developed both within NSW and by the US EPA. Modelling of TSP, PM_{10} and $PM_{2.5}$ was undertaken using the particle size specific inventories and was assumed to emit and deposit from the plume in accordance with the deposition rate appropriate for particles with an aerodynamic diameter equal to the geometric mean of the particle size range.

5.2 Particulate matter emissions

Estimates of emissions for each source were developed on an hourly time step taking into account activities that would take place at that location. Thus, for each source, for each hour, an emission rate was determined which depended on the level of activity and the wind speed. Dust generating activities were represented by a series of volume sources situated according to the location of activities. Two emissions scenarios were investigated:

1. ‘Typical day’ operations, based on an annual average quarry throughput of 530,000 tpa.
2. ‘Maximum day’ operations, based on a daily quarry throughput of 2,600 tpd.

Through iterative modelling an additional scenario has been evaluated. The default ‘Maximum day’ scenario is based on 24 operating hours per day. In reality, this is only sought to be permitted on 20-days per year. A second ‘Maximum day’ scenario has then been evaluated adopting the typical day operational hours of 5am to 10pm (‘Maximum day – restricted hours’).

The locations of the volume sources, used to represent the Site activities, are shown in Appendix A. Information on the point sources is provided in Section 6.4.

The information used for developing the inventories has been based on the operational descriptions and drawings and used to determine haul road distances and routes, activity operating hours, truck sizes and other details that are necessary to estimate dust emissions.

It is acknowledged that the quarry staging (refer Figure 2-3). Given that the quarry stages get progressively closer to off-site sensitive receptors, the final quarry stage (Stage 4) has been evaluated in this assessment so as to represent a ‘reasonable worst-case’.

Not every activity will occur at each source location and some source locations will see significantly more activities than others.

It is also noted that iterative modelling was completed, showing that the most significant contributor to particulate matter concentrations, in particular R13, were haul road emissions. Therefore additional controls, in the form of chemical dust suppressant application to all unsealed haul roads was applied.

Table 5-1 presents the emissions inventory by activity for the different particle size fractions for both the typical and maximum day scenarios.

Table 5-1: Estimated TSP, PM_{10} and $PM_{2.5}$ emissions for the Proposed Project

Activity	TSP Emissions (kg/y)	PM_{10} Emissions (kg/y)		$PM_{2.5}$ Emissions (kg/y)	
	Typical day	Typical day	Maximum day	Typical day	Maximum day
QUARRY - Drilling rock [1]	22	12	n/a	1	n/a
QUARRY - Blasting rock	178	93	1,127	5	65
QUARRY - Excavators on Quarry Floor	291	137	246	21	37
QUARRY - Truck Rear Dumping	78	37	66	6	10
QUARRY - FELS	291	137	246	21	37
QUARRY - Primary crushing	286	129	231	24	43
QUARRY - Secondary crushing	179	80	231	15	43
QUARRY - Tertiary crushing	143	64	144	12	27
QUARRY - Primary screening	525	176	316	12	21
QUARRY - Primary screening	328	110	316	7	21
QUARRY - Conveyor Transfer Points (2)	23	11	19	2	3
QUARRY - Conveyor Drop Points (8)	11	5	10	1	1
QUARRY - Rock Truck - Loaded, Onsite (unsealed)	10,302	2,908	5,207	291	521
QUARRY - Rock Truck - Unloaded, Onsite (unsealed)	5,768	1,628	2,915	163	292
QUARRY - Truck and dog - Loaded, Direct to market (unsealed)	1,096	309	554	31	55
QUARRY - Truck and dog - Unloaded, Direct to market (unsealed)	442	125	223	12	22
QUARRY - Rock Truck - Loaded, Onsite (sealed)	2452	692	1239	69	124
QUARRY - Rock Truck - Unloaded, Onsite (sealed)	1,719	485	869	49	87
QUARRY - Truck and dog - Loaded, Direct to market (sealed)	252	71	127	7	13
QUARRY - Truck and dog - Unloaded, Direct to market (sealed)	132	37	67	4	7
WE - Stockpiles and conveyors (STP1-STP10)	964	482	482	72	72
WE - Stockpiles and conveyors (STP11)	18	9	9	1	1

Activity	TSP Emissions (kg/y)	PM_{10} Emissions (kg/y)		$PM_{2.5}$ Emissions (kg/y)	
	Typical day	Typical day	Maximum day	Typical day	Maximum day
WE - Stockpiles and conveyors (STP12)	9	4	4	1	1
WE - Stockpiles and conveyors (STP13)	13	7	7	1	1
WE - Stockpiles and conveyors (STP14)	9	4	4	1	1
WE - Stockpiles and conveyors (STP15)	9	4	4	1	1
WE - Stockpiles and conveyors (STP16)	13	7	7	1	1
WE - Stockpiles and conveyors (STP17)	9	4	4	1	1
WE - Stockpiles and conveyors (STP18)	9	4	4	1	1
WE - Stockpiles and conveyors (STP19)	26	13	13	2	2
WE - Pit	1,862	931	931	140	140
CRP - Truck Rear Dumping	12	6	6	1	1
CRP - Crushing	12	5	5	1	1
CRP - Truck and dog - Delivery of Dry Products	91	26	26	3	3
CRP - Truck and dog - Delivery of Dry Products (loaded)	91	26	26	1	3
CRP - Truck and dog - Delivery of Dry Products (unloaded)	48	13	13	1	1
CBP - Coarse Aggregate - Truck Rear Dumping	13	6	6	0	1
CBP - Sand - Truck Rear Dumping	3	1	1	0	0
CBP - Transfer of Aggregate	4	2	2	0	0
CBP - Transfer of Sand	1	0	0	3	0
CBP - Loaded weight of a truck and dog - coarse aggregate	100	28	28	1	3
CBP - Unloaded weight of a truck and dog - coarse aggregate	52	15	15	2	1
CBP - Loaded weight of a truck and dog - Sand	76	22	22	1	2
CBP - Unloaded weight of a truck and dog - Sand	40	11	11	1	1
CBP - Loaded weight of Tanker - cement and cement supplement brought onsite	44	12	12	1	1

Activity	TSP Emissions (kg/y)	PM_{10} Emissions (kg/y)		$PM_{2.5}$ Emissions (kg/y)	
	Typical day	Typical day	Maximum day	Typical day	Maximum day
CBP - Unloaded weight of Tanker - cement and cement supplement brought onsite	28	8	8	9	1
CBP - Loaded weight of Agitator truck - product taken offsite	310	88	88	6	9
CBP - Unloaded weight of Agitator truck - product taken offsite	201	57	57	0	6
AP - Bitumen Delivery and Storage	0	0	0	0	0
AP - High quality aggregate delivery and storage	0	0	0	0	0
AP - Truck Load Out	0	0	0	0	0
AP - Loaded weight of Tanker - bitumen delivery	19	5	5	0	0
AP - Unloaded weight of Tanker - bitumen delivery	12	3	3	4	0
AP - Loaded weight of a truck and dog - asphalt to market	164	40	40	2	4
AP - Unloaded weight of a truck and dog - asphalt to market	86	21	21	1	2
Mixer Loading with bag filter	5	2	3	2	3
Dryer with bag filter	581	67	95	67	95
TOTAL EMISSIONS	**29,359**	**9,157**	**16,091**	**1,079**	**1,785**

Notes: 1. Drilling will not occur on the same day as blasting.

5.3 Other emissions

The concrete batching and asphalt plants emissions include metals as specified in AP-42 Section 11.1 and Section 11.12 (United States Environmental Protection Agency, 2006) (United States Environment Protection Agency, 2011). Table 5-2 presents the emission rates considered in this assessment for these additional species.

Table 5-2: Emission rates for other species considered in this assessment

Species	Concrete Batching Plant Bag filter emission rate (g/sec)[1]	Asphalt dryer Bag Filter emission rate (g/sec unless specified otherwise)[2]
NO_x	-	0.02
CO	-	0.1
SO_2	-	0.003
Benzene	-	0.0003
Ethylbenzene	-	0.0002
Formaldehyde	-	0.002
Hexane	-	0.0007
Methyl chloroform	-	0.00004
Polycyclic aromatic hydrocarbon (PAH) as benzo[a]pyrene	-	0.00015
Toluene	-	0.0001
Xylene	-	0.0002
n-Heptane	-	0.007
n-Pentane	-	0.0002
Antimony and compounds	-	$1.4x10^{-7}$ **
Arsenic and compounds	$2.2x10^{-7}$ *	$4.4x10^{-7}$ **
Barium (soluble compound)	-	$4.6x10^{-7}$ **
Cadmium and cadmium compounds	$5.3x10^{-10}$ *	$3.2x10^{-7}$ **
Total Chromium	$9.4x10^{-8}$ *	$4.5x10^{-6}$ **
Copper fumes	-	$2.5x10^{-6}$ **
Chromium VI compounds	-	$2.6x10^{-7}$ **
Lead	$2.7x10^{-8}$ *	$4.9x10^{-7}$ **
Manganese and compounds	$2.8x10^{-6}$ *	$6.1x10^{-6}$ **
Mercury	-	$2.7x10^{-7}$ **
Nickel and nickel compounds	$1.8x10^{-7}$ *	0.00005
Silver soluble compounds (as Ag)	-	$3.8x10^{-7}$ **
Zinc	-	$4.8x10^{-5}$ **
Odour	-	43,333.3 (OU/sec)***

1.Calculated using emission factors obtained from AP-42 Section 11.12 (United States Environmental Protection Agency, 2006)

2.Calculated using emission factors obtained from Section 11.1 (United States Environmental Protection Agency, 2004).

** Calculated for the total concrete mix production of 20,000 m^3 (47,200 tpa), averaged over the year*

*** Calculated for the total asphalt production (50,000 tpa), averaged over the year*

**** Calculated using odour emission rate of 1,040,000 OU m^3/min (GHD, 2008)*

5.4 Screening Assessment

Prior to dispersion modelling, a screening assessment was undertaken to determine whether all emissions from the proposed operation were likely to result in material impact to ambient air quality.

It was considered that as the proposed development had multiple sources of particulate matter, these emissions should automatically be considered in the air quality assessment. The asphalt and concrete batching plants are the only potential onsite sources of metals, combustion products and organic species, and these emissions were therefore taken forward to screening.

The screening assessment adopted guidance published in the United Kingdom, 'Air emissions risk assessment for your environmental permit guidance' (UK Department for Environment, Food and Rural Affairs Environment Agency, 2016). The approach uses conservative dispersion factors to determine the likely maximum contribution to ground level concentrations. Where the maximum concentration is below specific thresholds the species is excluded from further assessment. The details of the screening assessment are provided in Appendix B. The following species could not be screened out and therefore were included, in addition to particulate matter, in the dispersion modelling:

- Oxides of nitrogen (NO_x);
- Formaldehyde;
- Polycyclic aromatic hydrocarbons (PAH);
- Nickel; and
- Odour.

Emission rates for these species used in dispersion modelling are those provided in Table 5-2.

6. DISPERSION MODELLING ASSESSMENT

6.1 Modelling Methodology

This assessment has used the NSW EPA-endorsed CALPUFF dispersion model, in conjunction with generation of time-varying meteorological fields using the CALMET meteorological pre-processor.

CALPUFF is a multi-layer, multi-species non-steady state puff dispersion model that can simulate the effects of time and space varying meteorological conditions on pollutant transport, transformation and removal (Scire, 2000). The model contains algorithms for near-source effects such as building downwash, partial plume penetration, sub-grid scale interactions as well as longer-range effects such as pollutant removal, chemical transformation, vertical wind shear and coastal interaction effects. The model employs dispersion equations based on a Gaussian distribution of pollutants across the puff and takes into account the complex arrangement of emissions from point, area, volume, and line sources.

6.2 Metrological Modelling

Meteorological modelling was completed for the calendar year 2014. As identified in Section 4.3, 2014 is considered a representative meteorological data set for dispersion modelling.

Meteorological modelling was undertaken through a two-step process:

- Prognostic modelling using TAPM (developed by CSIRO); and
- Diagnostic modelling using CALMET (the meteorological pre-processor for the CALPUFF dispersion model).

6.2.1 TAPM

Initially, the prognostic meteorological model TAPM was run to provide surface and upper air data either missing, or not collected, at the nearest Bureau of Meteorology Station (Port Macquarie Airport).

TAPM was run using the following parameters:

- Four nests of 30 km, 10 km, 3km, and 1 km;
- Grid centre of 31°26’ S, 152°49’ E (MGA Zone 55 482712mE, 6522001mS);
- Grid of 25 x 25 cells;
- Observation file for observations from Port Macquarie meteorological station with area of influence of 5 km with 4 layers of the atmosphere influenced by the readings; and
- 25 vertical levels (10 m, 25 m, 50 m, 100 m, 150 m, 200 m, 250 m, 300 m, 400 m, 500 m, 600 m, 750 m, 1000 m, 1250 m, 1500 m, 1750 m, 2000 m, 2500 m, 3000 m, 3500 m, 4000 m, 5000 m, 6000 m, 7000 m and 8000 m).

6.2.2 CALMET

The setup of CALMET was completed in accordance with published guidance using a combination of observational and prognostic data (Barclay & Scire, 2011).

TAPM output was extracted at location 487712m E, 6533001m S (MGA Zone 55), and was used to generate a pseudo observation station for surface and upper air data within the modelled grid. For the surface data only where data was missing from Port Macquarie records for a particular hour was the data was included from the TAPM generated surface information file.

The CALMET model was set up using the system default settings with the exception of those shown in Table 7 1. Figure 7.1 shows meteorological grid extent used in the dispersion modelling.

Table 6-1: Non-standard settings selected in CALMET

Parameter	Setting
Period Modelled	January 1 2014 to 31 December 2014
UTM Zone	55 South
Grid south-west corner (MGA Zone 54)	470.483 km E, 6510.225 km N
Grid Spacing	150 m
Grid points	160 X 160
Cell face heights (m)	0, 20, 30, 40, 50, 70, 90, 100, 250, 500, 1000, 1500, 2000
Coriolis Frequency	7.5×10^{-5}
Bias adjustment for cell face heights	-1 , -1 , -.75 , -.75 , -.5 , -.25, 0 , 5 , 1 , 1 , 1 , 1
Terrad (km)[1]	0.5
RMAX 1 (km) [1]	7.5
RMAX2 (km) [1]	15.0
RMAX3 (km) [1]	30
RMIN (km) [1]	0.15
R1 (km) [1]	6.0
R2 (km) [1]	12.0
Surface Observation Station location	Port Macquarie (487.218km E, 6522.346km S),
Upper air observation (TAPM) location	487.712 km E, 6533.001 km S
Terrain data	ELVIS Elevation Information System (Australian Government Geoscience Australia, 2017)
Land use data	Catchment Scale Land Use of Australia (Department of Agriculture, 2016)

1.Selected in accordance with (Barclay & Scire, 2011)

Figure 7 1 Meteorological Grid extent used in the Dispersion Modelling

6.3 Dispersion Model Receptors

A Cartesian grid was set-up with the south west corner positioned at 476408 m E, 6516150 m N and grid receptors at regularly spaced intervals of 150m, covering an area of 12 km by 12 km.

Discrete receptors were chosen to represent nearby sensitive receptors described in Section 2.1.2

6.4 Emission Parameters

The configuration of the emission sources within the CALPUFF dispersion model comprised a combination of volume and point sources.

Dust generating activities were represented by a series of volume sources situated according to the location of activities with uniform application of sigma y of 10 metres and sigma z of 2 metres. Table 6-2 provides emission source parameters for point sources included in the dispersion model.

The locations of the volume sources, used to represent the Site along with the equation inputs, are shown in Appendix A.

Table 6-2: Emission source parameters for point sources used in the dispersion modelling

Source Name	X (m)	Y (m)	Stack height (m)	Base Elevation (m)	Stack Diameter (m)	Exit Velocity (m/sec)	Exit Temperature (deg. K)
ASPHALT	482657	6521845	5.0[2]	25.9	4.3[2]	0.85[2,3]	435.9[1]
C_BATCH	482938	6522122	5.0[4]	25.9	12.0[4]	0.025[4]	313.15[4]

1. Adopted from AP-42 Asphalt mix temperature (United States Environmental Protection Agency, 2004)

2. Adopted from technical data specification for Benninghoven Asphalt Mixing Plants (A Wirtgen Group Company, n.d.)

3. Converted from 28,000 Nm3/hour, using temperature of 435.928 K and stack diameter of 4.3 metres.

4. Assumed, given information from a similar type of facility (Environmental Resources Management Australia Pty Ltd, 2017)

6.4.1 Respirable Crystalline Silica

Rhyolite is a fine-grained volcanic rock of granitic composition, which contains medium silica content (as compared to basalt and granite). Several site-specific occupational dust samples were analysed by Workplace Environment Consultants in 2018. The results of the analysis shows that the 'respirable silica' fraction of the total 'respirable dust' to be between 5% and 14%.

For this assessment, the silica composition value within the respirable ($PM_{2.5}$) particle size fraction has been conservatively assumed to comprise 14%.

The predicted annual average concentrations of respirable crystalline silica were derived from $PM_{2.5}$ annual average concentrations as required by adopted assessment criterion (see Section 3.1.5).

6.4.2 Odour

Odour is generated from the asphalt plant. The structure of the asphalt plant has the potential to generate wake effect on the stack emissions. In accordance with the Approved Methods, the 1-hour average predicted odour concentration was converted to peak ground level concentration using factor 2.3 for wake-effected point source (State of NSW and Environment Protection Authority, 2016)

7. MODELLING RESULTS

7.1 Introduction

The modelling predictions for the Proposed Project are presented in the sections below. The contour plots are indicative of the concentrations that could potentially be reached under the conditions modelled. It is important to note that the isopleth figures are presented to provide a visual representation of the predicted impacts. To produce the contours, it is necessary to make interpolations between predicted concentrations, and as a result the contours will not always match exactly with predicted impacts at any specific location.

In the case of maximum 24-hour average concentrations, it is also important to note that individual contour plots do not represent one moment in time, but rather the maximum 24-hour average that could potentially occur at a sensitive receptor over the period of a year.

As discussed in Section 5.2, two emissions scenarios were developed:

1. 'Typical day' operations, based on an annual average quarry throughput of 530,000 tpa.
2. 'Maximum day' operations, based on a daily quarry throughput of 2,600 tpd.

The results analysis has taken into account an additional scenario, where the 'Maximum day' operations are split into operating either with the proposed (20-days per year) at 24 hours a day or by adopting the typical day operational hours of 5am to 10pm.

7.2 Predicted PM_{10} Concentrations

Table 7-1 provides the incremental (results shown in brackets) and cumulative results of the PM_{10} predicted concentrations. A daily varying background file, representing Wyong data from 2014 (refer Section 4.5.1) was used in the applying an appropriate background concentration.

All receptors are shown to comply with the DPIE impact assessment criterion for the 24-hour and annual averaging periods with the Proposed Project operating under typical day operations and maximum day when hours are limited to 5am to 10pm.

When operating at 24-hour operations, one receptor (R13) was predicted to exceed the DPIE impact assessment criterion of 50µg/m^3 using the maximum day scenario and operating for 24 hours a day.

Additional analysis has been completed for R13 (maximum day, 24-hour operations) in accordance with Table 11.3 of the Approved Methods (DPIE, 2016) and is shown in Table 7-2.

Table 7-1: Predicted cumulative PM_{10} concentrations

Receptor ID	Predicted PM_{10} Concentrations (µg/m^3) Maximum impact (increment)		
	24 Hour Average		Annual
	Maximum day (5am – 10am)	Maximum day (24 hours)	Typical day
1	42.7 (3.9)	43.0 (3.5)	15.7 (0.6)
2	42.7 (4.0)	42.9 (3.5)	15.7 (0.6)
3	43.5 (4.8)	43.8 (5.8)	16 (0.9)
4	44.5 (6.8)	44.8 (8.0)	16.4 (1.3)
5	42.2 (4.4)	42.1 (3.5)	15.4 (0.3)
6	41.9 (1.0)	41.9 (0.7)	15.2 (0.1)
7	43.3 (11.3)	43.7 (12.7)	16.4 (1.3)
8	42.2 (3.9)	42.8 (6.3)	15.7 (0.6)
9	43.2 (6.2)	44.6 (8.7)	16.1 (1)

Receptor ID	Predicted PM_{10} Concentrations (µg/m^3) Maximum impact (increment)		
	24 Hour Average		Annual
	Maximum day (5am – 10am)	Maximum day (24 hours)	Typical day
10	43.5 (5.1)	44 (7.1)	16.1 (1)
11	42.2 (2.8)	42.1 (2.7)	15.4 (0.3)
12	42.7 (3.3)	42.9 (3.2)	15.6 (0.5)
13	49.0 (21.4)	**52.1** (28.5)	18.9 (3.8)
14	43.5 (5.4)	44 (5.6)	16.1 (1)
15	44.4 (7.2)	44.7 (8.0)	16.4 (1.3)
16	42.9 (5.8)	43.2 (5.1)	15.9 (0.8)
17	43.8 (4.8)	44.2 (5.2)	16 (0.9)
18	42.2 (2.7)	42.1 (2.7)	15.5 (0.4)
19	43.2 (7.1)	42.8 (6.2)	16 (0.9)
20	42.3 (8.8)	42.2 (6.5)	15.5 (0.4)
21	42 (1.5)	42.0 (1.0)	15.2 (0.1)
22	41.9 (0.8)	41.9 (0.5)	15.1 (<0.1)
23	42 (1.2)	41.9 (0.8)	15.1 (<0.1)
24	42.2 (4.0)	42.1 (3.2)	15.3 (0.2)
25	42.1 (2.2)	42 (1.8)	15.2 (0.1)
26	41.9 (0.9)	41.9 (0.9)	15.1 (<0.1)
27	42 (1.2)	41.9 (0.7)	15.1 (<0.1)
28	41.9 (1.1)	41.9 (0.8)	15.1 (<0.1)
29	41.9 (1.0)	41.9 (0.7)	15.2 (0.1)
30	41.9 (1.0)	41.9 (1.1)	15.2 (0.1)
31	41.9 (0.9)	41.9 (0.7)	15.2 (0.1)
32	42.2 (3.5)	42.1 (2.9)	15.5 (0.4)
33	42.6 (1.5)	42.8 (1.8)	15.3 (0.2)
34	42.1 (4.2)	42.1 (5.9)	15.6 (0.5)
35	42.1 (2.6)	42.1 (5.0)	15.6 (0.5)
36	41.9 (0.7)	41.9 (0.6)	15.2 (0.1)
37	42 (1.6)	42 (2.7)	15.3 (0.2)
38	42.0 (1.7)	42 (2.6)	15.3 (0.2)
39	42.0 (1.8)	42 (2.1)	15.3 (0.2)
40	42.0 (1.6)	42 (2.6)	15.3 (0.2)
41	42.6 (2.3)	42.7 (2.2)	15.5 (0.4)
42	42.9 (2.7)	43.2 (2.7)	15.6 (0.5)
43	42.6 (2.7)	42.8 (2.6)	15.6 (0.5)
44	42.8 (4.8)	43.5 (7.1)	15.9 (0.8)
45	42 (2.1)	42.0 (4.0)	15.5 (0.4)
Criterion	50	50	25

1. Results without brackets are cumulative (inclusive of background) predictions. Incremental predictions are shown in brackets.

2. Maximum day (24-hour) predictions are representative of 24-hour operations, which in reality will only be permitted for up to 20 days annually.

Table 7-2: Level 2 Assessment of PM_{10} at R13 for maximum day, 24-hour operations

Date	PM_{10} 24-hour average (µg/m³)			Date	PM_{10} 24-hour average (µg/m³)		
	Background	Predicted increment	Total		Background	Highest predicted increment	Total
02/01/2014	41.9	7.9	49.8	10/05/2014	10.4	28.5	38.9
18/12/2014	41.1	8.8	49.9	20/05/2014	11.3	25.3	36.6
10/02/2014	39.2	12.9	**52.1**	14/03/2014	13.9	24.4	38.3
17/12/2014	37.3	2.9	40.2	09/08/2014	17.0	24.1	41.1
06/10/2014	36.9	13.7	**50.6**	08/07/2014	10.9	22.7	33.6
30/12/2014	35.8	2.8	38.6	18/05/2014	9.0	21.9	30.9
31/10/2014	35.5	12.1	47.6	10/04/2014	11.1	21.8	32.9
30/10/2014	35.1	7.8	42.9	01/04/2014	11.3	21.7	33
03/01/2014	33.7	2.0	35.7	23/03/2014	21.1	21.2	42.3
06/01/2014	33	2.2	35.2	06/03/2014	29.2	21.1	**50.3**

7.3 Predicted $PM_{2.5}$ Concentrations

Table 7-3 provides the incremental (results shown in brackets) and cumulative results of the $PM_{2.5}$ predicted concentrations. A daily varying background file, representing Wyong data from 2014 (refer Section 4.5.1) was used in the applying an appropriate background concentration.

All receptors are shown to comply with the DPIE impact assessment criterion for the 24-hour and annual averaging periods when operating under both typical and maximum day (24/7) operations.

Table 7-3: Predicted $PM_{2.5}$ concentrations

Receptor ID	Predicted $PM_{2.5}$ Concentrations (µg/m^3) Maximum impact (increment)		
	24 Hour Average		Annual
	Maximum day (5am – 10am)	Maximum day (24 hours)	Typical day
1	19.7 (2.4)	20.2 (2.3)	5.6 (0.1)
2	19.8 (2.5)	20.2 (2.2)	5.6 (0.1)
3	19.8 (2.8)	20.4 (2.4)	5.6 (0.1)
4	20 (3.3)	20.7 (3.1)	5.7 (0.2)
5	19.8 (0.8)	19.8 (0.7)	5.5 (<0.1)
6	19.7 (0.3)	19.7 (0.2)	5.5 (<0.1)
7	19.7 (2.3)	20.1 (2.5)	5.7 (0.2)
8	19.7 (1.1)	20.1 (1.7)	5.6 (0.1)
9	19.7 (1.2)	20.4 (1.9)	5.6 (0.1)
10	19.8 (1.7)	20.5 (2.3)	5.6 (0.1)
11	19.7 (0.9)	19.7 (0.7)	5.6 (0.1)
12	19.8 (2.3)	20.1 (1.9)	5.6 (0.1)
13	20.4 (5)	21.9 (6.7)	6 (0.5)
14	19.8 (2.6)	20.4 (2.8)	5.7 (0.2)
15	19.9 (3.3)	20.6 (3.1)	5.7 (0.2)
16	19.8 (3)	20.4 (2.8)	5.6 (0.1)
17	19.9 (2.8)	20.4 (2.4)	5.6 (0.1)
18	19.9 (1.3)	19.9 (1)	5.6 (0.1)
19	19.9 (2.2)	20.1 (1.9)	5.6 (0.1)
20	19.7 (2.9)	19.8 (2.2)	5.6 (0.1)
21	19.7 (0.6)	19.7 (0.4)	5.5 (<0.1)
22	19.7 (0.2)	19.7 (0.2)	5.5 (<0.1)
23	19.7 (0.3)	19.7 (0.2)	5.5 (<0.1)
24	19.7 (0.7)	19.8 (0.7)	5.5 (<0.1)
25	19.7 (0.4)	19.8 (0.4)	5.5 (<0.1)
26	19.7 (0.3)	19.7 (0.2)	5.5 (<0.1)
27	19.7 (0.4)	19.7 (0.3)	5.5 (<0.1)
28	19.7 (0.3)	19.7 (0.2)	5.5 (<0.1)
29	19.7 (0.3)	19.7 (0.2)	5.5 (<0.1)
30	19.7 (0.2)	19.7 (0.2)	5.5 (<0.1)
31	19.7 (0.2)	19.7 (0.2)	5.5 (<0.1)
32	19.7 (1)	19.8 (0.8)	5.6 (0.1)
33	19.7 (0.5)	19.7 (0.5)	5.5 (<0.1)
34	19.7 (0.8)	19.8 (1.3)	5.6 (0.1)
35	19.7 (0.8)	19.9 (1.5)	5.6 (0.1)
36	19.7 (0.2)	19.7 (0.1)	5.5 (<0.1)
37	19.7 (0.3)	19.7 (0.4)	5.5 (<0.1)
38	19.7 (0.3)	19.7 (0.4)	5.5 (<0.1)
39	19.7 (0.3)	19.7 (0.4)	5.5 (<0.1)
40	19.7 (0.3)	19.7 (0.4)	5.5 (<0.1)

Receptor ID	Predicted $PM_{2.5}$ Concentrations (µg/m^3) Maximum impact (increment)		
	24 Hour Average		Annual
	Maximum day (5am – 10am)	Maximum day (24 hours)	Typical day
41	19.7 (1.9)	20 (1.5)	5.6 (0.1)
42	19.8 (2)	20.1 (1.6)	5.6 (0.1)
43	19.7 (2)	20.1 (1.7)	5.6 (0.1)
44	19.7 (1.2)	20.3 (1.9)	5.6 (0.1)
45	19.7 (0.6)	19.8 (1.1)	5.6 (0.1)
Criterion	25	25	8

1. Results without brackets are cumulative (inclusive of background) predictions. Incremental predictions are shown in brackets.

2. Maximum day predictions are representative of 24-hour operations, which in reality will only be permitted for up to 20 days annually.

7.4 Predicted Concentrations for all Other Species

Table 7-4 provides the predicted concentrations for all species other than PM_{10} and $PM_{2.5}$ included in the dispersion modelling against the adopted criteria. The results for these species included in the dispersion modelling are below the adopted criteria at all sensitive receptor locations.

Table 7-4: Predicted concentrations for all species included in the dispersion modelling

Receptor ID	Predicted TSP (µg/m³) Maximum impact (increment)	Predicted Silica (µg/m³) Maximum impact	Predicted Dust Deposition (g/m²/month) Maximum impact (increment)	Predicted NO_2 (µg/m³) Maximum impact (increment)		Predicted Formaldehyde (µg/m³) Maximum impact	Predicted PAH (µg/m³) Maximum impact	Predicted Nickel (µg/m³) Maximum impact	Predicted Odour (OU/m³) Maximum impact
	Annual Mean	Annual Mean	Annual Mean	Annual Mean	1 Hour Mean	1 Hour Mean	1 Hour Mean	1 Hour Mean	Nose Response Time
1	30.7 (0.5)	<0.1	2 (<0.1)	10.3 (<0.1)	70.4 (<0.1)	0.08	<0.01	<0.01	1.5
2	30.8 (0.6)	<0.1	2 (<0.1)	10.3 (<0.1)	70.3 (<0.1)	0.06	<0.01	<0.01	1.2
3	31.2 (1)	<0.1	2 (<0.1)	10.3 (<0.1)	70.2 (<0.1)	0.05	<0.01	<0.01	0.9
4	32 (1.8)	<0.1	2 (<0.1)	10.3 (<0.1)	70.1 (<0.1)	0.04	<0.01	<0.01	1.1
5	30.6 (0.4)	<0.1	2 (<0.1)	10.3 (<0.1)	70 (0.1)	0.02	<0.01	<0.01	0.3
6	30.3 (0.1)	<0.1	2 (<0.1)	10.3 (<0.1)	69.9 (0.1)	0.01	<0.01	<0.01	0.2
7	32.9 (2.7)	<0.1	2 (<0.1)	10.3 (<0.1)	70.1 (0.1)	0.04	<0.01	<0.01	1.2
8	31.1 (0.9)	<0.1	2 (<0.1)	10.3 (<0.1)	70.2 (0.1)	0.05	<0.01	<0.01	0.9
9	31.8 (1.6)	<0.1	2 (<0.1)	10.3 (<0.1)	70.1 (0.1)	0.03	<0.01	<0.01	0.7
10	31.7 (1.5)	<0.1	2 (<0.1)	10.3 (<0.1)	70.1 (0.1)	0.04	<0.01	<0.01	0.8
11	30.7 (0.5)	<0.1	2 (<0.1)	10.3 (<0.1)	70 (0.1)	0.03	<0.01	<0.01	0.7

Receptor ID	Predicted TSP (µg/m³) Maximum impact (increment)	Predicted Silica (µg/m³) Maximum impact	Predicted Dust Deposition (g/m²/month) Maximum impact (increment)	Predicted NO_2 (µg/m³) Maximum impact (increment)		Predicted Formaldehyde (µg/m³) Maximum impact	Predicted PAH (µg/m³) Maximum impact	Predicted Nickel (µg/m³) Maximum impact	Predicted Odour (OU/m³) Maximum impact
	Annual Mean	Annual Mean	Annual Mean	Annual Mean	1 Hour Mean	1 Hour Mean	1 Hour Mean	1 Hour Mean	Nose Response Time
12	30.7 (0.5)	<0.1	2 (<0.1)	10.3 (<0.1)	70.2 (0.1)	0.06	<0.01	<0.01	1.1
13	37.6 (7.4)	0.1	2.2 (0.2)	10.3 (<0.1)	70.4 (0.1)	0.07	<0.01	<0.01	2.1
14	31.4 (1.2)	<0.1	2 (<0.1)	10.3 (<0.1)	70.1 (0.1)	0.04	<0.01	<0.01	1.0
15	31.9 (1.7)	<0.1	2 (<0.1)	10.3 (<0.1)	70.1 (0.1)	0.04	<0.01	<0.01	1.1
16	31.1 (0.9)	<0.1	2 (<0.1)	10.3 (<0.1)	70.3 (0.1)	0.06	<0.01	<0.01	1.0
17	31.4 (1.2)	<0.1	2 (<0.1)	10.3 (<0.1)	70.1 (0.1)	0.04	<0.01	<0.01	0.9
18	30.7 (0.5)	<0.1	2 (<0.1)	10.3 (<0.1)	70 (0.1)	0.03	<0.01	<0.01	0.7
19	31.6 (1.4)	<0.1	2.1 (0.1)	10.3 (<0.1)	70.1 (0.1)	0.03	<0.01	<0.01	0.7
20	30.6 (0.4)	<0.1	2 (<0.1)	10.3 (<0.1)	70 (0.1)	0.02	<0.01	<0.01	0.2
21	30.3 (0.1)	<0.1	2 (<0.1)	10.3 (<0.1)	69.9 (0.2)	0.01	<0.01	<0.01	0.1
22	30.2 (<0.1)	<0.1	2 (<0.1)	10.3 (<0.1)	69.9 (0.2)	0.01	<0.01	<0.01	0.1
23	30.2 (<0.1)	<0.1	2 (<0.1)	10.3 (<0.1)	69.9 (0.2)	0.01	<0.01	<0.01	0.1

Receptor ID	Predicted TSP (µg/m³) Maximum impact (increment)	Predicted Silica (µg/m³) Maximum impact	Predicted Dust Deposition (g/m²/month) Maximum impact (increment)	Predicted NO_2 (µg/m³) Maximum impact (increment)		Predicted Formaldehyde (µg/m³) Maximum impact	Predicted PAH (µg/m³) Maximum impact	Predicted Nickel (µg/m³) Maximum impact	Predicted Odour (OU/m³) Maximum impact
	Annual Mean	Annual Mean	Annual Mean	Annual Mean	1 Hour Mean	1 Hour Mean	1 Hour Mean	1 Hour Mean	Nose Response Time
24	30.5 (0.3)	<0.1	2 (<0.1)	10.3 (<0.1)	70 (0.2)	0.02	<0.01	<0.01	0.3
25	30.4 (0.2)	<0.1	2 (<0.1)	10.3 (<0.1)	69.9 (0.2)	0.02	<0.01	<0.01	0.3
26	30.2 (<0.1)	<0.1	2 (<0.1)	10.3 (<0.1)	69.9 (0.2)	0.01	<0.01	<0.01	0.1
27	30.3 (0.1)	<0.1	2 (<0.1)	10.3 (<0.1)	69.9 (0.1)	0.01	<0.01	<0.01	0.1
28	30.3 (0.1)	<0.1	2 (<0.1)	10.3 (<0.1)	69.9 (0.1)	0.01	<0.01	<0.01	0.1
29	30.3 (0.1)	<0.1	2 (<0.1)	10.3 (<0.1)	69.9 (0.1)	0.01	<0.01	<0.01	0.2
30	30.3 (0.1)	<0.1	2 (<0.1)	10.3 (<0.1)	69.9 (0.1)	0.01	<0.01	<0.01	0.2
31	30.3 (0.1)	<0.1	2 (<0.1)	10.3 (<0.1)	69.9 (0.1)	0.02	<0.01	<0.01	0.2
32	30.8 (0.6)	<0.1	2 (<0.1)	10.3 (<0.1)	70 (0.1)	0.03	<0.01	<0.01	0.8
33	30.5 (0.3)	<0.1	2 (<0.1)	10.3 (<0.1)	70.1 (0.1)	0.04	<0.01	<0.01	0.6
34	31 (0.8)	<0.1	2 (<0.1)	10.3 (<0.1)	70.1 (0.1)	0.04	<0.01	<0.01	0.8
35	30.8 (0.6)	<0.1	2 (<0.1)	10.3 (<0.1)	70.4 (0.1)	0.07	<0.01	<0.01	1.1

Receptor ID	Predicted TSP (µg/m³) Maximum impact (increment)	Predicted Silica (µg/m³) Maximum impact	Predicted Dust Deposition (g/m²/month) Maximum impact (increment)	Predicted NO_2 (µg/m³) Maximum impact (increment)		Predicted Formaldehyde (µg/m³) Maximum impact	Predicted PAH (µg/m³) Maximum impact	Predicted Nickel (µg/m³) Maximum impact	Predicted Odour (OU/m³) Maximum impact
	Annual Mean	Annual Mean	Annual Mean	Annual Mean	1 Hour Mean	1 Hour Mean	1 Hour Mean	1 Hour Mean	Nose Response Time
36	30.3 (0.1)	<0.1	2 (<0.1)	10.3 (<0.1)	69.9 (0.1)	0.01	<0.01	<0.01	0.3
37	30.5 (0.3)	<0.1	2 (<0.1)	10.3 (<0.1)	70 (0.1)	0.03	<0.01	<0.01	0.5
38	30.5 (0.3)	<0.1	2 (<0.1)	10.3 (<0.1)	70 (0.1)	0.03	<0.01	<0.01	0.5
39	30.5 (0.3)	<0.1	2 (<0.1)	10.3 (<0.1)	70 (<0.1)	0.03	<0.01	<0.01	0.5
40	30.5 (0.3)	<0.1	2 (<0.1)	10.3 (<0.1)	70 (<0.1)	0.03	<0.01	<0.01	0.5
41	30.6 (0.4)	<0.1	2 (<0.1)	10.3 (<0.1)	70.2 (<0.1)	0.05	<0.01	<0.01	1
42	30.8 (0.6)	<0.1	2 (<0.1)	10.3 (<0.1)	70.1 (0.1)	0.04	<0.01	<0.01	0.8
43	30.6 (0.4)	<0.1	2 (<0.1)	10.3 (<0.1)	70.2 (<0.1)	0.05	<0.01	<0.01	1.1
44	31.4 (1.2)	<0.1	2 (<0.1)	10.3 (<0.1)	70 (<0.1)	0.03	<0.01	<0.01	0.7
45	30.7 (0.5)	<0.1	2 (<0.1)	10.3 (<0.1)	70.3 (<0.1)	0.07	<0.01	<0.01	0.8
Criteria	**90**	**3**	**2**	**62**	**246**	**20**	**0.4**	**0.18**	**6.5**

8. MITIGATION MEASURES

This air quality impact assessment has considered reasonable and feasible mitigation measures to minimise the emissions from the proposed activities at the site. The mitigation measures considered in this assessment include:

- Roads which are likely to remain unchanged throughout the Project stages and to be frequently used by machinery, will be sealed using asphalt and swept daily to minimise wheel-generated dust emissions;
- Full dust extraction system for drilling;
- Utilisation of water sprays during truck rear dumping;
- The use of mobile sprinkler systems during the operation of front end loaders (FELs);
- Dust suppression measures such as water sprays in place at the crushers and screeners;
- Water sprays used on all conveyor transfer points;
- The conveyor loading to be enclosed by a shroud;
- Unsealed haul roads are to apply a dust suppressant;
- Water sprays to be utilised to minimise wind erosion from stockpiles, as required;
- The dry product delivered to the concrete batching, concrete recycling and asphalt plants to be stored in aggregate storage bins enclosed on three sides. The aggregate storage bins to be fitted with water sprays;
- Cement and cement supplement to be delivered to the concrete batching plant and pneumatically fed;
- Concrete batching loading point to be enclosed with all particulate matter emissions generated by the facility captured by one bag filter located above the pan mixer;
- Concrete recycling facility out-loading to be directly to processed material storage bins enclosed on three sides. The recycled concrete storage bins to be fitted with water sprays;
- Vapour balancing system to be installed for the delivery of bitumen at the asphalt plant;
- Asphalt plant will be totally enclosed. All particulate matter emissions generated at the plant will be captured by one fabric filter associated with the natural-gas fired dryer; and
- Vapour recovery system to be employed for transfer of asphalt to trucks.

9. MONITORING AND MANAGEMENT MEASURES

It is recommended that in addition to management measures described in Section 8, the Site employs real-time ambient air quality monitoring system. This will allow staff to identify when additional mitigation measures are to be implemented to minimise impact from the onsite activities.

Given the proximity of Receptor 13 to the site boundary and moderate occurrence of winds from the north-western and north-eastern directions (Figure 4-1), it is recommended that one real-time monitor is placed along the southern boundary of the Site to monitor conditions when the Site is upwind of R13. Another monitor may be placed along the northern boundary to obtain the background PM concentration under these conditions (i.e. northerly winds).

As noted above, contemporaneous analysis identified that the cumulative (background plus Proposed Project contributions) 24-hour average PM_{10} concentrations predict an exceedance of the Approved Methods Criterion at receptor R13 when operating under maximum daily throughput scenario over a 24-hour period. However, when the hours are reduced to operate between 5am and 10pm with the same maximum daily throughput compliance is demonstrated at R13.

It is anticipated that the probability of meteorological conditions conducive to causing an exceedance at receptor R13 occurring during the proposed 20 days of 24-hour operations is low. It is thus considered that this risk may be mitigated by provision of additional dust management planning and controls prior to 24-hour operations, as documented within the site Air Quality Management Plan.

Table 9-1 provides recommendations for the environmental management to ensure minimisation of air quality impact to the surrounding land use as a result of construction activities.

Table 9-1 Recommendations for the environmental management plan

Item	Mitigation/ Management/Control Measure	Trigger/Timing	Responsibility
Clearing, Site Preparation and Excavation			
1	Modify working practices by limiting clearing, stripping and spoil handling during periods of adverse weather (hot, dry and windy conditions) and when dust is seen leaving the site.	When visible dust is being generated	Supervisors, Construction Manager
2	Limit the extent of clearing of vegetation and topsoil to the designated footprint required for construction and appropriate staging of any clearing.	During construction works planning stage	Construction Manager
3	All disturbed areas where trees and other vegetation are removed are to be stabilised and or revegetated/ rehabilitated in accordance with the contractual requirements as soon as practical following final land shaping	After final land shaping	Supervisors, Construction Manager
4	Minimise the exposure of fill and excavated material to active work fronts.	Ongoing	Supervisors
5	Use water sprays as a suppressant during road construction, when movement of materials generates visible dust.	When visible dust is being generated.	Supervisors, Construction Manager
6	Minimise drop heights for material transport to prevent dust dispersal.	Ongoing	Supervisors
7	Maintain all construction equipment, machinery and vehicles to ensure optimal performance which would minimise exhaust emissions.	Ongoing	Supervisors
8	Minimise idling of construction equipment, machinery and vehicles to no more than 5 minutes to minimise exhaust emissions.	Ongoing	Supervisors
9	Plan construction methodology to ensure capacity of construction equipment, machinery and vehicles is fully utilised.	During construction works planning stage	Construction Manager
Haulage and Heavy Plant and Equipment Movements			
10	Modifying work practices during periods of high winds and/or dry conditions by limiting scraper/ grader activity.	Ongoing	Supervisors
11	All vehicles on-site will be confined to a designated route with a speed limit of 30 km/hr enforced.	Ongoing	Supervisors
12	All unsealed haul roads will be sealed with a chemical suppressant.	Ongoing	Supervisors
13	Trips and trip distances will be controlled and reduced where possible, for example by coordinating delivery and removal of materials to avoid unnecessary trips.	Ongoing	Supervisors, Construction Manager

Item	Mitigation/ Management/Control Measure	Trigger/Timing	Responsibility
14	All trucks delivering fill or leaving the site with spoil material will have their load covered.	Ongoing	Supervisors
15	No idling of vehicles unless power is required for unloading or cooling for the occupant of vehicle on days of high temperature.	Ongoing	Supervisors
Wind Erosion			
16	Wind erosion from exposed ground will be limited by avoiding unnecessary vegetation and topsoil clearing and limiting to the minimum footprint required.	Ongoing	Supervisors, Manager
17	Wind erosion from temporary stockpiles will be limited by minimising the number of work faces on stockpiles, minimising the number of stockpiles and through covering or temporary stabilisation (compaction of surface, water sprays, seeding, veneering) of the stockpiles.	Ongoing	Supervisors, Manager
Dust monitoring			
18	Visual checks for excessive dust generation will be undertaken daily during construction	Ongoing	Supervisors, Manager

10. CONCLUSIONS

ERM was engaged by Hanson to undertake specialist assessments to inform the EIS for the proposed Sancrox Quarry Extension Project. This updated AQIA is to accompany the Response to Submission report that includes a revised quarry plan including staging and undertook the following scope of works:

- Assessment of potential for ambient air quality impacts and greenhouse gas emissions from construction and operation of the Project;
- Provision of mitigation measures to minimise impacts to the surrounding land use; and
- Recommendations for ambient monitoring to ensure compliance with legislation.

The assessment of ambient air quality impacts identified that:

- The cumulative annual mean concentrations of PM_{10} are below the Approved Methods criterion at all sensitive receptors;
- Contemporaneous analysis identified that the cumulative (background plus Proposed Project contributions) 24-hour average PM_{10} concentrations predict an exceedance of the Approved Methods Criterion at receptor R13 when operating under maximum daily throughput scenario over a 24-hour period. However, when the hours are reduced to operate between 5am and 10pm with the same maximum daily throughput compliance is demonstrated at R13.
- It is anticipated that the probability of meteorological conditions conducive to causing an exceedance at receptor R13 occurring during the proposed 20 days of 24-hour operations is low. It is thus considered that this risk may be mitigated by provision of additional dust management planning and controls prior to 24-hour operations, as documented within the site Air Quality Management Plan.
- The cumulative annual mean concentrations of $PM_{2.5}$ are below the Approved Methods criterion at all sensitive receptors;
- The predicted concentrations for all other species are below the adopted criteria at all sensitive receptor locations.

This assessment considered reasonable and feasible mitigation measures to minimise the emissions from the proposed activities at the site and provided recommendations for ambient monitoring.

11. REFERENCES

A Wirtgen Group Company, n.d. Mobile Asphalt Mixing Plants Type MBA. [Online]

Available at: https://media.wirtgen-group.com/media/06_benninghoven/infomaterial_8/produkte/mix_mobil/Finale_screen_Prospekt_MBA_EN_R1.pdf

[Accessed 28 February 2018].

Australian Government Department of Sustainability, Environment, Water, Population and Communities, 2012. NPI Emission Estimation Technique Manual for Mining V3.1, Canberra: Commonwealth of Australia.

Australian Government Department of Sustainability, Environment, Water, Population and Communities, 2012. NPI Emission Estimation Technique Manual for Mining, Version 3.1. [Online]

Available at: http://www.npi.gov.au/system/files/resources/7e04163a-12ba-6864-d19a-f57d960aae58/files/mining.pdf

[Accessed 30 November 2017].

Australian Government Department of the Environment, 2014. National Pollutant Inventory Emission Estimation Technique Manual for Mining and Processing of Non-Metallic Minerals Version 2.1. [Online]

Available at: http://www.npi.gov.au/system/files/resources/5416d84f-4419-3304-8da1-bded5b9b01d2/files/eet-manual-mining-processing-non-metallic-minerals-2-1.pdf

[Accessed 21 February 2018].

Australian Government Geoscience Australia, 2017. ELVIS - Elevation Information System. [Online]

Available at: http://www.ga.gov.au/elvis/

[Accessed 10 May 2017].

Australian Government, 2016. National Environment Protection (Ambient Air Quality) Measure. [Online]

Available at: https://www.legislation.gov.au/Details/F2016C00215

[Accessed 21 February 2018].

Barclay, J. & Scire, J., 2011. Generic Guidance and Optimum Model Settings for the CALPUFF Modeling System for Inclusion into the 'Approved Methods for the Modeling and Assessments of Air Pollutants in NSW, Australia'. [Online]

Available at: http://www.environment.nsw.gov.au/resources/air/CALPUFFModelGuidance.pdf

[Accessed December 2012].

Department of Planning and Environment, 2017. Reissue of State Significant Development - Secretary's Requirements Sancrox Quarry Extension Project (SSD 7293), Sydney: Department of Planning and Environment.

Edinburgh Napier University, n.d. Chapter 4 Mix Design Calculation Sheet. [Online]

Available at: https://www.napier.ac.uk/~/media/worktribe/output-217380/abukershappendix2pdf.pdf

[Accessed 19 February 2018].

Environment Protection Authority Victoria, 2007. Protocol for Environmental Management State Environment Protection Policy (Air Quality Management) Mining and Extractive Industries, Southbank: EPA Victoria.

Environment Protection Authority Victoria, 2013. EPA Publication 1551 Guidance notes for using the regulatory air pollution model AERMOD in Victoria. [Online]

Available at: http://www.epa.vic.gov.au/~/media/Publications/1551.pdf

[Accessed 27 July 2016].

Environmental Resources Management Australia Pty Ltd, 2013. Air Quality Assessment Sancrox Quarry Modification of Development Consent, Sydney: Environmental Resources Management Australia Pty Ltd.

Environmental Resources Management Australia Pty Ltd, 2017. Port Kembla Cement Terminal Updated Air Quality Assessment , Melbourne: Environmental Resources Management Australia Pty Ltd.

Excel Concrete Pty Ltd, 2011. Excel Agitator Dimensions. [Online]

Available at: http://www.excelconcrete.com.au/docs/excelagitatordimensionsaug2011.pdf

[Accessed 12 April 2018].

GHD, 2008. Report on Ulverstone Asphalt Plant Air Quality Assessment. [Online]

Available at: http://epa.tas.gov.au/documents/asphalt_suppliers_ulverstone_2008_dpemp_appendix_c_air_quality_assessment.pdf

[Accessed 28 February 2018].

Government of Ontario, 2017. Regulation 417/06: Air Pollution - Local Air Quality. [Online]

Available at: https://www.ontario.ca/laws/regulation/050419#BK75

[Accessed 28 February 2018].

New South Wales Government, 2017. Protection of the Environment Operations (Clean Air) Regulation 2010. [Online]

Available at: http://www.legislation.nsw.gov.au/maintop/view/inforce/subordleg+428+2010+cd+0+N

[Accessed 21 February 2018].

Northern Arizona University, n.d. Igneous Rocks. [Online]

Available at: http://www2.nau.edu/~gaud/RiodeFlag/ignsrck.htm

[Accessed 28 February 2018].

RitchieSpecs, 2018. Caterpillar 769C Rock truck. [Online]

Available at: http://www.ritchiespecs.com/specification?type=Co&category=Rock+Truck&make=Caterpillar&model=769C&modelid=93321

[Accessed 21 February 2018].

State of NSW and Environment Protection Authority, 2016. Approved Methods for the Modelling and Assessment of Air Pollutants in New South Wales, Sydney: State of NSW and Environment Protection Authority.

UK Department for Environment, Food and Rural Affairs Environment Agency, 2016. Guidance Air emissions risk assessment for your environmental permit. [Online]

Available at: https://www.gov.uk/guidance/air-emissions-risk-assessment-for-your-environmental-permit#calculate-pc-to-air

[Accessed 21 February 2017].

United States Environment Protection Agency, 2011. Section 11.12, AP-42 Compilation of Air Emission Factors. [Online]

Available at: https://www3.epa.gov/ttn/chief/ap42/ch11/final/c11s12.pdf

[Accessed 19 February 2018].

United States Environmental Protection Agency, 1996. Appendix B.2 Generalized Particle Size Distributions. [Online]

Available at: https://www3.epa.gov/ttn/chief/ap42/appendix/appb-2.pdf

[Accessed 21 February 2016].

United States Environmental Protection Agency, 2004. Hot Mix Asphalt Plants. [Online]

Available at: https://www3.epa.gov/ttn/chief/ap42/ch11/final/c11s01.pdf

[Accessed 27 February 2018].

United States Environmental Protection Agency, 2006. Section 11.12 Concrete Batching, Chapter 11: Minteral Products Industry, AP-42 Air Emission Factors and Quantification. [Online]

Available at: https://www3.epa.gov/ttn/chief/ap42/ch11/index.html

[Accessed 21 February 2018].

United States Environmental Protection Agency, 2012. Memorandum. Haul Road Workgroup Final Report Submission to EPA-OAQPS, Research Triangle Park, NC: United States Environmental Protection Agency.

Wojciech Grabowski, Ł. J., 2010. ISSUES OF ENERGY CONSUMPTION DURING HOT MIX ASPHALT (HMA) PRODUCTION. Lithuania , Vilnius Gediminas Technical University .

APPENDIX A AIR QUALITY EMISSION ESTIMATION

Table A 1: TSP emissions for Typical day operations

ACTIVITY	Scenario 2 (Stage 5) TSP Emission	Intensity	Units	Emission factor	Units	Variable 1	Units	Variable 2	Units	Variable 3	Units	Variable 3	Units	Variable 4	Units	Control	Units	Control measure
QUARRY - Drilling rock	22	3750	holes/y	0.59	kg/hole											99	% control	Full dust extraction system, Section B.1.1
QUARRY - Blasting rock	178	30	blasts/y	5.94	kg/blast	900	Area of									0	% control	n/a. Section 6.2.2
QUARRY - Excavators on Quarry Floor	291	530000	t/y	0.00055	kg/t	1.67	average of	5	moisture content (%)							0	% control	n/a
QUARRY - Truck Rear Dumping	78	477000	t/y	0.00055	kg/t	1.67	average of	5	moisture content (%)							70	% control	70% from water sprays, per NPI
QUARRY - FELS	291	530000	t/y	0.00055	kg/t	1.67	average of	5	moisture content (%)							0	% control	n/a
QUARRY - Primary crushing	286	477000	t/y	0.0006	kg/t											0	% control	no control discussed in report
QUARRY - Secondary crushing	179	298125	t/y	0.0006	kg/t											0	% control	no control discussed in report
QUARRY - Tertiary crushing	143	238500	t/y	0.0006	kg/t											0	% control	no control discussed in report
QUARRY - Primary screening	525	477000	t/y	0.0011	kg/t											0	% control	Wet emission factor used
QUARRY - Primary screening	328	298125	t/y	0.0011	kg/t											0	% control	Wet emission factor used
QUARRY - Conveyor Transfer Points (2)	23	954000	t/y	0.00024	kg/t	1.67	average of	9	moisture content (%)							90	% control	90% control from water sprays
QUARRY - Conveyor Drop Points (8)	11	477000	t/y	0.00024	kg/t	1.67	average of	9	moisture content (%)							90	% control	90% control from water sprays
QUARRY - Rock Truck - Loaded, Onsite (unsealed)	10,302	477000	t/y	0.13498	kg/t	37	t/load	68	vehicle gross mass (t)	1.129	km	4.413	kg/VKT	8.0	% silt content	84	% control	Chemical supressant
QUARRY - Rock Truck - Unloaded, Onsite (unsealed)	5,768	477000	t/y	0.07558	kg/t	37	t/load	31	vehicle gross mass (t)	0.902	km	3.093	kg/VKT	8.0	% silt content	84	% control	Chemical supressant
QUARRY - Truck and dog - Loaded, Direct to market (unsealed)	1,096	53000	t/y	0.12921	kg/t	32	t/load	43	vehicle gross mass (t)	1.17	km	3.582	kg/VKT	8.0	% silt content	84	% control	Chemical supressant
QUARRY - Truck and dog - Unoaded, Direct to market (unsealed)	442	53000	t/y	0.05211	kg/t	32	t/load	10	vehicle gross mass (t)	0.902	km	1.874	kg/VKT	8.0	% silt content	84	% control	Chemical supressant
QUARRY - Rock Truck - Loaded, Onsite (sealed)	2,452	477000	t/y	0.05141	kg/t	37	t/load	68	vehicle gross mass (t)	0.43	km	4.413	kg/VKT	8.0	% silt content	90	% control	Sealed
QUARRY - Rock Truck - Unloaded, Onsite (sealed)	1,719	477000	t/y	0.03603	kg/t	37	t/load	31	vehicle gross mass (t)	0.43	km	3.093	kg/VKT	8.0	% silt content	90	% control	Sealed
QUARRY - Truck and dog - Loaded, Direct to market (sealed)	252	53000	t/y	0.04749	kg/t	32	t/load	43	vehicle gross mass (t)	0.43	km	3.582	kg/VKT	8.0	% silt content	90	% control	Sealed
QUARRY - Truck and dog - Unoaded, Direct to market (sealed)	132	53000	t/y	0.02484	kg/t	32	t/load	10	vehicle gross mass (t)	0.43	km	1.874	kg/VKT	8.0	% silt content	90	% control	Sealed
WE - Stockpiles and converyors (STP1-STP10)	964	2.2	ha	0.1	kg/ha/h	8760	h									50	% control	50% control from use of water sprays
WE - Stockpiles and conveyors (STP11)	18	0.04	ha	0.1	kg/ha/h	8760	h									50	% control	50% control from use of water sprays
WE - Stockpiles and conveyors (STP12)	9	0.02	ha	0.1	kg/ha/h	8760	h									50	% control	50% control from use of water sprays
WE - Stockpiles and conveyors (STP13)	13	0.03	ha	0.1	kg/ha/h	8760	h									50	% control	50% control from use of water sprays
WE - Stockpiles and conveyors (STP14)	9	0.02	ha	0.1	kg/ha/h	8760	h									50	% control	50% control from use of water sprays
WE - Stockpiles and conveyors (STP15)	9	0.02	ha	0.1	kg/ha/h	8760	h									50	% control	50% control from use of water sprays
WE - Stockpiles and conveyors (STP16)	13	0.03	ha	0.1	kg/ha/h	8760	h									50	% control	50% control from use of water sprays
WE - Stockpiles and conveyors (STP17)	9	0.02	ha	0.1	kg/ha/h	8760	h									50	% control	50% control from use of water sprays
WE - Stockpiles and conveyors (STP18)	9	0.02	ha	0.1	kg/ha/h	8760	h									50	% control	50% control from use of water sprays
WE - Stockpiles and conveyors (STP19)	26	0.06	ha	0.1	kg/ha/h	8760	h									50	% control	50% control from use of water sprays
WE - Pit	1,862	8.500	ha	0.1	kg/ha/h	8760	h									75	% control	Only 25% of area susceptable to WE at any one time.
CRP - Truck Rear Dumping	12	20000	t/y	0.00198	kg/t	1.67	average of	2	moisture content (%)							70	% control	70% from water sprays, per NPI
CRP - Crushing	12	20000	t/y	0.0006	kg/t											0	% control	no control discussed in report
CRP - Truck and dog - Delivery of Dry Products (loaded)	91	20000	t/y	0.04561	kg/t	32	t/load	43	vehicle gross mass (t)	0.41	km	3.582	kg/VKT	8	% silt content	90	% control	Sealed
CRP - Truck and dog - Delivery of Dry Products (unloaded)	48	20000	t/y	0.02386	kg/t	32	t/load	10	vehicle gross mass (t)	0.41	km	1.874	kg/VKT	8	% silt content	90	% control	Sealed
CBP - Coarse Aggregate - Truck Rear Dumpings	13	21868	t/y	0.00198	kg/t	1.67	average of	2	moisture content (%)							70	% control	70% from water sprays, per NPI
CBP - Sand - Truck Rear Dumping	3	16750	t/y	0.00055	kg/t	1.67	average of	5	moisture content (%)							70	% control	70% from water sprays, per NPI
CBP - Transfer of Aggregate	4	21868	t/y	0.00198	kg/t	1.67	average of	2	moisture content (%)							90	% control	90% control from water sprays
CBP - Transfer of Sand	1	16750	t/y	0.00055	kg/t	1.67	average of	5	moisture content (%)							90	% control	90% control from water sprays
CBP - Loaded weight of a truck and dog - coarse aggregate	100	21868	t/y	0.04561	kg/t	32	t/load	43	vehicle gross mass (t)	0.413	km	3.582	kg/VKT	8	% silt content	90	% control	Sealed
CBP - Unloaded weight of a truck and dog - coarse aggregate	52	21868	t/y	0.02386	kg/t	32	t/load	10	vehicle gross mass (t)	0.413	km	1.874	kg/VKT	8	% silt content	90	% control	Sealed
CBP - Loaded weight of a truck and dog - Sand	76	16750	t/y	0.04561	kg/t	32	t/load	43	vehicle gross mass (t)	0.413	km	3.582	kg/VKT	8	% silt content	90	% control	Sealed
CBP - Unloaded weight of a truck and dog - Sand	40	16750	t/y	0.02386	kg/t	32	t/load	10	vehicle gross mass (t)	0.413	km	1.874	kg/VKT	8	% silt content	90	% control	Sealed
CBP - Loaded weight of Tanker - cement and cement supplement brought onsit	44	6617	t/y	0.06575	kg/t	20	t/load	32	vehicle gross mass (t)	0.413	km	3.152	kg/VKT	8	% silt content	90	% control	Sealed
CBP - Unloaded weight of Tanker - cement and cement supplement brought on	28	6617	t/y	0.04260	kg/t	20	t/load	12	vehicle gross mass (t)	0.413	km	2.042	kg/VKT	8	% silt content	90	% control	Sealed
CBP - Loaded weight of Agitator truck - product taken offsite	310	47200	t/y	0.06575	kg/t	20	t/load	32	vehicle gross mass (t)	0.413	km	3.152	kg/VKT	8	% silt content	90	% control	Sealed
CBP - Unloaded weight of Agitator truck - product taken offsite	201	47200	t/y	0.04260	kg/t	20	t/load	12	vehicle gross mass (t)	0.413	km	2.042	kg/VKT	8	% silt content	90	% control	Sealed
AP - Bitumen Delivery and Storage	-															100	% control	Vapour recover system
AP - High quality aggregate delivery and storage	-															100	% control	Already covered as source : One of the FELs located around the processing plant andstockpile area will b
AP - Truck Load Out	-															100	% control	Vapour recover system
AP - Loaded weight of Tanker - bitumen delivery	19	4000	t/y	0.04733	kg/t	20	t/load	32	vehicle gross mass (t)	0.48	km	1.940	kg/VKT	4	% silt content	90	% control	Sealed
AP - Unloaded weight of Tanker - bitument delivery	12	4000	t/y	0.03067	kg/t	20	t/load	12	vehicle gross mass (t)	0.48	km	1.257	kg/VKT	4	% silt content	90	% control	Sealed
AP - Loaded weight of a truck and dog - asphalt to market	164	50000	t/y	0.03284	kg/t	32	t/load	43	vehicle gross mass (t)	0.48	km	2.205	kg/VKT	4	% silt content	90	% control	Sealed
AP - Unloaded weight of a truck and dog - asphalt to market	86	50000	t/y	0.01718	kg/t	32	t/load	10	vehicle gross mass (t)	0.48	km	1.153	kg/VKT	4	% silt content	90	% control	Sealed
TOTAL TSP EMISSIONS	**28,772**																	

Table A 2: PM_{10} emissions for Typical day operations

ACTIVITY	Scenario 2 (Stage 5) TSP Emissions (kg/y)	Intensity	Units	Emission factor	Units	Variable 1	Units	Variable 2	Units	Variable 3	Units	Variable 3	Units	Variable 4	Units	Control	Units	Control measure
QUARRY - Drilling rock	12	3750	holes/y	0.3068	kg/hole											99	% control	Full dust extraction system, Section B.1.1
QUARRY - Blasting rock	93	30	blasts/y	3.0888	kg/blast	900	Area of blast in square metres									0	% control	n/a. Section 6.2.2
QUARRY - Excavators on Quarry Floor	137	530000	t/y	0.00026	kg/t	1.67	average of (wind speed/2.2)^1.3 in m/s	5	moisture content (%)							0	% control	n/a
QUARRY - Truck Rear Dumping	37	477000	t/y	0.00026	kg/t	1.67	average of (wind speed/2.2)^1.3 in m/s	5	moisture content (%)							70	% control	70% from water sprays, per NPI
QUARRY - FELS	137	530000	t/y	0.00026	kg/t	1.67	average of (wind speed/2.2)^1.3 in m/s	5	moisture content (%)							0	% control	n/a
QUARRY - Primary crushing	129	477000	t/y	0.00027	kg/t											0	% control	no control discussed in report
QUARRY - Secondary crushing	80	298125	t/y	0.00027	kg/t											0	% control	no control discussed in report
QUARRY - Tertiary crushing	64	238500	t/y	0.00027	kg/t											0	% control	no control discussed in report
QUARRY - Primary screening	176	477000	t/y	0.00037	kg/t											0	% control	Wet emission factor used
QUARRY - Primary screening	110	298125	t/y	0.00037	kg/t											0	% control	Wet emission factor used
QUARRY - Conveyor Transfer Points (2)	11	954000	t/y	0.00011	kg/t	1.67	average of (wind speed/2.2)^1.3 in m/s	9	moisture content (%)							90	% control	90% control from water sprays
QUARRY - Conveyor Drop Points (8)	5	477000	t/y	0.00011	kg/t	1.67	average of (wind speed/2.2)^1.3 in m/s	9	moisture content (%)							90	% control	90% control from water sprays
QUARRY - Rock Truck - Loaded, Onsite (unsealed)	2,908	477000	t/y	0.03810	kg/t	37	t/load	68	vehicle gross mass (t)	1.129	km	1.246	kg/VKT	8.0	% silt content	84	% control	Chemical supressant
QUARRY - Rock Truck - Unloaded, Onsite (unsealed)	1,628	477000	t/y	0.02133	kg/t	37	t/load	31	vehicle gross mass (t)	0.902	km	0.873	kg/VKT	8.0	% silt content	84	% control	Chemical supressant
QUARRY - Truck and dog - Loaded, Direct to market (unsealed)	309	53000	t/y	0.03647	kg/t	32	t/load	43	vehicle gross mass (t)	1.17	km	1.011	kg/VKT	8.0	% silt content	84	% control	Chemical supressant
QUARRY - Truck and dog - Unoaded, Direct to market (unsealed)	125	53000	t/y	0.01471	kg/t	32	t/load	10	vehicle gross mass (t)	0.902	km	0.529	kg/VKT	8.0	% silt content	84	% control	Chemical supressant
QUARRY - Rock Truck - Loaded, Onsite (sealed)	692	477000	t/y	0.01451	kg/t	37	t/load	68	vehicle gross mass (t)	0.43	km	1.246	kg/VKT	8.0	% silt content	90	% control	Sealed
QUARRY - Rock Truck - Unloaded, Onsite (sealed)	485	477000	t/y	0.01017	kg/t	37	t/load	31	vehicle gross mass (t)	0.43	km	0.873	kg/VKT	8.0	% silt content	90	% control	Sealed
QUARRY - Truck and dog - Loaded, Direct to market (sealed)	71	53000	t/y	0.01341	kg/t	32	t/load	43	vehicle gross mass (t)	0.43	km	1.011	kg/VKT	8.0	% silt content	90	% control	Sealed
QUARRY - Truck and dog - Unoaded, Direct to market (sealed)	37	53000	t/y	0.00701	kg/t	32	t/load	10	vehicle gross mass (t)	0.43	km	0.529	kg/VKT	8.0	% silt content	90	% control	Sealed
WE - Stockpiles and converyors (STP1-STP10)	482	2.2	ha	0.05	kg/ha/h	8760	h									50	% control	50% control from use of water sprays
WE - Stockpiles and conveyors (STP11)	9	0.04	ha	0.05	kg/ha/h	8760	h									50	% control	50% control from use of water sprays
WE - Stockpiles and conveyors (STP12)	4	0.02	ha	0.05	kg/ha/h	8760	h									50	% control	50% control from use of water sprays
WE - Stockpiles and conveyors (STP13)	7	0.03	ha	0.05	kg/ha/h	8760	h									50	% control	50% control from use of water sprays
WE - Stockpiles and conveyors (STP14)	4	0.02	ha	0.05	kg/ha/h	8760	h									50	% control	50% control from use of water sprays
WE - Stockpiles and conveyors (STP15)	4	0.02	ha	0.05	kg/ha/h	8760	h									50	% control	50% control from use of water sprays
WE - Stockpiles and conveyors (STP16)	7	0.03	ha	0.05	kg/ha/h	8760	h									50	% control	50% control from use of water sprays
WE - Stockpiles and conveyors (STP17)	4	0.02	ha	0.05	kg/ha/h	8760	h									50	% control	50% control from use of water sprays
WE - Stockpiles and conveyors (STP18)	4	0.02	ha	0.05	kg/ha/h	8760	h									50	% control	50% control from use of water sprays
WE - Stockpiles and conveyors (STP19)	13	0.06	ha	0.05	kg/ha/h	8760	h									50	% control	50% control from use of water sprays
WE - Pit	931	8,500	ha	0.05	kg/ha/h	8760	h									75	% control	Only 25% of area susceptable to WE at any one time.
CRP - Truck Rear Dumping	6	20000	t/y	0.00094	kg/t	1.67	average of (wind speed/2.2)^1.3 in m/s	2	moisture content (%)							70	% control	70% from water sprays, per NPI
CRP - Crushing	5	20000	t/y	0.00027	kg/t											0	% control	no control discussed in report
CRP - Truck and dog - Delivery of Dry Products	26	20000	t/y	0.01288	kg/t	32	t/load	43	vehicle gross mass (t)	0.413	km	1.011	kg/VKT	8	% silt content	90	% control	Sealed
CRP - Truck and dog - Delivery of Dry Products	13	20000	t/y	0.00674	kg/t	32	t/load	10	vehicle gross mass (t)	0.413	km	0.529	kg/VKT	8	% silt content	90	% control	Sealed
CBP - Coarse Aggregate - Truck Rear Dumpings	6	21868	t/y	0.00094	kg/t	1.67	average of (wind speed/2.2)^1.3 in m/s	2	moisture content (%)							70	% control	70% from water sprays, per NPI
CBP - Sand - Truck Rear Dumping	1	16750	t/y	0.00026	kg/t	1.67	average of (wind speed/2.2)^1.3 in m/s	5	moisture content (%)							70	% control	70% from water sprays, per NPI
CBP - Transfer of Aggregate	2	21868	t/y	0.00094	kg/t	1.67	average of (wind speed/2.2)^1.3 in m/s	2	moisture content (%)							90	% control	90% control from water sprays
CBP - Transfer of Sand	0	16750	t/y	0.00026	kg/t	1.67	average of (wind speed/2.2)^1.3 in m/s	5	moisture content (%)							90	% control	90% control from water sprays
CBP - Loaded weight of a truck and dog - coarse aggregate	28	21868	t/y	0.01288	kg/t	32	t/load	43	vehicle gross mass (t)	0.413	km	1.011	kg/VKT	8	% silt content	90	% control	Sealed
CBP - Unloaded weight of a truck and dog - coarse aggregate	15	21868	t/y	0.00674	kg/t	32	t/load	10	vehicle gross mass (t)	0.413	km	0.529	kg/VKT	8	% silt content	90	% control	Sealed
CBP - Loaded weight of a truck and dog - Sand	22	16750	t/y	0.01288	kg/t	32	t/load	43	vehicle gross mass (t)	0.413	km	1.011	kg/VKT	8	% silt content	90	% control	Sealed
CBP - Unloaded weight of a truck and dog - Sand	11	16750	t/y	0.00674	kg/t	32	t/load	10	vehicle gross mass (t)	0.413	km	0.529	kg/VKT	8	% silt content	90	% control	Sealed
CBP - Loaded weight of Tanker - cement and cement supplement brought onsit	12	6617	t/y	0.01856	kg/t	20	t/load	32	vehicle gross mass (t)	0.413	km	0.890	kg/VKT	8	% silt content	90	% control	Sealed
CBP - Unloaded weight of Tanker - cement and cement supplement brought on	8	6617	t/y	0.01203	kg/t	20	t/load	12	vehicle gross mass (t)	0.413	km	0.577	kg/VKT	8	% silt content	90	% control	Sealed
CBP - Loaded weight of Agitator truck - product taken offsite	88	47200	t/y	0.01856	kg/t	20	t/load	32	vehicle gross mass (t)	0.413	km	0.890	kg/VKT	8	% silt content	90	% control	Sealed
CBP - Unloaded weight of Agitator truck - product taken offsite	57	47200	t/y	0.01203	kg/t	20	t/load	12	vehicle gross mass (t)	0.413	km	0.577	kg/VKT	8	% silt content	90	% control	Sealed
AP - Bitumen Delivery and Storage	-															100	% control	Vapour recover system
AP - High quality aggregate delivery and storage	-															100	% control	Already covered as source : One of the FELs located around the processing plant andstockpile area will b
AP - Truck Load Out	-															100	% control	Vapour recover system
AP - Loaded weight of Tanker - bitumen delivery	5	4000	t/y	0.01163	kg/t	20	t/load	32	vehicle gross mass (t)	0.483	km	0.477	kg/VKT	4	% silt content	90	% control	Sealed
AP - Unloaded weight of Tanker - bitument delivery	3	4000	t/y	0.00754	kg/t	20	t/load	12	vehicle gross mass (t)	0.483	km	0.309	kg/VKT	4	% silt content	90	% control	Sealed
AP - Loaded weight of a truck and dog - asphalt to market	40	50000	t/y	0.00807	kg/t	32	t/load	43	vehicle gross mass (t)	0.483	km	0.542	kg/VKT	4	% silt content	90	% control	Sealed
AP - Unloaded weight of a truck and dog - asphalt to market	21	50000	t/y	0.00422	kg/t	32	t/load	10	vehicle gross mass (t)	0.483	km	0.283	kg/VKT	4	% silt content	90	% control	Sealed
TOTAL TSP EMISSIONS	**9,088**																	

Table A 3: $PM_{2.5}$ emissions for Typical day operations

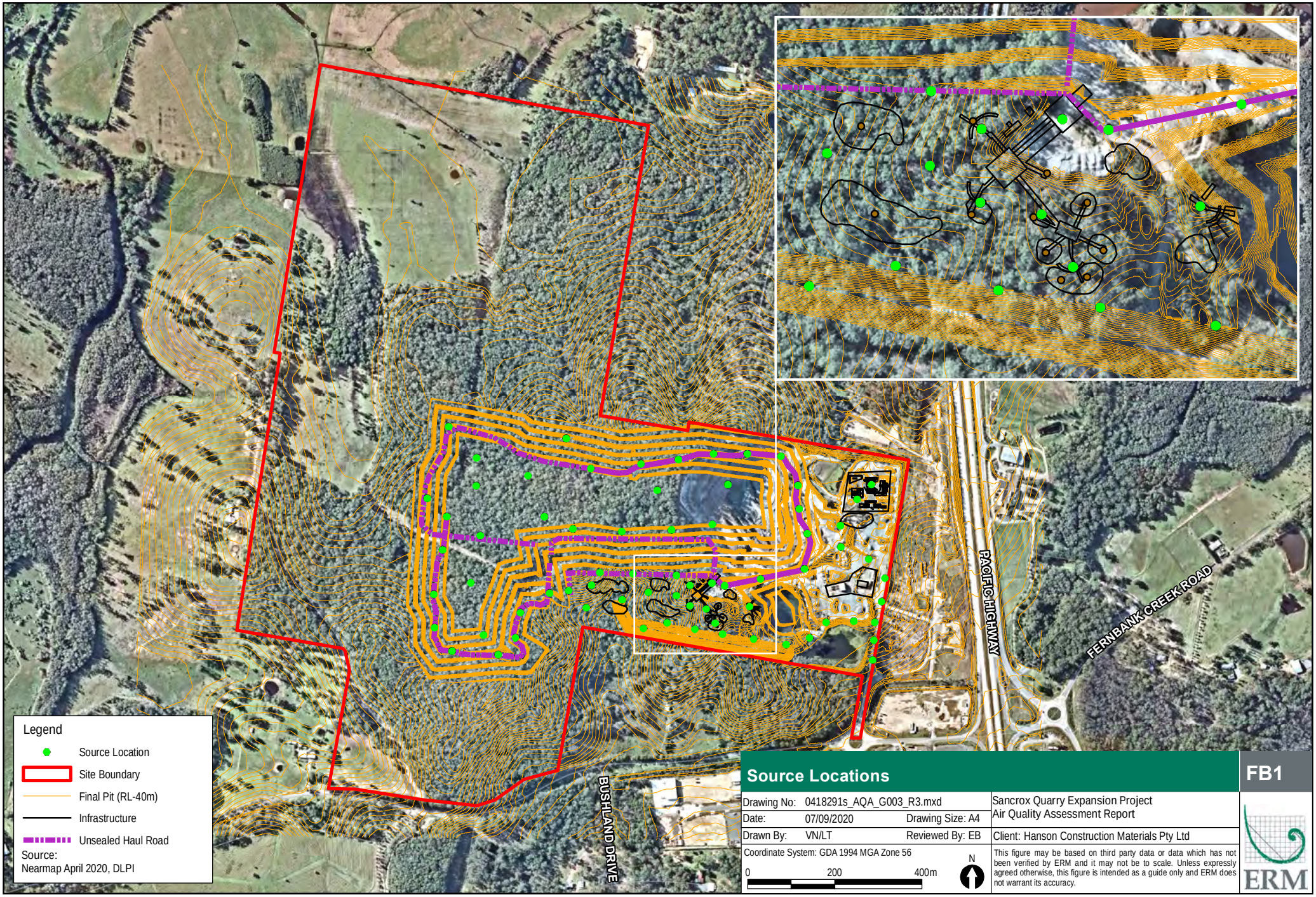
ACTIVITY	Scenario 2 (Stage 5) TSP Emissions (kg/y)	Intensity	Units	Emission factor	Units	Variable 1	Units	Variable 2	Units	Variable 3	Units	Variable 3	Units	Variable 4	Units	Control	Units	Control measure
QUARRY - Drilling rock	1	3750	holes/y	0.0177	kg/hole											99	% control	Full dust extraction system, Section B.1.1
QUARRY - Blasting rock	5	30	blasts/y	0.1782	kg/blast	900	Area of blast in square metres									0	% control	n/a. Section 6.2.2
QUARRY - Excavators on Quarry Floor	21	530000	t/y	0.00004	kg/t	1.67	average of (wind speed/2.2)^1.3 in m/s	5	moisture content (%)							0	% control	n/a
QUARRY - Truck Rear Dumping	6	477000	t/y	0.00004	kg/t	1.67	average of (wind speed/2.2)^1.3 in m/s	5	moisture content (%)							70	% control	70% from water sprays, per NPI
QUARRY - FELS	21	530000	t/y	0.00004	kg/t	1.67	average of (wind speed/2.2)^1.3 in m/s	5	moisture content (%)							0	% control	n/a
QUARRY - Primary crushing	24	477000	t/y	0.00005	kg/t											0	% control	no control discussed in report
QUARRY - Secondary crushing	15	298125	t/y	0.00005	kg/t											0	% control	no control discussed in report
QUARRY - Tertiary crushing	12	238500	t/y	0.00005	kg/t											0	% control	no control discussed in report
QUARRY - Primary screening	12	477000	t/y	0.000025	kg/t											0	% control	Wet emission factor used
QUARRY - Primary screening	7	298125	t/y	0.000025	kg/t											0	% control	Wet emission factor used
QUARRY - Conveyor Transfer Points (2)	2	954000	t/y	0.00002	kg/t	1.67	average of (wind speed/2.2)^1.3 in m/s	9	moisture content (%)							90	% control	90% control from water sprays
QUARRY - Conveyor Drop Points (8)	1	477000	t/y	0.00002	kg/t	1.67	average of (wind speed/2.2)^1.3 in m/s	9	moisture content (%)							90	% control	90% control from water sprays
QUARRY - Rock Truck - Loaded, Onsite (unsealed)	291	477000	t/y	0.00381	kg/t	37	t/load	68	vehicle gross mass (t)	1.129	km	0.125	kg/VKT	8.0	% silt content	84	% control	Chemical supressant
QUARRY - Rock Truck - Unloaded, Onsite (unsealed)	163	477000	t/y	0.00213	kg/t	37	t/load	31	vehicle gross mass (t)	0.902	km	0.087	kg/VKT	8.0	% silt content	84	% control	Chemical supressant
QUARRY - Truck and dog - Loaded, Direct to market (unsealed)	31	53000	t/y	0.00365	kg/t	32	t/load	43	vehicle gross mass (t)	1.17	km	0.101	kg/VKT	8.0	% silt content	84	% control	Chemical supressant
QUARRY - Truck and dog - Unoaded, Direct to market (unsealed)	12	53000	t/y	0.00147	kg/t	32	t/load	10	vehicle gross mass (t)	0.902	km	0.053	kg/VKT	8.0	% silt content	84	% control	Chemical supressant
QUARRY - Rock Truck - Loaded, Onsite (sealed)	69	477000	t/y	0.00145	kg/t	37	t/load	68	vehicle gross mass (t)	0.43	km	0.125	kg/VKT	8.0	% silt content	90	% control	Sealed
QUARRY - Rock Truck - Unloaded, Onsite (sealed)	49	477000	t/y	0.00102	kg/t	37	t/load	31	vehicle gross mass (t)	0.43	km	0.087	kg/VKT	8.0	% silt content	90	% control	Sealed
QUARRY - Truck and dog - Loaded, Direct to market (sealed)	7	53000	t/y	0.00134	kg/t	32	t/load	43	vehicle gross mass (t)	0.43	km	0.101	kg/VKT	8.0	% silt content	90	% control	Sealed
QUARRY - Truck and dog - Unoaded, Direct to market (sealed)	4	53000	t/y	0.00070	kg/t	32	t/load	10	vehicle gross mass (t)	0.43	km	0.053	kg/VKT	8.0	% silt content	90	% control	Sealed
WE - Stockpiles and converyors (STP1-STP10)	72	2.2	ha	0.0075	kg/ha/h	8760	h									50	% control	50% control from use of water sprays
WE - Stockpiles and conveyors (STP11)	1	0.04	ha	0.0075	kg/ha/h	8760	h									50	% control	50% control from use of water sprays
WE - Stockpiles and conveyors (STP12)	1	0.02	ha	0.0075	kg/ha/h	8760	h									50	% control	50% control from use of water sprays
WE - Stockpiles and conveyors (STP13)	1	0.03	ha	0.0075	kg/ha/h	8760	h									50	% control	50% control from use of water sprays
WE - Stockpiles and conveyors (STP14)	1	0.02	ha	0.0075	kg/ha/h	8760	h									50	% control	50% control from use of water sprays
WE - Stockpiles and conveyors (STP15)	1	0.02	ha	0.0075	kg/ha/h	8760	h									50	% control	50% control from use of water sprays
WE - Stockpiles and conveyors (STP16)	1	0.03	ha	0.0075	kg/ha/h	8760	h									50	% control	50% control from use of water sprays
WE - Stockpiles and conveyors (STP17)	1	0.02	ha	0.0075	kg/ha/h	8760	h									50	% control	50% control from use of water sprays
WE - Stockpiles and conveyors (STP18)	1	0.02	ha	0.0075	kg/ha/h	8760	h									50	% control	50% control from use of water sprays
WE - Stockpiles and conveyors (STP19)	2	0.06	ha	0.0075	kg/ha/h	8760	h									50	% control	50% control from use of water sprays
WE - Pit	140	8.500	ha	0.0075	kg/ha/h	8760	h									75	% control	Only 25% of area susceptable to WE at any one time.
CRP - Truck Rear Dumping	1	20000	t/y	0.00014	kg/t	1.67	average of (wind speed/2.2)^1.3 in m/s	2	moisture content (%)							70	% control	70% from water sprays, per NPI
CRP - Crushing	1	20000	t/y	0.00005	kg/t											0	% control	no control discussed in report
CRP - Truck and dog - Delivery of Dry Products	3	20000	t/y	0.00129	kg/t	32	t/load	43	vehicle gross mass (t)	0.413	km	0.101	kg/VKT	8	% silt content	90	% control	Sealed
CRP - Truck and dog - Delivery of Dry Products	1	20000	t/y	0.00067	kg/t	32	t/load	10	vehicle gross mass (t)	0.413	km	0.053	kg/VKT	8	% silt content	90	% control	Sealed
CBP - Coarse Aggregate - Truck Rear Dumpings	1	21868	t/y	0.00014	kg/t	1.67	average of (wind speed/2.2)^1.3 in m/s	2	moisture content (%)							70	% control	70% from water sprays, per NPI
CBP - Sand - Truck Rear Dumping	0	16750	t/y	0.00004	kg/t	1.67	average of (wind speed/2.2)^1.3 in m/s	5	moisture content (%)							70	% control	70% from water sprays, per NPI
CBP - Transfer of Aggregate	0	21868	t/y	0.00014	kg/t	1.67	average of (wind speed/2.2)^1.3 in m/s	2	moisture content (%)							90	% control	90% control from water sprays
CBP - Transfer of Sand	0	16750	t/y	0.00004	kg/t	1.67	average of (wind speed/2.2)^1.3 in m/s	5	moisture content (%)							90	% control	90% control from water sprays
CBP - Loaded weight of a truck and dog - coarse aggregate	3	21868	t/y	0.00129	kg/t	32	t/load	43	vehicle gross mass (t)	0.413	km	0.101	kg/VKT	8	% silt content	90	% control	Sealed
CBP - Unloaded weight of a truck and dog - coarse aggregate	1	21868	t/y	0.00067	kg/t	32	t/load	10	vehicle gross mass (t)	0.413	km	0.053	kg/VKT	8	% silt content	90	% control	Sealed
CBP - Loaded weight of a truck and dog - Sand	2	16750	t/y	0.00129	kg/t	32	t/load	43	vehicle gross mass (t)	0.413	km	0.101	kg/VKT	8	% silt content	90	% control	Sealed
CBP - Unloaded weight of a truck and dog - Sand	1	16750	t/y	0.00067	kg/t	32	t/load	10	vehicle gross mass (t)	0.413	km	0.053	kg/VKT	8	% silt content	90	% control	Sealed
CBP - Loaded weight of Tanker - cement and cement supplement brought onsit	1	6617	t/y	0.00186	kg/t	20	t/load	32	vehicle gross mass (t)	0.413	km	0.089	kg/VKT	8	% silt content	90	% control	Sealed
CBP - Unloaded weight of Tanker - cement and cement supplement brought on	1	6617	t/y	0.00120	kg/t	20	t/load	12	vehicle gross mass (t)	0.413	km	0.058	kg/VKT	8	% silt content	90	% control	Sealed
CBP - Loaded weight of Agitator truck - product taken offsite	9	47200	t/y	0.00186	kg/t	20	t/load	32	vehicle gross mass (t)	0.413	km	0.089	kg/VKT	8	% silt content	90	% control	Sealed
CBP - Unloaded weight of Agitator truck - product taken offsite	6	47200	t/y	0.00120	kg/t	20	t/load	12	vehicle gross mass (t)	0.413	km	0.058	kg/VKT	8	% silt content	90	% control	Sealed
AP - Bitumen Delivery and Storage	-															100	% control	Vapour recover system
AP - High quality aggregate delivery and storage	-															100	% control	Already covered as source : One of the FELs located around the processing plant andstockpile area will b
AP - Truck Load Out	-															100	% control	Vapour recover system
AP - Loaded weight of Tanker - bitumen delivery	0	4000	t/y	0.00116	kg/t	20	t/load	32	vehicle gross mass (t)	0.483	km	0.048	kg/VKT	4	% silt content	90	% control	Sealed
AP - Unloaded weight of Tanker - bitument delivery	0	4000	t/y	0.00075	kg/t	20	t/load	12	vehicle gross mass (t)	0.483	km	0.031	kg/VKT	4	% silt content	90	% control	Sealed
AP - Loaded weight of a truck and dog - asphalt to market	4	50000	t/y	0.00081	kg/t	32	t/load	43	vehicle gross mass (t)	0.483	km	0.054	kg/VKT	4	% silt content	90	% control	Sealed
AP - Unloaded weight of a truck and dog - asphalt to market	2	50000	t/y	0.00042	kg/t	32	t/load	10	vehicle gross mass (t)	0.483	km	0.028	kg/VKT	4	% silt content	90	% control	Sealed
TOTAL TSP EMISSIONS	**1,010**																	

Table A 4: PM_{10} emissions for Maximum day operations

ACTIVITY	Scenario 2 (Stage 5) TSP Emissions (kg/y)	Intensity	Units	Emission factor	Units	Variable 1	Units	Variable 2	Units	Variable 3	Units	Variable 3	Units	Variable 4	Units	Control	Units	Control measure
QUARRY - Drilling rock	-	45625	holes/y	0.3068	kg/hole											100	% control	Drilling will not occur on the same day as a blast.
QUARRY - Blasting rock	1,127	365	blasts/y	3.0888	kg/blast	900	Area of blast in square metres									0	% control	n/a. Section 6.2.2
QUARRY - Excavators on Quarry Floor	246	949000	t/y	0.00026	kg/t	1.67	average of (wind speed/2.2)^1.3 in m/s	5	moisture content (%)							0	% control	n/a
QUARRY - Truck Rear Dumping	66	854100	t/y	0.00026	kg/t	1.67	average of (wind speed/2.2)^1.3 in m/s	5	moisture content (%)							70	% control	70% from water sprays, per NPI
QUARRY - FELS	246	949000	t/y	0.00026	kg/t	1.67	average of (wind speed/2.2)^1.3 in m/s	5	moisture content (%)							0	% control	n/a
QUARRY - Primary crushing	231	854100	t/y	0.00027	kg/t											0	% control	no control discussed in report
QUARRY - Secondary crushing	231	854100	t/y	0.00027	kg/t											0	% control	no control discussed in report
QUARRY - Tertiary crushing	144	533813	t/y	0.00027	kg/t											0	% control	no control discussed in report
QUARRY - Primary screening	316	854100	t/y	0.00037	kg/t											0	% control	Wet emission factor used
QUARRY - Primary screening	316	854100	t/y	0.00037	kg/t											0	% control	Wet emission factor used
QUARRY - Conveyor Transfer Points (2)	19	1708200	t/y	0.00011	kg/t	1.67	average of (wind speed/2.2)^1.3 in m/s	9	moisture content (%)							90	% control	90% control from water sprays
QUARRY - Conveyor Drop Points (8)	10	854100	t/y	0.00011	kg/t	1.67	average of (wind speed/2.2)^1.3 in m/s	9	moisture content (%)							90	% control	90% control from water sprays
QUARRY - Rock Truck - Loaded, Onsite (unsealed)	5,207	854100	t/y	0.03810	kg/t	37	t/load	68	vehicle gross mass (t)	1.129	km	1.246	kg/VKT	8.0	% silt content	84	% control	Chemical supressant
QUARRY - Rock Truck - Unloaded, Onsite (unsealed)	2,915	854100	t/y	0.02133	kg/t	37	t/load	31	vehicle gross mass (t)	0.902	km	0.873	kg/VKT	8.0	% silt content	84	% control	Chemical supressant
QUARRY - Truck and dog - Loaded, Direct to market (unsealed)	554	94900	t/y	0.03647	kg/t	32	t/load	43	vehicle gross mass (t)	1.17	km	1.011	kg/VKT	8.0	% silt content	84	% control	Chemical supressant
QUARRY - Truck and dog - Unoaded, Direct to market (unsealed)	223	94900	t/y	0.01471	kg/t	32	t/load	10	vehicle gross mass (t)	0.902	km	0.529	kg/VKT	8.0	% silt content	84	% control	Chemical supressant
QUARRY - Rock Truck - Loaded, Onsite (sealed)	1,239	854100	t/y	0.01451	kg/t	37	t/load	68	vehicle gross mass (t)	0.43	km	1.246	kg/VKT	8.0	% silt content	90	% control	Sealed
QUARRY - Rock Truck - Unloaded, Onsite (sealed)	869	854100	t/y	0.01017	kg/t	37	t/load	31	vehicle gross mass (t)	0.43	km	0.873	kg/VKT	8.0	% silt content	90	% control	Sealed
QUARRY - Truck and dog - Loaded, Direct to market (sealed)	127	94900	t/y	0.01341	kg/t	32	t/load	43	vehicle gross mass (t)	0.43	km	1.011	kg/VKT	8.0	% silt content	90	% control	Sealed
QUARRY - Truck and dog - Unoaded, Direct to market (sealed)	67	94900	t/y	0.00701	kg/t	32	t/load	10	vehicle gross mass (t)	0.43	km	0.529	kg/VKT	8.0	% silt content	90	% control	Sealed
WE - Stockpiles and converyors (STP1-STP10)	482	2.2	ha	0.05	kg/ha/h	8760	h									50	% control	50% control from use of water sprays
WE - Stockpiles and conveyors (STP11)	9	0.04	ha	0.05	kg/ha/h	8760	h									50	% control	50% control from use of water sprays
WE - Stockpiles and conveyors (STP12)	4	0.02	ha	0.05	kg/ha/h	8760	h									50	% control	50% control from use of water sprays
WE - Stockpiles and conveyors (STP13)	7	0.03	ha	0.05	kg/ha/h	8760	h									50	% control	50% control from use of water sprays
WE - Stockpiles and conveyors (STP14)	4	0.02	ha	0.05	kg/ha/h	8760	h									50	% control	50% control from use of water sprays
WE - Stockpiles and conveyors (STP15)	4	0.02	ha	0.05	kg/ha/h	8760	h									50	% control	50% control from use of water sprays
WE - Stockpiles and conveyors (STP16)	7	0.03	ha	0.05	kg/ha/h	8760	h									50	% control	50% control from use of water sprays
WE - Stockpiles and conveyors (STP17)	4	0.02	ha	0.05	kg/ha/h	8760	h									50	% control	50% control from use of water sprays
WE - Stockpiles and conveyors (STP18)	4	0.02	ha	0.05	kg/ha/h	8760	h									50	% control	50% control from use of water sprays
WE - Stockpiles and conveyors (STP19)	13	0.06	ha	0.05	kg/ha/h	8760	h									50	% control	50% control from use of water sprays
WE - Pit	931	8.500	ha	0.05	kg/ha/h	8760	h									75	% control	Only 25% of area susceptable to WE at any one time.
CRP - Truck Rear Dumping	6	20000	t/y	0.00094	kg/t	1.67	average of (wind speed/2.2)^1.3 in m/s	2	moisture content (%)							70	% control	70% from water sprays, per NPI
CRP - Crushing	5	20000	t/y	0.00027	kg/t											0	% control	no control discussed in report
CRP - Truck and dog - Delivery of Dry Products	26	20000	t/y	0.01288	kg/t	32	t/load	43	vehicle gross mass (t)	0.413	km	1.011	kg/VKT	8	% silt content	90	% control	Sealed
CRP - Truck and dog - Delivery of Dry Products	13	20000	t/y	0.00674	kg/t	32	t/load	10	vehicle gross mass (t)	0.413	km	0.529	kg/VKT	8	% silt content	90	% control	Sealed
CBP - Coarse Aggregate - Truck Rear Dumpings	6	21868	t/y	0.00094	kg/t	1.67	average of (wind speed/2.2)^1.3 in m/s	2	moisture content (%)							70	% control	70% from water sprays, per NPI
CBP - Sand - Truck Rear Dumping	1	16750	t/y	0.00026	kg/t	1.67	average of (wind speed/2.2)^1.3 in m/s	5	moisture content (%)							70	% control	70% from water sprays, per NPI
CBP - Transfer of Aggregate	2	21868	t/y	0.00094	kg/t	1.67	average of (wind speed/2.2)^1.3 in m/s	2	moisture content (%)							90	% control	90% control from water sprays
CBP - Transfer of Sand	0	16750	t/y	0.00026	kg/t	1.67	average of (wind speed/2.2)^1.3 in m/s	5	moisture content (%)							90	% control	90% control from water sprays
CBP - Loaded weight of a truck and dog - coarse aggregate	28	21868	t/y	0.01288	kg/t	32	t/load	43	vehicle gross mass (t)	0.413	km	1.011	kg/VKT	8	% silt content	90	% control	Sealed
CBP - Unloaded weight of a truck and dog - coarse aggregate	15	21868	t/y	0.00674	kg/t	32	t/load	10	vehicle gross mass (t)	0.413	km	0.529	kg/VKT	8	% silt content	90	% control	Sealed
CBP - Loaded weight of a truck and dog - Sand	22	16750	t/y	0.01288	kg/t	32	t/load	43	vehicle gross mass (t)	0.413	km	1.011	kg/VKT	8	% silt content	90	% control	Sealed
CBP - Unloaded weight of a truck and dog - Sand	11	16750	t/y	0.00674	kg/t	32	t/load	10	vehicle gross mass (t)	0.413	km	0.529	kg/VKT	8	% silt content	90	% control	Sealed
CBP - Loaded weight of Tanker - cement and cement supplement brought onsit	12	6617	t/y	0.01856	kg/t	20	t/load	32	vehicle gross mass (t)	0.413	km	0.890	kg/VKT	8	% silt content	90	% control	Sealed
CBP - Unloaded weight of Tanker - cement and cement supplement brought on	8	6617	t/y	0.01203	kg/t	20	t/load	12	vehicle gross mass (t)	0.413	km	0.577	kg/VKT	8	% silt content	90	% control	Sealed
CBP - Loaded weight of Agitator truck - product taken offsite	88	47200	t/y	0.01856	kg/t	20	t/load	32	vehicle gross mass (t)	0.413	km	0.890	kg/VKT	8	% silt content	90	% control	Sealed
CBP - Unloaded weight of Agitator truck - product taken offsite	57	47200	t/y	0.01203	kg/t	20	t/load	12	vehicle gross mass (t)	0.413	km	0.577	kg/VKT	8	% silt content	90	% control	Sealed
AP - Bitumen Delivery and Storage	-															100	% control	Vapour recover system
AP - High quality aggregate delivery and storage	-															100	% control	Already covered as source : One of the FELs located around the processing plant andstockpile area will b
AP - Truck Load Out	-															100	% control	Vapour recover system
AP - Loaded weight of Tanker - bitumen delivery	5	4000	t/y	0.01163	kg/t	20	t/load	32	vehicle gross mass (t)	0.483	km	0.477	kg/VKT	4	% silt content	90	% control	Sealed
AP - Unloaded weight of Tanker - bitument delivery	3	4000	t/y	0.00754	kg/t	20	t/load	12	vehicle gross mass (t)	0.483	km	0.309	kg/VKT	4	% silt content	90	% control	Sealed
AP - Loaded weight of a truck and dog - asphalt to market	40	50000	t/y	0.00807	kg/t	32	t/load	43	vehicle gross mass (t)	0.483	km	0.542	kg/VKT	4	% silt content	90	% control	Sealed
AP - Unloaded weight of a truck and dog - asphalt to market	21	50000	t/y	0.00422	kg/t	32	t/load	10	vehicle gross mass (t)	0.483	km	0.283	kg/VKT	4	% silt content	90	% control	Sealed
TOTAL TSP EMISSIONS	**15,993**																	

Table A 5: $PM_{2.5}$ emissions for Maximum day operations

ACTIVITY	Scenario 2 (Stage 5) TSP Emissions (kg/y)	Intensity	Units	Emission factor	Units	Variable 1	Units	Variable 2	Units	Variable 3	Units	Variable 3	Units	Variable 4	Units	Control	Units	Control measure
QUARRY - Drilling rock	-	45625	holes/y	0.0177	kg/hole											100	% control	Drilling will not occur on the same day as a blast.
QUARRY - Blasting rock	65	365	blasts/y	0.1782	kg/blast	900	Area of blast in square metres									0	% control	n/a. Section 6.2.2
QUARRY - Excavators on Quarry Floor	37	949000	t/y	0.00004	kg/t	1.67	average of (wind speed/2.2)^1.3 in m/s	5	moisture content (%)							0	% control	n/a
QUARRY - Truck Rear Dumping	10	854100	t/y	0.00004	kg/t	1.67	average of (wind speed/2.2)^1.3 in m/s	5	moisture content (%)							70	% control	70% from water sprays, per NPI
QUARRY - FELS	37	949000	t/y	0.00004	kg/t	1.67	average of (wind speed/2.2)^1.3 in m/s	5	moisture content (%)							0	% control	n/a
QUARRY - Primary crushing	43	854100	t/y	0.00005	kg/t											0	% control	no control discussed in report
QUARRY - Secondary crushing	43	854100	t/y	0.00005	kg/t											0	% control	no control discussed in report
QUARRY - Tertiary crushing	27	533813	t/y	0.00005	kg/t											0	% control	no control discussed in report
QUARRY - Primary screening	21	854100	t/y	0.000025	kg/t											0	% control	Wet emission factor used
QUARRY - Primary screening	21	854100	t/y	0.000025	kg/t											0	% control	Wet emission factor used
QUARRY - Conveyor Transfer Points (2)	3	1708200	t/y	0.00002	kg/t	1.67	average of (wind speed/2.2)^1.3 in m/s	9	moisture content (%)							90	% control	90% control from water sprays
QUARRY - Conveyor Drop Points (8)	1	854100	t/y	0.00002	kg/t	1.67	average of (wind speed/2.2)^1.3 in m/s	9	moisture content (%)							90	% control	90% control from water sprays
QUARRY - Rock Truck - Loaded, Onsite (unsealed)	521	854100	t/y	0.00381	kg/t	37	t/load	68	vehicle gross mass (t)	1.129	km	0.125	kg/VKT	8.0	% silt content	84	% control	Assumes Level 2 watering.
QUARRY - Rock Truck - Unloaded, Onsite (unsealed)	292	854100	t/y	0.00213	kg/t	37	t/load	31	vehicle gross mass (t)	0.902	km	0.087	kg/VKT	8.0	% silt content	84	% control	Assumes Level 2 watering.
QUARRY - Truck and dog - Loaded, Direct to market (unsealed)	55	94900	t/y	0.00365	kg/t	32	t/load	43	vehicle gross mass (t)	1.17	km	0.101	kg/VKT	8.0	% silt content	84	% control	Assumes Level 2 watering.
QUARRY - Truck and dog - Unoaded, Direct to market (unsealed)	22	94900	t/y	0.00147	kg/t	32	t/load	10	vehicle gross mass (t)	0.902	km	0.053	kg/VKT	8.0	% silt content	84	% control	Assumes Level 2 watering.
QUARRY - Rock Truck - Loaded, Onsite (sealed)	124	854100	t/y	0.00145	kg/t	37	t/load	68	vehicle gross mass (t)	0.43	km	0.125	kg/VKT	8.0	% silt content	90	% control	Sealed
QUARRY - Rock Truck - Unloaded, Onsite (sealed)	87	854100	t/y	0.00102	kg/t	37	t/load	31	vehicle gross mass (t)	0.43	km	0.087	kg/VKT	8.0	% silt content	90	% control	Sealed
QUARRY - Truck and dog - Loaded, Direct to market (sealed)	13	94900	t/y	0.00134	kg/t	32	t/load	43	vehicle gross mass (t)	0.43	km	0.101	kg/VKT	8.0	% silt content	90	% control	Sealed
QUARRY - Truck and dog - Unoaded, Direct to market (sealed)	7	94900	t/y	0.00070	kg/t	32	t/load	10	vehicle gross mass (t)	0.43	km	0.053	kg/VKT	8.0	% silt content	90	% control	Sealed
WE - Stockpiles and converyors (STP1-STP10)	72	2.2	ha	0.0075	kg/ha/h	8760	h									50	% control	50% control from use of water sprays
WE - Stockpiles and conveyors (STP11)	1	0.04	ha	0.0075	kg/ha/h	8760	h									50	% control	50% control from use of water sprays
WE - Stockpiles and conveyors (STP12)	1	0.02	ha	0.0075	kg/ha/h	8760	h									50	% control	50% control from use of water sprays
WE - Stockpiles and conveyors (STP13)	1	0.03	ha	0.0075	kg/ha/h	8760	h									50	% control	50% control from use of water sprays
WE - Stockpiles and conveyors (STP14)	1	0.02	ha	0.0075	kg/ha/h	8760	h									50	% control	50% control from use of water sprays
WE - Stockpiles and conveyors (STP15)	1	0.02	ha	0.0075	kg/ha/h	8760	h									50	% control	50% control from use of water sprays
WE - Stockpiles and conveyors (STP16)	1	0.03	ha	0.0075	kg/ha/h	8760	h									50	% control	50% control from use of water sprays
WE - Stockpiles and conveyors (STP17)	1	0.02	ha	0.0075	kg/ha/h	8760	h									50	% control	50% control from use of water sprays
WE - Stockpiles and conveyors (STP18)	1	0.02	ha	0.0075	kg/ha/h	8760	h									50	% control	50% control from use of water sprays
WE - Stockpiles and conveyors (STP19)	2	0.06	ha	0.0075	kg/ha/h	8760	h									50	% control	50% control from use of water sprays
WE - Pit	140	8,500	ha	0.0075	kg/ha/h	8760	h									75	% control	Only 25% of area susceptable to WE at any one time.
CRP - Truck Rear Dumping	1	20000	t/y	0.00014	kg/t	1.67	average of (wind speed/2.2)^1.3 in m/s	2	moisture content (%)							70	% control	70% from water sprays, per NPI
CRP - Crushing	1	20000	t/y	0.00005	kg/t											0	% control	no control discussed in report
CRP - Truck and dog - Delivery of Dry Products	3	20000	t/y	0.00129	kg/t	32	t/load	43	vehicle gross mass (t)	0.413	km	0.101	kg/VKT	8	% silt content	90	% control	Sealed
CRP - Truck and dog - Delivery of Dry Products	1	20000	t/y	0.00067	kg/t	32	t/load	10	vehicle gross mass (t)	0.413	km	0.053	kg/VKT	8	% silt content	90	% control	Sealed
CBP - Coarse Aggregate - Truck Rear Dumpings	1	21868	t/y	0.00014	kg/t	1.67	average of (wind speed/2.2)^1.3 in m/s	2	moisture content (%)							70	% control	70% from water sprays, per NPI
CBP - Sand - Truck Rear Dumping	0	16750	t/y	0.00004	kg/t	1.67	average of (wind speed/2.2)^1.3 in m/s	5	moisture content (%)							70	% control	70% from water sprays, per NPI
CBP - Transfer of Aggregate	0	21868	t/y	0.00014	kg/t	1.67	average of (wind speed/2.2)^1.3 in m/s	2	moisture content (%)							90	% control	90% control from water sprays
CBP - Transfer of Sand	0	16750	t/y	0.00004	kg/t	1.67	average of (wind speed/2.2)^1.3 in m/s	5	moisture content (%)							90	% control	90% control from water sprays
CBP - Loaded weight of a truck and dog - coarse aggregate	3	21868	t/y	0.00129	kg/t	32	t/load	43	vehicle gross mass (t)	0.413	km	0.101	kg/VKT	8	% silt content	90	% control	Sealed
CBP - Unloaded weight of a truck and dog - coarse aggregate	1	21868	t/y	0.00067	kg/t	32	t/load	10	vehicle gross mass (t)	0.413	km	0.053	kg/VKT	8	% silt content	90	% control	Sealed
CBP - Loaded weight of a truck and dog - Sand	2	16750	t/y	0.00129	kg/t	32	t/load	43	vehicle gross mass (t)	0.413	km	0.101	kg/VKT	8	% silt content	90	% control	Sealed
CBP - Unloaded weight of a truck and dog - Sand	1	16750	t/y	0.00067	kg/t	32	t/load	10	vehicle gross mass (t)	0.413	km	0.053	kg/VKT	8	% silt content	90	% control	Sealed
CBP - Loaded weight of Tanker - cement and cement supplement brought onsit	1	6617	t/y	0.00186	kg/t	20	t/load	32	vehicle gross mass (t)	0.413	km	0.089	kg/VKT	8	% silt content	90	% control	Sealed
CBP - Unloaded weight of Tanker - cement and cement supplement brought on	1	6617	t/y	0.00120	kg/t	20	t/load	12	vehicle gross mass (t)	0.413	km	0.058	kg/VKT	8	% silt content	90	% control	Sealed
CBP - Loaded weight of Agitator truck - product taken offsite	9	47200	t/y	0.00186	kg/t	20	t/load	32	vehicle gross mass (t)	0.413	km	0.089	kg/VKT	8	% silt content	90	% control	Sealed
CBP - Unloaded weight of Agitator truck - product taken offsite	6	47200	t/y	0.00120	kg/t	20	t/load	12	vehicle gross mass (t)	0.413	km	0.058	kg/VKT	8	% silt content	90	% control	Sealed
AP - Bitumen Delivery and Storage	-															100	% control	Vapour recover system
AP - High quality aggregate delivery and storage	-															100	% control	Already covered as source : One of the FELs located around the processing plant andstockpile area will b
AP - Truck Load Out	-															100	% control	Vapour recover system
AP - Loaded weight of Tanker - bitumen delivery	0	4000	t/y	0.00116	kg/t	20	t/load	32	vehicle gross mass (t)	0.483	km	0.048	kg/VKT	4	% silt content	90	% control	Sealed
AP - Unloaded weight of Tanker - bitument delivery	0	4000	t/y	0.00075	kg/t	20	t/load	12	vehicle gross mass (t)	0.483	km	0.031	kg/VKT	4	% silt content	90	% control	Sealed
AP - Loaded weight of a truck and dog - asphalt to market	4	50000	t/y	0.00081	kg/t	32	t/load	43	vehicle gross mass (t)	0.483	km	0.054	kg/VKT	4	% silt content	90	% control	Sealed
AP - Unloaded weight of a truck and dog - asphalt to market	2	50000	t/y	0.00042	kg/t	32	t/load	10	vehicle gross mass (t)	0.483	km	0.028	kg/VKT	4	% silt content	90	% control	Sealed
TOTAL TSP EMISSIONS	**1,688**																	



Source Locations

FB1

Drawing No:	0418291s_AQA_G003_R3.mxd		Sancrox Quarry Expansion Project Air Quality Assessment Report
Date:	07/09/2020	Drawing Size: A4	
Drawn By:	VN/LT	Reviewed By: EB	Client: Hanson Construction Materials Pty Ltd
Coordinate System: GDA 1994 MGA Zone 56			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

APPENDIX B SCREENING ASSESSMENT

B1 SCREENING ASSESSMENT

There are a number of species of metals, combustion related emissions and organic compounds that have the potential to be released from both the concrete batching and asphalt plants. The emissions from these sources are small, and therefore a screening assessment was completed to determine which sources and species should be taken forward to dispersion modelling. It should be noted that particulate matter from these sources was not subject to the screening method, as it was considered that given the contribution from other sources at the Site, additional emissions from these sources should be included in the cumulative assessment.

The screening assessment for the concrete batching and asphalt plants was undertaken in accordance with UK 'Air emissions risk assessment for your environmental permit guidance' (UK Department for Environment, Food and Rural Affairs Environment Agency, 2016) using emission rates provided in Table 5-2. The Guidance provides dispersion factors expressed as µg/m^3/g/sec for a variety of release heights and averaging periods (Table B1) (UK Department for Environment, Food and Rural Affairs Environment Agency, 2016).Body Text style. Used as the general text throughout.

Table B1: Dispersion factors provided in the Air Emissions Risk Assessment for your Environmental Permit Guidance (UK Department for Environment, Food and Rural Affairs Environment Agency, 2016)

Effective height of release in metres	Annual dispersion factor	Monthly dispersion factor	Hourly dispersion factor
0	148	529	3900
10	32	33.7	580
20	4.6	6.2	161
30	1.7	2.3	77
50	0.52	0.68	31
70	0.24	0.31	16
100	0.11	0.13	8.6
150	0.048	0.052	4
200	0.023	0.026	2.3

The release height of bag filter at the concrete batching facility was assumed to be 5 metres based on the information from a similar type of facility (Environmental Resources Management Australia Pty Ltd, 2017). The release height of the point source at the asphalt plant of 5 metres was adopted based on the technical data specification for Benninghoven Asphalt Mixing Plants (A Wirtgen Group Company, n.d.).

A linear interpolation method was used to derive the dispersion factor for the height of 5 metres using the dispersion factors in Table B1 (Equation B 1). The relevant dispersion factors are provided in Table B2.

Equation B 1 Linear interpolation of dispersion factors provided in the Air Emissions Risk Assessment for your Environmental Permit Guidance (UK Department for Environment, Food and Rural Affairs Environment Agency, 2016)

$$\mathrm{DF}_{n+1} = \frac{(H_{n+1} - H_n)(DF_{n+2} - DF_n)}{(H_{n+2} - H_n)} + DF_n$$

Where:

DF_n and DF_{n+2} are dispersion factors provided in the Guidance in µg/m^3/g/sec

DF_{n+1} is the dispersion factor required in µg/m^3/g/sec

H_n and H_{n+2} are the associated effective heights of release in metres; and

H_{n+1} is the required release height in metres.

Table B2: Dispersion factors adopted in the assessment

Averaging period	Dispersion factor (µg/m^3/g/sec)[1]
10 minute	2,375[5]
15 minute	2,224[3]
30 minute	1,907[5]
1 hour	1,660
8 hour	1,162[4]
24 hour	979[2]
Annual	58

1. The dispersion factors presented in Table are subject to interpolation of the dispersion factors provided in the Guidance;

2. 24 hour dispersion factor was derived from the hourly dispersion factor using factor of 0.59 as recommended in the Guidance;

3. 15 minute dispersion factor was derived from the hourly dispersion factor using factor of 1.34 as recommended in the Guidance;

4. 8 hour dispersion factor was derived from the hourly dispersion factor using factor of 0.7 as recommended in the Guidance;

5. Conversion of 1 hour model results to 10 minute and 30 minute averages has been undertaken using the peak to mean ratio as described in Victorian EPA Publication 1551 (Environment Protection Authority Victoria, 2013).

Equation B-2, contained within the Guidance, was used to combine the emission rates in Table 5-2 with the dispersion factors in Table B2 to provide the estimated maximum short-term and long-term ground level concentrations attributed to each source.

Equation B 2 Estimation environmental concentrations for the species

$$EC = ER \times DF$$

Where:
EC is the environmental concentration of the species in micrograms per cubic meter
ER is emission rate in gram per second
DF is dispersion factor in micrograms per cubic metre per gram per second

Table provides short-term and long-term environmental concentrations for species emitted from concrete batching plant.

Table B3: Short-term and long-term contribution to environmental concentrations for species emitted from concrete batching plant

	Concentration (ug/m^3)	Criterion (ug/m^3)	Percent (%)
Arsenic	0.0004	0.09	0.4
Cadmium	8.8×10^{-7}	0.018	0.0
Chromium	0.0002	0.09	0.2
Lead	1.6×10^{-6}	0.5	0.0
Manganese	0.005	18	0.0
Nickel	0.0003	0.18	0.2

The Guidance outlines that the following criteria must be met in order to screen out species that result in an insignificant contribution to ambient air quality and for which no further assessment is required (UK Department for Environment, Food and Rural Affairs Environment Agency, 2016):

- The estimated short-term environmental concentration is less than 10% of the short-term environmental standard; and
- The estimated long-term environmental concentration is less than 1% of the long-term environmental standard.

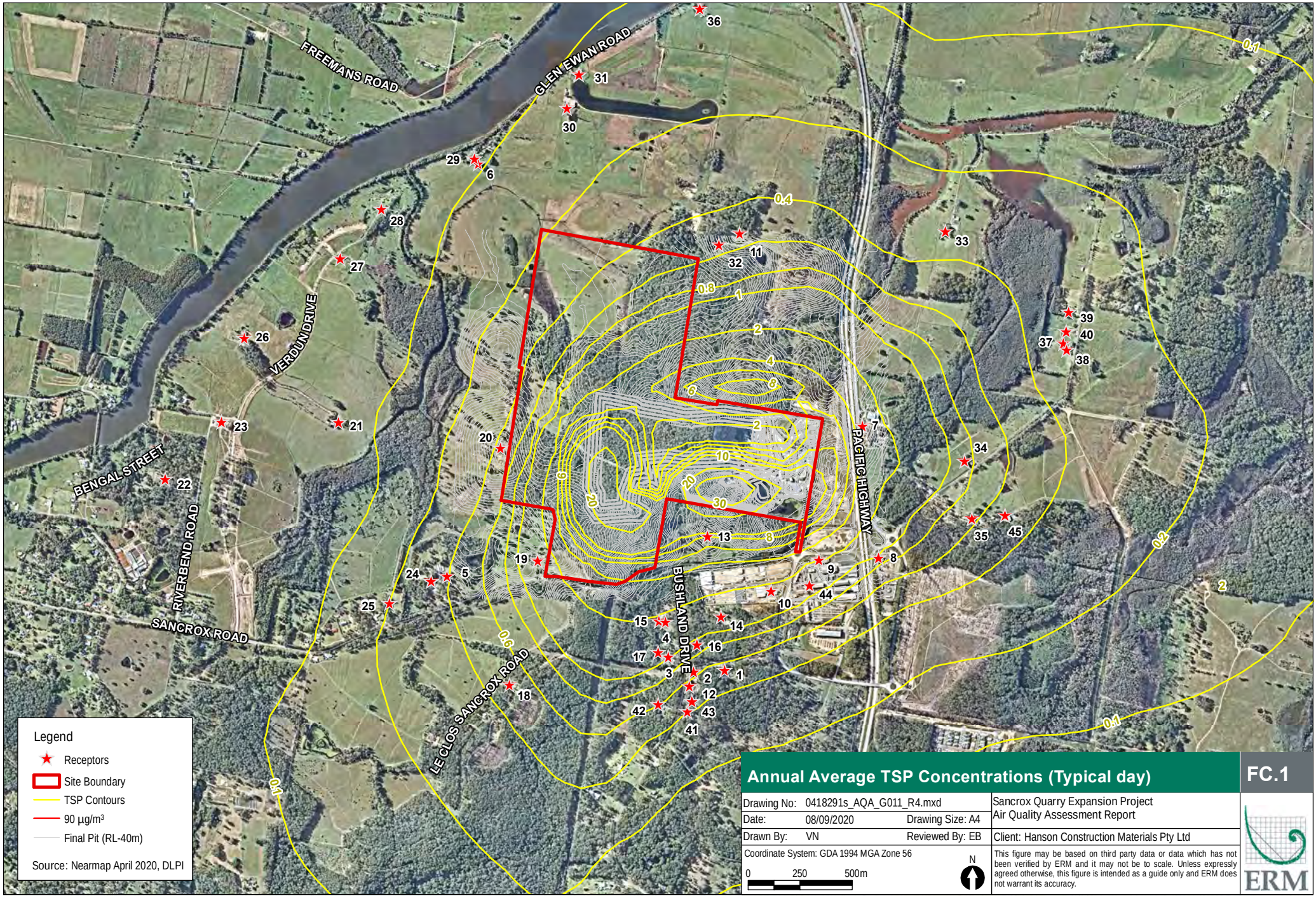
Table B4 indicates that the total short-term environmental concentrations related to the batching plant are below 10 percent of the relevant criteria for all species and the total long-term environmental concentrations are below one percent of the relevant criteria for all species. It is therefore considered that emissions from the concrete batching facility are not likely to be significant contributors to ambient air quality concentrations and no further assessment is required. It should be also considered that dispersion factors in the Guidance result in a very conservative assessment and the environmental concentrations for the species in reality will be much lower than presented in Table B4.

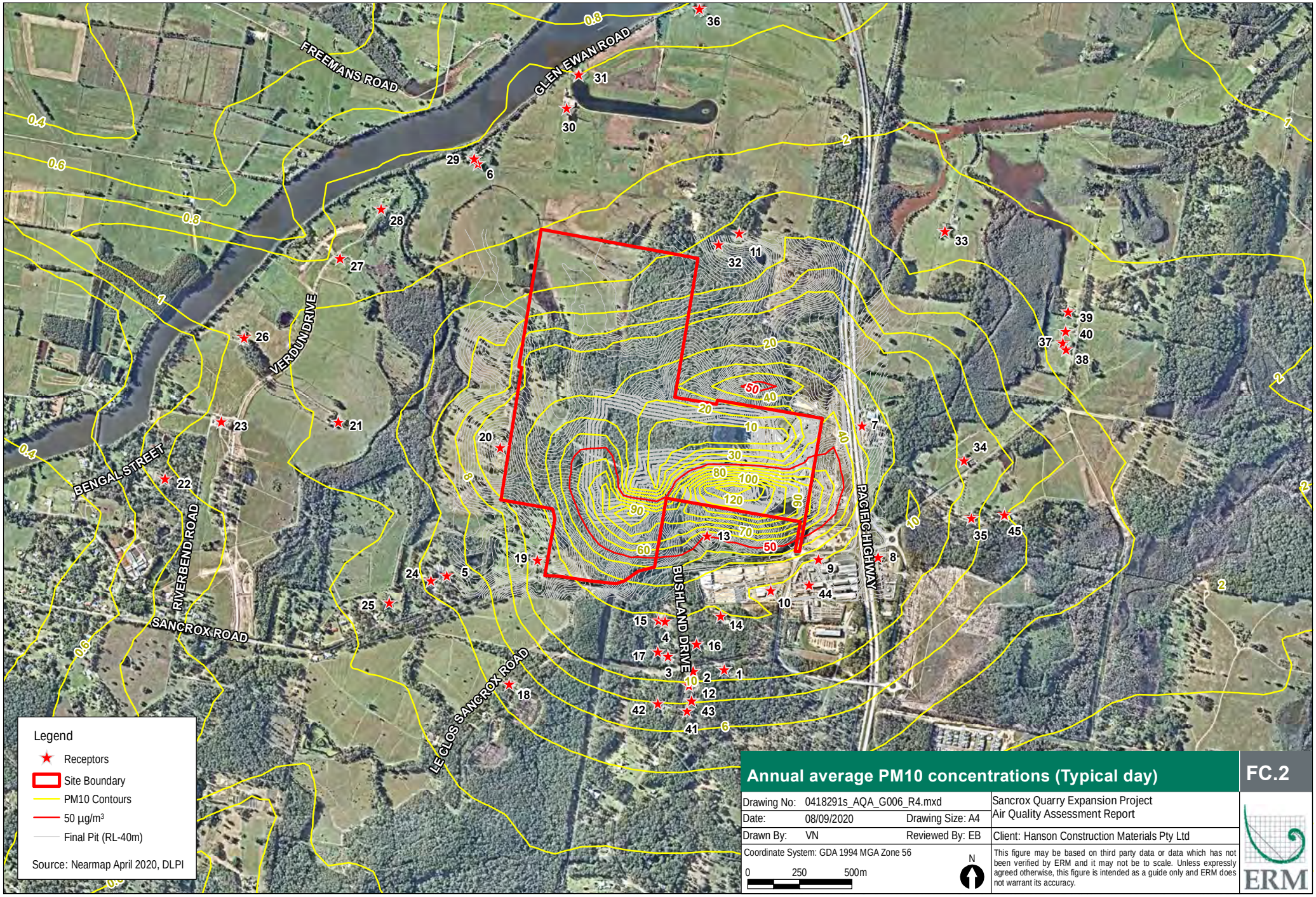
- Table B4 provides short-term and long-term environmental concentrations for species emitted from asphalt plant. Table B4 indicates that the total short-term environmental concentrations are below 10 percent of the relevant criteria for all species, except for NO_2, formaldehyde, PAH and nickel, and the total long-term environmental concentrations are below one percent of the relevant criteria for all species, except for NO_2. Only NO_2, formaldehyde, PAH and nickel were included in the dispersion modelling and no further assessment was required for any other species contained in Table B4 It should be also considered that dispersion factors in the Guidance result in a very conservative assessment and the environmental concentrations for the species in reality will be much lower than presented in Table B4.

Table B4: Short-term and long-term contribution to environmental concentrations for species emitted from asphalt plant

Species	Averaging period	Concentration (ug/m^3)	Criterion (ug/m^3)	Percent (%)
NO_2	1 hour	34.2	246	**13.91**
	Annual	1.2	62	**1.93**
Formaldehyde	1 hour	4.1	20	**20.40**
PAH	1 hour	0.3	0.4	**62.51**
Nickel	1 hour	0.1	0.18	**46.06**
CO	15 min	229.2	100000	0.23
	1 hour	171.1	30000	0.57
	8 hour	119.7	10000	1.20
SO_2	10 min	6.4	712	0.90
	1 hour	4.5	570	0.78
	24 hour	2.6	228	1.16
	Annual	0.2	60	0.26
Benzene	1 hour	0.5	29	1.77
Ethylbenzene	1 hour	0.3	8000	0.00
Hexane	1 hour	1.2	3200	0.04
Methyl chloroform	1 hour	0.1	12500	0.00
Toluene	1 hour	0.2	360	0.05
Xylene	1 hour	0.3	190	0.14
Heptane	30 min	16.6	33000	0.05
n-Pentane	1 hour	0.3	33000	0.00
Antimony	1 hour	0.0002	9	0.00
Arsenic	1 hour	0.0007	0.09	0.82
Barium	1 hour	0.008	9	0.08
Cadmium	1 hour	0.0005	0.018	3.00
Chromium	1 hour	0.007	9	0.08
Copper	1 hour	0.004	3.7	0.11
Hexavalent Chromium	1 hour	0.0006	0.09	0.66
Lead	Annual	0.00003	0.5	0.01
Manganese	1 hour	0.0101	18	0.06
Mercury	1 hour	0.0004	0.18	0.25
Silver	1 hour	0.0006	0.18	0.35
Zinc	30 min	0.09	100	0.09
	24 hour	0.05	120	0.04
Asphalt petroleum fumes	1 hour	6.9	90	7.66

APPENDIX C CONTOUR PLOTS


FREEMANS ROAD
GLEN EWAN ROAD
VERDUN DRIVE
BENGAL STREET
RIVERBEND ROAD
SANCROX ROAD
LE CLOS SANCROX ROAD
BUSHLAND DRIVE
PACIFIC HIGHWAY
0.1
0.2
0.4
0.6
0.8
1
2
4
6
8
10
20
30
Legend
Receptors
Site Boundary
TSP Contours
90 µg/m³
Final Pit (RL-40m)
Source: Nearmap April 2020, DLPI
Annual Average TSP Concentrations (Typical day)
FC.1
Drawing No: 0418291s_AQA_G011_R4.mxd
Date: 08/09/2020
Drawing Size: A4
Drawn By: VN
Reviewed By: EB
Coordinate System: GDA 1994 MGA Zone 56
0 250 500m
N
Sancrox Quarry Expansion Project
Air Quality Assessment Report
Client: Hanson Construction Materials Pty Ltd
This figure may be based on third party data or data which has not been verified by ERM and it may not be to scale. Unless expressly agreed otherwise, this figure is intended as a guide only and ERM does not warrant its accuracy.
ERM



Annual average PM10 concentrations (Typical day)

FC.2

Drawing No:	0418291s_AQA_G006_R4.mxd		Sancrox Quarry Expansion Project Air Quality Assessment Report
Date:	08/09/2020	Drawing Size: A4	
Drawn By:	VN	Reviewed By: EB	Client: Hanson Construction Materials Pty Ltd

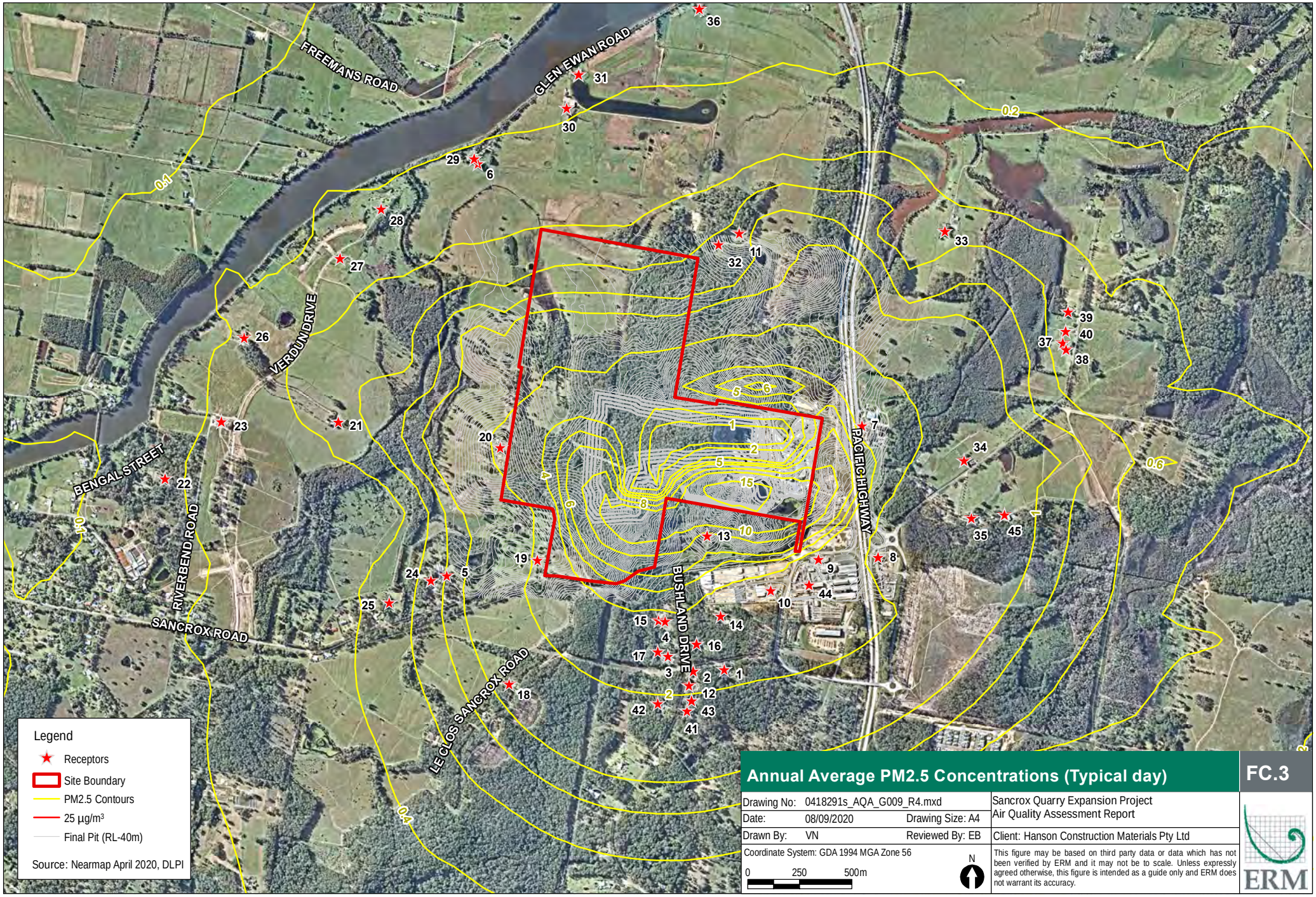
Coordinate System: GDA 1994 MGA Zone 56

0 250 500m

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



Annual Average PM2.5 Concentrations (Typical day)

FC.3

Drawing No:	0418291s_AQA_G009_R4.mxd		Sancrox Quarry Expansion Project Air Quality Assessment Report
Date:	08/09/2020	Drawing Size: A4	
Drawn By:	VN	Reviewed By: EB	Client: Hanson Construction Materials Pty Ltd

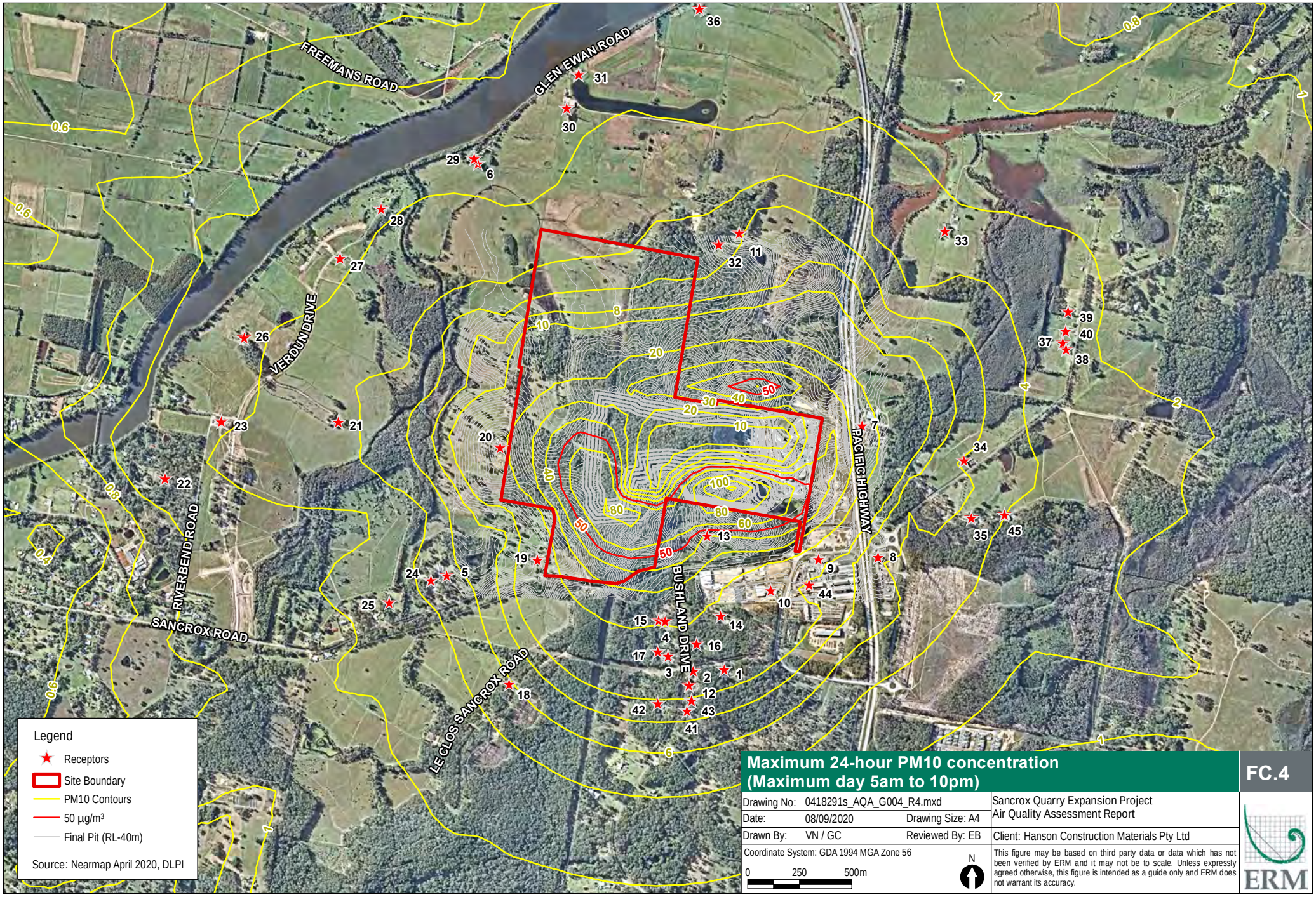
Coordinate System: GDA 1994 MGA Zone 56

0 250 500m

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

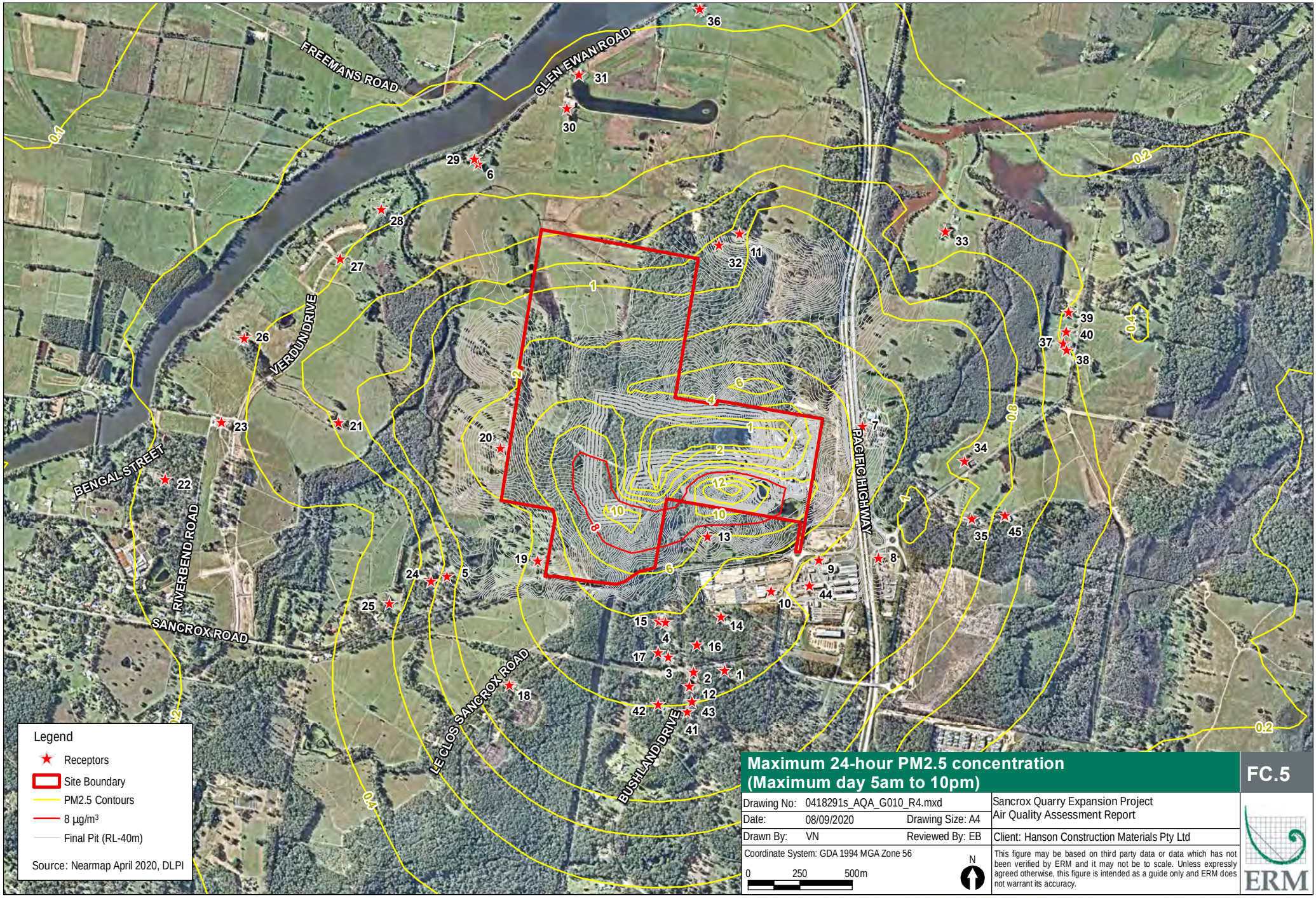


Maximum 24-hour PM10 concentration (Maximum day 5am to 10pm)

FC.4

Drawing No:	0418291s_AQA_G004_R4.mxd		Sancrox Quarry Expansion Project Air Quality Assessment Report
Date:	08/09/2020	Drawing Size: A4	
Drawn By:	VN / GC	Reviewed By: EB	Client: Hanson Construction Materials Pty Ltd
Coordinate System: GDA 1994 MGA Zone 56			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



Maximum 24-hour PM2.5 concentration (Maximum day 5am to 10pm)

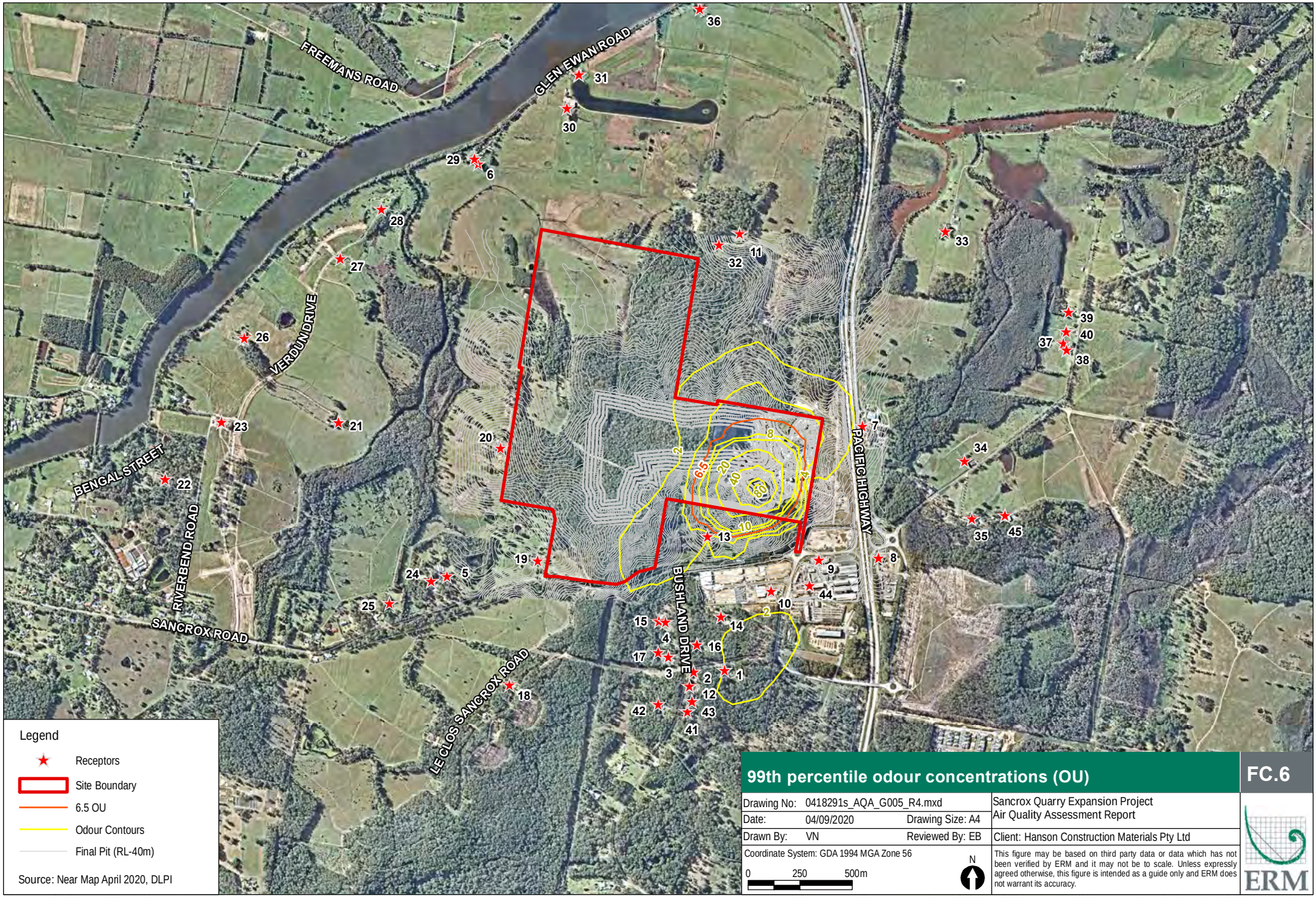
FC.5

Drawing No:	0418291s_AQA_G010_R4.mxd		Sancrox Quarry Expansion Project Air Quality Assessment Report
Date:	08/09/2020	Drawing Size: A4	
Drawn By:	VN	Reviewed By: EB	Client: Hanson Construction Materials Pty Ltd
Coordinate System: GDA 1994 MGA Zone 56			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.

0 250 500m

N

ERM


FREEMANS ROAD
GLEN EWAN ROAD
VERDUN DRIVE
BENGAL STREET
RIVERBEND ROAD
SANCROX ROAD
LE CLOS SANCROX ROAD
BUSHLAND DRIVE
PACIFIC HIGHWAY
Legend
Receptors
Site Boundary
6.5 OU
Odour Contours
Final Pit (RL-40m)
Source: Near Map April 2020, DLPI
99th percentile odour concentrations (OU)
FC.6
Drawing No: 0418291s_AQA_G005_R4.mxd
Date: 04/09/2020
Drawing Size: A4
Drawn By: VN
Reviewed By: EB
Coordinate System: GDA 1994 MGA Zone 56
0 250 500m
N
Sancrox Quarry Expansion Project
Air Quality Assessment Report
Client: Hanson Construction Materials Pty Ltd
This figure may be based on third party data or data which has not been verified by ERM and it may not be to scale. Unless expressly agreed otherwise, this figure is intended as a guide only and ERM does not warrant its accuracy.
ERM

ERM has over 160 offices across the following countries and territories worldwide

Argentina
Australia
Belgium
Brazil
Canada
Chile
China
Colombia
France
Germany
Ghana
Guyana
Hong Kong
India
Indonesia
Ireland
Italy
Japan
Kazakhstan
Kenya
Malaysia
Mexico
Mozambique
Myanmar
The Netherlands
New Zealand
Norway
Panama
Peru
Poland
Portugal
Puerto Rico
Romania
Russia
Senegal
Singapore
South Africa
South Korea
Spain
Sweden
Switzerland
Taiwan
Tanzania
Thailand
UAE
UK
US
Vietnam

ERM's Sydney Office
Level 15
309 Kent Street
Sydney NSW 2000

T: +61 2 8584 8888

www.erm.com

The business of sustainability

ERM

Appendix G

Supplementary Surface and Groundwater Response

Sancrox Quarry Expansion

Response to submissions - Water

3 December 2020

Project No.: 0418291

The business of sustainability

ERM

Document details	
Document title	Sancrox Quarry Expansion
Document subtitle	Response to submissions - Water
Project No.	0418291
Date	3 December 2020
Version	1.0
Author	K. Sheehy
Client Name	Hanson

Document history

				ERM approval to issue		
Version	Revision	Author	Reviewed by	Name	Date	Comments
Final	00	K. Sheehy	R. Winckworth	C. Gimber	03.12.2020	

Signature Page

3 December 2020

Sancrox Quarry Expansion

Response to submissions - Water

Chris Gimber
Partner

Environmental Resources Management Australia Pty Ltd
Level 15 309 Kent Street
SYDNEY NSW 2000

© Copyright 2020 by ERM Worldwide Group Ltd and / or its affiliates ("ERM").
All rights reserved. No part of this work may be reproduced or transmitted in any form,
or by any means, without the prior written permission of ERM

CONTENTS

1. INTRODUCTION 2
2. GROUNDWATER MATTERS 2
3. WATER SHARING PLANS 3
4. SURFACE WATER MATTERS 4
5. REFERENCES 11

APPENDIX A GROUNDWATER PEER REVIEW

1. INTRODUCTION

This report responds to submissions received with respect to surface water and groundwater matters associated with State Significant Development 7293 (SSD 7293), Sancrox Quarry Expansion Project. The submissions originate from Department of Planning, Industry and Environment (DPIE) and Water and the Natural Resources Access regulator (NRAR) response dated 10 February 2020 and specific issues raised by public submissions in response to water management.

2. GROUNDWATER MATTERS

Information request

DPIE Water - Groundwater Assessment, Licencing and Monitoring

- Assess and classify the groundwater model against the Australian Groundwater Modelling Guidelines and have the model peer reviewed.
- Provide details on acquiring suitable surface/groundwater entitlement to cover estimated take.
- Correctly identify potentially impacted water sources and revise its Aquifer Interference Policy (AIP) (DPI 2012) assessment as required

Public submissions – Surface water and groundwater

- Significantly impacts on groundwater sources available to the community

Response

The NSW Aquifer Interference Policy defines the criteria for highly productive groundwater sources as:

- Has Total Dissolved Solids (TDS) of less than 1500 mg/L, and
- Contains water supply works that can yield water at a rate greater than 5 L/s.

Field measurements for electrical conductivity (EC) were undertaken at monitoring bores SA1501, SA1502 and SA1503 from which TDS values were estimated. Estimated TDS values for SA1501 and SA1502 exceed the criteria to define the groundwater source as highly productive.

An independent peer review of the groundwater model was undertaken (provided as Appendix A). The review concluded that the confidence level of the Sancrox Quarry groundwater model may be classified as “Class 1”, as defined by the Australian Groundwater Modelling Guidelines. As such, the groundwater model may be used for predicting long-term impacts of proposed developments in low-value aquifers.

The minimal impact considerations of the NSW Aquifer Interference Policy specify a maximum of a 2 m decline at any water supply network. Thirteen groundwater users are within a 2 km radius of the quarry development. Only one (of the thirteen groundwater users) falls within the modelled 2 m drawdown contour, increasing to two of the thirteen for the sensitivity run scenario.

Estimated hydraulic conductivity at SA1501 and SA1502 were 0.001 m/day and 0.0003 m/day. These low hydraulic conductivity values align with the observations from the existing pit where groundwater seepage to the pit is reportedly negligible with no active dewatering required according to site management. The low hydraulic conductivity will impact the progression of the cone of depression outside of the immediate vicinity of the quarry development and delay observable impacts of the dewatering at more distant locations. The nearest groundwater user, located inside the modelled 2 m drawdown, is approximately 700 m distant from the final quarry perimeter.

Mitigation measures for the potential impacts associated with drawdown on groundwater users will vary dependant on the extent of the impact, but would include (if deemed necessary):

- lowering the bore pump in the bore casing;

- drilling a deeper bore; or
- providing an alternative water source as part of “make good” arrangements.

The NSW Aquifer Interference Policy specifies that monitoring requirements need to be developed that allow for the monitoring of actual impacts compared to predicted impacts, allowing for contingency plans to be enacted in a timely manner if actual impacts are higher than predicted and these impacts are found to be significant. It is recommended that a groundwater monitoring plan be developed that includes specifics of such a monitoring program, including threshold trigger values as well as a contingency strategy if triggers are exceeded.

The groundwater monitoring program will include monitoring of water levels at the potentially affected groundwater bores. In order to be able to identify over or under predictions by the modelling in a reasonable way, it is recommended that all bores showing a >0.5 m of simulated drawdown be included in the monitoring program.

As the predicted drawdown is based on steady state drawdown associated with the final stage of pit extension (the maximum drawdown expected over the life of the Project), initial monitoring of water levels can serve as a baseline against which to compare future water level measurements. Monitoring frequency should be adaptable (depending on trends observed and stages of the quarry development) with twice annual monitoring recommended for the first year of monitoring. Water level data will be reported on an annual basis along with the reporting of the water take estimates.

3. WATER SHARING PLANS

WSPs are established as a statutory obligation under the WM Act developed as a 10 year management plan tailored to the guide water provisions and allocation for a given catchment area. Once a WSP commences, the licencing provisions of the WM Act come into effect in the plan area.

The purpose of WSPs are to:

- provide water users with a clear picture of when and how water will be available for extraction;
- protect the fundamental environmental health of the water source; and
- ensure the water source is sustainable in the long-term.

Table 3-1 Applicable Water Sharing Plans

Water Sharing Plan	GW or SW	Effective Date	WSP Capacity
Water Sharing Plan for the Hastings Unregulated and Alluvial Water Sources 2019 Note: the Project site is located within the Coastal Hastings Water Source)	SW & GW	July 2019 to June 2029	■ The Hastings water sharing plan does not permit the granting of new unregulated river access licences. New commercial developments requiring water must purchase licence shares from existing access licences in accordance with the dealing rules defined in the water sharing plan.
Water Sharing Plan for the North Coast Fractured and Porous Rock Groundwater Sources 2016 (note: the Hastings Alluvium sits adjacent to the quarry extent but partly within the project boundary)	GW	July 2016 to June 2026	■ The long-term average annual extraction limit for the New England Fold Belt Coast Groundwater Source is 60,000 ML/year ■ At the commencement of this Plan, the water requirements of persons entitled to domestic and stock rights are 9,605 ML/year in the New England Fold Belt Coast Groundwater Source.

The need for a Water Access Licence for aquifer interference and/or surface water extraction will be determined in consultation with WaterNSW, noting the latter will require purchasing from existing licence shares.

4. SURFACE WATER MATTERS

Information request

Public submissions – Surface water and groundwater

- Surface water on the site will be diverted away from alluvial flood plains of the Hastings River and Haydons Creek

Response

The west and northwest portions of the Project site are located in the Haydons Creek catchment. Haydons Creek is situated approximately 1 km west from the western boundary of the quarry expansion footprint and flows into the Hastings River, approximately 900 m to the north. The remaining portion of the Project site is located in the Fernbank Creek catchment area, with surface flows likely to join a third order watercourse prior to meeting with those from the southern quarry site discharge location which also flows to the Hastings River, approximately 5 km to the northeast. Haydons Creek and Fernbank Creek discharge to the Hastings River upstream of its confluence with the Wilson River.

The existing footprint of the site is approximately 23 ha and located in the Fernbank Creek catchment, as shown in Figure 1. The Haydons Creek and Fernbank Creek (excluding the site) catchment areas are approximately 850 ha and 1,162 ha respectively. The existing quarry footprint occupies approximately 2 % of the Fernbank Creek catchment. All surface water discharges from the existing quarry are to Fernbank Creek. The footprint of the Project site at the final stage of the Sancrox Quarry expansion is approximately 57 ha with the expansion primarily in the Haydon Creek catchment as shown in Figure 2. The change in Project footprint and the proportional change across Haydens Creek and Fernbank Creek catchments are shown in

Table 4-1. A quantitative modelling approach was not applied to the study area of the Fernbank Creek and Hayden's Creek due to no available calibration point.

Table 4-1: Project footprint change as proportion of total catchment area

Catchment	Total Area (ha)	Existing footprint in catchment (ha)	Total Area excluding existing Site (ha)	Stage 4 footprint expansion (ha)	Stage 4 expansion footprint as proportion of total area
Hayden's Creek	850	0	850	24	3%
Fernbank Creek	1,185	23	11,52	33	1%

The expansion of Sancrox quarry at its maximum footprint will reduce the Haydons Creek catchment area by 24 ha corresponding to approximately 3% reduction in the catchment area. Although the expansion footprint will affect an additional 10 ha (approximately 1%) of the Fernbank Creek catchment, all discharges from the quarry's water management system including affected Haydons Creek catchment will discharge to Fernbank Creek and thence Hastings River. Potential reduction in flow within the Fernbank catchment may be reduced due to the site discharge location lying within the Fernbank catchment area. Further, the Hastings River is considered tidal for a distance of approximately 32 km upstream from the river mouth (Patterson Britton & Partners, 2019). The Hayden's Creek confluence with the Hastings River is approximately 16 km upstream from the river mouth and as a result, impact of reduced flow contribution to the Hastings River is difficult to quantify.

The contribution to flows in Haydons Creek will reduce proportionally with catchment area (i.e. 3%), however this proportion will be partly mitigated by the characteristics of the transformed catchment area which would currently have a lower contribution to flows due to the area being comprised almost entirely of woodland vegetation which results in lower rainfall runoff than the remaining catchment area which has a much lower proportion of woodland vegetation.

Figure 1: Existing Project site and catchments

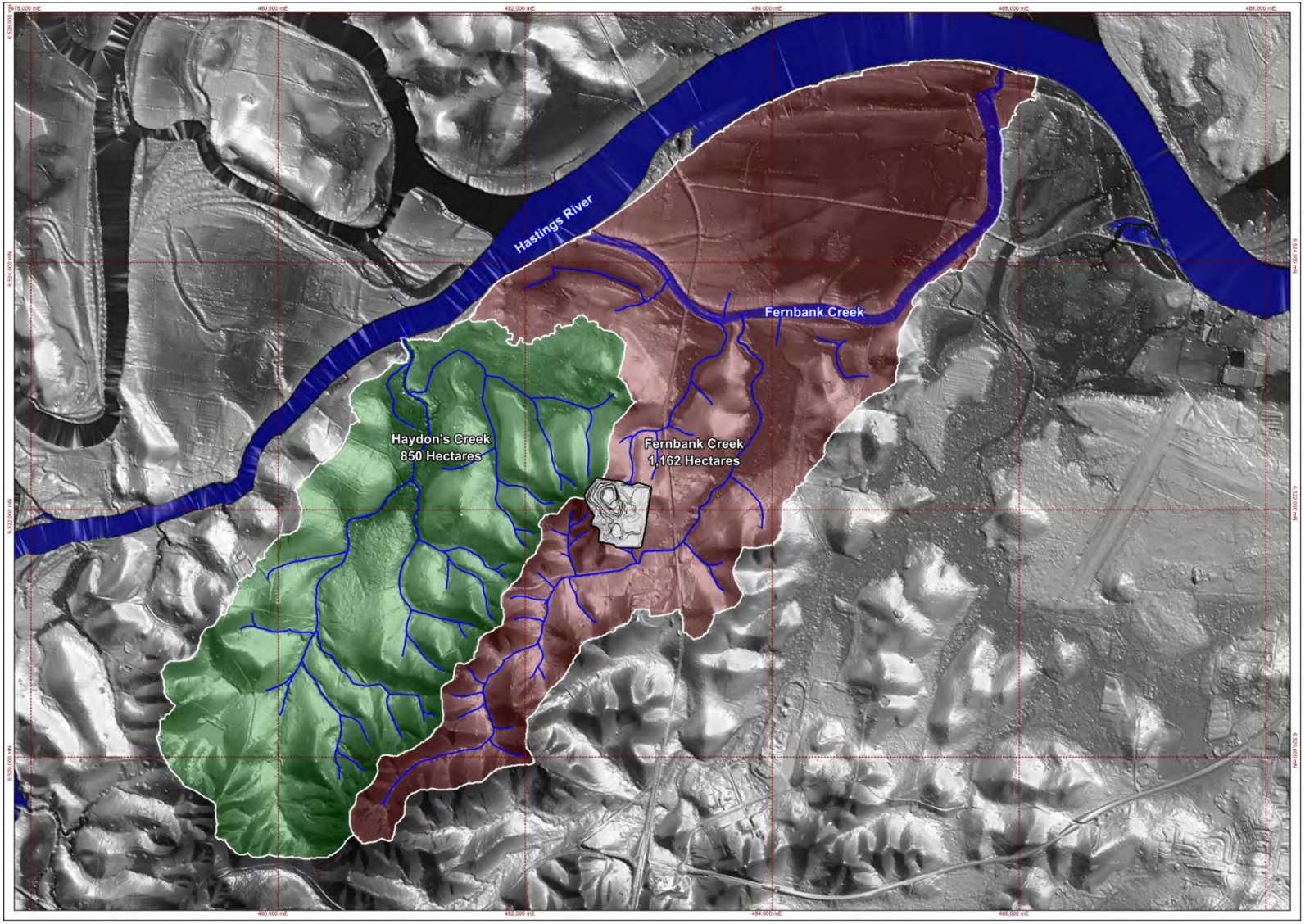
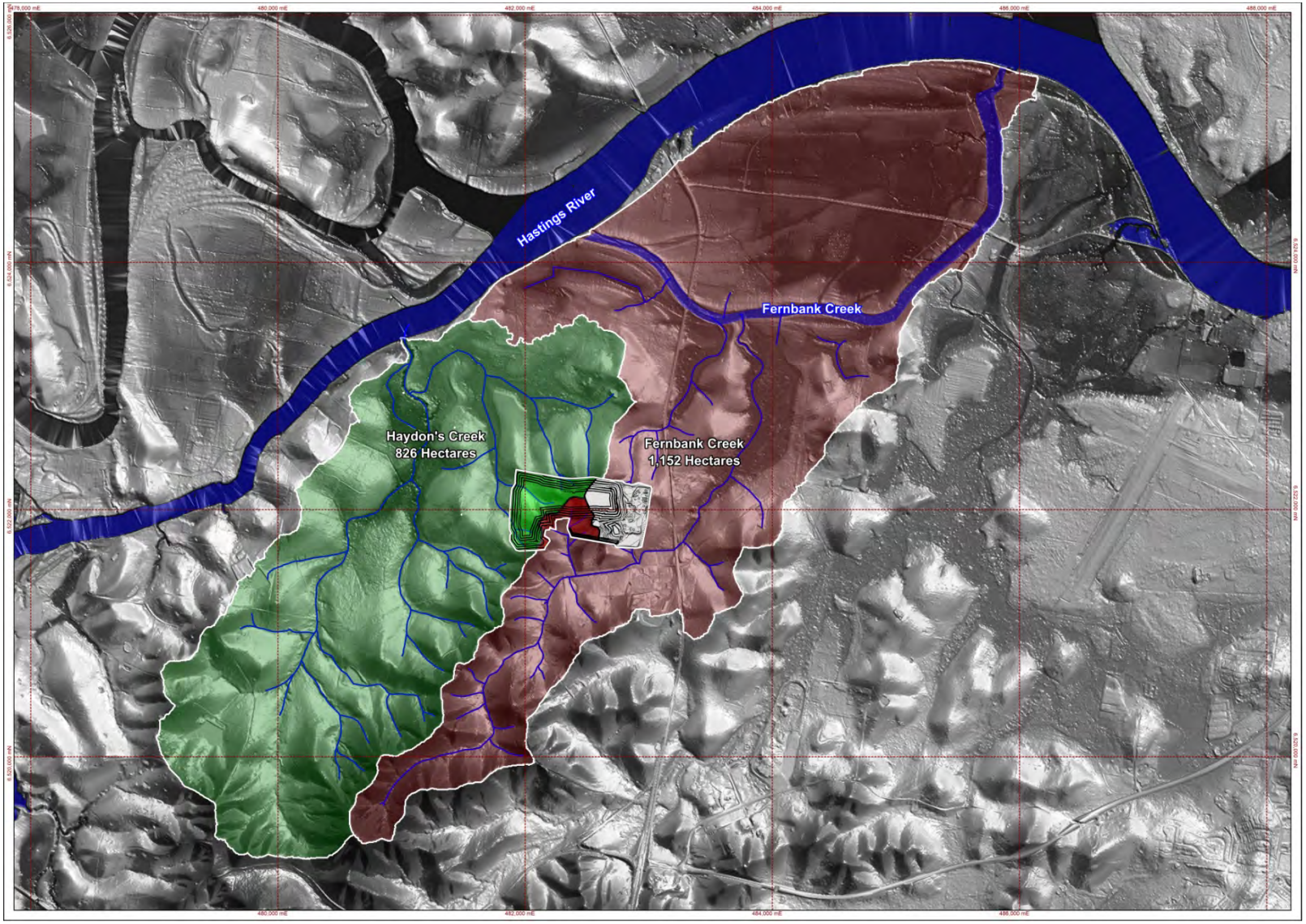


Figure 2: Stage 4 Project site and catchments



Information request

- Use of on-site water inappropriate given drought conditions

Response

Water is required for quarrying operations predominantly for dust suppression (crushing and screening dust suppression, road dust suppression). Other minor uses include concrete manufacture, asphalt production and concrete agitator washout. Demand management and water reuse initiatives will be adopted, however there will be losses due to evaporation and product moisture. In extreme circumstances the operations could be modified to consolidate movement on fewer roads, thus reducing watering requirements. Other dust suppression strategies could also be implemented including the use of surfactants, tacifiers etc.

It is proposed that water is sourced by harvesting water accumulating in disturbed areas of the quarry, as well as groundwater seepage into the pit. The effects of these two sources have been assessed in the EIS with additional information provided in the earlier response within the report.

Although not predicted, any impact to groundwater access or availability would be remedied through modifying the supply bore at the affected location, or providing an alternative water supply.

The surface water used to support the quarrying operation would not otherwise be harvested or available for use, and would instead contribute to environmental flows in Fernbank Creek and Haydons Creek. The impact on environmental flows, both in terms of frequency and characteristics, is deemed to be negligible as noted in the earlier response.

Information request

- Information on the volume of water that will be required to suppress dust on the overburden stockpile in the site's water balance.

Response

Overburden stockpiles are the upper zone soil and weathered material not suitable for quarry products. Overburden materials will be stockpiled at planned locations around the quarry particularly for use as stormwater diversion and acoustic attenuation bunds. These stockpiles/bunds will be stabilised using site won topsoil and vegetation as part of the erosion and sediment control strategy for the quarry. The need for dust control of stabilised overburden stockpiles/bunds will be minimal and if necessary primarily in the establishment phase. Therefore it is estimated that water demand for dust suppression of overburden stockpiles/bunds will not exceed 1ML per annum, a minor increase in the total water demands estimated for the quarry operation at its final stage and provided in Table 7.3 of the EIS. An updated breakdown of approximate peak water demands is provided in Table 4-2.

Table 4-2: Approximate total water demand from on-site sources

Activity	Approximate Volume Water Required (ML) from on-site sources
Road dust suppression	45.9
Concrete manufacture	3.3
Concrete agrigator washout	0.9
Crushing and screening dust suppression	75.0
Product moisture	4.5
Ashphalt production	1.5
Overburden stockpile dust suppression	1.0
Total	132.1

Information request

- Provide further details on the intended usage of reticulated water supply.

Response

Sancrox quarry receives potable water from Port Macquarie Hastings Council's water supply network. The primary demand for potable water is for amenities for the current workforce of 15. The proposed expansion and additional site operations is estimated to increase the workforce by a further 10 employees to 25. Potential demands for potable water are provided at Section 7.1.1 of Appendix E to the EIS and estimated an increased demand for potable water at 365kL per annum.

The potential use of potable water elsewhere in the quarry is limited to some use in the workshop area. However, for all quarry water demands as noted in Table 4-2 above, surface water collected in the network of three site dams is the prioritised supply.

Section 7.1.1 of Appendix E to the EIS also identified the potential for collecting roof water for use in some amenities and/or miscellaneous use at the workshop to reduce demand for potable water.

Information request

- Stormwater drainage from the site and its effects on adjoining landowners

Response

There has been historical concerns from the landowner adjoining the eastern boundary of the quarry site regarding seepage flows from the base of the batters in the north eastern portion of the quarry site onto that landowner's property. Although the exact source of the seepage flows has not been specifically determined, it has been assumed to be subsurface flows originating from either stormwater flows collected on the north eastern portion of the quarry, and/or in the eastern internal drainage system and/or from the northern silt retention dam (refer Figure 7.1 of the EIS). It is assumed these potential sources infiltrate through the fill material placed to create the current crushing and product stockpile area.

Hanson has also observed that subsurface flows in the fractured bedrock flow into the quarry pit following periods of sustained rainfall and hence there is a possibility the flows may be sourced from seeps or springs. Nevertheless, Hanson has undertaken a number of measures over the years in an attempt to mitigate these subsurface flows leaving the quarry site to the east, primary though:

- grading the area with a more impermeable hardstand surface to a formalised internal drainage system, that flows to either a sump with a pump discharging flows to the silt retention pond or directly to the internal eastern perimeter drain;
- realigning the silt retention dam's spillway to direct flows to the internal eastern perimeter drain that directs stormwater to the southern water holding dam (WH02);
- increased bunding of the outside of the northern portion of the perimeter drain, concrete lining the southern portion of the drain and formalising its outlet into WH02; and
- prioritising use of water collected in the silt retention pond for processing and dust suppression demands or pumped directly to WH02, hence managing the volume and elevation of water in the dam and reducing the occurrence of overflows via the spillway.

ERM has inspected the seepage in 2015 and again in July 2020 and confirm the flows, though of low volume and velocity, appear to be relatively constant. Observations during both inspections confirmed that the flows were visibly clear having minimal entrained sediment, the likely parameter that would indicate the seepage was sourced directly from quarry surface stormwater.

It is recommended Hanson continue to work with the adjacent landowner to develop an agreed approach to manage the seepage flows to ensure they are directed to a stable down-gradient surface water system.

Information request

- Erosion and sediment control and the importance of both source and release controls.

Response

The hydrological Assessment (Appendix E to the EIS) confirms Hanson's commitment to develop a Soil and Water Management Plan (SWMP) for the expanded quarry. Principles for effective soil and water management are provided including prioritising erosion control of high risk areas; installation of sediment basins at appropriate locations during early disturbance works including earthworks removing overburden; and progressive site rehabilitation.

Once quarrying commences in disturbed expansion areas the creation of quarry faces and benches result in these areas becoming catchments for the quarry void, hence reducing the area requiring additional erosion and sediment controls. The quarry void is not self-draining and runoff is collected in a sump which is pumped to the onsite dams for reuse for product moisture, dust control and rehabilitation works or eventual discharge offsite within pH, suspended solids and oil and grease criteria under an existing Environment Protection Licence (EPL).

Therefore, the potential offsite impacts from erosion and sedimentation will be managed through the implementation of appropriate mitigation and management which will be outlined in a Soil and Water Management Plan (SWMP).

5. REFERENCES

Patterson Britton & Partners, 2019. Hastings River Flood Study. NSW Flood Data Portal. Accessed 3 December 2020.

https://www.industry.nsw.gov.au/water/plans-programs/water-sharing-plans/how-water-sharing-plans-work

https://www.industry.nsw.gov.au/water/plans-programs/water-sharing-plans/status

https://www.industry.nsw.gov.au/water/plans-programs/water-sharing-plans/status/north-coast-region

https://www.industry.nsw.gov.au/__data/assets/pdf_file/0020/235253/background-document-for-hastings-wsp-2019.pdf

https://www.industry.nsw.gov.au/__data/assets/pdf_file/0018/235251/rules-summary-sheets-hastings-water-sharing-plan-2019.pdf

APPENDIX A GROUNDWATER PEER REVIEW

HANSON CONSTRUCTION MATERIALS

SANCROX QUARRY EXPANSION

INDEPENDENT PEER REVIEW OF SANCROX QUARRY EXPANSION GROUNDWATER MODEL

GW-HANSON-20-02-REP-001

Hanson HEIDELBERGCEMENT Group

REN Consulting Pty Ltd

HANSON CONSTRUCTION MATERIALS

SANCROX QUARRY EXPANSION

Document Title	:	INDEPENDENT PEER REVIEW OF SANCROX QUARRY EXPANSION GROUNDWATER MODEL
Document No.	:	GW-HANSON-20-02-REP-001
Revision No.	:	A
Date	:	07 SEPTEMBER 2020

Rev	Description	Originator	Reviewer	Approver	Date
A	Issued for Client Review	JA	TA	JA	07 SEP '20

Contents

1 INTRODUCTION 1
1.1 Background 1
1.2 Scope of work 2
1.3 Modelling guidelines 2
1.4 NSW Planning Industry & Environment 2
2 PEER REVIEW 3
2.1 Model objectives 3
2.2 Model confidence level classification 3
2.3 Data analysis 5
2.4 Hydrogeological conceptualisation 6
2.5 Model design 8
2.6 Boundary conditions 9
2.7 Model calibration 9
2.8 Sensitivity analysis and verification 10
3 SUMMARY AND CONCLUSION 12
Appendix A – Review Checklist 14
Appendix B – Department of Planning Industry & Environment Review 20

List of Tables

Table 2-1 Performance measures and targets 9

List of Figures

Figure 1-1 Locality map 1
Figure 2-1 Groundwater monitoring bores 4
Figure 2-2 Topography of study area 7
Figure 2-3 Regional surface geology 7
Figure 2-4 Plot of residual and monthly rainfall 11

1 INTRODUCTION

This report provides a review of the groundwater model that has been developed to address the impact assessment requirements of the NSW Aquifer Interference Policy. The groundwater model was developed by Environmental Resources Management Australia Pty Ltd (ERM) and the modelling components are described in the Sancrox Quarry Expansion Environmental Impact Statement (EIS) - Annex F: Groundwater Assessment[1].

1.1 Background

The site is an operational hard rock quarry, located in Sancrox approximately 8 km to the west of Port Macquarie. The quarry has been owned and operated by Hanson since 1998. Hanson owns approximately 145 ha of land, of which approximately 12 ha has been in use for the extraction, processing, and storage of aggregates. Infrastructure associated with the existing quarry includes the processing plant, offices, weighbridge, and workshop.

The Study Area includes the existing quarry site, the area identified for the quarry expansion and a 2 km radius from the perimeter of the final pit to identify groundwater users that may be impacted by the proposed activity. The eastern portion of the Study Area has been disturbed by active quarrying activities while the west and northwest portions of the Study Area are largely undisturbed and predominantly covered with remnant woodland vegetation. Some smaller sections of ground are covered with pasture. **Figure 1-1** shows the location of the existing quarry site.

Figure 1-1 Locality map

[1] ERM, 2019 Sancrox Quarry Expansion, Groundwater Assessment, Hanson Construction Materials Pty Ltd, 0418291_Final, August 2019

1.2 Scope of work

The key tasks for this review were as follows:

- Review the development and calibration of the groundwater model and comment on:
  - Adequacy of the modelling approach for the intended purpose; and
  - Appropriateness of the assumptions used in the model.

1.3 Modelling guidelines

The peer review has been structured according to the following guidelines:

- Australian groundwater modelling guidelines, June 2012[2]; and,
- The Standard Guide for Conceptualization and Characterization of Ground-Water Systems (ASTM 5979-96).

The modelling has been assessed according to the Model Review checklist in the Australian Modelling Guidelines. This checklist has questions on (1) The Report; (2) Data Analysis; (3) Conceptualisation; (4) Model Design; (5) Calibration; (6) Verification; (7) Prediction; (8) Sensitivity Analysis; and (9) Uncertainty Analysis. Not all questions are pertinent to a site-specific model. Appendix A includes a checklist for a groundwater model review.

The effort put into a modelling study is dependent on timing and budgetary constraints that are generally not known to a reviewer. Hence, reduced performance in one aspect of the modelling effort could be the result of a conscious decision by the modelling team to get the model finished on budget and/or on time, or to apply extra focus on specific issues arising during modelling.

1.4 NSW Planning Industry & Environment

The DPIE review on the EIS – "Annex F: Groundwater Assessment" is provided in Appendix B. This review mainly questioned whether a model review has been undertaken, as stated in the Australian Groundwater Modelling Guidelines, to ascertain model's applicability for the impact assessment. It examined the model verification, impact on third party bores and available historical data on groundwater level and quality.

The DPIE pointed out that the proponent has misidentified the applicable Water Sharing Plans and Water Sources potentially affected by this development and has failed to identify the New England Fold Belt Coast Groundwater Source of the Water Sharing Plan for the North Coast Fractured and Porous Rock Groundwater Sources 2016 as the impacted water source. (The Hastings Alluvium sits adjacent to the quarry extent but partly within the project boundary.)

[2] Barnett et al, 2012, Australian groundwater modelling guidelines, Waterlines report, National Water Commission, Canberra

2 PEER REVIEW

2.1 Model objectives

The modelling guidelines are specific about defining the modelling objectives. These objectives should explain in detail the purpose or 'desired end' or 'outcome' of a groundwater model. Section 1.2 of Annex F discusses that the objective of the Groundwater Assessment is to meet the requirement of the Secretary's Environmental Assessment Requirements (SEARs):

- Identification of any licensing requirements or other approvals under the Water Act 1912 and/or Water Management Act 2000.
- An assessment of the likely impacts on the quality and quantity of existing surface and groundwater resources, including a detailed assessment of proposed water discharge quantities and quality against receiving water quality and flow objectives.
- An assessment of the likely impacts of the development on aquifers, watercourses, riparian land, water-related infrastructure, and other water users.
- A detailed description of the proposed water management system (including sewage), water monitoring program and other measures to mitigate surface and groundwater impacts.

The modelling objectives are to evaluate groundwater inflow rates into the expanded quarry as well as potential groundwater drawdown proximal to the quarry and the potential magnitude of drawdown at identified groundwater users.

The modelling objectives were stated in specific and measurable terms, along with the resource management objectives. However, it can be enhanced by discussing questions to be answered by the model and scenarios to be modelled.

2.2 Model confidence level classification

Models are used to produce predictions and the majority of models inherently have some degree of uncertainty associated with them. Hence, their predictions are imperfect. The potential for imperfection in predictions or the "wrongness" of model predictions arises from:

- Insufficient available data for unique estimation of parameterization detail; and
- Errors in its conceptual basis.

It is important to identify these constraints and how they affected the modelling process, especially in the development of a groundwater model of high complexity. This a schematic drawing or tabular form, showing all the hydrological stresses acting on the groundwater system and the reliability of the components obtained and input to the groundwater model.

Some of the hydrological stresses acting on the system are as follows:

- Rainfall recharge
- Evapotranspiration
- Groundwater extraction
- Groundwater seepage (quarry)

- Base flow discharge (gully catchment areas)

It is critical to provide a clear statement on how these hydrological input stresses were collated or simulated using the availablehistorical monitoring data. Three 50 mm dia. monitoring bores (SA1501 – SA1503) were drilled in 2015 for hydrogeological investigation and to record groundwater level fluctuations **Figure 2-1**.

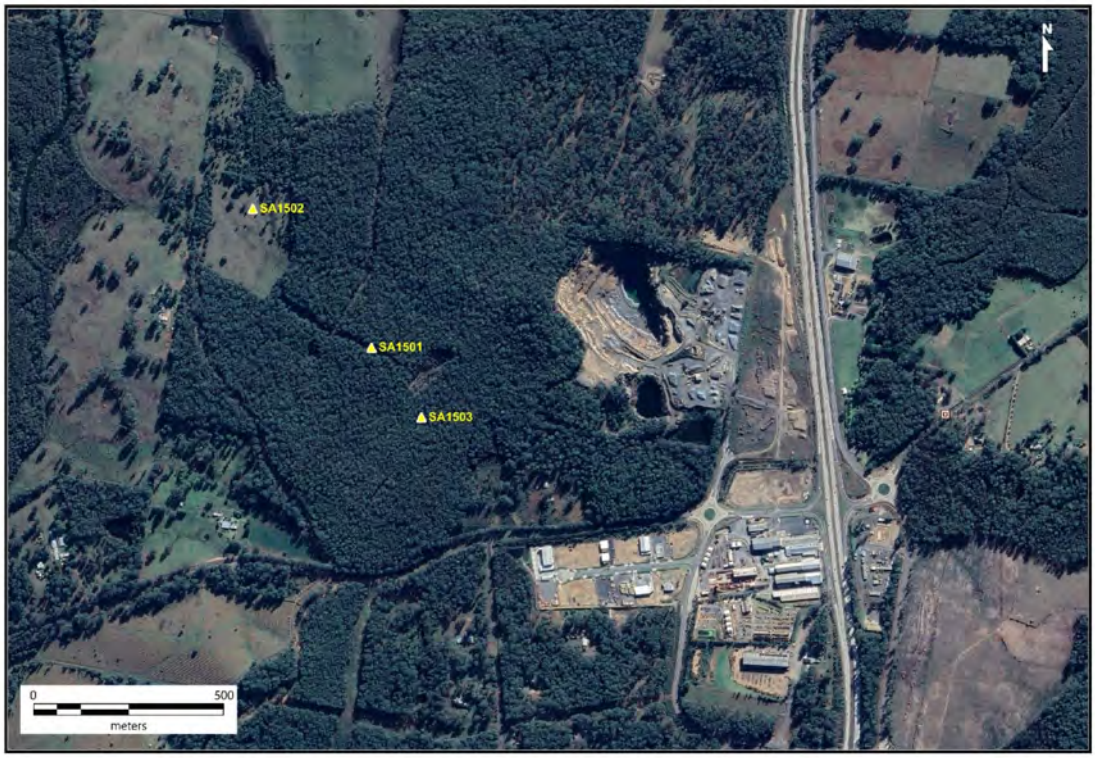


Figure 2-1 Groundwater monitoring bores

These bores are located in a near straight line which is not ideal for inferring groundwater flow directions spatially within the study area. Historical water levels that were collected from these bores were neither provided nor analysed to understand the hydrological stresses. It is also noted that no hydrogeological information from the surrounding groundwater bores, GW060512, GW060513, GW300120, GW301263, GW302376, GW303436, GW303749 and GW306269, has been included in the groundwater model development.

The model confidence-level classification (Class 1, Class 2, or Class 3 in order of increasing confidence) has been proposed in the Australian Groundwater Modelling Guidelines in order to assess whether or not the model has met this target. The confidence-level classification is mainly based on the available data (and the accuracy of that data) for conceptualisation, design, and construction.

The following limitations to the model are presented in the modelling report:

- The measured hydraulic conductivities were extrapolated throughout the model domain with the assumption that there are no structural or other geological features present with hydraulic characteristics significantly different to the pumping test results.

- Hydraulic conductivity of weathered rock and quarrying impacted rock and its effect on recharge rates are unknown.
- The rate of recharge was determined during model calibration and has significant uncertainty.
- A topographic high occurs in the southern portion of the domain which may present a groundwater flow divide, creating flow to the southwest as well as towards the Hastings River. There is no groundwater elevation information in this portion of the model to establish model outflows boundaries. This may result in overly elevated heads in the southwest portion of the Model.
- This model does not include a transient analysis (groundwater level and flow estimates varying over time). Therefore, the model-calculated pit inflows are stabilized long-term values that do not include groundwater in storage effects. These storage effects, although temporary, could increase the current estimates significantly within the initial stages of the quarry expansion where large amounts may be released from aquifer storage.
- Similarly, the drawdown estimates are stabilized long-term estimates that represent the largest cone to be formed by the quarry dewatering. In reality, the cone of depression will expand gradually over time.
- Pit inflow estimates are based on groundwater seepage only, and do not include directly precipitated waters or surface water runoff into pit, with direct precipitation through rainfall likely being the major component of pit dewatering requirements.
- The current model is not sufficiently detailed to identify pit wall-groundwater issues and does not include additional estimates for pit slope pore pressure reduction. Should such systems (e.g. horizontal pit wall wells) be required, groundwater flows would be higher than current estimates. A more detailed analysis including transient flows and more detailed pit geometry configurations would be required to assess such issues.

The confidence level of the Sancrox Quarry groundwater model may be classified as “Class 1”, as defined by the Australian Groundwater Modelling Guidelines, as three poorly distributed monitoring bores were relied upon to obtain groundwater and geological information. As such, the groundwater model may be used for predicting long-term impacts of proposed developments in low-value aquifers. The model results should be used to plan additional data gathering to improve the confidence-level of the groundwater model.

2.3 Data analysis

It is reported that water level loggers were deployed in all three monitoring bores, SA1501 (Oct’15 – Sep’17), SA1502 (Dec’16 – Sep’17) and SA1503 (Dec’16 – Jul’17), and the loggers were programmed to collect water level measurements at 12 hour intervals. A summary of the water level measurements has been included in the report. However, comparison of the recorded logger data with the residual rainfall might help to understand the hydrological stresses for the model calibration and verifications.

Two short-term pumping tests were carried out at monitoring bores SA1501 and SA1502 over the period 28/29 November 2017. The pre-pumping test standing water levels were 10.72 and 1.53 mbGL in Bores SA1501 and SA1502, respectively. The standing water level was 11.43 mbGL in Bore SA1503, however this bore was not included in the pumping test program due a blockage within the bore.

The field records suggest that variable discharge pumping tests were carried out at these bores. Pumping rates at SA1502 were increased from 1 L/min to 3 L/min and at SA1501 from 3 L/min to 6 L/min.Water level recovery was observed in both bores. As such, these pumping tests should be analysed using the variable discharge flow equations.

The investigation / quantification of the following matters has not been sufficiently documented in the modelling report.

- Comparison of historical groundwater levels with the residual rainfall
- Existing groundwater bore survey
- Seepage discharge and evapotranspiration processes

Investigation / quantification of the matters listed above may provide some insight into the quantification of errors in the derivation of hydrological stresses.

2.4 Hydrogeological conceptualisation

Gravity is the main driving force for groundwater flow, while topography and geology define the effects on groundwater flow. The topography of the Study Area can be characterised by low lying hilly terrain (**Figure 2-2**) of relatively low hydraulic conductivity metasedimentary rocks. In these areas, the groundwater flow field is controlled by the topography and the groundwater table closely follows the landscape topography.

The eastern portion of the Study Area has been disturbed by active quarrying activities. while the west and northwest portions of the Study Area are largely undisturbed. A conceptual model diagram that conveys the essential features of the hydrological system, denoting all recharge/discharge processes. would be a useful addition to the documentation. Such a diagram could serve a dual purpose of displaying the water balance components derived from data sources and the uncertainty associated with the derivation of the water balance components.

ASTM 5979-96 provides a stepwise method for the qualitative conceptualisation and quantitative characterisation of groundwater flow systems, including the unsaturated zone, for natural or human-induced behaviour or changes.

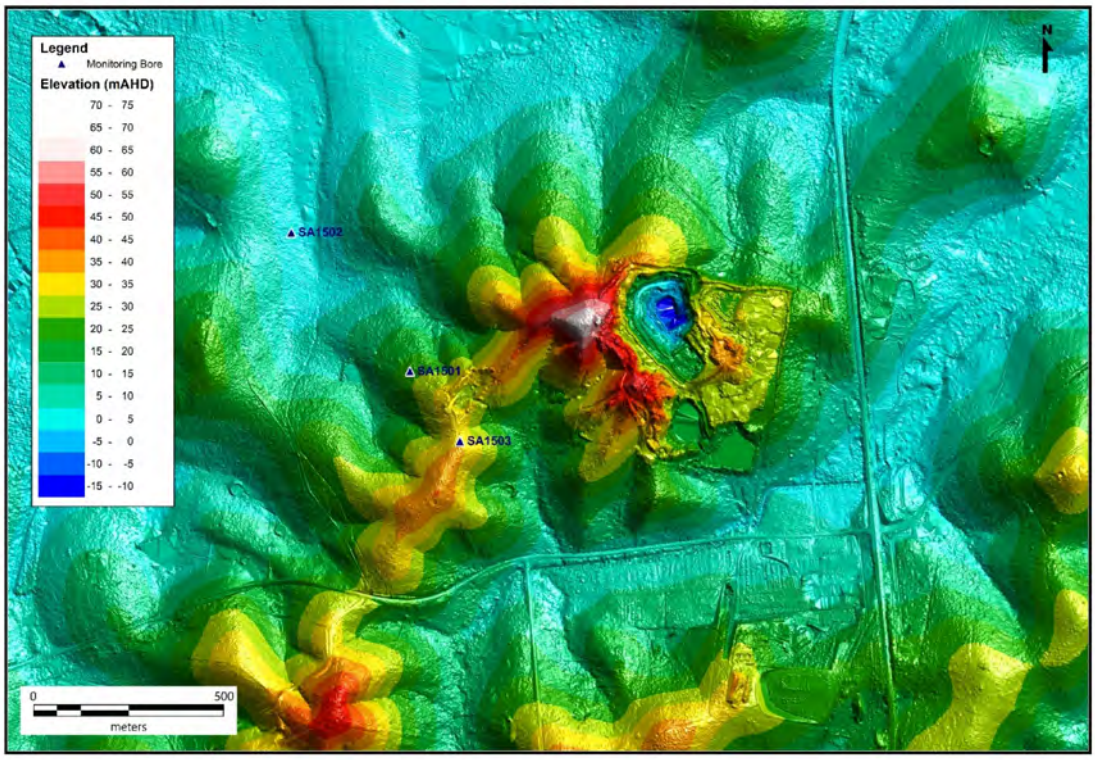


Figure 2-2 Topography of study area

Figure 2-3 Regional surface geology

The regional surface geology map (***Figure 2-3***) indicates that the Study Area is underlain by the Byabbara Beds of the Carboniferous Period. The Byabbara Beds' geology has been inferred to comprise conglomerate, sandstone, and siltstone to the north of the fault line and predominantly shale to the south of the fault line. The meta-sediments of the Byabbara Beds underlying the Study Area are considered to present a fractured rock aquifer, with groundwater storage and flow largely controlled by secondary porosity.

Three monitoring bores (SA1501 – SA1503) have been installed at the Study Area and the aquifer thickness values presented for SA1501 and SA1502 were 70 m and 36 m, respectively. It is recommended that a hydrogeological cross-section across SA1501 – SA1503 be provided showing hydro-stratigraphic units andstructural discontinuities to illustrate the key groundwater flow processes in the Study Area. In the absence of specific documentation relating to the bulk water movements between the layers of the model, the construction of a 4-layered model is potentially fraught with significant uncertainties.

The quantification of groundwater system water balance components was not documented in the modelling report for conceptual model development. The quantification of water balance components provides insight into potential deficiencies in the data collection.

2.5 Model design

A numerical groundwater flow model for the Study Area was developed using MODFLOW-NWT[3], a Newton formulation of MODFLOW-2005[4]. MODFLOW is a block-centred finite difference code and it views the three-dimensional system as a sequence of layers of porous material, though transmissivity within a layer may vary due to spatial variations in aquifer thickness and/or hydraulic conductivity. Finite difference grids are made of square or rectangular cells described as uniform or rectilinear grids, respectively.

The groundwater model is a four-layered MODFLOW based model. The model grid comprises 220 rows and 220 columns and is aligned with the primary groundwater flow direction across the Site towards the Hastings River. The model area was discretized with a uniform finite difference grid of 20 m x 20 m and covers an area of 19.36 km^2. Layer 1 was set to a constant 10 m thickness to represent quaternary alluvium and weathered meta-sediments. Layers 2 and 3 are a combined 100 m to represent the fractured meta-sediments and the full depth of the monitoring bores. Layer 4 is a constant 20 m thickness to allow for interaction of deeper metasedimentary rocks.

During normal MODFLOW operation, when the water levels in some model cells fall below the base of those cells, these cells are declared as "dry" and rendered inactive. Even though they can be "re-wet" at a later stage of the simulation process if necessary, numerical solution convergence difficulties are experienced due to the use of certain thresholds in the re-wetting process. Because of the limited implementation of drying-re-wetting functionality in MODFLOW, MODFLOW-NWT, which does not set dewatered cells as no-flow or inactive, was selected to overcome numerical instabilities during de-saturation. It is considered that MODFLOW-NWT code is an appropriate choice to achieve the objectives of the study. However, questions on the adequacy of field data for the spatially distributed MODFLOW

[3] Niswonger, R.G., Panday, Sorab, and Ibaraki, Motomu, 2011: MODFLOWNWT, A Newton formulation for MODFLOW-2005: U.S. Geological Survey Techniques and Methods, Book 6, Chapter A37.
[4] Harbaugh, A.W., 2005, MODFLOW-2005: the U.S. Geological Survey modular groundwater model – the Groundwater Flow Process: U.S. Geological Survey Techniques and Methods 6-A16, variously paginated.

model has to be resolved. In order to address this deficiency, it is recommended that additional field investigations at key locations be carried out in order to gather data and to allow subsequent improvement of model performance.

2.6 Boundary conditions

The following four types of boundary conditions have been assigned to the groundwater model:

- No-flow boundaries were set as the bottom of Layer 4 and the northwest, southwest and southeast boarders.
- A constant head boundary (CHB) was set in Layer 1 as the domain outflow on the northwest boundary of the model to represent discharge to the Hastings River and the southwest corner to represent discharge to quaternary materials.
- Recharge rates of 2.7 and 40 mm/year were determined during model calibration over the meta-sedimentary rocks and quaternary alluvial units, respectively.
- Drainage package was used to model seepage into the quarry pit.

The modelling report Figure 5.1 does not clearly show the limits constant, no-flow boundaries at the northwest and southwest boundaries and the assigned constant head. The modelling report also does not provide supporting data nor discusses the basis for the above boundary conditions.

2.7 Model calibration

A number of performance measures have been prescribed in Australian Groundwater Modelling Guidelines to demonstrate that a model is robust, simulates the water balance as required and is consistent with the conceptual model on which it is based (***Table 2-1***).

Table 2-1 Performance measures and targets

Performance measure	Criterion
Model convergence The model must converge in the sense that the maximum change in heads between iterations is acceptably small.	The iteration convergence criterion should be one or two orders of magnitude smaller than the level of accuracy required in head predictions. Typically, of the order of centimetres or millimetres.
Water balance The model must demonstrate an accurate water balance, at all times and in steady state. The water balance error is the difference between total predicted inflow and total predicted outflow, including changes in storage, divided by either total inflow or outflow and expressed as a percentage.	A value less than 1% should be achieved and reported at all times and cumulatively over the whole simulation. Ideally the error should be much less. An error of >5% would be unacceptable, and usually indicates some kind of error in the way the model has been set up.

Performance measure	Criterion
Qualitative measures The model results must make sense and be consistent with the conceptual model. Contours of heads, hydrographs and flow patterns must be reasonable, and similar to those anticipated, based either on measurements or intuition. Estimated parameters must make sense and be consistent with the conceptual model and with expectations based on similar hydrogeological systems.	Qualitative measures apply during calibration, when comparisons can be made with historical measurements, but also during predictions, when there is still a need for consistency with expectations. There is no specific measure of success. A subjective assessment is required as to the reasonableness of model results, relative to observations and expectations. The modeller should report on relevant qualitative measures and discuss the reasons for consistency and inconsistency with expectations.
Quantitative measures The goodness of fit between the model and historical measurements can be quantified, using statistics such as RMS, SRMS, MSR and SMSR for trial-and-error calibration and the objective function in automated calibration.	Quantitative measures only apply during calibration. Statistics of goodness of fit are useful descriptors but should not necessarily be used to define targets. Goodness of fit of heads is only one part of a regularised objective function—the other relates to agreement between parameter estimates and prior estimates, so in this situation, the two components of the objective function should both be reported. Targets such as SRMS < 5% or SRMS < 10% may be useful if a model is similar to other existing models and there is good reason to believe that the target is achievable. Even if a formal target is not set, these measures may provide useful guides.

Model calibration was carried out for a steady state condition in which groundwater elevation data was collected from three monitoring bores (SA1501, SA1502 and SA1503) prior to the start of the pumping tests conducted on 28 November 2017. It appears that no other data such as water levels in the surrounding groundwater bores, hand-drawn groundwater level contours based on the topography for pre-mining and current conditions, etc. have been considered to demonstrate robustness to the calibration process.

The goodness of fit of the three target data points presented in the modelling report cannot be considered as a useful information on the model calibration. This is because target data does not adequately represent the groundwater flow processes within the Study Area. Furthermore, the simulated groundwater equipotential surface presented in the modelling report (Figure 5.4) may not agree with the topography of the Study Area (i.e. ground surface is appeared to be lower than the simulated groundwater equipotential surface). No modelling results were presented to show the effect of the existing quarry surface on the groundwater equipotential surface.

It is concluded that model calibration does not systematically address the performance measures and targets (***Table 2-1***) and the uncertainty and lack of data has to be resolved.

2.8 Sensitivity analysis and verification

Sensitivity analysis is a procedure for quantifying the impact on an aquifer's simulated response due to an incremental variation in a model parameter or a model stress. Its purpose is to identify those

parameters which are most important in determining aquifer behaviour. A sensitivity scenario in which combined higher hydraulic conductivities in the metasedimentary unit and expanded locations of the southwest and southeast boundaries by 1,000 m has been documented in the report. The sensitivity analysis shows that the modelled drawdown at groundwater boreGW303749 increased from 2.90 m (base case) to 7.23 m and modelled drawdown in groundwater boresGW303436 and GW306260 increased by 0.90 m and 1.72 m, respectively. This indicates that the assignment of no flow boundary conditions at the southwest and southeast boundaries has to be reviewed and water levels at the groundwater bores GW060512, GW060513, GW300120, GW301263, GW302376, GW303436, GW303749 and GW306269 have to be included in the model calibration.

No verification of the model performance was reported. Verification is a test of whether the model can be used as a predictive tool by demonstrating that the calibrated model is an adequate representation of the physical system. The steady state model has been calibrated based on the groundwater elevation data collected on 28 November 2017 and the rainfall data available for the site from the DataDrill[5] climate repository (**Figure 2-4**) indicates that the Study Area experienced more than average rainfall in the latter part of 2017.

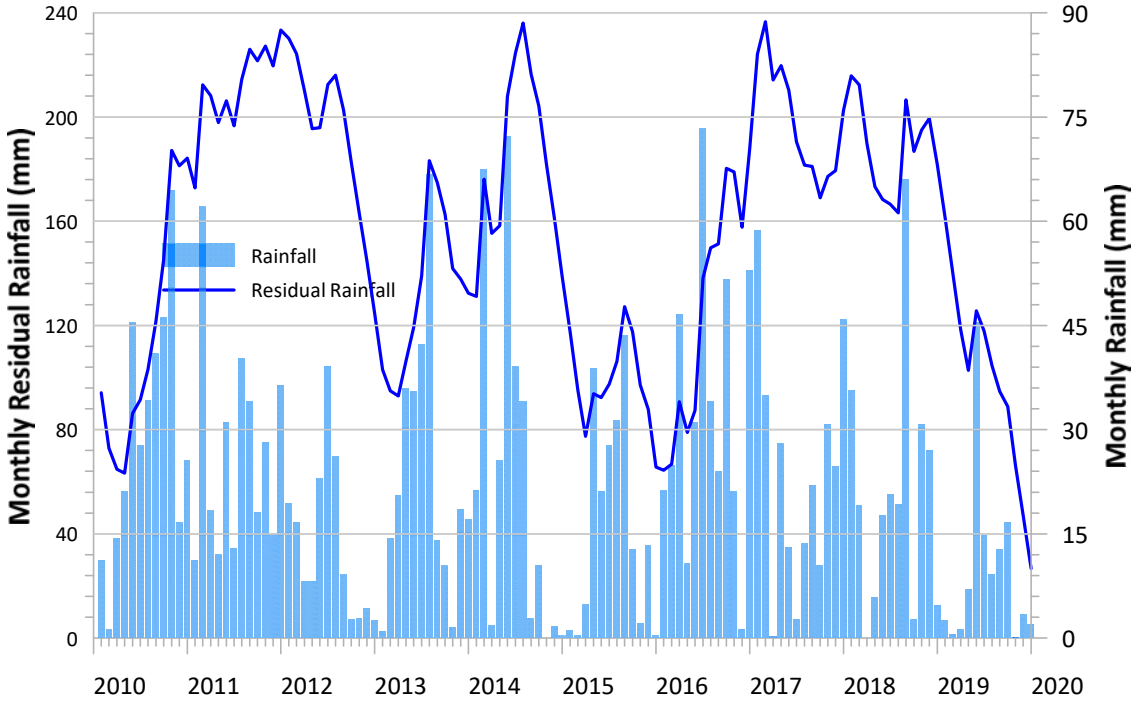


Figure 2-4 Plot of residual and monthly rainfall

Consideration should be given to verification of the model using the logger data to assess if the model is a reliable tool for the prediction of groundwater level fluctuation with varying climate data.

[5] https://www.longpaddock.qld.gov.au/silo/point-data/

3 SUMMARY AND CONCLUSION

The information provided in the Sancrox Quarry Expansion Environmental Impact Statement (EIS) – Annex F: Groundwater Assessment relating to groundwater modelling was reviewed based on the Australian Groundwater Modelling Guideline checklist. The groundwater model data files were not reviewed by REN.

The following conclusions were made:

- The statement of modelling objectives in the report could be enhanced by discussing questions to be answered by the model and scenarios to be modelled.
- A set of static groundwater elevation data collected at only three monitoring bores, SA1501, SA1502 and SA1503, prior to the pumping test has been included in the model development. Water level data that was collected from these bores was neither provided nor analysed to understand the hydrological stresses in the Study Area.
- No hydrogeological information from the surrounding groundwater bores, GW060512, GW060513, GW300120, GW301263, GW302376, GW303436, GW303749 and GW306269, has been included in the groundwater model development.
- The investigation / quantification of the following matters has to be analysed to provide some insight into the quantification of errors in the derivation of hydrological stresses:
    - Comparison of historical groundwater levels with the residual rainfall
    - Existing groundwater bore survey
    - Seepage discharge and evapotranspiration processes.
- The hydrogeological cross-section across the monitoring bores: SA1501, SA1502 and SA1503, should be presented to support the adopted model layer configuration.
- The quantification of groundwater system water balance components has to be provided in order to gain insight into potential deficiencies in the data collection.
- The modelling report neither provides supporting data nor discusses the basis for the adopted boundary conditions.
- Estimated pre-quarrying and current groundwater level contours have to be presented to verify the modelled groundwater level contours.
- The modelled groundwater equipotential surface presented in the modelling report may not agree with the topography of the study area (i.e. ground surface appears to be lower than the modelled groundwater equipotential surface).
- The model calibration does not systematically address the performance measures and targets as outlined in the Groundwater Modelling Guidelines and the uncertainty and lack of data have to be resolved.
- Sensitivity analysis of the assignment of no flow boundary conditions at the southwest and southeast boundaries has to be reviewed and water levels at the groundwater bores, GW060512, GW060513,

GW300120, GW301263, GW302376, GW303436, GW303749 and GW306269, have to be included in the model calibration.

- No verification of the model performance was reported. Verification of the model using the logger data is needed to assess if the model is a reliable tool for the prediction of groundwater level fluctuation with varying climate data.

The confidence level of the Sancrox Quarry groundwater model may be classified as "Class 1", as defined by the Australian Groundwater Modelling Guidelines, as three poorly distributed monitoring bores were relied upon to obtain groundwater and geological information. As such, the groundwater model may be used for predicting long-term impacts of proposed developments in low-value aquifers. The model results should be used to plan additional data gathering to improve the confidence-level of the groundwater model.

Appendix A – Review Checklist

Review questions	Yes/No	Comment
1. Planning		
1.1 Are the project objectives stated?	Yes	
1.2 Are the model objectives stated?	Yes	
1.3 Is it clear how the model will contribute to meeting the project objectives?	Yes	
1.4 Is a groundwater model the best option to address the project and model objectives?	Yes	
1.5 Is the target model confidence-level classification stated and justified?	No	
1.6 Are the planned limitations and exclusions of the model stated?	Yes	
2. Conceptualisation		
2.1 Has a literature review been completed, including examination of prior investigations?	No	
2.2 Is the aquifer system adequately described?	No	
2.2.1 hydrostratigraphy including aquifer type (porous, fractured rock ...)	No	
2.2.2 lateral extent, boundaries and significant internal features such as faults and regional folds	No	
2.2.3 aquifer geometry including layer elevations and thicknesses	No	
2.2.4 confined or unconfined flow and the variation of these conditions in space and time?	No	
2.3 Have data on groundwater stresses been collected and analysed?	No	
2.3.1 recharge from rainfall, irrigation, floods, lakes	No	
2.3.2 river or lake stage heights	n/a	
2.3.3 groundwater usage (pumping, returns etc)	No	
2.3.4 evapotranspiration	No	
2.3.5 other?		
2.4 Have groundwater level observations been collected and analysed?	No	
2.4.1 selection of representative bore hydrographs	No	
2.4.2 comparison of hydrographs	No	
2.4.3 effect of stresses on hydrographs	No	
2.4.4 water-table maps/piezometric surfaces?	No	
2.4.5 If relevant, are density and barometric effects taken into account in the interpretation of groundwater head and flow data?	n/a	
2.5 Have flow observations been collected and analysed?	No	
2.5.1 baseflow in rivers	No	
2.5.2 discharge in springs	n/a	
2.5.3 location of diffuse discharge areas?	n/a	
2.6 Is the measurement error or data uncertainty reported?	No	

Review questions	Yes/No	Comment
2.6.1 measurement error for directly measured quantities (e.g. piezometric level, concentration, flows)	No	
2.6.2 spatial variability/heterogeneity of parameters	No	
2.6.3 interpolation algorithm(s) and uncertainty of gridded data?	No	
2.7 Have consistent data units and geometric datum been used?	Yes	
2.8 Is there a clear description of the conceptual model?	No	
2.8.1 Is there a graphical representation of the conceptual model?	No	
2.8.2 Is the conceptual model based on all available, relevant data?	No	
2.9 Is the conceptual model consistent with the model objectives and target model confidence level classification?	No	
2.9.1 Are the relevant processes identified?	No	
2.9.2 Is justification provided for omission or simplification of processes?	No	
2.10 Have alternative conceptual models been investigated?	No	
3. Design and construction		
3.1 Is the design consistent with the conceptual model?	No	
3.2 Is the choice of numerical method and software appropriate (**Error! Reference source not found.**)?	Yes	
3.2.1 Are the numerical and discretisation methods appropriate?	Yes	
3.2.2 Is the software reputable?	Yes	
3.2.3 Is the software included in the archive or are references to the software provided?	Yes	
3.3 Are the spatial domain and discretisation appropriate?		
3.3.1 1D/2D/3D	Yes	
3.3.2 lateral extent	No	
3.3.3 layer geometry?	No	
3.3.4 Is the horizontal discretisation appropriate for the objectives, problem setting, conceptual model and target confidence level classification?	No	
3.3.5 Is the vertical discretisation appropriate? Are aquitards divided in multiple layers to model time lags of propagation of responses in the vertical direction?	No	
3.4 Are the temporal domain and discretisation appropriate?		
3.4.1 steady state or transient	No	
3.4.2 stress periods	n/a	
3.4.3 time steps?	n/a	
3.5 Are the boundary conditions plausible and sufficiently unrestrictive?		
3.5.1 Is the implementation of boundary conditions consistent with the conceptual model?	No	
3.5.2 Are the boundary conditions chosen to have a minimal impact on key model outcomes? How is this ascertained?	No	

Review questions	Yes/No	Comment
3.5.3 Is the calculation of diffuse recharge consistent with model objectives and confidence level?	No	
3.5.4 Are lateral boundaries time-invariant?	No	
3.6 Are the initial conditions appropriate?	n/a	
3.6.1 Are the initial heads based on interpolation or on groundwater modelling?	n/a	
3.6.2 Is the effect of initial conditions on key model outcomes assessed?	n/a	
3.6.3 How is the initial concentration of solutes obtained (when relevant)?	n/a	
3.7 Is the numerical solution of the model adequate?		
3.7.1 Solution method/solver		
3.7.2 Convergence criteria		
3.7.3 Numerical precision		
4. Calibration and sensitivity		
4.1 Are all available types of observations used for calibration?		
4.1.1 Groundwater head data	No	
4.1.2 Flux observations	No	
4.1.3 Other: environmental tracers, gradients, age, temperature, concentrations etc.	n/a	
4.2 Does the calibration methodology conform to best practice?		
4.2.1 Parameterisation	No	
4.2.2 Objective function	No	
4.2.3 Identifiability of parameters	No	
4.2.4 Which methodology is used for model calibration?		
4.3 Is a sensitivity of key model outcomes assessed against?		
4.3.1 parameters	Yes	
4.3.2 boundary conditions	Yes	
4.3.3 initial conditions	n/a	
4.3.4 stresses	n/a	
4.4 Have the calibration results been adequately reported?	No	
4.4.1 Are there graphs showing modelled and observed hydrographs at an appropriate scale?	No	
4.4.2 Is it clear whether observed or assumed vertical head gradients have been replicated by the model?	No	
4.4.3 Are calibration statistics reported and illustrated in a reasonable manner?	Yes	
4.5 Are multiple methods of plotting calibration results used to highlight goodness of fit robustly? Is the model sufficiently calibrated?		
4.5.1 spatially	No	
4.5.2 temporally	No	
4.6 Are the calibrated parameters plausible?	Yes	

Review questions	Yes/No	Comment
4.7 Are the water volumes and fluxes in the water balance realistic?	No	
4.8 has the model been verified?	No	
5. Prediction		
5.1 Are the model predictions designed in a manner that meets the model objectives?	Yes	
5.2 Is predictive uncertainty acknowledged and addressed?	No	
5.3 Are the assumed climatic stresses appropriate?	No	
5.4 Is a null scenario defined?	n/a	
5.5 Are the scenarios defined in accordance with the model objectives and confidence level classification?	No	
5.5.1 Are the pumping stresses similar in magnitude to those of the calibrated model? If not, is there reference to the associated reduction in model confidence?	No	
5.5.2 Are well losses accounted for when estimating maximum pumping rates per well?	No	
5.5.3 Is the temporal scale of the predictions commensurate with the calibrated model? If not, is there reference to the associated reduction in model confidence?	No	
5.5.4 Are the assumed stresses and timescale appropriate for the stated objectives?	No	
5.6 Do the prediction results meet the stated objectives?	No	
5.7 Are the components of the predicted mass balance realistic?	No	
5.7.1 Are the pumping rates assigned in the input files equal to the modelled pumping rates?	n/a	
5.7.2 Does predicted seepage to or from a river exceed measured or expected river flow?	n/a	
5.7.3 Are there any anomalous boundary fluxes due to superposition of head dependent sinks (e.g. evapotranspiration) on head-dependent boundary cells (Type 1 or 3 boundary conditions)?	n/a	
5.7.4 Is diffuse recharge from rainfall smaller than rainfall?	Yes	
5.7.5 Are model storage changes dominated by anomalous head increases in isolated cells that receive recharge?	n/a	
5.8 Has particle tracking been considered as an alternative to solute transport modelling?	n/a	
6. Uncertainty		
6.1 Is some qualitative or quantitative measure of uncertainty associated with the prediction reported together with the prediction?	n/a	
6.2 Is the model with minimum prediction-error variance chosen for each prediction?	n/a	
6.3 Are the sources of uncertainty discussed?		
6.3.1 measurement of uncertainty of observations and parameters	No	
6.3.2 structural or model uncertainty	Yes	
6.4 Is the approach to estimation of uncertainty described and appropriate?	n/a	

Review questions	Yes/No	Comment
6.5 Are there useful depictions of uncertainty?	n/a	
7. Solute transport		
7.1 Has all available data on the solute distributions, sources and transport processes been collected and analysed?	n/a	
7.2 Has the appropriate extent of the model domain been delineated and are the adopted solute concentration boundaries defensible?	n/a	
7.3 Is the choice of numerical method and software appropriate?	n/a	
7.4 Is the grid design and resolution adequate, and has the effect of the discretisation on the model outcomes been systematically evaluated?	n/a	
7.5 Is there sufficient basis for the description and parameterisation of the solute transport processes?	n/a	
7.6 Are the solver and its parameters appropriate for the problem under consideration?	n/a	
7.7 Has the relative importance of advection, dispersion and diffusion been assessed?	n/a	
7.8 Has an assessment been made of the need to consider variable density conditions?	n/a	
7.9 Is the initial solute concentration distribution sufficiently well-known for transient problems and consistent with the initial conditions for head/pressure?	n/a	
7.10 Is the initial solute concentration distribution stable and in equilibrium with the solute boundary conditions and stresses?	n/a	
7.11 Is the calibration based on meaningful metrics?	n/a	
7.12 Has the effect of spatial and temporal discretisation and solution method taken into account in the sensitivity analysis?	n/a	
7.13 Has the effect of flow parameters on solute concentration predictions been evaluated, or have solute concentrations been used to constrain flow parameters?	n/a	
7.14 Does the uncertainty analysis consider the effect of solute transport parameter uncertainty, grid design and solver selection/settings?	n/a	
7.15 Does the report address the role of geologic heterogeneity on solute concentration distributions?	n/a	
8. Surface water–groundwater interaction		
8.1 Is the conceptualisation of surface water–groundwater interaction in accordance with the model objectives?	n/a	
8.2 Is the implementation of surface water–groundwater interaction appropriate?	n/a	
8.3 Is the groundwater model coupled with a surface water model?	n/a	
8.3.1 Is the adopted approach appropriate?	n/a	
8.3.2 Have appropriate time steps and stress periods been adopted?	n/a	
8.3.3 Are the interface fluxes consistent between the groundwater and surface water models?	n/a	

Appendix B – Department of Planning Industry & Environment Review

OUT19/14564

Melissa Anderson
Environmental Assessment Officer
Planning & Assessments
NSW Department of Planning and Environment

melissa.anderson@planning.nsw.gov.au

Dear Ms Anderson

Sancrox Quarry Expansion Project (SSD-7293)
EIS Exhibition

I refer to your email of 25 October 2019 to the Department of Planning, Industry and Environment (DPIE) Water and the Natural Resources Access Regulator (NRAR) about the above matter.

The following recommendations for you to consider are provided from DPIE Water and NRAR. Please note Crown Lands, the Department of Primary Industries (DPI) – Fisheries and DPI - Agriculture all now provide a separate response directly to you. Please note more detail is provided in **Attachment A**.

Pre-Approval

Groundwater Assessment, Licencing and Monitoring

- Assess and classify the groundwater model against the Australian Groundwater Modelling Guidelines and have the model peer reviewed.
- Provide details on acquiring suitable surface/groundwater entitlement to cover estimated take.
- Correctly identify potentially impacted water sources and revise its Aquifer Interference Policy (AIP) (DPI 2012) assessment as required.

Post Approval

Groundwater Licencing and Monitoring

- If a Water Access Licence (WAL) is required it must be obtained prior to the commencement of works.
- Develop a groundwater monitoring plan in consultation with DPIE Water including threshold trigger values as well as a contingency strategy if triggers are exceeded.
- Develop a water quality monitoring plan for the in-pit sump(s) and existing monitoring bores while they remain accessible.

Surface Water Assessment

- Establish a sediment control structure adjacent to the northern aggregate stockpile to the southeast of the Project area.

Any further referrals to DPIE – Water and NRAR can be sent by email to: landuse.enquiries@dpi.nsw.gov.au.

Any further referrals to (a) Crown Lands; (b) DPI – Fisheries; and (c) DPI – Agriculture can be sent by email to: (a) lands.ministerials@industry.nsw.gov.au; (b) ahp.central@dpi.nsw.gov.au; and (c) landuse.ag@dpi.nsw.gov.au respectively.

Yours sincerely

Simon Francis
Senior Project Officer, Assessments
Water – Strategic Relations
10 February 2020

Sancrox Quarry Expansion Project (SSD-7293)
EIS Exhibition

Groundwater Assessment, Licencing and Monitoring

The numerical groundwater model (herein the model) reported in the EIS was calibrated in steady state only and with no transient verification. The proponent has not referenced the Australian Groundwater Modelling Guidelines (2012) in the EIS or in Appendix F. No report is given of a peer review and no classification is made under the Guidelines. However, the model is appropriately constructed and well calibrated.

The model does not incorporate surface water harvesting and enhanced pit inflows, nor does it take into account harvested surface water storages close to the pit. These have the potential to alter the model final iterations in its current form.

The proponent has misidentified the applicable Water Sharing Plans and Water Sources potentially affected by this development, possibly misguided by the possibility that the Water Sharing Plan for the Hastings Unregulated and Alluvial Water Sources (2019) was yet to be gazetted at the time of the groundwater assessment.

In any event, the proponent has failed to identify the New England Fold Belt Coast Groundwater Source of the Water Sharing Plan for the North Coast Fractured and Porous Rock Groundwater Sources 2016 as the impacted water source. (The Hastings Alluvium sits adjacent to the quarry extent but partly within the project boundary.)

Despite this, the minimum impact considerations of the AIP are correctly made for a less productive porous rock aquifer, but should be reassessed by the proponent in view of the other errors made and the shortcomings identified with the numerical model.

The bulk of the water demands are to be supplied from harvesting overland flows on site, with an estimated peak operational demand of at 131 ML/year. The groundwater seepage into the pit void is modelled at between 15 to 22 ML/year – representing the full volume of groundwater take.

The proponent has not provided details on acquiring suitable surface/groundwater entitlement for the predicted water take within the WSP. The predicted 100-year 2 m drawdown contour is not entirely within lands owned by the proponent (and quarry lease). The proponent has modelled drawdown impacts on two neighbouring third-party bores that breach the 2 m limit required under the AIP. The proponent will need to implement monitoring of these sites in the WMP and provide triggers for make good provisions on impacted bores.

There are currently three groundwater monitoring bores within the proponents lease area and a further 13 bores within a 2 km radius of the pit. Two years of water level data were collected in the three monitoring bores at 12 hr intervals between October 2015 and July 2017. Water quality monitoring was completed only once during the pump test completed in November 2017 – this is insufficient to represent baseline conditions.

A water monitoring plan will need to be developed in consultation with DPIE Water.

Surface Water Assessment

Surface water runoff flows into the main pit and is pumped into water holding dams in the southeast corner of the site. There is a sediment basin in the north east of the quarry that captures water from the crushing plant and stock pile. The northern aggregate stockpile area drains to the southeast and has minimal sediment control. The proponent has committed to reviewing sediment control on site. The quarry is surrounded by a bund at its extents.

The quarry sites represent a challenge for erosion control deemed “high risk”, due to the large areas of exposed soil surface (which is often unavoidable), and erosion control will only ever be partially effective. To protect receiving waters against pollution, sediment controls such as large sediment basins near final discharge locations and smaller sediment traps targeting problem areas, will be an important element of the Soil and Water Management Plan.

ERM has over 160 offices across the following countries and territories worldwide

Argentina
Australia
Belgium
Brazil
Canada
Chile
China
Colombia
France
Germany
Hong Kong
India
Indonesia
Ireland
Italy
Japan
Kazakhstan
Kenya
Malaysia
Mexico
Mozambique
Myanmar
The Netherlands
New Zealand
Norway
Panama
Peru
Poland
Portugal
Puerto Rico
Romania
Russia
Singapore
South Africa
South Korea
Spain
Sweden
Switzerland
Taiwan
Thailand
UAE
UK
US
Vietnam

ERM's Melbourne Office
Citic House
Level 6, 99 King Street
Melbourne VIC 3000

PO BOX 266
South Melbourne VIC 3205

T: +61 3 9696 8011
F: +61 3 9696 8022

www.erm.com

Appendix H

Revised Biodiversity Assessment Report

SANCROX QUARRY EXPANSION PROJECT

State Significant Development (SSD 7293)
Biodiversity Assessment Report - RTS Final Version

Prepared for: Hanson Heidelberg Cement Group

SLR Ref: 630.11478.00100
Version No: -v2.5
May 2021

PREPARED BY

SLR Consulting Australia Pty Ltd
ABN 29 001 584 612
10 Kings Road
New Lambton NSW 2305 Australia
(PO Box 447 New Lambton NSW 2305)
T: +61 2 4037 3200 F: +61 2 4037 3201
E: newcastleau@slrconsulting.com www.slrconsulting.com

BASIS OF REPORT

This report has been prepared by SLR Consulting Australia Pty Ltd with all reasonable skill, care and diligence, and taking account of the timescale and resources allocated to it by agreement with Hanson Heidelberg Cement Group. Information reported herein is based on the interpretation of data collected, which has been accepted in good faith as being accurate and valid.

This report is for the exclusive use of No warranties or guarantees are expressed or should be inferred by any third parties. This report may not be relied upon by other parties without written consent from SLR

SLR disclaims any responsibility to the Client and others in respect of any matters outside the agreed scope of the work.

DOCUMENT CONTROL

Reference	Date	Prepared	Checked	Authorised
630.11478.00100-R01-v2.5	13 May 2021	Jeremy Pepper, M Consterdine	J Pepper	J Pepper

EXECUTIVE SUMMARY

Project Description

Hanson Construction Materials Pty Ltd is seeking project approval for the expansion of the existing Sancrox hard rock quarry, located on Sancrox Road, Sancrox. The Sancrox Quarry Expansion Project will involve extending the life of the quarry to 30 years and increasing approved extraction limits of 175,000 m^3. The Project will be assessed as a State Significant Development (SSD 7293) as defined under *State Environmental Planning Policy (State and Regional Development) 2011*, and will require development consent under Part 4, Division 4.1 of the NSW *Environmental Planning and Assessment Act 1979*. Under the *NSW Biodiversity Offsets Policy for Major Projects,* impacts on biodiversity values are assessed according to the *Framework for Biodiversity Assessment* (FBA). A *Biodiversity Assessment Report* is required to describe the biodiversity values present on the development site and the impact of the Major Project on these values.

Existing Biodiversity Values

Field surveys were completed in accordance with the relevant sections of the FBA and comprised targeted surveys for threatened orchid species (completed 16 October 2015), BioBanking plot based vegetation and habitat surveys, diurnal and nocturnal surveys targeting relevant threatened fauna (completed 30 November to 4 December 2015) and additional surveys targeting threatened nocturnal fauna (completed 14 and 15 December 2015). Supplementary surveys for the Koala were also conducted in October 2020.

Vegetation and Plant Communities

The Development Site contains stands of native forest, along with areas of cleared and disturbed land and constructed ponds for water retention around the existing pit. Native vegetation within the Development Site has been described in terms of Plant Community Types (PCTs), with two PCTs identified and mapped across the site, as follows:

- PCT 1215 (NR 247) Spotted Gum - Grey Ironbark open forest of the Macleay Valley lowlands of the NSW North Coast Bioregion (11.08 ha); and
- PCT 1265 (NR 263) Tallowwood - Small-fruited Grey Gum dry grassy open forest of the foothills of the NSW North Coast (27.94 ha).

Neither of these PCTs is listed as a threatened ecological community under the NSW *Biodiversity Conservation Act 2016* (BC Act). A small stand of Blackbutt - Pink Bloodwood shrubby open forest (PCT 686) was previously located within the southern/central portion of the Development Site; however, the proposed pit layout has been amended to exclude this patch of vegetation, which is identified as the threatened ecological community *Subtropical Coastal Floodplain Forest of the New South Wales North Coast Bioregion*.

No significant state or regional biodiversity links have been mapped on the Development Site; however aerial imagery identified two local links that traverse the site that contribute to vegetation connectivity in the area. There is also a portion of a “sub-regional biodiversity corridor” mapped in the Greater Sancrox Structure Plan, which traverses south-north through the centre of the Development Site.

EXECUTIVE SUMMARY

Flora and Fauna Habitats

During the field surveys habitat features, such as hollow-bearing trees, were recorded throughout the Development Site. No naturally occurring aquatic habitats were recorded as the site contains only ephemeral (unnamed) first and second order watercourses, most of which drain into retention dams constructed as part of the existing quarry.

Threatened Species

A total of eight threatened species listed under the BC Act, all of which generate ecosystem credits (for foraging habitat), were recorded on site: Eastern Freetail-bat, Eastern False Pipistrelle, Greater Broad-nosed Bat, Yellow-bellied Sheathtail-bat, Little Bent-wing Bat, Eastern Bentwing-bat, Grey-headed Flying-fox and Koala. One species credit species, the Koala (*Phascolarctos cinereus)* was recorded on site and the forested parts of the site contain Koala feed trees and constitute habitat for this species.

No threatened flora species were recorded on the Development Site, despite targeted surveys during the known flowering periods for relevant species.

Biodiversity Impacts

The direct impacts associated with the project include the clearing of 39.02 ha of native forest vegetation. Other impacts include the loss of hollow-bearing trees, which may provide potential breeding habitat and roost sites for a number of arboreal mammals, microchiropteran bats and bird species and the removal of foraging habitat for native fauna.

The clearing of 39.02 ha of native forest vegetation has been quantified in terms of biodiversity credits, with the proposed clearing resulting in the generation of 2,230 ecosystem credits. The type and number of ecosystem credits generated by the proposed vegetation removal is as follows:

- Spotted Gum - Grey Ironbark open forest of the Macleay Valley lowlands of the NSW North Coast Bioregion (NR247) – 505 credits; and
- Tallowwood - Small-fruited Grey Gum dry grassy open forest of the foothills of the NSW North Coast (NR263) – 1725 credits.

The proposed development will require the removal of 39.02 ha of Koala habitat. According to the FBA, this will necessitate the retirement of 1015 species credits to offset the loss of habitat There are no other species credits generated as a result of the impacts associated with the project.

EPBC Act

One matter of national environmental significance, the Koala, which is listed as 'vulnerable' under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act), was recorded. Given the proposed removal of koala habitat associated with the development, a referral has been prepared and submitted to the Department of Agriculture, Water and the Environment for determination under the EPBC Act.

EXECUTIVE SUMMARY

Impact Avoidance, Mitigation and Offsetting

Impact avoidance measures for the project have involved site selection and optimisation of the development footprint. A selection of management practices and mitigation measures will be implemented during construction and operation, including a site-specific *Operational Environmental Management Plan* and a *Landscaping Strategy*, to minimise impacts on biodiversity values.

The assessment has determined that a biodiversity offset is required in accordance with the FBA. The offset comprises a combination of ecosystem credits and species credits, as follows:

- 505 ecosystem credits of Spotted Gum - Grey Ironbark open forest (NR247)
- 1725 ecosystem credits of Tallowwood - Small-fruited Grey Gum dry grassy open forest (NR263)
- 1015 Koala species credits

Biodiversity offsets under the FBA are generally secured prior to commencement of construction, although this can be deferred if a Voluntary Planning Agreement (under the *Environmental Planning and Assessment Act 1979*) is entered into prior to project approval. The offset will be secured through a combination of purchase and retirement of biodiversity credits from the credit market, creation of credits through a Stewardship Agreement on surplus lands within the study area and/ or payment of an equivalent monetary value into the Biodiversity Conservation Fund.

CONTENTS

1 INTRODUCTION 1
1.1 Background 1
1.2 Proposed Development Site 1
1.3 Proposed Development 5
1.3.1 Ancillary Infrastructure 5
1.3.2 Operational Development Footprint 5
1.4 Scope and Aims of this Report (SEARs) 6
1.5 Information Sources 9
1.6 Methods Summary 9
1.7 SLR Project Team – Staff Qualifications 10
1.8 Definitions 11
2 LANDSCAPE FEATURES 12
2.1 Overview 12
2.2 IBRA Bioregions and Subregions 12
2.3 Mitchell Landscapes 14
2.4 Soils 14
2.5 Native Vegetation extent 15
2.6 Topography 16
2.7 Waterbodies 16
2.7.1 Rivers and Streams 16
2.7.2 Wetlands and estuarine areas 17
2.8 Biodiversity corridors and links 17
2.9 Landscape Value 19
2.9.1 Native Woody Vegetation cover 19
2.9.2 Connectivity 19
2.9.3 Patch Size 20
2.9.4 Landscape Value Score 20
3 NATIVE VEGETATION 21
3.1 Study Area Characteristics 21
3.2 Regional (Broad-scale) Vegetation Mapping 21
3.2.1 Spotted Gum Grassy Dry Forest 22
3.2.2 White Stringybark – Tallowwood – Grey Gum Dry Forest 22
3.3 Vegetation Classes 22
3.4 Plant Community Types (PCTs) 25

CONTENTS

3.4.1 Overview ... 25
3.4.2 Spotted Gum-Grey Ironbark Open Forest (PCT 1215) ... 27
3.4.3 Tallowwood – Small fruited Grey Gum dry grassy open forest (PCT 1262) ... 28
3.5 Site Specific Vegetation Mapping – Differences to Regional Mapping ... 29
3.5.1 Biometric vegetation classification ... 30
3.5.2 Mapping of Port Macquarie-Hastings LGA ... 30
3.6 Vegetation Zones ... 31
3.7 Threatened Ecological Communities ... 33
3.7.1 Desktop Results ... 33
3.7.2 Subtropical coastal floodplain forest ... 34
4 THREATENED SPECIES ... 35
4.1 Overview ... 35
4.2 Summary of Threatened Species Recorded on Site ... 35
4.3 Ecosystem Credit Species ... 37
4.3.1 Generated by credit calculator ... 37
4.3.2 Wildlife Atlas (10 km search) ... 39
4.3.3 Predicted Ecosystem Credit Species ... 40
4.4 Species Credit Species ... 45
4.4.1 Assessment of Geographic / Habitat Features ... 45
4.4.2 Candidate species – Generated by credit calculator ... 46
4.4.3 Other Candidate Species (BioNet records) ... 48
4.4.4 Candidate Species Credit Species – present on site ... 50
5 IMPACT AVOIDANCE AND MINIMISATION ... 52
5.1 Impact Avoidance Measures ... 52
5.1.1 Extraction boundary ... 52
5.1.2 Site Selection ... 52
5.1.3 Optimising the proposed layout ... 52
5.2 Final Development Footprint Areas ... 53
5.3 Direct Impacts ... 54
5.3.1 Overview ... 54
5.3.2 Impacts on vegetation zones ... 54
5.4 Indirect Impacts ... 54
5.5 On-site Mitigation Measures ... 56
5.5.1 General ... 56
5.5.2 Rehabilitation ... 58

CONTENTS

6 IMPACT SUMMARY 61
6.1 Areas Not Requiring Further Assessment 61
6.2 Entities Not Requiring Offsets 61
6.3 Impacts Requiring Offsetting 61
6.3.1 PCTs Requiring Offset 61
6.3.2 Species Polygons Requiring Offset 62
6.4 Impacts Requiring Further Consideration 62
6.4.1 Biconvex Paperbark *Melaleuca biconvexa* 63
6.4.2 Spider Orchard *Dendrobium melaleucaphilum* 63
6.4.3 Southern Swamp Orchid *Phaius australis* 65
6.4.4 Impacts Requiring Further Consideration – General 66
6.5 Biodiversity Credit Requirement 66
6.5.1 Ecosystem credits 66
6.5.2 Landscape Value Score 67
6.5.3 Species Credits 67
6.6 Biodiversity Credit Report 68
7 BIODIVERSITY OFFSET STRATEGY 69
7.1 Overview 69
7.2 Biodiversity Matters Requiring Offsetting 69
7.3 Overview of Offset Options 69
7.4 Like-for-Like Offsets 71
7.4.1 Purchase Like-for-Like credits 71
7.4.2 Generate Credits via Stewardship Agreement 71
7.5 Apply Variation Rules 71
7.6 Supplementary Measures 72
7.7 Fund Payment 72
7.8 Preferred Offsetting Option 73
7.8.1 Proposed Offset Site – Generate Credits for Offsetting 73
7.8.2 Offset Strategy Proposed 76
7.8.3 Offset Strategy Actions 80
8 EPBC ACT MATTERS 82
8.1 Predicted Matters of NES 82
8.2 Relevant Matters of NES 82
8.2.1 Listed Threatened Species 82

CONTENTS

8.2.2 Listed Threatened Communities 85
8.2.3 Wetlands of National Significance 85
8.2.4 Migratory species 85
8.3 Impacts on Relevant Matter of NES 86
8.3.1 Listed Threatened Species 86
8.3.2 Migratory species 87
9 REFERENCES 88

DOCUMENT REFERENCES

TABLES

Table 1 Revised SEARs relating to Biodiversity 6
Table 2 Staff Roles and Qualifications 10
Table 3 Common definitions and abbreviations used in the BAR 11
Table 4 Native vegetation extent (by class) within outer (1,000 ha) circle 15
Table 5 Percent vegetation cover in the landscape 19
Table 6 Regional vegetation mapping within the study area# 21
Table 7 Vegetation Formations and Classes Mapped in the Study Area 22
Table 8 Conversion of Council mapping units to PCTs 25
Table 9 Plant Community Types (PCTs) mapped within the development footprint 27
Table 10 Formations, Classes and PCTs mapped within the development footprint 27
Table 11 Vegetation Zones mapped within the Development Site 31
Table 12 Threatened species recorded on the site 36
Table 13 Threatened species predicted to occur by the Credit Calculator (ecosystem credit species) 38
Table 14 Additional Ecosystem Credit Species generated by Wildlife Atlas 39
Table 15 Assessment of Geographic / Habitat Features for Species Credit Species 45
Table 16 Species credit species – Credit Calculator output and field survey records 46
Table 17 Additional species credit species – NSW Wildlife Atlas (BioNet) 48
Table 18 Development Footprint Areas 53
Table 19 Native Vegetation Impacts (clearing areas for vegetation zones) 54
Table 20 Mitigation measures to be implements before, during and after construction 56
Table 21 PCTs requiring offset and credits required 62
Table 22 Vegetation zones requiring offset and credits required 67
Table 23 Ecosystem credits required for offsetting the proposed development 67
Table 24 Ecosystem credits required for offset and matching credit types 68
Table 25 Options for Biodiversity Offsets for SSD projects 70
Table 26 Vegetation types mapped within the Offset site 73
Table 27 PCTs, Formations and Classes Mapped within the Offset Site 75
Table 28 Ecosystem Credits potentially created in the Proposed Offset Site 76
Table 29 Biodiversity Credit Balance – Credits Required vs Credits Generated in Offset 80
Table 30 PMST Results – Listed Threatened Species 82

CONTENTS

FIGURES

Figure 1 Study Area and Regional Location 3
Figure 2 Site Map 4
Figure 3 Aerial Image of the Development Site 8
Figure 4 Location Map 13
Figure 5 Biodiversity corridors 18
Figure 6 Regional vegetation mapping for Port Macquarie-Hastings LGA 24
Figure 7 Plant Community Types mapped within the Development Site 26
Figure 8 Vegetation Zones and Plot Locations 32
Figure 9 Fauna survey locations, habitat trees and threatened bat records 42
Figure 10 Council Vegetation Mapping within proposed Offset Site 74
Figure 11 Plant Community types within proposed Offset Site 78
Figure 12 Vegetation zones within proposed Offset Site 79

PHOTOS

Photo 1 Specimen of *Dendrobium gracilicaule* x *D. tarberi* (post-flowering, October 2015) 64
Photo 2 Specimen of *Dendrobium gracilicaule* x *D. tarberi* (flowering, September 2016) 65

APPENDICES

Appendix A SEARS (Biodiversity)
Appendix B Methods Statement
Appendix C Plot and Transect Data
Appendix D Greater Sancrox Structure Plan Area (MAP)
Appendix E Council BVT Profiles
Appendix F BioNet PCT Profiles
Appendix G Threatened Species Likelihood of Occurrence
Appendix H Koala Survey Report
Appendix I BioBanking Credit Reports
Appendix J Orchid Survey Report
Appendix K EPBC ACT PMST Results

1 Introduction

1.1 Background

SLR Consulting Australia (SLR) has been engaged to prepare a BioBanking Assessment Report (BAR) to support an application by Hanson Construction Materials Pty Ltd seeking project approval for expansion of the existing Sancrox hard rock quarry. The Sancrox Quarry (including the proposed development site) is located approximately 8 kilometres (km) west of Port Macquarie, within the Port Macquarie local government area on the Mid North Coast of New South Wales (NSW) (**Figure 1**).

The Project will be assessed as a State Significant Development (SSD) as defined under *State Environmental Planning Policy (State and Regional Development) 2011* (SRD SEPP), and will require development consent under Part 4, Division 4.1 of the NSW *Environmental Planning and Assessment Act 1979* (EP&A Act). As such, an environmental impact statement (EIS) will be required to be prepared to support the project application under the SSD process. It is intended that this BAR informs the EIS and will be included as a technical document in the EIS.

The Secretary's Environmental Assessment Requirements (SEARs) for the EIS, as issued by the Secretary of the Department of Planning and Environment (DP&E), require the preparation of a Biodiversity Assessment Report (BAR) in accordance with the *Framework for Biodiversity Assessment* (FBA). A copy of the SEARs that apply to this BAR, including the DP&E summary of requirements and the detailed requirements of the NSW Office of Environment and Heritage (OEH), are provided in **Appendix A.** The relevant SEARs and a listing of where they are addressed in this BAR are summarised in **Section 1.4**.

This BAR has been updated in May 2019 to address comments from OEH as part of the adequacy review of the EIS.

1.2 Proposed Development Site

The general location and features of the site and study area are displayed in the Site Map, which is provided in **Figure 2**. In accordance with the FBA, the Site Map contains the following features:

- Boundary of the development site;
- Lot boundaries and labels (i.e. cadastre);
- IBRA region and subregion;
- Mitchell landscapes;
- Rivers and streams (no wetlands are present); and
- Extent of native vegetation.

The study area, including the quarry lands owned by Hanson, comprises approximately 145 hectares (ha) of which 6.5 ha is currently occupied by the quarry and its facilities. The site is identified as Lot 1 in DP 702807, Lot 1 in DP 704890, Lot 2 in DP 574308 and Lot 353 in DP 754434. There is also a parcel of Crown Land separating Lot 2 into a north and a south section. The site is zoned RU1 (Primary Production) under the *Hastings Local Environmental Plan 2011*.

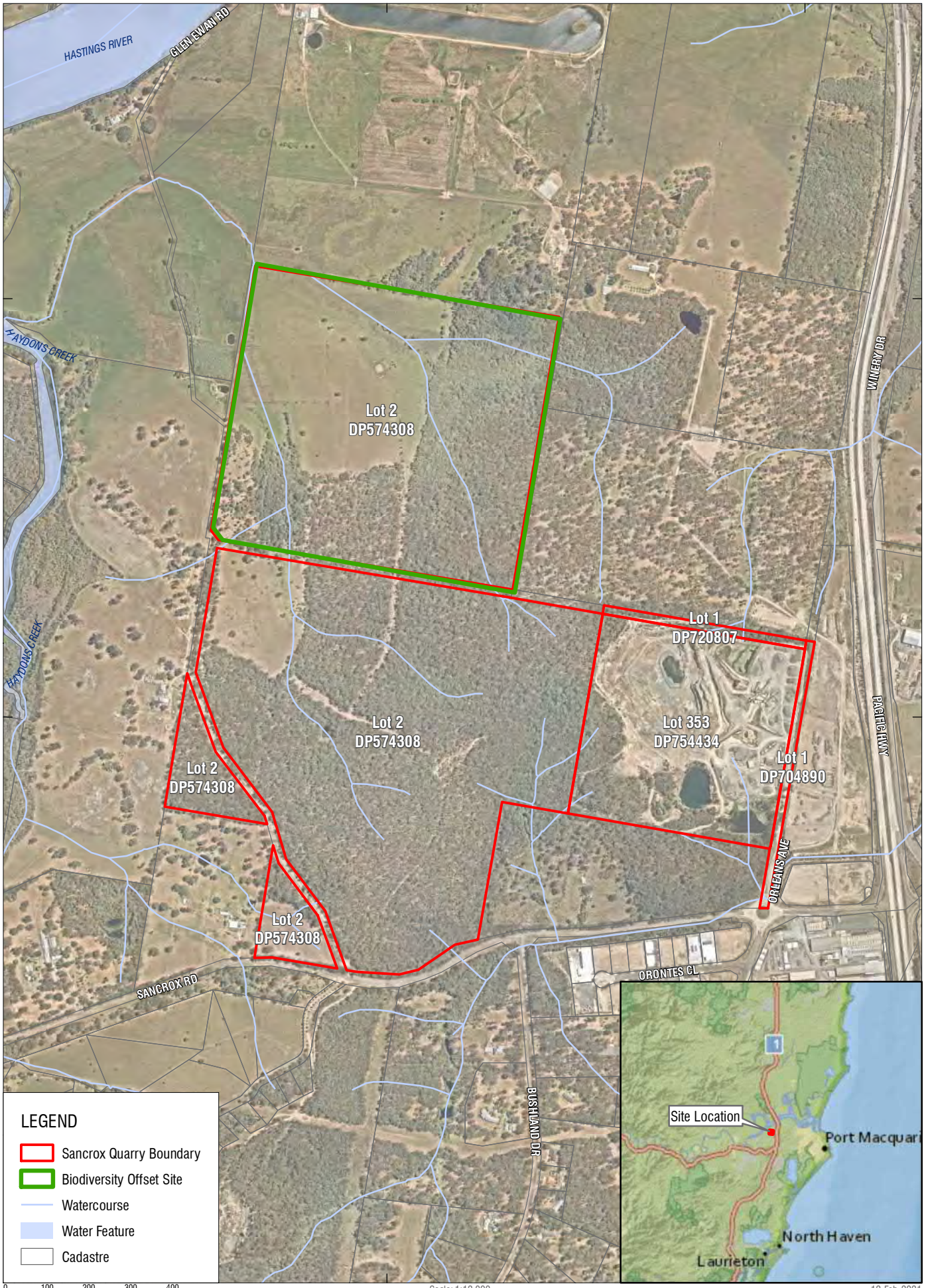
The site is located within the Port Macquarie-Hastings Local Government Area (LGA), Northern Rivers CMA and the NSW North Coast IBRA region and Macleay-Hastings sub-region. The Wauchope Coastal Foothills Mitchell landscape is mapped as occurring over the vast majority of the development site, with the Manning-Macleay Coastal Alluvial Plain landscape mapped as occurring across the northwestern parts of the study area (**Figure 2**).

There are no wetlands, rivers or streams traversing the development site, although a number of small ephemeral (and unnamed) first and second order watercourses are present, with two draining to the west and then north (beyond the site boundary) to Haydons Creek and then eventually the Hastings River. Other small tributaries drain south to the road drainage system of Sancrox Road or to the artificial dams located within the existing quarry area (**Figure 2**).

The vegetation within the study area and surrounding land is predominately native woody vegetation, interspersed with large expanses of cleared grassland (predominantly used for stock grazing), some areas of industrial use (i.e. the Sancrox industrial estate to the south) and major infrastructure of the Pacific Highway to the west (**Figure 2**). The southern parts of Lot 2 contain mostly white stringy bark-tallowwood-grey gum dry forest with patches of spotted grey gum grassy dry forest. The northern parts of Lot 2 contain stands of broad-leaved paperbark-mixed eucalypt swamp forest complex and stands of swamp mahogany-swamp forest. There are also small stands of flax-leaved paperbark-eucalyptus-prickly leaved tea tree forests among larger communities of white stringybark-tallowwood-grey gum dry forest.

The topography of the development site is varied, ranging between approximately 4 metres Australian Height Datum (AHD) and 62 metres AHD. The site area includes sections of steep slopes and ridgelines. The visual amenity is that of woodland with a small amount of disturbed land outside the area of current operations. There are two man-made ponds on the site as well as a drainage line that run from north to south.

There are patches of cleared grassland in the western and northwestern parts of Lot 2, which lie in the western margins of the study area and are currently subject to cattle grazing.



Sheet Size : A4

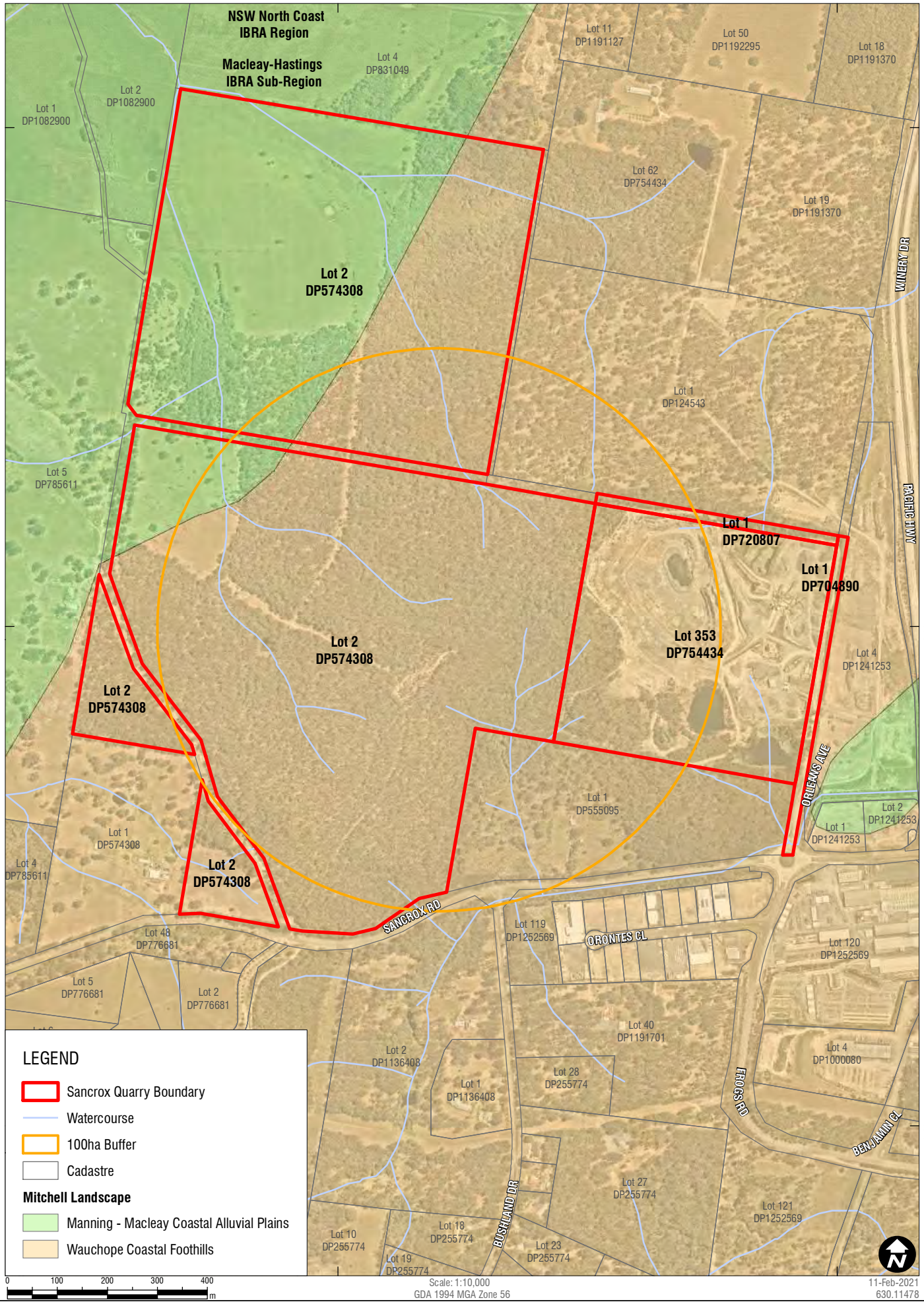
SLR

www.slrconsultingaustralia.com.au

Data Source: NSW SS 2020
Aerial imagery supplied by Nearmap (November, 2020)

Study Area and Regional Location

FIGURE 1



Sheet Size : A4

SLR

www.slrconsultingaustralia.com.au

Data Source: NSW SS 2020
Aerial imagery supplied by Nearmap (November, 2020)

Site Map

FIGURE 2

1.3 Proposed Development

The information provided in this section is drawn from the *Preliminary Environmental Assessment* (Hanson 2015).

Hanson is seeking development consent under Part 4 of the EP&A Act to expand the quarry to extract and distribute construction materials for civil infrastructure, concrete and road construction projects. The proposed development will involve extending the life of the quarry to 30 years and increasing the approved extraction limit of 185,000 tonnes per annum (as per both DA1995/0193 and DA2004/609), to 530,000 tonnes per annum.

The development will comprise expansion of the quarry footprint in a westerly direction into Lot 2, DP 574308 (**Figure 1**). This will include an upgrade and relocation of the existing infrastructure area including processing plant, offices, weighbridge, and workshop. Additionally the project includes the proposal for the construction of a concrete batching plant, concrete recycling facility, asphalt plant and pug mil. **Figure 3** shows the proposed extraction limit and infrastructure area.

Hanson is also seeking to enclose and purchase a parcel of Crown land, pursuant to the NSW *Roads Act 1993*, which splits Lot 2 (DP 574308), into northern and southern portions (**Figure 2**). This purchase will enable the methodical development of the quarry site.

1.3.1 Ancillary Infrastructure

The proposed project will involve an upgrade and relocation of the existing infrastructure area including processing plant, offices, weighbridge, and workshop. Additionally the project includes the proposal for the construction of a concrete batching plant, concrete recycling facility, asphalt plant and pug mil on site. The concrete plant will supply concrete within the local markets. The plant will produce approximately 20,000 m^3 of concrete each year. The plant infrastructure will be constructed on a concrete hard stand area and water runoff will be managed on site. The plant would consist of upright silo(s), incline conveyor belt, load bins, admixture bunded area, and batch room/amenities.

Other ancillary works include a noise mound, which is to be constructed along the southern boundary of the site, and the establishment of an asset protection zone (APZ) around the administration buildings in the eastern parts of the site (within the existing quarry area) as depicted in **Figure 3**.

1.3.2 Operational Development Footprint

The layout of the proposed development is displayed in **Figure 3**. The total development footprint is 57.55 ha, comprising the proposed pit expansion area and the proposed infrastructure area (containing plant, stockpiles, access tracks, administration building, etc). Both areas include the current (and historically cleared and disturbed) quarry footprint.

Importantly, the proposed quarry footprint area assessed in this BAR was adjusted after the assessment, to avoid a mapped flood risk area. As a result, the quarry pit area was reduced by around three hectares in the northwestern corner of the pit. The current quarry layout is presented in **Figure 3.**

Conversely, since the original BAR assessment was completed, the proposed development footprint now includes a noise attenuation structure (mound or bund) along the southern boundary, which will require additional vegetation removal.

In addition to extraction, the proposed development will also include the following operational activities:

- Blasting: 8 am – 5 pm Monday to Friday;
- Truck movements and equipment loading: 5 am to 10 pm, 7 days a week;
- Quarry operations (incl. production and maintenance): 5 am to 10 pm, 7 days a week;
- Concrete batching plant - 20,000 m^3 per year;
- Concrete recycling plant - 20, 000 tonnes per year; and
- Constructing and operating an asphalt plant producing 50,000 tonnes per annum.

Further details on the Project are provided in the accompanying EIS and Response to Submissions (RTS).

1.4 Scope and Aims of this Report (SEARs)

Under the *NSW Biodiversity Offsets Policy for Major Projects* (NSW Government & OEH 2014), the SEARs require a proponent to apply the Framework for Biodiversity Assessment (FBA) to assess impacts on biodiversity. The FBA is also applied to identify reasonable measures and strategies that can bel taken to avoid and minimise impacts on biodiversity. A Biodiversity Assessment Report (BAR) is required to describe the biodiversity values present on the development site and the impact of the Major Project on these values. Additionally, a Biodiversity Offset Strategy (BOS) is required to outline how the proponent intends to offset the impacts of the Major Project. These reports form part of the EIS.

The Department of Planning and Environment provided the SEARs for the Sancrox Quarry Extension Project (SSD 7293) on 19 October 2015. Biodiversity was identified as an issue in the SEARs and was "*to be assessed and documented in accordance with the Framework for Biodiversity Assessment…*" As the two year validity period on the original SEARs lapsed, revised SEARs were issued in September 2017. An excerpt of the revised SEARs is provided in **Appendix A** of this report.

Table 1 lists the revised SEARs that are relevant to biodiversity. Of particular note is the requirement (as stated in the revised agency letter from OEH) for the biodiversity assessment to be prepared according to the Biodiversity Assessment Method (BAM), pursuant to the NSW *Biodiversity Conservation Act 2016* (BC Act), which came into effect on 25 August 2017 (**Table 1**). However, the transitional arrangements for the BC Act allow for biodiversity assessments for State Significant Developments to be prepared under the former legislation for which SEARs were issued prior to 25 August 2017. Accordingly, this Biodiversity Assessment Report has been prepared according to the FBA, pursuant to the (former) *Threatened Species Conservation Act 1995* (as amended).

Table 1 Revised SEARs relating to Biodiversity

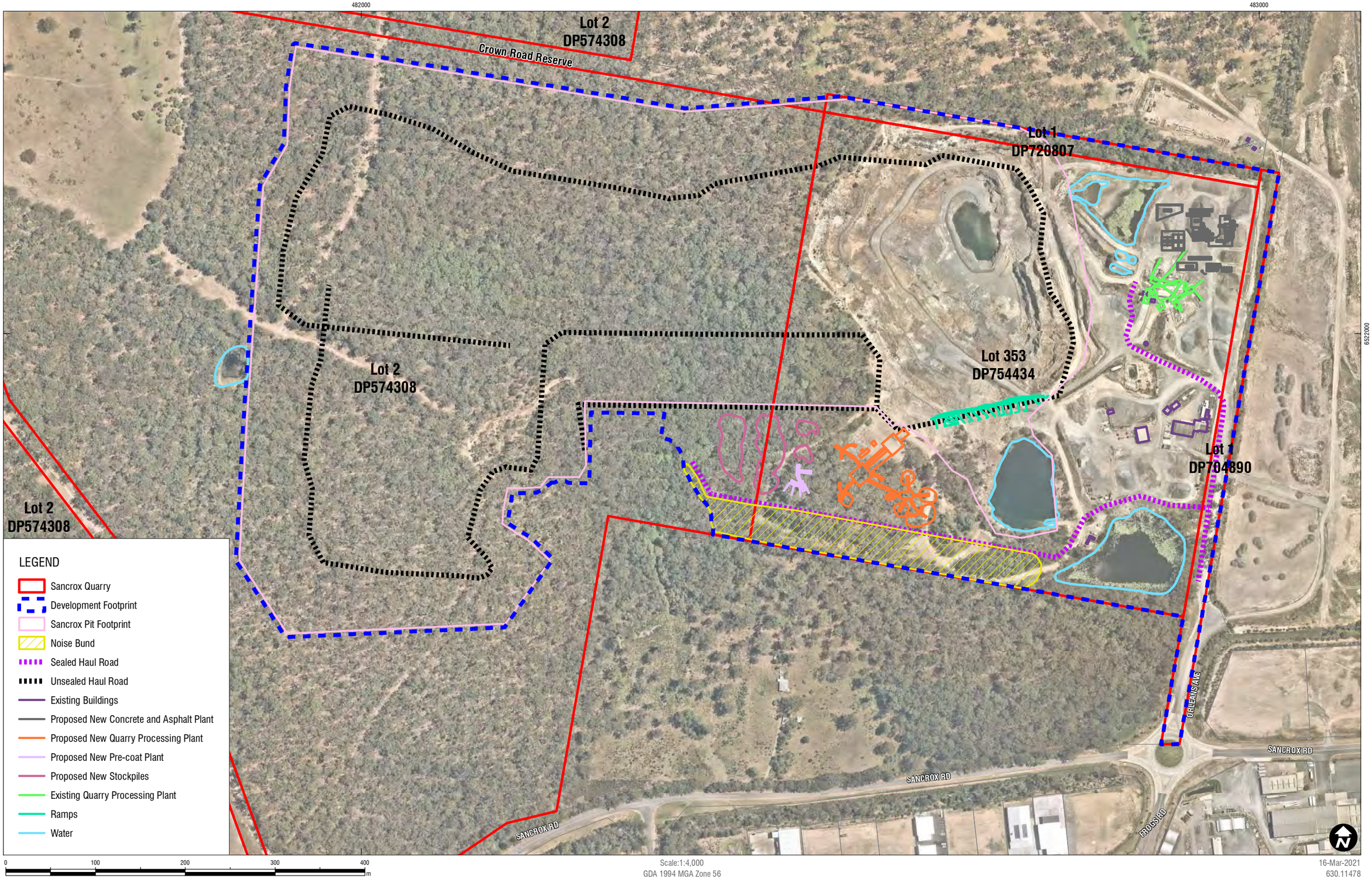
SEARs	Location in BAR
Key Issue – Biodiversity to include:	
Accurate predictions of any vegetation clearing on site.	Chapters 5 and 6

SEARs	Location in BAR
a detailed assessment of the likely biodiversity impacts of the development, paying particular attention to threatened species, populations and ecological communities and groundwater dependent ecosystems, and having regard to the *NSW Biodiversity Offsets Policy for Major Projects* and the *Framework for Biodiversity Assessment.*	Chapters 5 and 6
A strategy to offset any residual impacts of the development in accordance with the *NSW Biodiversity Offsets Policy for Major Projects*, including evidence that the appropriate type and quantum of offsets be available.	Chapter 7
OEH requirements (SEARs letter, Attachment B)	
The EIS is to include relevant local planning undertaken by the Port Macquarie – Hastings Council for the Greater Sancrox Area, in the context of the landscape to assess existing, and future habitat connectivity, especially in regards to alignment of subregional corridors, and local habitat linkages in accordance with s4.2.1.3(d) of the BAM.	Section 2.8
The species listed below as 1(a) and (b) are to be included, as part of the 'potential' serious and irreversible impacts, on other threatened entities as part of s10.2.1.5 of the *Biodiversity Assessment Method 2017* (BAM), not listed in the *Guidance and criteria to assist the decision maker to determine a serious and irreversible.* Should one of these entities be identified during survey, the proponent is required to provide additional information in accordance with section 10.2 of the BAM • *Dendrobium melaleucaphilum*- Spider Orchid • *Phaius australis* - Southern Swamp Orchid	Chapters 4 to 6

Consideration of the *Environment Protection & Biodiversity Conservation Act 1999* (EPBC Act) is also provided (see **Section 8**). Matters of National Environmental Significance (MNES) are protected under the EPBC Act and the FBA requires proponents to identify and assess the impacts on all nationally listed threatened species and threatened ecological communities that may be on the development site. Other MNES are not considered by the FBA.

The aims of the Report are as follows:

- Address the requirements of the SEARs;
- Address the requirements of the FBA;
- Describe the existing flora and fauna and other diversity values of the development site;
- Identify threatened biota of potential relevance to the site;
- Describe and quantify impacts on biodiversity values in accordance with the FBA; and
- Identify suitable measures to avoid, minimise and offset impacts on biodiversity associated with the Project.



Sheet Size : A3

SLR

www.slrconsultingaustralia.com.au PH: 61 2 4037 3200

Data Source: NSW SS 2020
Aerial imagery supplied by Nearmap (November, 2020)

Aerial Image of the Development Site

Figure 3

1.5 Information Sources

The key information sources utilised in the assessment include:

- the *OEH Atlas of NSW Wildlife* for previous records of threatened species from the locality;
- the Protected Matters Search Tool, located on the Department of the Environment website (DE 2014b) for matters of national environment significance (as listed under the EPBC Act) predicted to occur within the locality;
- the *Threatened Species Profile Database*, for detailed information on threatened species of relevance to the site and the locality;
- GIS data on Interim Biogeographic Regionalisation for Australia (IBRA) regions and Mitchell Landscapes;
- the BioBanking Credit Calculator, for lists of predicted ecosystem credit species and species credit species and for the Project credit requirements;
- regional vegetation mapping, including GIS data that was utilised to prepare base vegetation maps and design field surveys;
- data collected during field surveys; and
- officers of the Office of Environment and Heritage (OEH), NSW Offsets Policy Team who provided assistance on particular matters relating to the FBA and the Credit Calculator.

Key documents that were reviewed and applied to inform this BAR include:

- Greater Sancrox Structure Plan 2014-2034 (PMHC 2015);
- Greater Sancrox Ecological Assessment (Biolink 2011); and
- Vegetation of the Port Macquarie Hastings LGA (Biolink 2013).

Other references and published literature are listed in the References section.

1.6 Methods Summary

This BAR was prepared according to the steps and processes detailed in the FBA, with the key steps being:

- Desktop review – database searches to identify listed threatened biota (species, populations and communities) of potential relevance to the study area; initial GIS mapping; survey design;
- Field survey of the study area (see **Appendix B** for details);
- GIS mapping and data compilation;
- Using GIS and field survey results to complete the 'landscape assessment';
- Identification of vegetation zones and use of BioBanking plot/transect data and GIS mapping to assess 'site value';
- Applying the proposed development footprint in GIS to calculate vegetation removal;
- application of the Credit Calculator, including identification of candidate threatened species and impact credit calculations; and
- Preparation of the BAR and BOS.

Appendix B provides details of the field surveys, including methods, survey effort and weather conditions. The field surveys conducted as part of this BAR are as follows:

- Targeted orchid survey on the 16 October 2015, timed to coincide with the known flowering period of the threatened orchid *Dendrobium melaleucaphilum*; details regarding the survey methods and results for the targeted orchid survey are provided in **Section 6.4**;
- five-day, four-night survey for threatened fauna species conducted by two SLR ecologists from 30 November to 4 December 2015;
- two-day survey by two SLR ecologists to conduct plot/transect surveys according to the BioBanking methodology set out in the FBA; and
- a one-night one day survey conducted by one SLR ecologist between 14 and 15 December 2015, to address minimum recommended survey effort (when combined with the five-day four-night survey) for a selection of threatened species previously recorded in the locality.

The purpose of the field surveys was to inspect the areas proposed for development and to collect the necessary floristic and habitat details for completion of the FBA assessment (including plot and transect data for site value score and targeted threatened species surveys). The survey design, including the location, number and set out of plot/transects, was completed according to the FBA. Copies of plot/transect field sheets are provided in **Appendix C**.

Application of the BioBanking Credit Calculator was completed by Jeremy Pepper, Principal Ecologist, accredited under s.142B(1)(c) of the *Threatened Species Conservation Act 1995* (TSC Act) (assessor #0107).

Additionally, as part of the Response to Submissions (RTS) on the EIS, SLR were engaged to conduct supplementary targeted surveys for the Koala in October 2020. The methods and results of the survey are summarised in the discussion of candidate species credit species in **Section 4.4.**

1.7 SLR Project Team – Staff Qualifications

The roles and qualifications of all staff responsible for preparation of this report are listed in **Table 2**.

Table 2 Staff Roles and Qualifications

Staff Name	Project Role	Qualifications
Jeremy Pepper	Project Manager Threatened orchid surveys FBA field work (plot/transects) Report co-author Credit Calculations Accredited BioBanking Assessor	Bachelor of Science (Hons Class 1) University of NSW 1996 Certificate II Bushland Regeneration, TAFE NSW Cert III Horticulture (Arboriculture), TAFE NSW BioBanking accredited assessor (#0107)
Gary Leonard	Flora and vegetation survey FBA plots/transects Plant identification Reporting	Masters of Science (in progress) Diploma of Education National Diploma of Horticulture Horticulture Certificate
Matt Doherty	Report drafting and research	Bachelor of Environmental Science and Management, University of Newcastle 2016

Staff Name	Project Role	Qualifications
Matt Consterdine	Ecologist Threatened species surveys Reporting	Bachelor of Environmental Science & Management, University of Newcastle, 2011
Louise Hibbert	CAD/GIS Draftsperson	Dip Architectural Technology, 2007 Cert IV Civil Construction Design, 2012
Stacy Mail	Threatened species surveys	Bachelor of Engineering (Civil) Diploma of Land Management

1.8 Definitions

Definitions used in this report are listed in **Table 3**.

Table 3 Common definitions and abbreviations used in the BAR

Term	Definition
BC Act	NSW *Biodiversity Conservation Act 2016*
Development Site	The area proposed for the quarry expansion and associated infrastructure and ancillary works, as shown in **Figure 3**
EPBC Act	Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*
Locality	All land within 10 kilometres (km) of the Development Site.
Study Area	Area of land containing the Development Site and surrounding land that was subject to field surveys and desktop review
Threatened biota	Any threatened species, population or ecological community listed under the schedules of the BC Act (or former TSC Act). Threatened species and ecological communities listed under the EPBC Act.
TSC Act	NSW *Threatened Species Conservation Act 1995* (now repealed)
Matter of NES	Matter of national environmental significance listed under the EPBC Act
TEC	Threatened ecological community listed under BC Act, TSC Act and/or EPBC Act
EEC	Endangered ecological community listed under BC Act, TSC Act and/or EPBC Act

2 Landscape Features

This chapter describes the landscape features of the study area and surrounds, in accordance with Section 4 of the FBA.

2.1 Overview

Relevant landscape features pertaining to the study area have been identified according to Chapter 4 of the FBA, including:

- IBRA regions and subregions;
- Mitchell landscapes;
- Native vegetation extent and any 'cleared areas' (noting any differences between mapped vegetation and aerial imagery);
- Rivers and streams; and
- Wetlands.

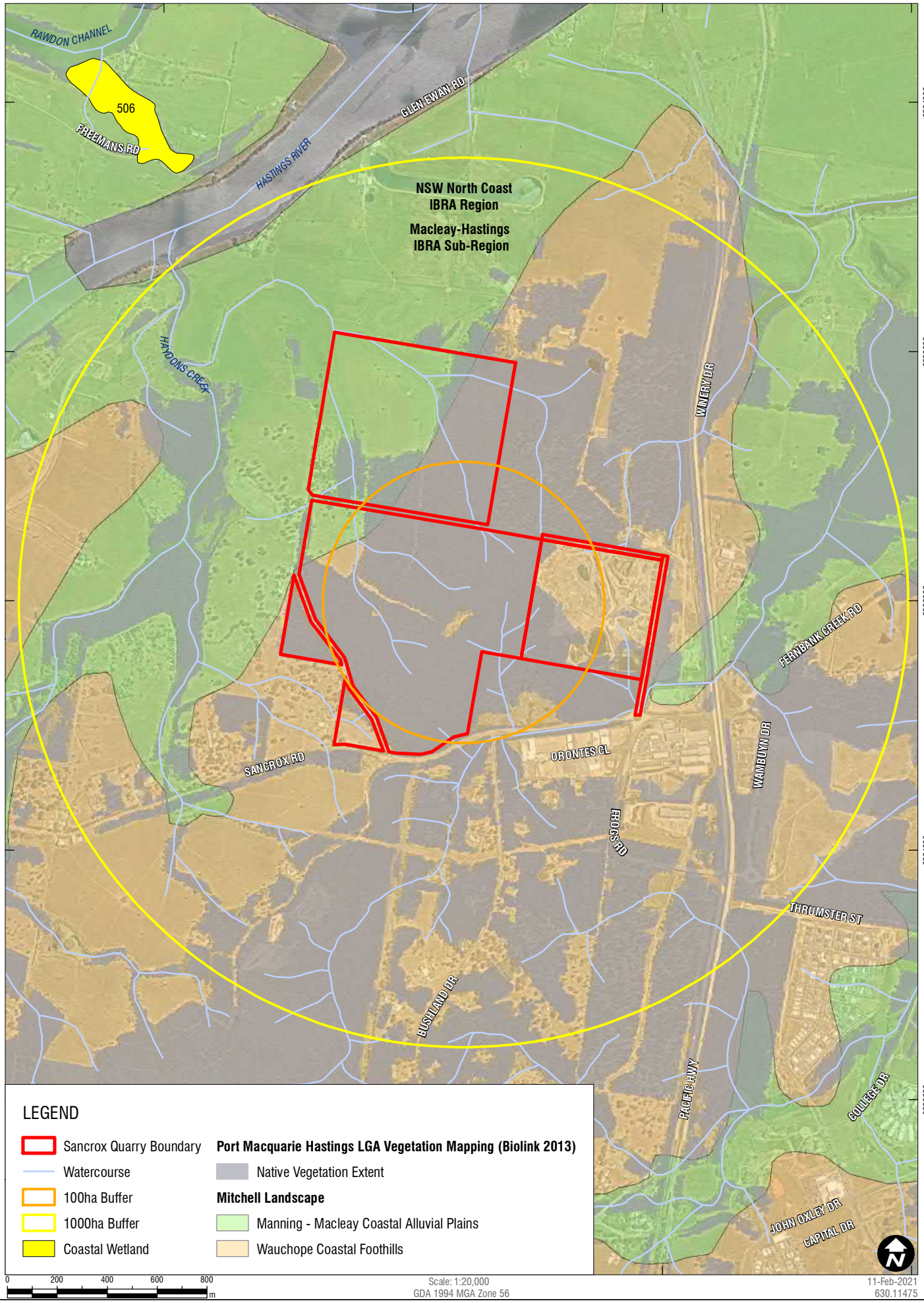
Relevant landscape features within the inner and outer assessment circles are displayed in the Site Map (**Figure 2**) and Location Map (**Figure 4**), as per Section 4 of the FBA.

No landscape features are specifically identified in the SEARs, although the SEARs (OEH) refer to existing and future habitat connectivity, biodiversity linkages and corridors, in the context of local planning undertaken by Port Macquarie Hastings Council. In this regard, biodiversity corridors and the Greater Sancrox Structure Plan are both discussed in **Section 2.8**.

Relevant landscape features are described in the following sections.

2.2 IBRA Bioregions and Subregions

The study area lies in the middle of the North Coast bioregion. The North Coast bioregion is adjacent to the New England Tablelands and Nandewar bioregions to the west and the Sydney Basin bioregion to the south (OEH 2016). The North Coast Bioregion lies on the east coast of New South Wales (NSW), with a small portion just inside the Queensland border, and covers an area of approximately 5,924,130 hectares, 96 % of which lies in NSW (IBRA). The North Coast Bioregion extends from Nelson Bay just north of Newcastle subregion north to Tweed Heads. Within its boundaries lie the towns of Maitland, Forster, Taree, Murrurundi, Port Macquarie, Kempsey, Coffs Harbour, Yamba, Grafton, Ballina, Byron Bay and Tweed Heads. The bioregion contains the Tweed, Richmond, Clarence, Coffs Harbour, Bellinger, Nambucca, Macleay, Hastings and Manning River catchments (OEH 2011).



Sheet Size : A4

SLR

www.slrconsultingaustralia.com.au

Data Source: NSW SS 2020
Aerial imagery supplied by Nearmap (November, 2020)

Location Map

FIGURE 4

The study area lies within Macleay-Hastings IBRA subregion, which is characterised by Silurian and Devonian slates, Carboniferous mudstones and Permian sandstones and shales. Soils are mainly red-brown structured loams on basalt; however there are a range of other, poorly known soils that relate to the subregions geology. Vegetation comprises of wet sclerophyll forest with White Mahogany, Small-fruited Grey Gum, Sydney Blue Gum, Blackbutt, Tallowwood and Brush Box. The open flat areas of the subregion are dominated by White Gum, Blackbutt, Forest Red Gum and Grey Box, while the coastal areas contain banksia, paperbark, Smooth-barked Apple and Blackbutt. The Barrington areas has a dense covering of Antarctic Beech and the Comboyne Plateau area has mixed patches of cool temperate and warm temperate rainforests. Stands of these main vegetation types are present within vegetation communities of the study area.

2.3 Mitchell Landscapes

The study area lies within two Mitchell landscapes:

- Manning - Macleay Coastal Alluvial Plains, which covers the north-western corner of the Development Site in Lot 2 south (DP 574308) as well as the western half of the proposed offset site in Lot 2 north (DP 574308).
- Wauchope Coastal Foothills, which occur throughout the majority of the Development Site in Lot 2 south (DP 574308), excluding the small portion in the north-west, as well as the eastern half of the proposed offset site in Lot 2 north (DP 574308).

The distribution of Mitchell Landscapes across the study area is shown in the Location Map (**Figure 4)**.

Manning-Macleay Coastal Alluvial Plains are described by DECCW (2002) as “Wide valleys, channels, floodplains, swamps and terraces of the Manning and Macleay rivers and other coastal streams on Quaternary alluvium with a general elevation of 0 to 50 m and a local relief of 15 m. Soils are described as dark, organic loams and silty clay on the floodplains, gradational brown loams and yellow yellow-brown texture contrast soil on terraces with organic silty mud in swamps.” The Manning - Macleay Coastal Alluvial Plains landscape is 57 % cleared.

Wauchope Coastal Foothills are described by DECCW (2002) as “hills and ranges of the coastal fall with some dendritic drainage on faulted carboniferous lithic sandstone, tuff and some limestone with a general elevation of 50 m to 460 m and a local relief of 200 m. Soils are described as having a red and yellow texture contrast throughout the area.” Common native plant species are Blackbutt, White Mahogany, Spotted Gum, Forest Red Gum, Grey Gum and Red Bloodwood (DECCW, 2002). The Wauchope Coastal Foothills landscape is 44 % cleared. As the Mitchell landscape occupying the majority of the Development Site, the percentage cleared value for Wauchope Coastal Foothills was applied to calculate the patch size score, in accordance with Appendix 4 of the FBA.

2.4 Soils

The study area has been mapped by NSW Office of Environment and Heritage (OEH) as Australian Soil Classification (ASC) type Kurosol. Kurosols are soils that have a strong texture contrast between the topsoil and subsoil horizons and contain strongly acidic subsoil and have moderate to moderately low inherent fertility. There are three Soil Landscape Units within the study area: Kundabung, Euroka and Cooperabung.

The study area has been assessed by OEH as Land and Soil Capability Classes 5 and 6 (OEH, 2012)

- Class 5 Moderately Low Capability Land: high limitations for high-impact agricultural land uses. Will largely restrict land use to grazing, some horticulture (orchards), forestry and nature conservation. The limitations need to be carefully managed to prevent long-term degradation.
- Class 6 Low Capability Land: very high limitations for high-impact agricultural land uses. Land use restricted to low-impact land uses such as grazing, forestry and nature conservation. Careful management of limitations is required to prevent severe land and environmental degradation.

2.5 Native Vegetation extent

The extent of native vegetation within the study area and within the locality has been obtained using broad scale vegetation mapping data for the Port Macquarie-Hastings LGA (Phillips *et al.* 2013). The extent of native vegetation within the outer assessment circle, by vegetation class, is listed in **Table 4**

Around 45 % (447 ha) of the outer assessment circle comprises native vegetation, with the remaining 55 % (550 ha) comprising either cleared land or land that has not been mapped or assigned to a vegetation type.

Table 4 Native vegetation extent (by class) within outer (1,000 ha) circle

Class	Sum of Area	Proportion (%)
Estuarine seagrass	1.31	0
Coastal Floodplain Wetlands	58.57	13
Coastal Swamp Forests	45.51	10
Hunter - Macleay Dry Sclerophyll Forests	11.88	3
Mangrove Swamps	0.43	0
North Coast Dry Sclerophyll Forests	324.00	72
North Coast Wet Sclerophyll Forests	0.58	0
Northern Hinterland Wet Sclerophyll Forests	6.27	1
Unassigned	4.18	1
Grand Total	**452.73**	**100**
Total Native Vegetation Extent (1000 ha)	447.25	99

Conversely, areas not mapped as native vegetation, including 'cleared areas' and exotic vegetation, within the outer assessment circle account for 552.75 ha. Cleared areas within the Sancrox locality include:

- Built up areas and industrial land uses around the Sancrox industrial estate, immediately south of the site;
- Cleared farmland; and
- Infrastructure, including the Pacific Highway, and local roads, Main Northern Rail Line and the open water of the major rivers and streams (notably Hastings River, just west and north of the site).

2.6 Topography

A review of topographical mapping indicates that the highest elevation of the Development Site is 62 m and the lowest elevation is 4 m, giving a local relief of 58 m. The high point of the site occurs a small rounded knoll immediately west of the existing quarry pit and slopes steeply to the west and north, then gradually becomes a gentle slope towards the western and northern boundaries of the site. The slopes in the southern direction are steep and varied as there are several high areas in the southern part of the site.

There is a second area of high elevation, around 34 m, in the southern parts of the proposed Development Site, which has been identified as an area of disturbed land that can be described as an open valley. In the southern parts of the subject site there is another high point, at 40 m, which has steep slopes towards the east, west, north and south. This area is outside of the proposed Development Site. Contour intervals vary between 4 m and 62 m throughout the site and are closely spaced within the Development Site.

2.7 Waterbodies

2.7.1 Rivers and Streams

The Development Site lies within the catchment of the Hastings River, which flows towards the coast in a north-easterly direction beyond the northern boundary of the Development Site (**Figure 4**). At its closest point, the river flows approximately 2 kilometres to the north-east of the site.

There are no notable surface water bodies or tributaries within the study area. The nearest waterway, Haydons Creek, which is a fifth order stream, flows approximately 1.5 kilometres to the west of the study area boundary at its closest point. Haydon Creek is fed by small first order tributaries which are located in the southern parts of the Development Site (**Figure 2**). There are two first order streams in the northern part of the Development Site in Lot 2 DP 577308. These two streams feed into second order stream that flows through the proposed offset site and join to make a third order stream in the north-east of the site. This third order stream then flows west into Haydons Creeks. Haydons Creek then continues to flow north into the Hastings River.

As a fifth order stream, Haydons Creek is defined in the FBA as a “regionally significant biodiversity link”, to which a 20 m riparian buffer applies. At its closest point this buffer will be approximately 1.2 kilometres from the site boundary.

The Hastings River is categorised as a seventh order stream, which is defined in the FBA as a “State significant biodiversity link”, to which a 50 m riparian buffer applies. At its closest point, the Development Site will be approximately 1.3 kilometres from the riparian buffer zone of the Hastings River. (It is worth noting that the boundary of the Hastings River riparian buffer zone at its closest point is adjacent to the boundary of the proposed offset site – see **Section 7**).

There is evidence that a drainage line runs north-south through the site, feeding into a small stream that runs east from the site boundary.

2.7.2 Wetlands and estuarine areas

There are two water bodies within the study area. These two water bodies have been identified as small ponds of water created by areas of the quarry filling with rainwater and water from the drainage line on the site. There are no significant wetlands and estuarine areas on the subject site and an EPBC Act protected matters search revealed that there are no RAMSAR wetlands within 10 kilometres of the subject site.

The nearest wetlands, as identified by the Port Macquarie Hastings LGA Vegetation Mapping (Biolink 2013), are shown to occur approximately 2.45 kilometres to the north-west of the development site on the west bank of the Hastings River. The wetland is not a protected wetland under the RAMSAR convention.

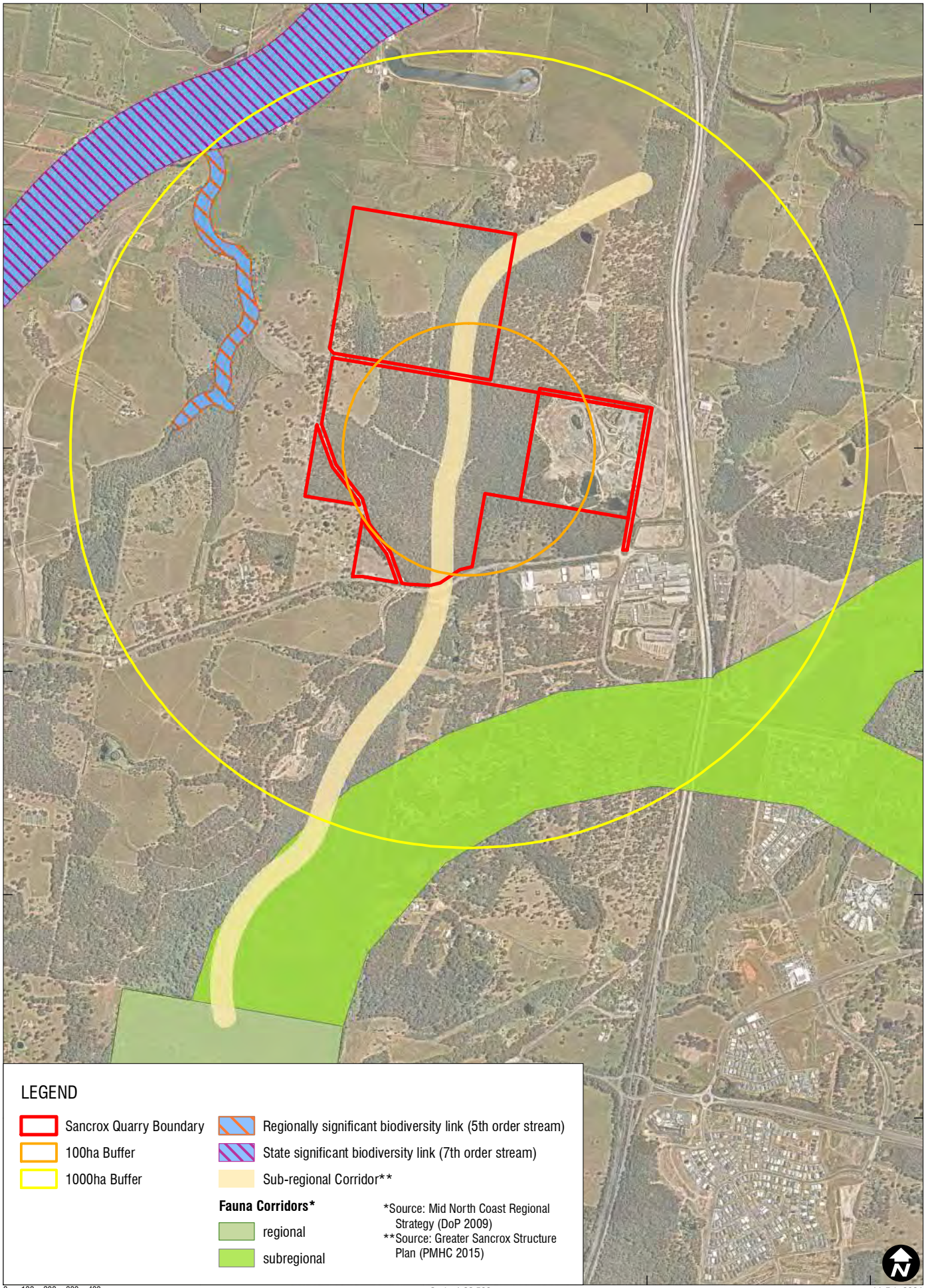
2.8 Biodiversity corridors and links

Published GIS data on State, regional and local biodiversity corridors links was obtained and reviewed as part of the preparation of this BAR. The key biodiversity corridors and links mapped within or near to the study area are mapped in **Figure 5** and include:

- a portion of a "sub-regional biodiversity corridor" mapped in the Greater Sancrox Structure Plan (see **Appendix D**), which traverses south-north through the centre of the Development Site. The corridor extends several kilometres south of the site; to the north of the site, it extends through the proposed offset site and before turning east and ending abruptly near the Pacific Highway; and
- a portion of a sub-regional "fauna corridor", mapped in the Mid North Coast Strategy, traverses just south of the Development Site before turning east. This corridor transforms into a "regional biodiversity corridor" further south of the Development Site. The subregional fauna corridor is approximately 1.5 kilometres from the Development Site.

The Mid-North Coast Regional Strategy (DOP 2009) states that fauna habitat corridors are of "high conservation importance" and as such urban development near these corridors should be limited.

In addition, the *Urban Growth Management Strategy 2017-2036* (PMHC 2017) classifies the area as a 'medium biodiversity asset/constraint' and identifies that the site could provide a 'major conceptual habitat link'. The strategy states the areas categorised as medium contain biodiversity assets that have the potential to be offset using the appropriate planning measures. The strategy maps **"**high priority koala habitat" within and surrounding the study area and there is a small portion of "medium-high priority biodiversity area" within the proposed Development Site. A large portion of the offset site has also been identified as 'key habitat' in the Strategy.



H:\Projects-SLR\660-SnWQL\630.11478 Sancrox Quarry Expansion\ArcGIS\Biodiversity Assessment Report\SLR630.11478_F05_BiodiversityCorridors_02.mxd

Sheet Size : A4

SLR

www.slrconsultingaustralia.com.au

Data Source: NSW SS 2020
Aerial imagery supplied by Nearmap (November, 2020)

Biodiversity Corridors

FIGURE 5

2.9 Landscape Value

Landscape value score was calculated according to Chapter 4 of the FBA. A 100 ha inner assessment circle was drawn in GIS, with the centroid on the Development Site using available aerial imagery as a base. Using a 1:10 ratio, a 1,000 ha outer assessment circle was also drawn. The inner and outer assessment circles are plotted in the Location Map (**Figure 4**).

2.9.1 Native Woody Vegetation cover

Native vegetation extent was mapped and the area calculated within the inner (100 ha) and outer (1,000 ha) landscape assessment circles using regional vegetation mapping of the Port Macquarie-Hastings LGA (Phillips *et al.* 2013). The extent of native vegetation within the landscape assessment circles is shown in **Figure 4**. The existing native vegetation cover within both assessment circles is listed in **Table 5**. Native vegetation comprises around 84 % of the inner assessment circle and 45 % of the outer assessment circle. These existing vegetation cover scores correspond to the cover classes of 81-85 % for the inner circle and 41-45 % for the outer circle.

Table 5 Percent vegetation cover in the landscape

Circle Size (ha)	Existing Veg. Cover (ha %)	Future Veg. Cover (ha %)
100	84.48 ha (84 %)	45.01 ha (45 %)
1000	452.74 ha (45 %)	413.27 ha (41 %)

The future extent of native vegetation cover within the inner and outer assessment circles was calculated by deducting the vegetation that would be removed as part of the proposed development (ie 39.02 ha) from the existing extent of native vegetation. Approximately 45.01 ha (45 %) native vegetation will remain within the inner assessment circle after clearing for the proposed development and around 413.27 ha (41 %) of native vegetation will remain in the outer assessment circle after development (**Table 5**). These future vegetation cover scores correspond to the cover class of 41-45 % in the Credit Calculator for both the inner circle and outer circle.

Based on the above results, the score for percentage native vegetation cover in the Credit Calculator is 2.95.

2.9.2 Connectivity

No State or regional biodiversity links occur within the Development Site, as discussed in **Section 2.8**. A 'site based assessment of connectivity' is therefore required, according to the approach set out in Appendix 4 of the FBA.

Connectivity score was calculated according to the method outlined in Appendix 4 of FBA. Using aerial imagery, connecting links of contiguous canopy vegetation across the study area were mapped. Inspection of aerial imagery reveals that two main links traverse the site, with native forest vegetation extending from south of the site through to north of the site. Beyond the northern boundary of the site, both links narrow to just one or two trees amongst cleared agricultural landscapes. However, within the site the linkages are wide, with a 'limiting width' at the narrowest point of over 100 m. The linkage width class for primary link before development was therefore assigned to > 100 m – 500- m wide. Removal of the native canopy vegetation as part of the quarry expansion within these theoretical links would render the future linkage width class to > 30 m to 100 m. Hence the number of linkage width classes crossed as a result of the impact of the proposed development is one.

The condition of vegetation within the vegetated link is assessed as likely to be within benchmark values for the respective plant community types. Hence linkage condition class (of woody vegetation) within the over-storey (canopy) and mid-storey or groundcover is estimated to be within benchmark before and after the proposed development (ie 'PFC at BM' and 'PFC of mid-storey/ groundcover at BM' chosen in the Credit Calculator). Hence no linkage condition classes are crossed (i.e. no change in linkage condition class).

The resulting score for connectivity in the Credit Calculator is 2.0.

2.9.3 Patch Size

Patch size of native woody vegetation was estimated using GIS and available spatial data for vegetation of the Port Macquarie-Hastings LGA by Phillips *et al.* (2013). The native woody vegetation in moderate to good condition on the site extends off the site to surrounding areas forming a large patch that is estimated to be 1255 ha (see **Figure 4**).

The percentage cleared value for Wauchope Coastal Foothills Mitchell landscape, which occupies the majority of the Development Site (see **Figure 4**), is 54 %. The 'patch size class' for a Mitchell landscape with a percentage cleared value of 30-70% and a patch size of > 200 ha is categorised as 'Extra-large' and attracts a patch size score of 12.

2.9.4 Landscape Value Score

Landscape value is calculated in the Credit Calculator based on the sum of the three landscape assessment components in the FBA: (i) native vegetation extent (ii) connectivity score and (iii) patch size. For the Sancrox SSD project the landscape score in the Credit Calculator is composed of the following scores:

- Native vegetation extent - 2.95;
- Connectivity score – 2.0; and
- Patch size score – 12,

giving an overall landscape value score of 17.

3 Native Vegetation

This chapter describes the native vegetation on the study area in accordance with Section 5 of the FBA.

3.1 Study Area Characteristics

The study area is a mosaic of forested areas, low-lying swampy terrain, cleared grazing land and areas of disturbance and infrastructure. The study area incorporates the existing quarry, with surrounding areas of cleared and disturbed terrain, open water in detention dams, roads and the buildings and infrastructure of the quarry administration centre. West of the existing pit, where the quarry expansion is proposed, lies a tract of bushland that extends over an elevated hill rising to 62 m above sea level. Further west, open grassland is interspersed with scattered trees across low lying terrain that drains to the northwest. Several hundred metres further northwest lies the Hastings River, which eventually drains to the coast at Port Macquarie several kilometres east of the study area. The cleared grassy areas in the western parts of the study area are used for cattle grazing.

Similarly in the northwestern parts of the study area (including the northern parts of Lot 2, which is proposed to set aside as a biodiversity offset) the land has been cleared and supports cattle grazing over grasslands. Adjoining these cleared grassy areas to the east are stands of swamp forest and paperbark swamp forest. Further details on the nature and condition of the proposed offset site are provided in **Section 7**.

3.2 Regional (Broad-scale) Vegetation Mapping

The following regional vegetation mapping resources are available for the study area and were reviewed as part of the preparation of this BAR:

- Vegetation of the Port Macquarie-Hastings LGA (Phillips *et al.* 2013);
- Mapping of the Northern Rivers catchment (NRCMA 2011); and
- 'CRAFTI' data prepared as part of the Comprehensive Regional Assessments (CRA) (NPWS 2012).

The Council data (Phillips *et al.* 2013), being smaller scale than the other data sets, was found to be the most accurate and precise when viewed at the scale of the study area. Accordingly, the Council mapping was adopted as a 'base map' to guide the field survey design, and was verified and, where necessary, modified during field surveys. An excerpt of the Council mapping for the study area is provided in **Table 6**.

The Council vegetation types mapped within the Development Footprint are shown in **Figure 6** and their mapped extents (in hectares) are listed in **Table 6**.

Table 6 Regional vegetation mapping within the study area#

Code	Council Vegetation Type	Area (ha)
PMVC_035	Spotted Gum Grassy Dry Forest	11.08
PMVC_037	White Stringybark - Tallowwood - Grey Gum Dry Forest	27.94
	Total:	**39.02**

Source: Phillips *et al.* 2013.

Profiles for each of the three vegetation types listed in are provided in **Appendix E**. A brief description of each is provided below:

3.2.1 Spotted Gum Grassy Dry Forest

This community is described as "A tall to extremely tall open forest dominated by Spotted Gum *Corymbia citriodora* [sic]. Common associates include Grey Ironbark *Eucalyptus siderophloia*, Broad-leaved White Mahogany *Eucalyptus carnea*, Tallowwood *Eucalyptus microcorys* and Grey Gum *Eucalyptus propinqua* with scattered Pink Bloodwood *Corymbia intermedia*, White Stringybark *Eucalyptus globoidea* and the occasional Blackbutt *Eucalyptus pilularis*" (Phillips *et al*. 2013). The community is restricted to the Cooperabung and Beechwood erosional soil landscapes at Red Hill and Sancrox.

Spotted Gum Grassy Dry Forest is mapped by Council through the central parts of the site, to the west of the existing pit, and with a small disjunct patch within the area adjacent to the east of the pit (see **Figure 6**).

3.2.2 White Stringybark – Tallowwood – Grey Gum Dry Forest

White Stringybark – Tallowwood – Grey Gum Dry Forest is described as "A tall to very tall open forest dominated by White Stringybark *Eucalyptus globoidea* growing in association with Tallowwood *Eucalyptus microcorys*. Common associates include Broad-leaved White Mahogany *Eucalyptus carnea*, which occurs occasionally as a sub-dominant, Grey Gum *Eucalyptus propinqua* and Turpentine *Syncarpia glomulifera*, less commonly Red Bloodwood *Corymbia gummifera* and Grey Ironbark *Eucalyptus siderophloia*" (Phillips *et al*. 2013). The community occurs in the NSW coastal hinterland between Sancrox and Heron's Creek.

The majority of the vegetation across the site is mapped as White Stringybark – Tallowwood – Grey Gum Dry Forest, occurring over much of the land west of the existing pit, extending to the western limits of (and beyond) the proposed development footprint, as well as narrow bands around the existing dam in the southeastern corner of the site (see **Figure 6**).

3.3 Vegetation Classes

According to broad-scale mapping of Port Macquarie-Hastings LGA (Phillips *et al.* 2013), the vegetation within the Development Footprint comprises two vegetation classes occurring within two vegetation formations, as listed in **Table 7**. Vegetation classes are described below.

Table 7 Vegetation Formations and Classes Mapped in the Study Area

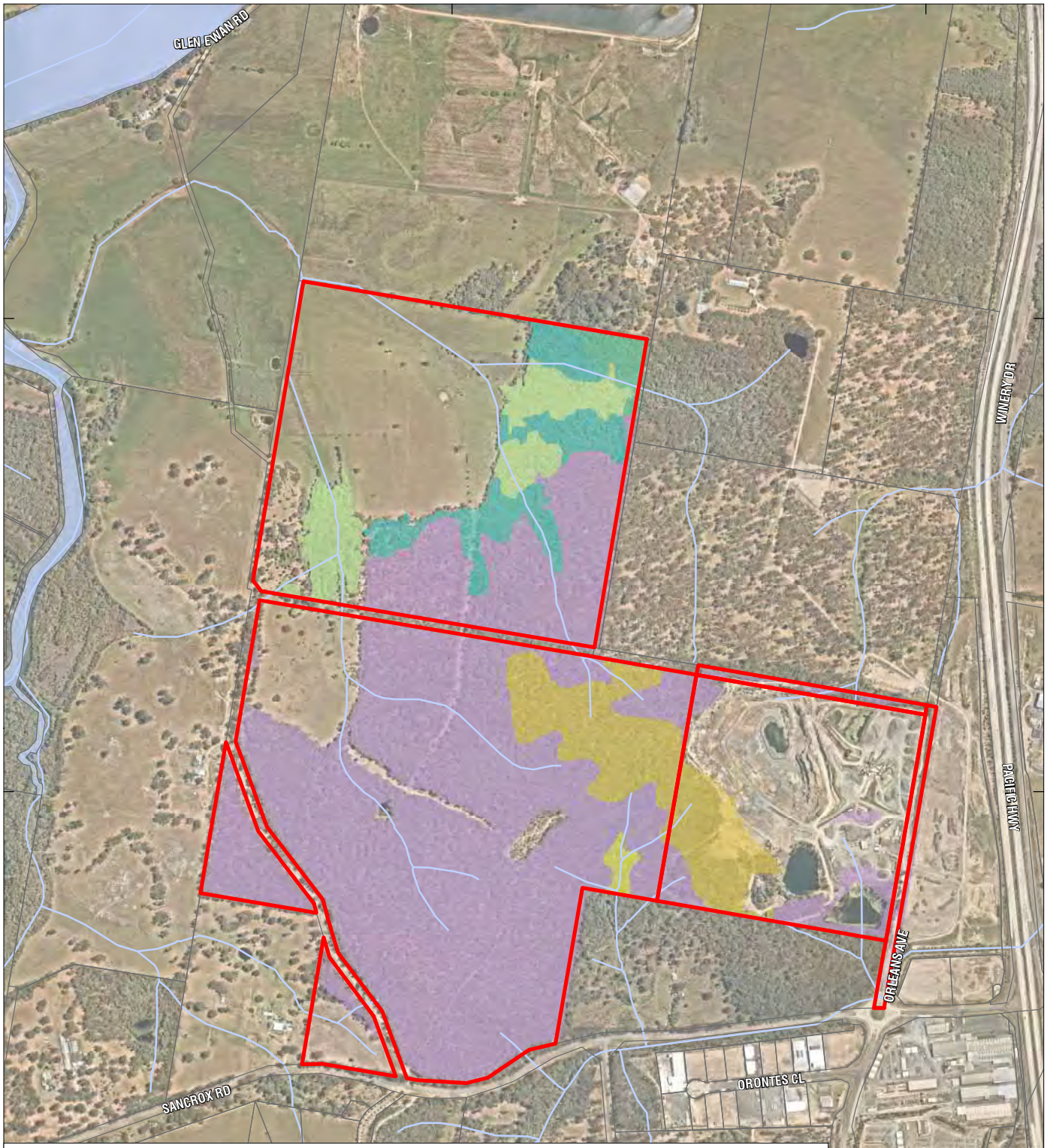
Vegetation Formation	Vegetation Class	Area (ha)
Dry Sclerophyll Forests (shrub/grass)	Hunter-Macleay Dry Sclerophyll Forests	11.08
Wet Sclerophyll Forests (Grassy sub-formation)	Northern Hinterland Wet Sclerophyll Forests	27.94
	Total	**39.02**

Hunter-Macleay Dry Sclerophyll Forests

Hunter-Macleay Dry Sclerophyll Forests are dry open eucalypt forest to 30 m tall, with a mixed sclerophyll and mesophyll shrub stratum and semi-continuous grassy groundcover. This vegetation class is dominated by large Eucalypt species including *Corymbia maculata* (spotted gum), *Eucalyptus crebra* (narrow-leaved ironbark), *E. moluccana* (grey box), *E. propinqua* (grey gum), *E. siderophloia* (grey ironbark) and *Syncarpia glomulifera* (turpentine). Hunter-Macleay Dry Sclerophyll Forests may also have *Angophora costata* (Sydney red gum) and *Eucalyptus punctata* (grey gum) though these species are mainly identified in the eastern Hunter valley. The community is associated with foothills and undulating terrain in rain shadow valleys below 400 m elevation in the eastern parts of coastal rainshadow valleys, well-drained loams derived from shales and foothills and undulating terrain below 400 m on loamy soils derived from shales. They are associated with the major coastal river valleys along the New South Wales coast, and occur in local areas that are transitional between Coastal Valley Grassy Woodlands and Northern Hinterland Wet Sclerophyll Forests. They are associated with the major coastal river valleys along the New South Wales coast, and occur in local areas that are transitional between Coastal Valley Grassy Woodlands and Northern Hinterland Wet Sclerophyll Forests. This vegetation class varies floristically in response to latitude and the influence of clay content within the soil (OEH, 2017b).

Northern Hinterland Wet Sclerophyll Forests

Northern Hinterland Wet Sclerophyll Forests are tall, open dry eucalypt forests to 40 m tall with a mix of sclerophyllous and monophyllous shrub stratum with a continuous grassy ground cover. The canopy of the vegetation class is dominated by *Eucalyptus microcorys* (tallowwood), *E. pilularis* (blackbutt), *E. propinqua* (grey gum), *E. siderophloia* (grey ironbark), *Syncarpia glomulifera* (turpentine). Minor occurrences or localised dominance of *Angophora subvelutina* (broad-leaved apple), *Corymbia intermedia* (pink bloodwood) and *Eucalyptus carnea* (thick-leaved mahogany) may also feature. The vegetation class is associated with the fertile soils of derived siltstone and metasediments on the upper slopes and ridges of coastal foothills and plateaux below 600m within areas where the mean annual rainfall exceeds 1,000mm. Its range extends along the northern New South Wales coastal areas north of the Sydney region through into South-east Queensland however, most dominate within the Coffs Harbour and Port Macquarie districts. The vegetation class is known to have an extensive, variable and diverse floristics that can be similar to that of North Coast Wet Sclerophyll Forest, which can co-occur in more sheltered and mesic parts of the landscape. A simplified grassy understorey can occur when extensively burnt and grazed.



LEGEND

- Sancrox Quarry Boundary
- Watercourse
- Water Feature
- Cadastre

Port Macquarie Hastings LGA Vegetation Mapping (Phillips et al. 2013)

Vegetation Community

- Broad-leaved Paperbark - Mixed Eucalypt Swamp Forest Complex
- Broad-leaved Paperbark - Swamp Mahogany Swamp Forest
- Flax-leaved Paperbark - Mixed Eucalypt Coastal Floodplain Wetlands Forest Complex
- Flax-leaved Paperbark - Prickly-leaved Tea Tree Forests
- Spotted Gum Grassy Dry Forest
- White Stringybark - Tallowwood - Grey Gum Dry Forest

0 100 200 300 400 m

Scale: 1:12,000
GDA 1994 MGA Zone 56

11-Feb-2021
630.11478

H:\Projects-SLR\660-SnWQL\630.11478 Sancrox Quarry Expansion\ArcGIS\Biodiversity Assessment Report\SLR630.11478_F06_CouncilVeg_02.mxd

Sheet Size : A4

SLR
www.slrconsultingaustralia.com.au

Data Source: NSW SS 2020
Aerial imagery supplied by Nearmap (November, 2020)

Regional Vegetation Mapping for Port Macquarie-Hastings LGA

FIGURE 6

3.4 Plant Community Types (PCTs)

3.4.1 Overview

Plant community types (PCTs) were mapped across the study area during the field survey, using vegetation mapping of the Port Macquarie-Hastings LGA (Phillips *et al.* 2013) as a base map. The following broad vegetation types mapped within the study area, as noted in **Section 3.2**, were recorded within the site:

- Spotted Gum Grassy Dry Forest; and
- White Stringybark - Tallowwood - Grey Gum Dry Forest.

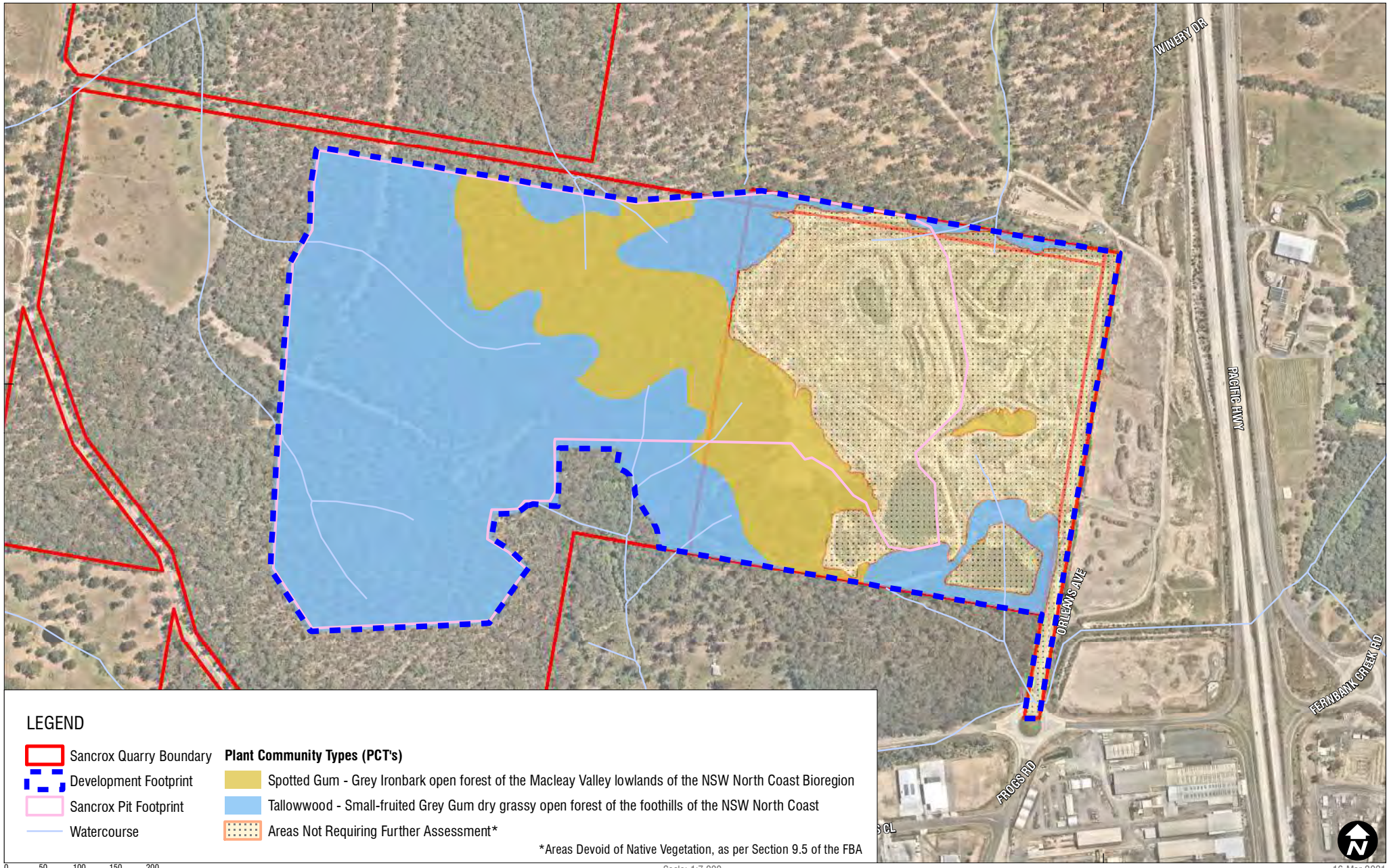
Using the online NSW BioNet Vegetation Classification database, these communities were converted into PCTs, as per **Table 8**.

Table 8 Conversion of Council mapping units to PCTs

Council Vegetation Type#	PCT	PCT Name
Spotted Gum Grassy Dry Forest	1215	Spotted Gum - Grey Ironbark open forest of the Macleay Valley lowlands of the NSW North Coast Bioregion
White Stringybark - Tallowwood - Grey Gum Dry Forest	1262	Tallowwood - Small-fruited Grey Gum dry grassy open forest of the foothills of the NSW North Coast

Source: Phillips *et al.* 2013

The PCTs mapped within the Development Footprint are listed in **Table 9**. The distribution of these plant community types within the study area is shown in **Figure 7**. The floristics and structure of these communities, as they occur on the site, is described below. Profiles of each PCT obtained from the BioNet Vegetation database are provided in **Appendix F.**



Sheet Size : A4

SLR
www.slrconsultingaustralia.com.au

Data Source: NSW SS 2020
Aerial imagery supplied by Nearmap (November, 2020)

Plant Community Types Mapped Within the Development Site

FIGURE 7

Table 9 Plant Community Types (PCTs) mapped within the development footprint

PCT Code	PCT Name*	TEC	% Cleared [2]	Area (ha)
1215	Spotted Gum - Grey Ironbark open forest of the Macleay Valley lowlands of the NSW North Coast Bioregion	No	35 %	11.08
1262	Tallowwood - Small-fruited Grey Gum dry grassy open forest of the foothills of the NSW North Coast	No	30 %	27.94
	Total Native Vegetation			**39.02**

Table 10 lists the vegetation formation and vegetation class associated with each PCT mapped within the study area.

Table 10 Formations, Classes and PCTs mapped within the development footprint

Vegetation Formation	Vegetation Class	PCT Name	Area (ha)
Dry Sclerophyll Forests	Hunter - Macleay Dry Sclerophyll Forests	Spotted Gum - Grey Ironbark open forest of the Macleay Valley lowlands of the NSW North Coast Bioregion	11.08
Wet Sclerophyll Forests	Northern Hinterland Wet Sclerophyll Forests	Tallowwood - Small-fruited Grey Gum dry grassy open forest of the foothills of the NSW North Coast	27.94
		Total Native Vegetation	**39.02**

One of the PCTs recorded within the study area, PCT 686, represents an example of the threatened ecological community *Subtropical coastal floodplain forest of the NSW North Coast bioregion*, which is listed as endangered on the BC Act. However, through amendments to the proposed pit layout (ie 'avoidance measures'), this vegetation will not be directly affected by the proposed development and will remain *in situ*. Threatened ecological communities are discussed further at **Section 3.7**.

3.4.2 Spotted Gum-Grey Ironbark Open Forest (PCT 1215)

Location:

This vegetation type occurs across the middle of the subject site on upper slopes, to the west of the quarry, in sandy well-drained soils.

Area: 11.08 ha.

Structure:

A tall open-forest with mostly grassy groundcover.

Trees from 15 to 25 m. FPC 15 to 35 %.

Shrubs and small trees from 2 to 12 m; FPC generally to 15 % to 35 % in some patches.

Groundcover 0.1 to 0.5 m. FPC up to 60%.

Floristics:

Trees:

- *Corymbia maculata* (Spotted Gum)
- *Eucalyptus acmenoides* (White Mahogany)
- *Eucalyptus siderophloia* (Northern Grey Ironbark)
- *Lophostemon confertus* (Brushbox)

Small Trees and Shrubs:

- *Allocasuarina torulosa* (Forest Oak)
- *Allocasuarina littoralis* (Black Oak)
- *Acacia melanoxylon* (Blackwood)
- *Acacia implexa* (Hickory)

Vines and Groundcovers:

- *Themeda triandra* (Kangaroo Grass)
- *Imperata cylindrica* var. *major* (Blady Grass)
- *Lomandra longifolia* (Spiny-headed Mat-rush)
- *Billardiera scandens* (Apple Berry)
- *Glycine* spp. (Love Creeper)

A total of 35 indigenous species and no exotic species were recorded in the BioBanking plot. The canopy species include: *Eucalyptus siderophloia* (5), *Corymbia maculata* (4), *Corymbia intermedia* (3) and *Eucalyptus globoidea* (3). Common mid-storey species include *Allocasuarina torulosa*, *Polyscias sambucifolia* and *Breynia oblongifolia*. Common groundcover species include *Themeda triandra*, *Entolasia marginata*, *Lomandra hystrix* and *Dichelachne micrantha*.

This plant community type does not constitute a TEC under the BC Act or EPBC Act.

3.4.3 Tallowwood – Small fruited Grey Gum dry grassy open forest (PCT 1262)

Location:

This vegetation type occurs across a large proportion of the subject site, especially in the western parts. This vegetation occurs mostly on coastal foothills.

Area: 27.94 ha

Structure:

An open-forest with mostly grassy groundcover.

Trees from 12 to 20 m. FPC 15 to 30%.

Small trees and shrubs from 2 to 12 m; FPC generally to 10%.

Groundcover 0.1 to 1 m; FPC up to 70%.

Floristics:

Trees:

- *Eucalyptus globoidea* (White Stringybark)
- *Eucalyptus microcorys* (Tallowwood)
- *Eucalyptus siderophloia* (Northern Grey Ironbark)
- *Eucalyptus propinqua* (Small-fruited Grey Gum)
- *Syncarpia glomulifera* subsp. *glomulifera* (Turpentine)

Small Trees and Shrubs:

- *Allocasuarina torulosa* (Forest Oak)
- *Allocasuarina littoralis* (Black Oak)
- *Persoonia linearis* (Narrow-leaved Geebung)
- *Dodonaea triquetra* (Hop-bush)

Vines and Groundcovers:

- *Themeda triandra* (Kangaroo Grass)
- *Imperata cylindrica* var. *major* (Blady Grass)
- *Lomandra longifolia* (Spiny-headed Mat-rush)
- *Pteridium esculentum* (Bracken Fern)
- *Hardenbergia violacea* (Purple Coral Pea).

A total of 32 indigenous species and one exotic species (several specimens of *Cinnamomum camphora*) were recorded. The canopy species include *Eucalyptus siderophloia* (3), *Corymbia gummifera* (3) and *Eucalyptus globoidea* (3). Common mid-storey species include *Allocasuarina littoralis*, *Melaleuca linariifolia*, *Callistemon salignus*, *Alphitonia excelsa* and *Glochidion ferdinandi* var. *ferdinandi*. Common groundcover species include *Imperata cylindrica* var. *major*, *Carex appressa*, *Centella asiatica*, *Microlaena stipoides* var. *stipoides* and *Dichondra repens.*

This plant community type does not constitute a TEC under the BC Act or EPBC Act.

3.5 Site Specific Vegetation Mapping – Differences to Regional Mapping

Vegetation types and vegetation mapping as described by Phillips *et al.* (2013) were adapted in the initial desk-top assessment and then validated by field work. For the purposes of this assessment, the vegetation descriptions used by Phillips *et al.* (2013) were then converted to the nearest approximation of descriptions of the NSW Plant Community Types that are stated to occur within the Northern Rivers Catchment Management Area (CMA).

3.5.1 Biometric vegetation classification

The NSW Plant Community Type classification was developed in 2011 "…to establish an unambiguous master community-level classification for use in vegetation mapping programs, regulatory decisions, and as a standard typology for other planning and data gathering programs…." In 2011 the PCT classification consolidated two existing community-level classifications:

1. The NSW Vegetation Classification and Assessment database (Benson 2006 & 2008; Benson *et al.* 2006 & 2010);
2. The Biometric Vegetation Types database used in NSW regulatory processes including property vegetation planning, Bio-certification and BioBanking.

Since 2011, several quantitatively derived regional classification data sets have been into the PCT classification.

3.5.2 Mapping of Port Macquarie-Hastings LGA

Phillips *et al.* (2013) state that "…Vegetation mapping was undertaken in two stages and involved polygon capture down to a minimum patch size of 0.25 ha (0.1 ha for littoral rainforest) using task-specific software and a combination of satellite, aerial and digital imagery. Excluding National Park and State Forest estate, approximately 115,922 ha of remnant vegetation was captured for purposes of the mapping project. Once captured, polygons were internally partitioned by hand. Field survey involved a combination of formal 0.04 ha floristic plots sampled in accord with Modules 1 and 2 of the NSW Government's Native Vegetation Type Standard. Less detailed but similarly quantitative "rapid" assessments were also undertaken in other areas, supported by foot-, vehicle- and air-based traverses for ground-truthing purposes. Available data from other studies was (sic) also employed to assist the mapping process…..Disregarding geographical constraints, approximately 70% of the mapped vegetation communities conform to those similarly recognised by the NSW Northern Rivers Catchment Management Area's Vegetation Classification System, the remainder constituting novel ecological entities for the Northern Rivers CMA that have hitherto not been detailed…..".

The vegetation mapping prepared by SLR for this report differs only slightly from the regional-scale mapping by Phillips *et al.* (2013), in the context of locations and extent of vegetation types.

The vegetation type that has the greatest spatial representation over the site is mapped by Phillips *et al.* (2013) as White Stringybark–Tallowwood–Grey Gum Dry Forest. The structural and floristic characteristics of the surveyed patches of vegetation validated this description. This vegetation type was matched with the Plant Community Type Tallowwood - Small-fruited Grey Gum dry grassy open forest (PCT 1262) and was found, after data analysis, to comply with the description of the PCT.

The vegetation is mapped as Spotted Gum Grassy Forest by Phillips *et al.* (2013) and is a distinctive plant community within the Port Macquarie-Hastings LGA and is only conserved at Bundjalung National Park, within the North Coast region (see Griffith 1993; Hager and Benson 1994). The Plant Community Type Spotted Gum Grey Ironbark open forest (PCT 1215) is the most appropriate classification for the vegetation recorded on the subject site.

With due consideration to the above listed factors, SLR has modified the regional vegetation mapping for the study area and has mapped native vegetation patches, where present, to create a site specific vegetation map for the study area (see **Figure 7)**. The PCTs recorded and mapped within the study area are described in **Section 3.4**.

3.6 Vegetation Zones

According to the FBA (OEH 2014), vegetation zones are areas of vegetation of the same type and same condition class. Vegetation zones are categorised into either 'low' or 'moderate to good' condition. To qualify as low condition the native vegetation (being woody vegetation) within a vegetation zone must have:

- a value of less than 25 % of the lower benchmark value in the canopy; and
- groundcover that is either less than 50 % indigenous (or native) or over 90 % cleared.

PCTs mapped within the study area have been further divided into the following vegetation zones:

- Veg Zone 2 - NR247_Moderate/Good Spotted Gum - Grey Ironbark open forest of the Macleay Valley lowlands of the NSW North Coast Bioregion;
- Veg Zone 3 - NR263_Moderate/Good Tallowwood - Small-fruited Grey Gum dry grassy open forest of the foothills of the NSW North Coast;
- Veg Zone 4 - NR263_Moderate/Good_Poor Tallowwood - Small-fruited Grey Gum dry grassy open forest of the foothills of the NSW North Coast; and
- Veg Zone 5 - NR247_Moderate/Good_Poor Spotted Gum - Grey Ironbark open forest of the Macleay Valley lowlands of the NSW North Coast Bioregion.

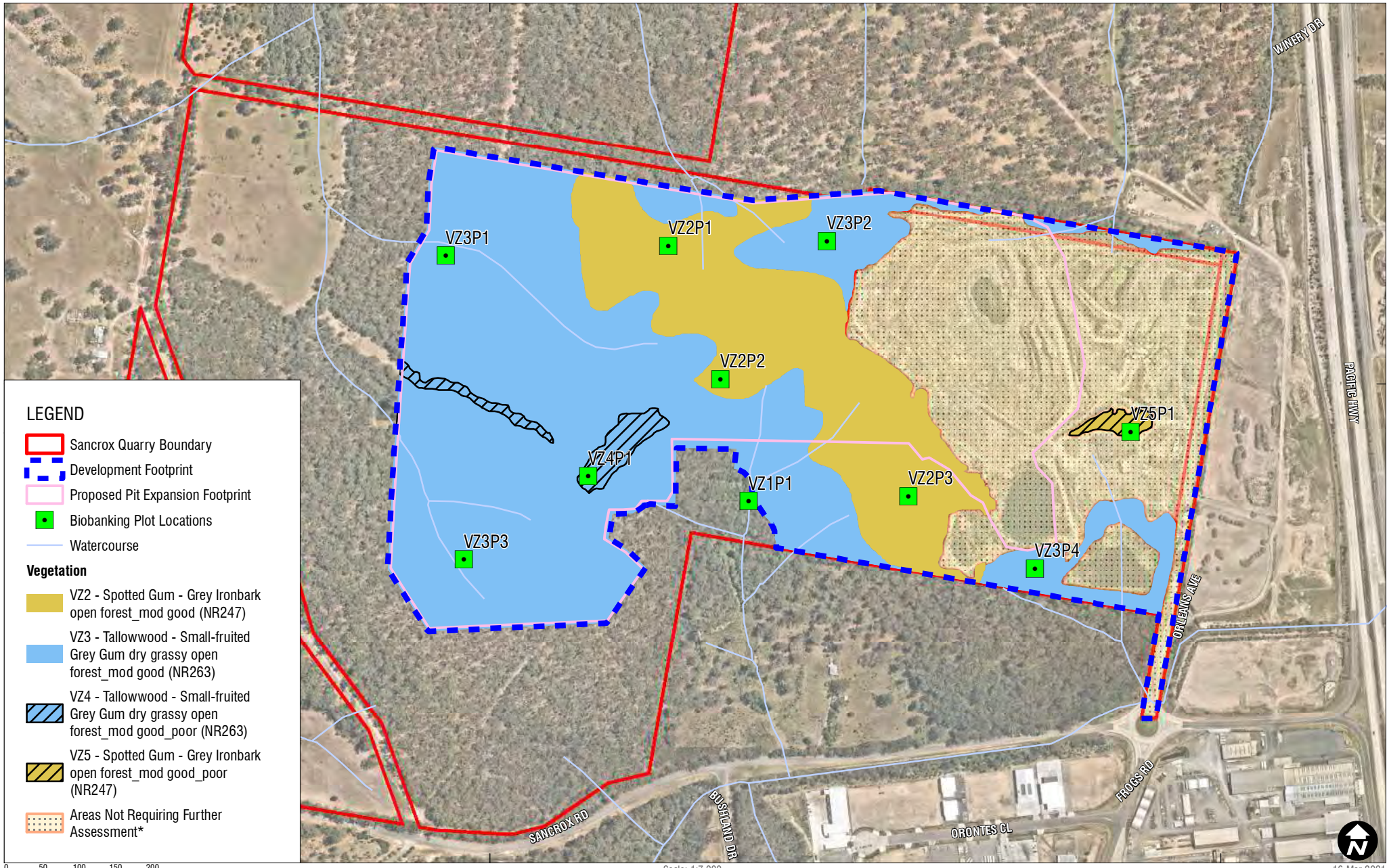
We note that vegetation zone 1 (Veg Zone 1 - NR117_Moderate/Good Blackbutt - Pink Bloodwood shrubby open forest of the coastal lowlands of the NSW North Coast Bioregion) formerly existed within the development footprint but has been removed from consideration due to amendments to the pit layout to avoid this vegetation type.

The distribution of these vegetation zones within the development site, as well as the location of plot/transects, is shown in **Figure 8**. The vegetation zones, their mapped extent within the study area and plots completed within each zone are listed in **Table 11**.

Table 11 Vegetation Zones mapped within the Development Site

No.	Vegetation Zone name	Vegetation type name	Area (ha)	Min plots#	Plots done
2	NR247_Moderate/Good	Spotted Gum - Grey Ironbark open forest of the Macleay Valley lowlands of the NSW North Coast Bioregion	10.83	3	3
3	NR263_Moderate/Good	Tallowwood - Small-fruited Grey Gum dry grassy open forest of the foothills of the NSW North Coast	27.10	4	4
4	NR263_Moderate/Good_Poor	Tallowwood - Small-fruited Grey Gum dry grassy open forest of the foothills of the NSW North Coast	0.84	1	1
5	NR247_Moderate/Good_Poor	Spotted Gum - Grey Ironbark open forest of the Macleay Valley lowlands of the NSW North Coast Bioregion	0.25	1	1
		Total	**39.02**	**9**	**9**

Minimum number of plots required in the FBA.



Sheet Size : A4

SLR

www.slrconsultingaustralia.com.au

*Areas Devoid of Native Vegetation, as per Section 9.5 of the FBA

Data Source: NSW SS 2020
Aerial imagery supplied by Nearmap (November, 2020)

Vegetation Zones and Plot Locations

FIGURE 8

3.7 Threatened Ecological Communities

3.7.1 Desktop Results

According to the NSW Wildlife Atlas (10 km search), nine threatened ecological communities (TECs) have been recorded within the locality, including;

- Coastal Saltmarsh in the New South Wales North Coast, Sydney Basin and South East Corner Bioregions
- Freshwater Wetlands on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions
- Littoral Rainforest in the New South Wales North Coast, Sydney Basin and South East Corner Bioregions
- Lowland Rainforest in the NSW North Coast and Sydney Basin Bioregions
- Lowland Rainforest on Floodplain in the New South Wales North Coast Bioregion
- Subtropical Coastal Floodplain Forest of the New South Wales North Coast Bioregion
- Swamp Oak Floodplain Forest of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions
- Swamp Sclerophyll Forest on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions
- Themeda grassland on seacliffs and coastal headlands in the NSW North Coast, Sydney Basin and South East Corner Bioregions.

Of the above listed communities, one was recorded within the study area: Subtropical coastal floodplain forest. However, this threatened community does not lie within the development site. No evidence for any other threatened ecological communities was recorded within the Development Site.

With reference to the above TECs:

- There is no estuarine habitat within the study area; hence no saltmarsh vegetation;
- There are no stands of rainforest vegetation within the study area;
- The detention ponds or dams that lie within the active quarry site, in the southeastern corner of the Development Site, are not natural wetlands and do not support the requisite flora assemblages that characterise the Freshwater Wetlands on Coastal Floodplains TEC;
- There are no stands of Swamp Oak on floodplain or estuarine margins;
- There are stands of Swamp Mahogany swamp forest and paperbark swamp forest in the proposed offset site, as discussed in **Section 7**; however no such vegetation occurs within the Development Site; and
- The site is located at some distance from the coast; hence there are no seacliffs or headlands that could support the Themeda grassland on seacliffs and coastal headlands TEC.

3.7.2 Subtropical coastal floodplain forest

A small patch of Blackbutt–Pink Bloodwood Shrubby Open-forest (PCT 686) lies beyond the southern boundary of the site and represents an example of the threatened ecological community *Subtropical coastal floodplain forest of the NSW North Coast bioregion*, which is listed as endangered under Schedule 1 (Part 3) the BC Act. This community is not listed under the EPBC Act. The community does not occur within the Development Site and therefore is not considered further in this BAR.

4 Threatened Species

This chapter describes the threatened species predicted to occur within the study area, based on the field survey results, the outputs of desktop assessment and the outputs of the BioBanking Credit Calculator, in accordance with Section 6 of the FBA.

4.1 Overview

Several sources of information have been employed to create a list of candidate threatened species and populations relevant to the study area. The Credit Calculator outputs of ecosystem credit species and species credit species are used as the basis for the consideration of threatened species in this BAR. In addition to this, the NSW Wildlife Atlas 10 km search tool was used to search for previous records of threatened species (as listed under the *Biodiversity Conservation Act 2016* - BC Act) from the locality.

Overall, an assemblage of 81 threatened species or populations are deemed as potential relevance to the study area. This assemblage consists of 14 plants, 35 birds, 24 mammals, four amphibians, three reptiles and one endangered population. The habitat requirements and ecology of the threatened species predicted to occur within the study area are described in the likelihood of occurrence table presented in **Appendix G** this report. The likelihood of occurrence rating is based on the results of field surveys, and particularly on the extent, nature and condition of habitat types and habitat features within the study area.

Of the 81 threatened biota potentially relevant to the site at Sancrox, seven were recorded within the study area during the current field surveys (see **Figure 9**). These species and the field survey results are discussed in **Sections 4.3** and **4.4**.

Additionally, the SEARs identify the following threatened species as requiring "further consideration":

- Biconvex Paperbark *Melaleuca biconvexa*;
- Spider Orchid *Dendrobium melaleucaphilum*; and
- Southern Swamp Orchid *Phaius australis*.

These species were not recorded during the current investigation, despite targeted searches for the two orchid species during their known flowering periods. These species are discussed further in **Section 6.4**.

This chapter describes the threatened species of potential relevance to the site and hence that were targeted during field surveys, in terms of (i) ecosystem credits (**Section 4.3**) and (ii) species credits (**Section 4.4**).

4.2 Summary of Threatened Species Recorded on Site

Threatened species recorded on the Development Site, including their respective habitat components and credit type, are listed in **Table 12**.

Table 12 Threatened species recorded on the site

Species	BC Act	Credit Type	Habitat Component Development Site
Eastern Bentwing-bat *Miniopterus schreibersii oceanensis*	Vulnerable	Ecosystem (foraging habitat) Species (breeding)	Foraging habitat available on site. Roosting habitat and breeding caves absent. Recorded on site via AnaBat Detector.
Eastern False Pipistrelle *Falsistrellus tasmaniensis*	Vulnerable	Ecosystem	Foraging and roosting habitat available. Recorded on site (AnaBat detector).
Eastern Freetail-bat *Mormopterus norfolkensis*	Vulnerable	Ecosystem	Foraging and roosting habitat available. Recorded on site (AnaBat detector).
Greater Broad-nosed Bat *Scoteanax rueppellii*	Vulnerable	Ecosystem	Foraging and roosting habitat available. Recorded on site (AnaBat detector)
Grey-headed Flying-fox *Pteropus poliocephalus*	Vulnerable	Ecosystem (foraging habitat) Species (breeding)	Foraging habitat available on site. No breeding habitat, including camp sites, on or near site. Recorded via visual observation and call recognition.
Koala *Phascolarctos cinereus*	Vulnerable	Species	Koala feed trees present within forested parts of site (within all PCTs mapped on site)
Little Bent-wing Bat *Miniopterus australis*	Vulnerable	Ecosystem (foraging habitat) Species (breeding)	Foraging habitat available on site. Roosting habitat and breeding caves absent. Recorded on site via AnaBat Detector.

A total of seven threatened fauna species were recorded on the site at Sancrox during the survey (31st November to 14th December 2015) including:

- six microchiropteran bats;
- the Koala; and
- one megachiropteran bat (Grey-headed Flying Fox).

A number of threatened microchiropteran bat species, listed under the BC Act, were recorded via ultrasonic detection (using AnaBat recorders), namely the Eastern Falsistrelle, Little Bent-wing Bat, Greater Broad-nosed Bat, East-coast Freetail Bat and Yellow-bellied Sheathtail-bat (possible ID), Eastern Bent-wing Bat (Probable ID). No microchiropteran bats were recorded in harp traps.

Individuals of the Grey-headed Flying-fox, which is listed under both the BC Act and the EPBC Act, were recorded during spotlighting surveys. However, no flying-fox camps (or other evidence of breeding or roosting) were recorded on the site.

Although limited evidence (via sightings or aural calls) for the Koala was recorded on the site during the original surveys (in 2015), recent findings from targeted surveys conducted for the Koala in October 2020 indicate the presence of this species on the site. Further details are provided in **Section 4.4**.

No threatened ground mammals (including Rufous Bettong, Spotted-tailed Quoll, Eastern Chestnut Mouse, and Common Planigale) were recorded via the use of cage trapping, Elliot trapping, camera monitoring or spotlighting.

No threatened arboreal mammals (other than the Koala, and including Squirrel Glider, Yellow-bellied Glider or Brush-tailed Phascogale) were recorded via glider-tube trapping, arboreal hair tube trapping or spotlighting.

No threatened amphibians were recorded during spotlighting or call playback at waterbodies in the bushland or within the quarry. All waterbodies on the site contain Mosquito Fish *Gambusia holbrooki*, which are a tadpole predator and would further decrease the likelihood of any threatened amphibians occurring.

The only reptiles observed were the Lace Monitor and Eastern Water Dragon. There are no threatened reptiles known to occur in the locality.

No threatened woodland birds or raptors were observed during avifauna surveys. No threatened forest owls were observed during spotlighting or call-playback surveys.

The following sections detail the threatened species of relevance to the Development Site, in terms of ecosystem credit species and species credit species.

4.3 Ecosystem Credit Species

According to the FBA, threatened species that attract ecosystem credits are predicted to occur in a given area based on the presence of "habitat surrogates"[1]. Where such habitat surrogates occur, these species have a "high likelihood of being present on the site" and therefore a threatened species survey is not required.

By contrast, targeted surveys are required for species that attract species credits, as discussed in **Section 4.4**.

4.3.1 Generated by credit calculator

A total of 25 ecosystem credit species have been predicted to occur within the study area according to the Credit Calculator (**Table 13**). Species prediction is based on the presence of certain habitat surrogates, including vegetation zones that have been mapped within the study area and on landscape values. According to Section 6.3 of the FBA, an ecosystem credit species is deemed as 'on site' if one or more of its habitat components are present on site. The three habitat components used for this assessment include foraging habitat, breeding habitat and roost/shelter habitat.

Table 13 lists the ecosystem credit species predicted to occur within the Development Footprint (including records from field surveys) and provides reasoning for the predicted presence or absence of the species within the study area (including habitat component). Species recorded on site are listed in bold type.

[1] IBRA subregion, PCT, percent vegetation cover and vegetation condition.

Table 13 Threatened species predicted to occur by the Credit Calculator (ecosystem credit species)

Species	BC Act	LoO*	On Site **	Habitat Component Development Site
Barking Owl *Ninox connivens*	Vulnerable	M	Yes	Foraging habitat available. Large hollow nesting habitat scarce. No records within of site (Atlas of NSW Wildlife)
Barred Cuckoo-shrike *Coracina lineata*	Vulnerable	M	Yes	Potential foraging and nesting habitat. No records within of site (Atlas of NSW Wildlife)
Brown Treecreeper *Climacteris picumnus victoriae*	Vulnerable	L	Yes	Potential foraging and nesting habitat availability, although prefers habitats inland of Great Dividing Range.
Bush Stone-curlew *Burhinus grallarius*	Endangered	L	Yes	Moderate habitat available on site, dense shrubs for nesting predominantly absent. No records within 10 km of site (Atlas of NSW Wildlife)
Diamond Firetail *Stagonopleura guttata*	Vulnerable	L	Yes	Foraging and nesting habitat available on site, dense shrubs for nesting predominantly absent. No records within 10 km of site (Atlas of NSW Wildlife)
Eastern False Pipistrelle ***Falsistrellus tasmaniensis***	**Vulnerable**	**P**	**Yes**	**Foraging and roosting habitat available, recorded on site (Anabat detector))**
Eastern Freetail-bat ***Mormopterus norfolkensis***	**Vulnerable**	**P**	**Yes**	**Foraging and roosting habitat available, recorded on site (Anabat detector)**
Glossy Black-Cockatoo *Calyptorhynchus lathami*	Vulnerable	L	Yes	Scattered foraging habitat available within pockets of *Allocasuarina* trees; Hollow-bearing trees for nesting are rare.
Greater Broad-nosed Bat ***Scoteanax rueppellii***	**Vulnerable**	**P**	**Yes**	**Foraging and roosting habitat available, recorded on site (Anabat detector)**
Hoary Wattled Bat *Chalinolobus nigrogriseus*	Vulnerable	H	Yes	Foraging and roosting habitat available.
Hooded Robin *Melanodryas cucullata cucullata*	Vulnerable	L	Yes	Potential foraging and nesting habitat although prefers structurally diverse forests or woodland. No records within of site (Atlas of NSW Wildlife)
Little Eagle *Hieraaetus morphnoides*	Vulnerable	M	Yes	Potential foraging and nesting habitat available on site; large home range.
Little Lorikeet *Glossopsitta pusilla*	Vulnerable	M	Yes	Potential foraging and nesting habitat on site. Large home range.
Long-nosed Potoroo *Potorous tridactylus*	Vulnerable	L	Yes	Foraging and breeding habitat availability, although dense understorey vegetation is predominantly absent on site.
Masked Owl *Tyto novaehollandiae*	Vulnerable	M	Yes	Foraging and breeding habitat available, although large hollow nesting habitat scarce, nearby records to site (within 2 km).

Species	BC Act	LoO*	On Site **	Habitat Component Development Site
Powerful Owl *Ninox strenua*	Vulnerable	L	Yes	Foraging and breeding habitat available, large hollow nesting habitat scarce, large home range.
Scarlet Robin *Petroica boodang*	Vulnerable	M	Yes	Potential foraging and nesting habitat available on site. Large home-ranges. No records within 10 km of site (Atlas of NSW Wildlife)
Spotted-tailed Quoll *Dasyurus maculatus*	Vulnerable	L	Yes	Potential foraging habitat availability, den opportunities scarce. Large home ranges
Square-tailed Kite *Lophoictinia isura*	Vulnerable	M	Yes	Foraging habitat availability in woodland areas; large home ranges. Low quality nesting habitat (preferred near to watercourses).
Swift Parrot *Lathamus discolour*	Endangered	L	Yes	Potential foraging habitat: winter flowering eucalypts (e.g. Spotted Gum) on site. Breed in Tasmania.
Varied Sittella *Daphoenositta chrysoptera*	Vulnerable	H	Yes	Foraging and nesting habitat available in woodland areas; nearby records to site (within 2 km).
Yellow-bellied Glider *Petaurus australis*	Vulnerable	L	Yes	Potential foraging habitat availability. Large hollow bearing trees scarce.
Yellow-bellied Sheathtail-bat *Saccolaimus flaviventris*	**Vulnerable**	**H**	**Yes**	**Possible recording on site (AnaBat Detector). Data likely to be confused with calls with those of other bat species). Foraging habitat available, roosting habitat (hollow-bearing trees) scarce.**

* Likelihood of occurrence – see **Appendix G** for likelihood definitions.

** Species marked 'Yes' have been ticked as 'On site' in the Credit Calculator.

4.3.2 Wildlife Atlas (10 km search)

A range of other ecosystem credit threatened species has been identified in the 10 km search results from the NSW Wildlife Atlas. Although not identified as 'predicted threatened species' in the Credit Calculator, these species were targeted during surveys conducted in December 2015. **Table 14** provides the listings and survey findings for each species.

The relevance of each species to the proposal is based on their individual habitat requirements, which are provided in the Likelihood of Occurrence (LoO) table in **Appendix G** of this report. The process of assessing habitat for such species was undertaken in accordance with the steps in Section 6.3 of the FBA. Species recorded on site are listed in bold type.

Table 14 Additional Ecosystem Credit Species generated by Wildlife Atlas

Species	TSC	LoO**	Relevance
Blue-billed Duck *Oxyura australis*	Vulnerable	L	Moderate habitat availability in large quarry dams (in disturbed quarry area), prefers dense aquatic vegetation. No habitat in proposed expansion area.

Species	TSC	LoO**	Relevance
Common Blossom-bat *Syconycteris australis*	Vulnerable	L	Low habitat availability; prefers littoral rainforest for roosting and feeds in heath or paperbark swamps. Occasionally occurs in wet sclerophyll forests.
Eastern Bentwing-bat *Miniopterus schreibersii oceanensis*	**Vulnerable**	**P**	**Foraging habitat available on site. Roosting habitat predominately absent. Breeding caves absent.**
Eastern Cave Bat *Vespadelus troughtoni*	Vulnerable	L	Foraging habitat available on site. Roosting and breeding habitat (caves) is absent.
Eastern Grass Owl *Tyto longimembris*	Vulnerable	L	Low habitat availability, prefers areas with tall grass, including tussocks, grassy plains, swampy areas or sedges on floodplains
Grey-headed Flying-fox *Pteropus poliocephalus*	**Vulnerable**	**P**	**Foraging habitat available on site.** **No breeding habitat, including camp sites, on or near site.**
Southern Myotis *Myotis macropus*	Vulnerable	M	Foraging habitat available on site particularly near larger waterbodies in quarry area. Roosting habitat such as caves, mine shafts or hollow-bearing trees is rare or absent.
Spotted Harrier *Circus assimilis*	Vulnerable	L	Habitat available on site, largely vagrant - unlikely to occur apart from possible foraging activity. Found most commonly in native grassland.
Rose-crowned Fruit-Dove *Ptilinopus regina*	Vulnerable	L	Low habitat availability, prefers rainforest and occasionally moist eucalypt forest; unlikely to occur.

* Based on 'probable' or 'possible' confidence level in identification of Anabat recordings. Some possibility of confusion of data with those of other bat species.

** Likelihood of occurrence – see Appendix G for likelihood definitions.

4.3.3 Predicted Ecosystem Credit Species

The relevant steps in Section 6 of the FBA have been applied to identify the ecosystem credit species present on the site, or which have a high likelihood of occurrence on the site. The likelihood of occurrence has been identified for all of the potential ecosystem credit species by conducting habitat and vegetation type assessments across the site. The results for this are provided in the likelihood of occurrence table in **Appendix G**. Furthermore, detailed ecological surveys for species with moderate or high likelihood of occurrence were undertaken on the site in December 2015.

A total of 25 threatened species (that attract ecosystem credits) have been predicted to occur within the site in the Credit Calculator. Of these, four threatened micro-bats were recorded during field surveys:

- Eastern False Pipistrelle;
- Eastern Freetail-bat;
- Greater Broad-nosed bat; and
- Yellow-bellied Sheathtail Bat;

Whilst not listed as 'predicted threatened species' in the Credit Calculator, an additional three threatened bats were recorded on site:

- Eastern Bentwing-bat;

- Little Bentwing-bat; and
- Grey-headed Flying-fox.

The Eastern False Pipistrelle, Eastern Freetail-bat, Greater Broad-nosed bat and Yellow-bellied Sheathtail Bat attract ecosystem credits; whereas the Eastern Bentwing-bat, Little Bentwing-bat and Grey-headed Flying Fox attract ecosystem credits for foraging habitat and species credits for impacts on their breeding habitat (see **Section 4.4**).

The ecosystem credit bat species recorded on the site are described below, including credit type (within Northern Rivers CMA), conservation status, habitat requirements and conservation biology. The locations of records within the study area (which are all linked to Anabat detector locations) are shown in **Figure 9**. Data on credit type and other ecology of each species is sourced from the Threatened Species Profile Database.

Eastern False Pipistrelle *Falsistrellus tasmaniensis*

Credit type: Ecosystem

NSW Status - Vulnerable (BC Act); Commonwealth status – not listed (EPBC Act)

The Eastern False Pipistrelle inhabits sclerophyll forests in south eastern Australia from southern Queensland to Tasmania with a preference for moist forest types and tall trees (>20m). It roosts predominantly in hollow-bearing trees although can use caves or buildings. Foraging distances can be large with one record of a 12 km commute from roost.

This species breeds during Spring months and young are usually born in December or January. Hibernation occurs during winter months. The best time of year for identification of this species is mid-spring to mid-autumn.

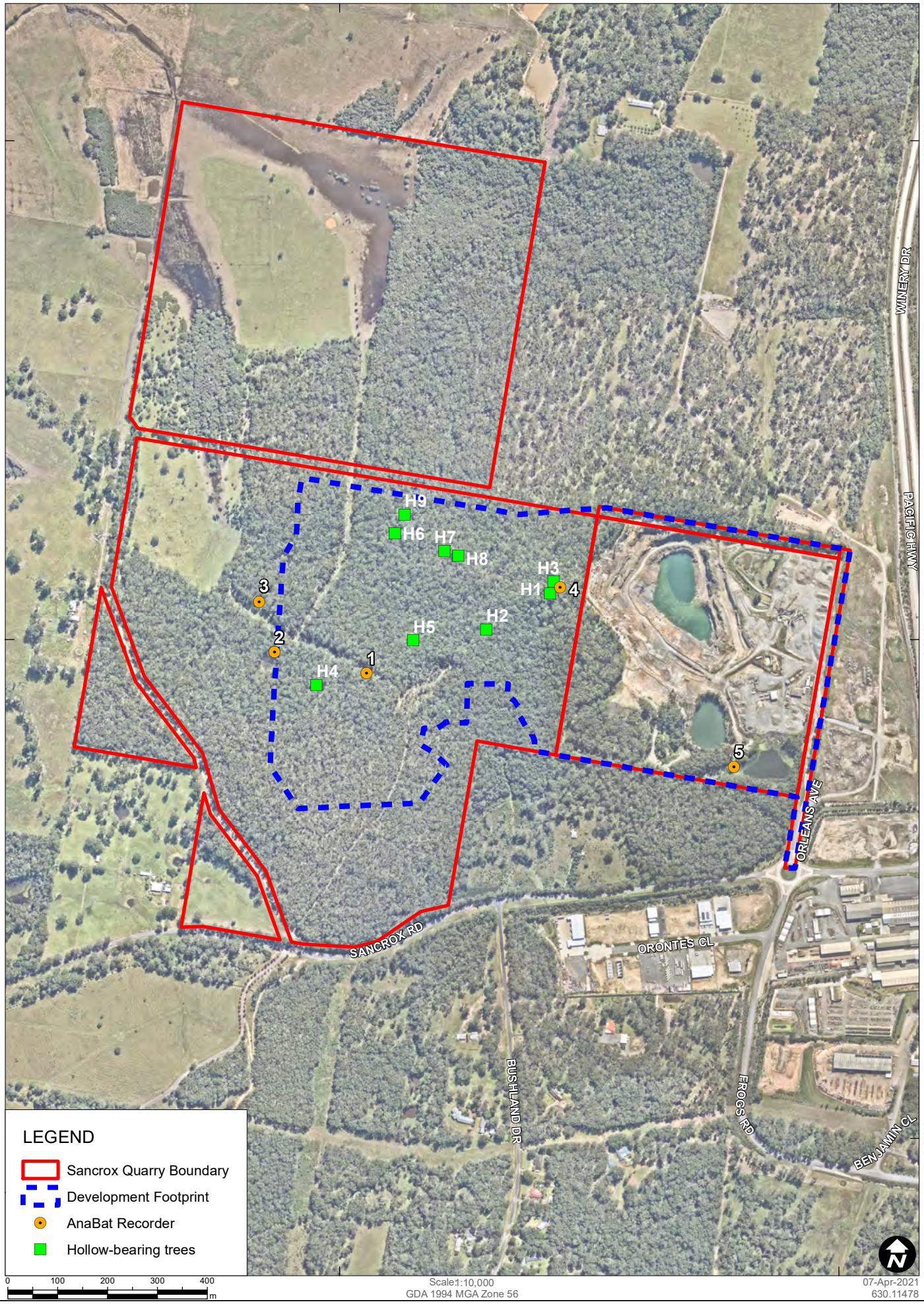
Within the Northern Rivers CMA, the Eastern False Pipistrelle can only tolerate up to 10 % loss of foraging habitat and up to 10 % loss of hollow-bearing trees.

Eastern Freetail-bat *Mormopterus norfolkensis*

Credit type: Ecosystem

NSW Status - Vulnerable (BC Act); Commonwealth status – not listed (EPBC Act)

The Eastern Freetail-bat is found dry sclerophyll forest, woodland, swamp forests and mangrove forests east of the Great Dividing Range. This species nests in hollow-bearing trees although will also roost under bark or in man-made structures. The site contains limited hollow-bearing trees that might provide roosting habitat for this species. Forest and woodland foraging habitat is abundant.



Sheet Size : A4

SLR
www.slrconsultingaustralia.com.au

Data Source: NSW SS 2020
Aerial imagery supplied by Nearmap (November, 2020)

Fauna survey locations, habitat trees and threatened bat records

FIGURE 9

Within the Northern Rivers CMA, the Eastern Freetail-bat can only tolerate temporary loss of up to 10 % foraging habitat and no more than 10 % hollow bearing trees.

Greater Broad-nosed Bat *Scoteanax rueppellii*

Credit type: Ecosystem

NSW Status - Vulnerable (BC Act); Commonwealth status – not listed (EPBC Act)

The Greater Broad-nosed Bat utilises habitats from woodland through to moist and dry eucalypt forest and rainforest, though it is most commonly found in tall wet forest. Its distribution includes slopes of the Great-dividing range and coastal regions from north-eastern Victoria to the Atherton Tableland in Queensland. This species predominantly roosts in tree hollows, which are available on the site in small amounts. Woodland foraging habitat for this species is abundant on the site however preferred creek line and riparian vegetation is largely absent.

Within the Northern Rivers CMA, the Greater Broad-nosed Bat can only tolerate temporary loss of 10 % of foraging habitat and 10 % loss of hollow-bearing trees. Loss of riparian habitat cannot be tolerated.

Yellow-bellied Sheathtail-bat *Saccolaimus flaviventris*

Credit type: Ecosystem

NSW Status - Vulnerable (BC Act); Commonwealth status – not listed (EPBC Act)

The Yellow-bellied Sheathtail Bat was also recorded as a 'Possible Identification', meaning the calls recorded by Anabat are *likely* to be confused with calls with those of other bat species. The site does contain suitable foraging habitat for this species although roosting habitat such as hollow-bearing trees are scarce. This species is regarded as present and is included in the offset calculation for the proposal on the site.

This species occurs in many habitat types and occupies very large ranges. Like all microchiropteran bats, this species is most active in warmer months between October and March. It forages throughout most habitats over its large range, even in treeless areas. Individuals roosts in tree hollows and in treeless areas, and is also known to roost in mammal burrows. Breeding has been recorded from December to mid-March. Some of the hollow-bearing trees recorded within the site could provide roosting habitat for this species.

The Yellow-bellied Sheathtail-bat can only tolerate temporary loss of 10 % of foraging habitat and 10 % of hollow-bearing trees within the Northern Rivers CMA.

Eastern Bentwing-bat *Miniopterus schreibersii oceanensis*

Credit types: Ecosystem (foraging habitat) and Species (land containing caves or similar structures)

NSW Status - Vulnerable (BC Act); Commonwealth status – not listed (EPBC Act)

The Eastern Bent-wing Bat is an ecosystem credit species that was not predicted to occur in the Credit Calculator but was recorded using AnaBat detectors (with 'Probable' confidence level) within the Development Site (see **Figure 9**). Probable confidence level means that the calls recorded by AnaBat have some possibility of confusion of calls with those of other bat species.

This species occurs in a variety of forest formations along the east and north-west coasts of Australia. Roosting occurs predominantly in caves and occasionally in derelict mines, storm-water tunnels, buildings and other man-made structures. Populations use maternity caves in spring and summer and during other months disperse up to 300 km from these caves.

Foraging habitat, in the form of forest, woodland and adjoining open areas, is present within the site. Roosting and breeding habitat (i.e. caves, disused mines shafts, some buildings) is absent from the site.

Within the Northern Rivers CMA, the Eastern Bentwing-bat attracts ecosystem credits for foraging habitat and species credits for breeding habitat (land containing caves or similar structures). As no caves or similar structures were recorded within the study area, no species credits are generated for the impacts of the development on the Eastern Bentwing-bat. Impacts on the Eastern Bentwing Bat as a result of the proposed development are therefore quantified via loss of foraging habitat represented as ecosystem credits.

Within the Northern Rivers CMA, the Eastern Bentwing-bat cannot tolerate loss of natural breeding or roosting habitat and can tolerate no more than 10 % loss of foraging habitat within 500 m of breeding habitat (caves in Karst). There can be no capping of loss of foraging habitat elsewhere.

Grey-headed Flying-fox *Pteropus poliocephalus*

Credit types: Ecosystem (foraging habitat) and Species (land within 40 m of rainforest, coastal scrub, riparian or estuarine communities)

NSW Status - Vulnerable (BC Act); Commonwealth status – Vulnerable (EPBC Act)

The Grey-headed Flying-fox is an ecosystem credit species that was not predicted to occur in the Credit Calculator but was recorded during field surveys within the Development Site. This species occurs in a variety of woodland formations including subtropical and temperate rainforests, tall sclerophyll forests and woodlands, heaths and swamps as well as urban gardens and cultivated fruit crops. Roosting camps are generally located within 20 km of a regular food source and are commonly found in gullies, close to water, in vegetation with a dense canopy. Individual camps may have tens of thousands of animals and are used for mating, and for giving birth and rearing young. There is no roosting camp on or adjacent to the site. The forest and woodland habitats that extend across the site provide foraging resources for this species during flowering season when individuals search for nectar and pollen in native trees, in particular *Eucalyptus, Melaleuca* and *Banksia*, and fruits of rainforest trees and vines.

Within the Northern Rivers CMA, the Grey-headed Flying-fox attracts ecosystem credits for foraging habitat and species credits for breeding and roosting habitat (i.e. “land within 40 m of rainforest, coastal scrub, riparian or estuarine communities”). The forested parts of the Development Site represent foraging habitat for Grey-headed Flying-fox and accordingly, impacts on the foraging habitat for this species have been included as ecosystem credits. However, the site does not contain or lie within 40 m of rainforest, coastal scrub, riparian or estuarine communities. Hence no species credits are generated for the impacts of the development on the Grey-headed Flying-fox.

Within the Northern Rivers CMA, the Grey-headed Flying-fox cannot sustain loss of breeding habitat. It can tolerate up to 10 % loss of foraging habitat providing that "replanting" or "supplementary planting" is undertaken in offset sites.

Little Bentwing-bat *Miniopterus australis*

Credit types: Ecosystem (foraging habitat) and Species (breeding/roosting habitat)

NSW Status - Vulnerable (BC Act); Commonwealth status – not listed (EPBC Act)

The Little Bentwing-bat was not listed as a predicted threatened species in the Credit Calculator, but was nonetheless recorded using ultrasonic call detection (i.e. AnaBat detector).

The Little Bentwing-bat inhabits moist eucalypt forest, rainforest, vine thicket, wet and dry sclerophyll forest, Melaleuca swamps, dense coastal forests and banksia scrub in south eastern Australia from Cape York in Queensland to Wollongong in New South Wales. This species often uses caves, abandoned mines or buildings as roosting habitat however does also utilise tree hollows which are available (although limited) on the site. Like the Eastern Bentwing-bat, this species uses maternity caves during summer months to rear young.

Within the Northern Rivers CMA, the Little Bentwing Bat attracts both ecosystem credits and species credits. Ecosystem credits are linked to foraging habitat, whilst species credits are only applicable where breeding habitat (i.e. caves) occurs.

Whilst foraging habitat is widespread across the site, maternity caves or other similar resources for breeding and roosting for Little Bentwing Bat are not present. For this reason, preparation of a species polygon (according to Section 6.5 of the FBA) and creation of species credits is not required for the Little Bentwing-bat.

Within the Northern Rivers CMA, the Little Bentwing-bat can only tolerate 5% loss of tree hollows, and up to 10% loss of foraging habitat. No loss of breeding habitat can be tolerated.

4.4 Species Credit Species

A total of 29 candidate 'species credit species' have been determined relevant to the study area according to the Credit Calculator. This predicted list of species is based, *inter alia*, on previous records and the 'Geographic/Habitat Features' identified in the Credit Calculator.

4.4.1 Assessment of Geographic / Habitat Features

Potential candidate species credit species have been identified in the Credit Calculator based on relevant geographic and/or habitat features that are present on site. As part of the revision of this BAR, all threatened species and their habitat and geographic requirements at this step in the Credit Calculator were reviewed and (where necessary) updated. The relevant species and their associated habitat features are listed in **Table 15**.

Table 15 Assessment of Geographic / Habitat Features for Species Credit Species

Impact?	Common Name	Scientific Name	Feature
✓	Biconvex Paperbark	*Melaleuca biconvexa*	Swamps, swamp margins or creek edges
✓	Giant Barred Frog	*Mixophyes iteratus*	Land below 1000 m in altitude and within 40 m of rainforest or eucalypt forest with deep leaf litter.
✓	Pale-headed Snake	*Hoplocephalus bitorquatus*	Land within 40 m of watercourses, containing hollow-bearing trees, loose bark and/or fallen timber.

✓	Milky Silkpod	*Parsonsia dorrigoensis*	Subtropical or warm temperate rainforest or open eucalypt forest or ecotones between rainforest and eucalypt forest.
✓	North Brother Wattle	*Acacia courtil*	Shallow soils in dry open forest or rocky slopes.
✓	Common Planigale	*Planigale maculate*	Rainforest, eucalypt forest, healthland, marshland, grassland or rocky areas.
✓	Green-thighed Frog	*Litoria Brevipalmata*	Land within 100 m of semi-permanent or ephemeral ponds or depressions containing leaf litter.
✓	Willawarrin Doubletail	*Diuris disposita*	Grassy open forest

Other species credit species listed in the Credit Calculator under the Geographic/Habitat Features tab were not ticked as 'Impacted' (or relevant to the site) as their specific habitat requirements or geographic features are not present within the development site.

4.4.2 Candidate species – Generated by credit calculator

A total of 29 candidate 'species credit species' have been determined relevant to the project (**Table 16**). Species recorded on site during field surveys are listed in bold type.

Table 16 Species credit species – Credit Calculator output and field survey records

Species	BC Act	LoO*	On Site	Habitat present on site
Biconvex Paperbark *Melaleuca biconvexa*	Vulnerable	L	No	Potential habitat availability in low-lying areas containing paperbark in southern patch and in western area of site. Not recorded during surveys.
Brush-tailed Phascogale	*Phascogale tapoatafa*	M	No	Moderate potential habitat in woodland areas throughout site. Not recorded on site during fauna survey
Common Planigale *Planigale maculata*	Vulnerable	L	No	Potential habitat availability in woodland areas. Low occurrence of tree hollows may be a deterrent.
Eastern Chestnut Mouse *Pseudomys gracilicaudatus*	Vulnerable	L	No	Low habitat availability, prefers heathland mainly in dense, wet heath and swamps
Eastern Pygmy Possum *Cercartetus nanus*	Vulnerable	L	No	Possible habitat availability in woodland areas although lack of understorey and sparsity of trees may be a deterrent.
Giant Barred Frog *Mixophyes iteratus*	Endangered	L	No	Low habitat availability, prefers freshwater streams
Green-thighed frog *Litoria brevipalmata*	Vulnerable	L	No	Potential habitat availability in soaks and depressions on the site (following heavy rain). Can occur in drier sclerophyll forest (in disturbed quarry area).

Species	BC Act	LoO*	On Site	Habitat present on site
Groves Paperbark *Melaleuca groveana*	Vulnerable	L	No	Low habitat availability, prefers heath and shrub land, often in exposed sites, in low coastal hills, escarpment ranges and tablelands on outcropping granite, rhyolite and sandstone.
Koala *Phascolarctos cinereus*	**Vulnerable**	**M**	**Yes**	**Scats recorded in 2015. Scats and sighting of adult Koala during recent 2020 survey. Some areas modelled as 'high Koala activity'. Koala feed trees present on site.**
Leafless Tongue Orchid *Cryptostylis hunteriana*	Vulnerable	M	No	Marginal potential habitat occurs on site in very restricted locations in paperbark swamp forest margins.
Milky Silkpod *Parsonsia dorrigoensis*	Vulnerable	L	No	Low habitat availability, prefers subtropical and warm-temperature rainforest, on rainforest margins, and in moist eucalypt forest.
North Brother Wattle *Acacia courtii*	Vulnerable	L	No	Only found in the Laurieton district occurring on North Brother, Middle Brother and South Brother Mountains
Pale-headed Snake *Hoplocephalus bitorquatus*	Vulnerable	L	No	Possible habitat available. Low occurrence of tree hollows may be a deterrent.
Pale-vented Bush-hen	Vulnerable	L	No	No suitable habitat
Parma Wallaby	Vulnerable	L	No	Preferred habitat not available; prefers moist eucalypt forests and rainforest margins.
Rainforest Cassia *Senna acclinis*	Endangered	L	No	Low habitat availability, prefers margins of subtropical, littoral and dry rainforests.
Red-backed Button-quail *Turnix maculosus*	Vulnerable	L	No	Low habitat availability, prefers grasslands, heath and crops.
Regent Honeyeater *Anthochaera phrygia*	Critically Endangered	L	No	Low breeding habitat potential onsite due to small number of mature trees, open canopy, and lack of preferred woodland tree species. Possible foraging habitat in winter.
Rufous Bettong *Aepyprymnus rufescens*	Vulnerable	M	No	Potential habitat in woodland areas, native grasses in ground layer unlikely tall or dense enough for favourable habitat.
Rusty Plum *Niemeyera whitei*	Vulnerable	L	No	Low habitat availability, prefers gullies of warm temperate or littoral rainforests and the adjacent understorey of moist eucalypt forest.
Scant Pomaderris *Pomaderris queenslandica*	Endangered	L	No	Possible habitat availability, vegetation communities that occur on site are not typical species assemblages in which it is known to occur.
Slender Marsdenia *Marsdenia longiloba*	Endangered	L	No	Low habitat availability, prefers subtropical and warm temperate rainforest, lowland moist or open eucalypt forest adjoining rainforest and, sometimes, in areas with rock outcrops.

Species	BC Act	LoO*	On Site	Habitat present on site
Squirrel Glider *Petaurus norfolcensis*	Vulnerable	M	No	Potential habitat in woodland areas. Lack of understorey for foraging and tree hollows for shelter would likely be a deterrent.
Stephens Banded Snake *Hoplocephalus bitorquatus*	Vulnerable	L	No	Low habitat availability, prefers rainforest and moist eucalypt forests and rocky areas.
Three-toed Snake-tooth Skink *Coeranoscincus reticulatis*	Vulnerable	L	No	Low habitat availability; prefers rainforest and occasionally moist eucalypt forest, on loamy or sandy soils.
Tree Guinea Flower	Endangered	L	No	Typically grows in heath, open forest or rainforest. Open forest present on site, but no individuals found
White-eared Monarch *Carterornis leucotis*	Vulnerable	L	No	Low habitat availability, prefers dry and littoral rainforest or rainforest margins.
White-flowered Wax Plant *Cynanchum elegans*	Endangered	N	No	No habitat on site; prefers rainforest and littoral rainforest
Willawarrin Double tail *Diuris disposita*	Endangered	N	No	Outside distribution range

* Likelihood of occurrence – see **Appendix G** for likelihood definitions.

Additional species credit species relevant to the study area which have not been generated by the credit calculator but appear in database searches are listed below in **Section 4.4.3**.

4.4.3 Other Candidate Species (BioNet records)

Additional candidate threatened species of potential relevance to the site have been identified through obtaining previous records within 10 km of the site in the 'BioNet' *Atlas of NSW Wildlife*. Targeted surveys for these species were included as part of the December 2015 field survey program and their potential relevance to the site has been documented in the 'likelihood of occurrence' assessments for the site in **Appendix G**. These species are discussed below in **Table 17.**

Of these species, one, the Little Bentwing-bat *Miniopterus australis*, was recorded on the site.

Table 17 Additional species credit species – NSW Wildlife Atlas (BioNet)

Species	BC Act	LoO*	Explanation (for presence/absence)
Australasian Bittern *Botaurus poiciloptilus*	Endangered	M	Moderate habitat availability in large quarry dams (in disturbed quarry area), prefers dense aquatic vegetation. No habitat in proposed expansion area.
Black Bittern *Ixobrychus flavicollis*	Vulnerable	M	Moderate habitat availability in large quarry dams (in disturbed quarry area), prefers dense aquatic vegetation. No habitat in proposed expansion area.

Species	BC Act	LoO*	Explanation (for presence/absence)
Brush-tailed Phascogale *Phascogale tapoatafa*	Vulnerable	M	Moderate habitat available. Foraging habitat abundant throughout woodland containing rough bark trees. Hollows-bearing trees for nesting are relatively scarce.
Comb-crested Jacana *Irediparra gallinacea*	Vulnerable	L	Moderate habitat availability in large quarry dams (in disturbed quarry area), prefers dense, floating aquatic vegetation. No habitat in proposed expansion area.
Black-necked Stork *Ephippiorhynchus asiaticus*	Endangered	L	Low habitat availability; prefers floodplain wetlands. Could potentially occur in quarry dams containing aquatic vegetation.
Dwarf Heath Casuarina *Allocasuarina defungens*	Endangered	N	Low habitat availability, prefers tall heath on sand, but can also occur on clay soils and sandstone.
Eastern Osprey *Pandion cristatus*	Vulnerable	L	No habitat available on the site.
Lesser Sand-plover *Charadrius mongolus*	Vulnerable	N	No habitat available on the site.
Little Bentwing-bat *Miniopterus australis*	**Vulnerable**	**P**	**Foraging habitat available on site. Roosting habitat predominately absent Breeding caves absent.**
Little Tern *Sternula albifrons*	Endangered	N	No habitat available on the site.
Maundia triglochinoides	Vulnerable	L	Low habitat availability, prefers swamps, lagoons, dams, channels, creeks or shallow freshwater 30 - 60 cm deep on heavy clay with low nutrients. Potential low quality habitat in ponds within quarry area. Not recorded.
Narrow-leaved Black Peppermint *Eucalyptus nicholii*	Vulnerable	N	No habitat available on site. Outside distribution range. Not recorded.
Pied Oystercatcher *Haematopus longirostris*	Endangered	N	No habitat available on the site.
Sooty Oystercatcher *Haematopus fuliginosus*	Vulnerable	N	No habitat available on the site.
Southern Swamp Orchid *Phaius australis*	Endangered	L	Site lies outside of distributional range (i.e. south of Evans Head). Potential habitat in low-lying western area of site. Not recorded during targeted orchid surveys.
Spider Orchid *Dendrobium melaleucaphilum*	Endangered	L	Habitat available in Melaleucas present on and adjacent to site (particularly western area). Not recorded during targeted orchid surveys (during known flowering period).

Species	BC Act	LoO*	Explanation (for presence/absence)
Terek Sandpiper *Xenus cinereus*	Vulnerable	N	No habitat available on site.
Wallum Froglet *Crinia tinnula*	Vulnerable	L	No habitat availability on site. Prefers habitats associated with acidic swamps on coastal sand plains or sedgelands and wet heathland. Occasionally in swamp sclerophyll forests.

* Likelihood of occurrence – see **Appendix G** for likelihood definitions.

4.4.4 Candidate Species Credit Species – present on site

According to Section 6.5 (Step 3) of the FBA, an assessor must establish whether a candidate threatened species is present on a development site or is likely to use the habitat available on the site.

Four fauna species credit species were recorded during the December 2015 field survey: Koala, Eastern Bentwing-bat, Grey-headed Flying-fox and the Little Bentwing-bat. According to the Threatened Species Profile Database, the Eastern Bentwing-bat, Little Bentwing-bat and Grey-headed Flying-fox attract both ecosystem credits and species credits within the Northern Rivers CMA. Species credits for these species are linked to the presence of breeding habitat, which in the case of the Eastern Bentwing-bat and Little Bentwing-bat is "land containing caves or similar structures" and for the Grey-headed Flying Fox, is "land within 40 m of rainforest, coastal scrub, riparian or estuarine communities". Neither of these habitat types or features is present on the site at Sancrox. By following the steps for identifying species credit species in Section 6.5 of the FBA, these three species were excluded from the species credit entries in the Credit Calculator for this project based upon the absence of breeding habitat on the site. For this reason, and for the purpose of this assessment, each was assessed as an ecosystem credit species (see **Section 4.3**).

By contrast, the Koala is a species credit species. A description of the occurrence of the Koala on the Development Site is provided below.

No threatened plants have been recorded on the site. However, targeted searches for threatened orchids were conducted in October 2015 and revealed a specimen of an epiphytic orchid that was initially thought to be the Spider Orchid *Dendrobium melaleucaphilum*. Flowering of this specimen during 2016 revealed that the specimen was not *D. melaleucaphilum.* This species is listed in the SEARs as a species for which impacts require "further consideration". Accordingly, a description of the surveys and results for this threatened orchid species is provided in **Section 6.4.2**.

Koala *Phascolarctos cinereus*

Vulnerable (BC Act and EPBC Act)

The Koala has a fragmented distribution throughout eastern Australia from north-east Queensland to the Eyre Peninsula in South Australia. It occupies a wide range of eucalypt forest habitats, usually where preferred browse species of eucalypt occur.

Surveys targeting the Koala were conducted during the BAR surveys in 2015. During the survey, evidence of the Koala was observed in the form of scats and possible tree scratches. Despite comprehensive searches for Koalas using visual searches and the Spot Assessment Technique (SAT) (10 plots in total – see **Appendix B**), no direct evidence (via sightings or aural recognition of male calls) of the Koala was recorded on the site. The results of the SPOT assessment indicate that Koala activity on the site is low.

A supplementary survey for the Koala was conducted in October 2020. The aim of the survey was to gather additional data on Koala activity and usage of the site, in response to BCD comments on the original BAR. The full report describing the methods and results of the Koala survey is provided in **Appendix H.** Field survey techniques comprised both diurnal RGb-SAT (Regularised Grid-based Spot Assessment Technique, or SAT), with 15 SAT sites sampled, along with two consecutive nights of spotlight searches. Field transects were carried out by Biolink and SLR ecologists.

Evidence of Koalas in the form of diagnostic faecal pellets was recorded at eight of the 15 sampled SAT sites and one individual Koala was recorded during spotlighting. Analysis of SAT data revealed two Koala activity cells adjoining the western edge of the quarry, reaching both the northern and southern boundary of the site, as well as another cell in the western portion of the site. The modelled Koala activity results suggest the site contains 'high use' areas, with one or more resident Koalas within the study area.

The total area of Koala habitat within the development footprint comprises all stands of native forest (ie all PCTs mapped on site), which is estimated to be 39.02 hectares. Based on the current survey results and modelled activity levels, combined with previous Koala survey results, and the widespread occurrence of several Koala feed trees within the forested parts of the site, the site is considered to be habitat for the Koala.

SEPP 44 Koala Habitat Protection

State Environmental Planning Policy No.44 Koala Habitat Protection (SEPP 44) aims to encourage the conservation and management of natural vegetation areas that provide habitat for koalas to ensure permanent free-living populations will be maintained over their present range and to reverse the current trend of koala-population decline. It applies to areas of native vegetation greater than one hectare and in councils listed in Schedule 1 to the SEPP. Port Macquarie LGA is listed in Schedule 1 and the Project site is greater than one hectare. However, the Policy does not apply to Major Projects that are being assessed as State Significant Developments (SSD). Nonetheless, SEPP 44 Koala habitat definitions have been used in this section to determine potential and core Koala habitat areas. Port Macquarie Council koala habitat mapping, in combination with field survey results and vegetation mapping, was also used to identify Koala habitat within the study area.

The forested parts of the site contains two 'feed trees' as listed under Schedule 2 of SEPP 44: Tallowwood *Eucalyptus microcorys* and Small-fruited Grey Gum *E. propinqua*. These trees were found to constitute more than 15 % of the total canopy composition across the site, and accordingly the majority of the forested parts of the site would constitute 'potential Koala habitat' according to Clause 7 of SEPP 44. .

Koala Species Credits In light of the above results, there is requirement for preparation of a species polygon for the Koala according to Section 6.5 of the FBA. The species polygon includes all areas of native vegetation within the development footprint. This includes all patches of native PCTs mapped within the site (**Table 9**), which total 39.02 ha. Hence a species impact area for the Koala of 39.02 ha was entered into the Credit Calculator, generating a requirement for species credits (see credit results in **Section 6.3.2**).

5 Impact Avoidance and Minimisation

This chapter describes the impacts of the proposed development, in accordance with Section 8 of the FBA.

5.1 Impact Avoidance Measures

Hanson has endeavoured to avoid and minimise ecological impacts associated with the Project. This includes investigating the feasibility of using alternative quarry material, sites, extraction boundaries, operating hours and operation, whilst maximising the economic recovery associated with material extraction.

The following measures have been accepted by Hanson and would become commitments under the Project Approval. These measures would be described in a Biodiversity Management Plan for the project.

5.1.1 Extraction boundary

Avoid and minimise disturbance of native vegetations communities including:

- Redesign of pit to avoid or minimise disturbance to high value vegetation (ie threatened ecological communities listed under the BC Act, or 'EEC vegetation'). In this case, the pit layout was modified along its southern boundary to avoid clearing of the existing patch of Subtropical Coastal Floodplain Forest EEC (NR 117).
- Reduction in the development footprint from 60.6 hectares to 57.55 hectares. This area was refined based on geological and ecological constraints.
- The impact area was refined to minimise net impacts on biodiversity values (native vegetation and fauna habitats).

5.1.2 Site Selection

The proponent proposes to extend the life of the existing Sancrox quarry, rather than the opening of a new quarry in a nearby location. The use of the existing site allows for efficient use of existing quarry infrastructure, such as haul roads and shipping facilities; whereas developing an alternative site would require the purchase of additional land, exploration and construction of new quarry infrastructure.

Finding other resources of the same quality and reliability as what currently exists on the subject site is difficult as exploration of the surrounding area has identified only isolated pockets of good quality, consistent resource material located close enough to Port Macquarie as to be financially viable.

Selection of an alternative site for the Project would involve the acquisition of a new and/or 'greenfield' site which, apart from being more expensive than expanding the existing quarry, could potentially cause greater environmental impacts than the current proposal.

5.1.3 Optimising the proposed layout

The location and position of the existing resource within the study area (and current landholding) is such that expansion of the current quarry pit in a westerly direction requires clearing of existing native vegetation that cannot be avoided. The proposed quarry pit layout has been designed, as far as possible, to incorporate land already devoid of vegetation so as to limit the clearing of native vegetation where possible. As a result, 29 % of the development footprint includes cleared areas and areas of non-native vegetation.

Extending the proposed quarry footprint in other directions would not be viable as exploration investigations have only identified pockets of Metamorphic and volcanic rocks. The inconsistency of these pockets and the unknown suitability in hard rock applications make extending the quarry into areas containing these rock types unreliable.

With respect to optimising the layout of the proposed quarry pit, the following is also noted:

- The proposed pit expansion is required to be located adjacent and contiguous with the existing pit and associated infrastructure, due to the location of the geological resource, so there is no real possibility of locating the proposed pit to another location within the site (or beyond the site).
- The western boundary of the quarry has been rationalised (i.e. straightened) and pulled to the east, reducing potential 'edge effects' and ensuring that there is as much vegetation as possible for north-south connectivity for Koala and other fauna to move around the existing and proposed quarry pits.

5.2 Final Development Footprint Areas

The development footprint is defined as "*the area of land that is directly impacted on by a proposed Major Project that is under the EP&A Act, including access roads, and areas used to store construction materials*".

The development footprint includes clearing for the quarry expansion area, and the area designated for relocation of plant and access roads. The final development footprint is shown in **Figure 8** Total impact areas for the various features of the proposed development are included in **Table 18**.

The development footprint is approximately 57.55 ha, comprising 39.02 hectares (68 %) of native vegetation and18.53 ha (32 %) of areas devoid of native vegetation (i.e. areas not requiring further assessment under the FBA) (**Table 18**). The proposed quarry expansion will occur over the entire development footprint.

Table 18 Development Footprint Areas

Feature	Native Vegetation (ha)	Other (ha)#	Total (ha)
Pit footprint (Proposed Quarry Expansion Area)	31.72	9.14	40.86
Supporting infrastructure (administration buildings, plant, stockpiles, access and other ancillary works)	7.30	9.39	16.69
Total Area:	**39.02**	**18.53**	**57.55**

Areas not requiring further assessment (ie devoid of native vegetation)

As noted in **Section 1.3**, the BAR assesses the original proposed quarry footprint area (prior to decreasing the footprint to avoid the mapped flood risk area), and as such the proposed vegetation clearing estimates presented herein are representative of the larger originally proposed quarry footprint. The reduction in the quarry footprint will ultimately reduce vegetation clearing (by around 3.2 hectares).

5.3 Direct Impacts

5.3.1 Overview

According to the FBA, direct impacts on biodiversity values are described as "*an impact on biodiversity values that is a direct result of vegetation clearance from a development. It is predictable, usually occurs at or near to the development site and can be readily identified during the planning, design, construction, and operational phases of a development*."

The final development footprint will involve the following direct impacts:

- clearing of 39.02 ha of native forest vegetation;
- loss of hollow-bearing trees, some of which may provide potential roost sites and breeding habitat for a selection of bird, arboreal mammal, reptile and microchiropteran bat species; and
- removal of foraging habitat for locally occurring native fauna, in particular for threatened microchiropteran bats species, ground mammals, arboreal mammals and a range of bird species.

5.3.2 Impacts on vegetation zones

All native vegetation within the development footprint, which comprises the proposed expansion area and the area designated for relocation of plant, will be removed. Maps showing impacts on native plant communities are therefore equivalent to the PCTs shown in **Figure 7**. Impacts on native vegetation zones are shown in **Figure 8** and described in **Table 19**. The total area of vegetation removal required for construction and operation of the proposal is 39.02 ha, which represents 68 % of the development footprint. These areas of native vegetation will be replaced with permanent infrastructure for the proposed quarry and therefore impacts on native vegetation (and associated habitats) would be permanent (and unavoidable).

Table 19 Native Vegetation Impacts (clearing areas for vegetation zones)

Biometric Code	Vegetation Type Name	Condition	Clearing Area (ha)
NR247	Spotted Gum - Grey Ironbark open forest of the Macleay Valley lowlands of the NSW North Coast Bioregion	Mod/Good	10.83
NR263	Tallowwood - Small-fruited Grey Gum dry grassy open forest of the foothills of the NSW North Coast	Mod/Good	27.10
NR263	Tallowwood - Small-fruited Grey Gum dry grassy open forest of the foothills of the NSW North Coast	Mod/Good_Poor	0.84
NR247	Spotted Gum - Grey Ironbark open forest of the Macleay Valley lowlands of the NSW North Coast Bioregion	Mod/Good_Poor	0.25
		Total	**39.02**

5.4 Indirect Impacts

According to the FBA, indirect impacts on biodiversity values are described as follows:

> *"when development related activities affect threatened species, threatened species habitat, populations or ecological communities in a manner other than direct impact. Compared to direct impacts, indirect impacts often: occur over a wider area than just the site of the development; have a lower intensity of impact in the extent to which they occur compared to direct impacts; occur off site; have a lower predictability of when the impact occurs;* [and] *have unclear boundaries of responsibility."*

Indirect impacts in relation to the proposed development include:

- Potential for sedimentation and run-off to occur during construction and operation of the quarry and associated infrastructure. These are to be managed using appropriate sediment and erosion control measures and in accordance with an engineered stormwater management system (see EIS).
- There is some potential for animal strike (particularly macropods and birds) by increased traffic across the site. The speed limit will be reduced to 40 km/hr along the access road and at these speeds animal strikes are unlikely.
- Deposition of dust on vegetation adjoining the quarry, leading to reduced plant health and foraging quality for local native fauna.
- An increased presence of weeds is a possibility across the site. Weed management is to be integrated into the construction and operational management measures. Vehicle wash down is proposed and implementation of property maintenance will reduce the likelihood of weeds entering retained or adjacent areas of native vegetation.
- Rubbish and pollution may enter the site from staff or during the general day-to-day operation of the facility. To reduce the likelihood of waste entering the environment, all waste materials from the facility are proposed to be collected and transported off site for disposal or distribution. Skip bins will be provided and regularly maintained for other general waste.
- Edge effects, refers to potential reduction in habitat quality and associated adverse effects on flora and fauna along the edges of proposed development, where native vegetation and habitat adjoin development. In the case of Sancrox Quarry, the existing pit has been in place for several years and therefore the adjoining bushland around the perimeter of the pit would already be subject to edge effects. Such effects would theoretically include several of the indirect impacts listed above, including increased prevalence of weeds, increased light (or light spill) in adjoining areas, increased noise levels, and dust deposition on leaves. The proposed quarry expansion will relocate the zone of potential edge effects further west and create a larger total pit area, thereby increasing the perimeter of the edge. However, it is not likely that any theoretical edge effects along this perimeter will be any different to those active at present. Moreover, there was little evidence that any edge effects were active around the edges of the existing pit during field surveys and notably the recent sighting of the Koala was within a few metres of the western margin of the existing pit. It is therefore doubtful that any edge effects, if occurring, are likely to adversely affect local populations of native flora and fauna. Moreover, there are not likely to be any threatened species affected by edge effects, as no such species are likely to be inhabiting the fringes of the proposed pit footprint, or rely on those areas for their breeding or other life cycle processes.

It is noted that the FBA[2] does not contain a method for quantifying indirect impacts. Given the above considerations, the retirement of biodiversity credits to offset any indirect impacts is not warranted. However, suitable mitigation measures to minimise the risk of adverse effects arising from indirect impacts are provided below in **Section 5.5**.

[2] Furthermore, it is noted that the BAM does not determine a credit obligation for indirect impacts.

5.5 On-site Mitigation Measures

5.5.1 General

A selection of best management practices and mitigation measures will be implemented as part of the proposed development to prevent, minimise and/or manage the potential for adverse impacts upon the local environment and surrounding populace. Mitigation measures proposed during the construction and operational phases of the project include:

- A Biodiversity Management Plan (BMP) to be prepared to outline the clearance procedure, protocols for Koala finds and incidents and include an educational brochure for all workers to review prior to working at Sancrox.
- pre-clearance surveys (by qualified ecologist) immediately prior to the removal of any vegetation to give the clearance go ahead.
- Progressive rehabilitation of disturbed areas will be completed using locally indigenous plant species (see **Section 5.5.2**).
- Weed, sediment and erosion control before, during and after construction.
- Environmental management plans will be developed and implemented.
- Ecologist or wildlife /handler rescuer to be present during vegetation clearing to minimise impacts on threatened fauna (including the Koala, if present) displaced or injured during clearing.
- A Biodiversity Offset Strategy (BOS) will be prepared to offset the residual impacts on biodiversity value arising from the Project (see **Section 7.8**).
- Fencing around remnant native vegetation to be retained within the quarry site.
- Speed limits for vehicles within the site (to minimise risk of collisions with native fauna).
- Measures to restrict vehicles to designated haul roads.

A site-specific Operational Environmental Management Plan (EMP) for the proposed quarry to ensure that the commitments made within this EIS, along with relevant statutory obligations and the conditions of development consent (including Environment Protection Licence (EPL) requirements), are fully implemented and complied with.

A Landscaping Strategy will be prepared and implemented to screen the development from neighbouring landholders and generally improve the visual and environmental amenity of the development site.

On-site mitigation measures to reduce direct and indirect impacts include before, during and after construction measures as outlined in **Table 20** below.

Table 20 Mitigation measures to be implements before, during and after construction

Action	Outcome	Timing	Responsibility
Before Construction			
Pre-clearing surveys	Fauna residing within or occupying the expansion area are safely and ethically salvaged and relocated	Prior to tree felling or other related works	Project Ecologist

Action	Outcome	Timing	Responsibility
Protection of native vegetation	Delineate quarry expansion limit (to ensure no native vegetation outside expansion area is cleared)	Prior to and for the duration of any works	Construction contractor
Erosion and sediment control measures	Install and maintain erosion and sediment control measures in accordance with the requirements of the 'Blue Book' (Landcom 2004).	Prior to and for the duration of any works	Construction contractor
During Construction			
Fauna management	Supervision of tree felling to rescue and recover any fauna (as necessary)	During clearing	Project Ecologist
Weed Management	Vehicle wash-down Site weed control program Prepare weed control plan	Prior to and for the duration of any works	Project Ecologist
Rubbish management	Rubbish (such as food scraps and building waste) are to be properly managed during construction and must not be stockpiled on areas of native vegetation	Ongoing	Construction team
Exposed soil surface management	Revegetation – using re-use of topsoil layers and seeding of pasture grasses and legumes (see EIS)	Immediately following soil disturbances	Construction team
Traffic management	Speed limits of 40 km/hr to be imposed within site, reducing the likelihood of animal strikes. Educate workers on possibility of animal strike through construction management program	Ongoing	Construction team
Revegetation	Design and implement planting plan for corridor of native vegetation east and west of proposed quarry pit, to maintain north-south corridor link of canopy trees, as per sub-regional corridor in Greater Sancrox Structure Plan	During construction	Proponent (with Project Ecologist)
Post- Construction			
Traffic management	Speed limits of 40 km/hr are proposed, reducing the likelihood of animal strikes	Ongoing	Site operator
Weed management	Limit spread of weeds along with landscape maintenance program	Ongoing, half-yearly minimum	Site operator
Increased artificial light	Each luminaire will be aimed downwards and only switched on during loading-unloading and servicing activities outside of daylight hours and during heavy fog.	Ongoing	Site operator

Action	Outcome	Timing	Responsibility
Waste management	Appropriate systems will be implemented to ensure that each waste stream generated by the development is effectively managed and/or disposed of off-site (see detail in EIS). There will not be any on-site stockpiling or disposal of waste materials.	Ongoing	Site operator
Rehabilitation (Revegetation)	Maintain and monitor plantings within proposed native vegetation corridors east and west of quarry pit (See below)	Post-construction; operational life of quarry	Proponent (with Project Ecologist)
Surface water and run-off	An engineered surface water drainage and management strategy is to be prepared and implemented. Techniques currently proposed to manage stormwater include bunding walls, swales, underground water capture systems and dams (see EIS)	Ongoing	Site operator

5.5.2 Rehabilitation

Progressive rehabilitation will be a key component of the expansion project and would be undertaken in accordance with an approved Biodiversity and Rehabilitation Management Plan in consultation with DPIE, Local Council, Natural Resource Access Regulator and the Biodiversity Conservation Division, with final approval of the plan subject to review by DPIE.

Hanson's broad objective for progressive and final rehabilitation are to crease a final landform that is suitable for post-quarrying land uses. This includes the following specific objectives:

- To produce a geotechnically stable, safe and non-polluting landform through progressive shaping of the completed areas of the Quarry.
- To provide a landform that is free-draining and has low maintenance requirements.
- To blend the landform with the surrounding landscape through careful selection of species for revegetation.
- To monitor the success of rehabilitation over time to ensure revegetation is not dying back.
- Ensure that the final landform maintains the visual amenity of the locality and, where possible, enhances local biodiversity values.

Final Landuse and Rehab Overview

The primary final land use for the Quarry would be a stable and safe final landform that permits passive biodiversity conservation and maintenance of an established vegetated buffer and amenity barrier to shield views to the final landform. Dams and diversion drain would form a component of this landscape to limit erosion and sediment movement.

To improve visual amenity of the area and to provide use of the area as habitat, Hanson would progressively revegetate completed benches within the Quarry. Most of these rehabilitated areas would support vegetation and fauna habitat for long periods.

Upon cessation of quarrying it is anticipated that all Quarry-related infrastructure would be decommissioned and removed from the site. All waste material would be removed to a licenced landfill.

It is anticipated that progressive rehabilitation would initially focus on the amenity barrier (once constructed). Topsoil would be actively placed on the constructed barrier to support vegetation establishment. The surface would be revegetated with a mix of local native flora.

Terminal benches would be progressively profiled to be geotechnically stable and graded to ensure free drainage away to the sides of the benches. The benches would be then covered with overburden and topsoil and revegetated with local indigenous species suitable for a rocky ledge environment.

Rehabilitation of the Processing Stockpiling Area would first require a contamination assessment focused on fuel storage areas. The final surface would be profiled to drain and would be deep ripped to remove any compacted gravel sheeting. Overburden and topsoil would be applied, and surface would be revegetated with a mix of local native flora.

All redundant roads and tracks will be removed and scarified to a minimum of 75mm depth and prepared for revegetation. The access road may remain open and sealed to provide permanent access to the landform.

Fencing (or a similar barrier) will be erected where necessary to exclude and prohibit unauthorised entry into areas that have been rehabilitated. Signs will be placed in prominent locations to indicate areas that are undergoing rehabilitation.

This will be particularly important at the upper benches of the Quarry where trespassing may result in injury or death.

Revegetation Overview

The Project seeks to recreate native vegetation communities similar to those in the surrounding landscape. It is proposed to match the existing vegetation in both the upper canopy and understorey species. Hanson will seek to achieve a similar percentage of foliage cover, litter depth, microbial activity and ultimately canopy height.

A detailed plan of each stage will be prepared prior to rehabilitation works commencing. Native vegetation will largely be established using direct seeding and from the seed store within respread topsoil. Supplementary native pasture and/or tubestock planting will be undertaken where specific species combinations are required.

Rehabilitation of terminal benches would be undertaken progressively once extraction in that location is complete and the bench is no longer required for access to other part of the Quarry. As the extraction progresses through the resource, 10 m wide benches will be left every 10 m of depth to provide a horizontal platform on which native flora species will be established.

The revegetation program will re-establish native tree, shrub and ground cover and will aim to stabilise reshaped and benched areas. Benches will be treated to actively promote infiltration of water, which will enhance soil moisture requirements for direct tree seeding and minimise surface runoff to underlying benches and the pit floor dirty water control system. Revegetation will also visually screen disturbed areas and will re-establish habitat for native fauna; and Any dead trees will be replaced quickly to keep the overall progress of the re-vegetation maturity on track.

Revegetation methods

Direct seeding (via broadcasting) is preferred over tube stock planting as it enables a far greater success rate, limits the need for ongoing maintenance (e.g. watering) and is the most effective method in achieving a successful rehabilitation outcome. Notwithstanding this, tubestock will be utilised in landscape planting around the Quarry. Not all native trees and shrubs are suited to direct seeding due to their innate germination requirements, therefore, it may be required to supplement with some tubestock to increase biodiversity.

A mixture of native trees and shrubs endemic to the area will be sown onto the majority of the reshaped and benched pit areas following topdressing and site preparation. This tree and shrub seed will complement natural regeneration from seed contained within the soil seed bank. The seed mix used for revegetation of the disturbed quarry area will include some of the major tree and shrub species recorded on site.

Growth rates of between 1m and 2m per year can be initially expected for many of the more dominant trees and shrubs. The correct treatment and application of seed in the appropriate ratios is important in controlling emerging weeds and in allowing the tree stand to develop in a positive direction. The native tree and shrub seed mix will be sown at a suitable combined rate. Seed will be broadcast evenly onto top dressed areas. Care will be taken to ensure it will not be buried.

Seeding will be conducted in late spring, summer and early autumn giving superior results due to higher ground temperatures. Revegetation activities will generally be undertaken in spring and autumn; however opportunistic revegetation will be undertaken if areas become available for sowing in summer or winter. After surface soil amelioration and tillage is completed for any given area, revegetation will commence as soon as practicable. The proposed method of sowing will be via conventional spreading using agricultural broadcasting equipment, or by hand if the terrain is difficult and machinery use is not possible; and slope stabilising techniques such as hydro seeding and straw mulching will be undertaken on slopes exceeding 18 degrees for enhancement of pasture germination.

6 Impact Summary

This chapter describes the impact of the proposed development in terms of biodiversity credits, in accordance with Section 9 of the FBA.

6.1 Areas Not Requiring Further Assessment

Areas that do not require further assessment are those that do not contain native vegetation, as per Section 9.5 of the FBA (unless otherwise required by the SEARs). Of the development site, around 18.53 ha (29%) does not contain native plant communities. These areas, which do not require further assessment (and hence do not require offsets), are shown in **Figure 7** and **Figure 8**.

6.2 Entities Not Requiring Offsets

Impacts for which the assessor is not required to determine an offset (FBA, Section 9.4) comprise:

- Vegetation clearing within a vegetation zone that has a site value score of less than 17 and the PCT is not a TEC;
- Impacts on PCTs that are not threatened species habitat and are not TECs;
- Threatened species habitat within a vegetation zone that has a site value score of <17; and
- Species or populations that are not threatened and do not form part of a TEC.

All vegetation zones mapped and assessed have current site value scores greater than 17 and all zones represent potential threatened species habitat (subject to the findings outlined in **Chapter 4**). Hence, the only entities not requiring offsets are areas of native vegetation that will not be subject to clearing as part of the proposed development.

6.3 Impacts Requiring Offsetting

According to Section 9.3 of the FBA, impacts on native vegetation that require an offset include:

- Impacts on EECs and CEECs, unless specifically nominated in the SEARs as an impact requiring further consideration; and
- impacts on PCTs associated with threatened species habitat and in a vegetation zone that has a site value score of >= 17.

6.3.1 PCTs Requiring Offset

All vegetation zones mapped with the site have current site value scores of over 17 (see **Section 6.5.1**) and represent habitat for at least one threatened species; hence any clearing in these vegetation zones would require an offset. Accordingly, the PCTs within which clearing will occur and which require an offset are:

- Spotted Gum - Grey Ironbark open forest of the Macleay Valley lowlands of the NSW North Coast Bioregion; and
- Tallowwood - Small-fruited Grey Gum dry grassy open forest of the foothills of the NSW North Coast.

The PCTs requiring offset and the corresponding number of ecosystem credits required are listed in **Table 21**. Mapping showing the areas of PCTs and vegetation zones requiring offsetting is presented in **Figure 7** and **Figure 8**, respectively.

Table 21 PCTs requiring offset and credits required

PCT Code	PCT Name#	TEC	Clearing Area (ha)	Credits Required
1215	Spotted Gum - Grey Ironbark open forest of the Macleay Valley lowlands of the NSW North Coast Bioregion (NR247)	No	11.08	505
1262	Tallowwood - Small-fruited Grey Gum dry grassy open forest of the foothills of the NSW North Coast (NR263)	No	27.94	1725
	Total:		**39.02**	**2230**

Based on online NSW BioNet Vegetation Classification Database

Threatened ecological community, as listed under the BC Act

The Credit Report for development impacts is provided in **Appendix I.**

6.3.2 Species Polygons Requiring Offset

A species polygon for one species credit species, the Koala, has been created and species credits calculated in Credit Calculator according to the FBA to offset the loss of habitat for this species. A total of 39.02 ha of Koala habitat will be removed for the project, generating a requirement for 1015 species credits.

As discussed in Chapter 4 of this report, no other individuals or populations of threatened species that generate species credits were recorded within the Development Site. In addition, with regard to species that attract both ecosystem credits and species credits that were candidate species recorded on the site, and the species credit component is associated with breeding habitat for those species (i.e. Grey-headed Flying Fox, Little Bentwing-bat and Eastern Bentwing-bat), no such breeding habitat is present on the site for those species. Hence, the creation of species polygons for such species is not required for this assessment. Hence there are no other species credit polygons that require offset as part of the proposed development.

6.4 Impacts Requiring Further Consideration

In the attachments to the SEARs (see **Appendix A**), OEH identify impacts that require further consideration. OEH states "Impacts on the following species, populations and ecological communities will require further consideration and provision of the information specified in s.9.2 of the Framework for Biodiversity Assessment:

- Biconvex Paperbark *Melaleuca biconvexa*;
- Spider Orchid *Dendrobium melaleucaphilum*; and
- Southern Swamp Orchid *Phaius australis*."

No evidence for these threatened plant species was recorded during field surveys conducted for this BAR. It is noted that targeted searches for threatened plants were conducted across the site on several occasions during 2015 and 2016, including during the known flowering period of the two orchid species and no individuals of these species were recorded. The methods and results of the targeted orchid survey are discussed in the report attached in **Appendix J.**

Section 9.2 of the FBA sets out the information to be included in the BAR on threatened species requiring further assessment. Regardless of the lack of evidence for the above listed species, a brief description of the surveys conducted for these species and their ecology, habitat and distribution is provided below.

6.4.1 Biconvex Paperbark *Melaleuca biconvexa*

The *Melaleuca biconvexa* is a small to medium size shrub that grows up to 10 m tall, occasionally growing as tall as 20 m. It is only found in a limited extent with populations scattered throughout coastal NSW. Swamp, swamp margins and creek edges are essential habitat for *Melaleuca biconvexa* as it generally grows on low lying alluvial soils on sheltered aspects.

The bark of *Melaleuca biconvexa* is typical of the Myrtaceae family. The leaves of the species are distinctive as they are small, 18 mm long and 4 mm wide, and emerge in pair at right angles from the branch. Each leaf has a central vein with the leaf blade curving upwards on either side of the vein.

The species flowers over a four week period in September and October, producing white flowers in dense clusters. The fruits of the species are typically urn shaped and approximately three to five mm in diameter.

BioNet search results have identified numerous records of *Melaleuca biconvexa* approximately four kilometres to the south of the site. No individuals of *Melaleuca biconvexa* have been recorded during any of the surveys conducted on the site to date, despite targeted searches in areas of suitable habitat. Given that this species is not cryptic and can be readily identified via leaf morphology at any time of year, there is a low likelihood that this species occurs on the site.

6.4.2 Spider Orchard *Dendrobium melaleucaphilum*

This section summarises targeted surveys and assessments for threatened orchid species carried out across the Development Site by SLR in October 2015. A copy of the report that documents the methods and results of the survey (SLR 2016) is provided in **Appendix J.**

D. melaleucaphilum (Family Orchidaceae) is an orchid which grows on other plants (i.e. epiphytic) and sometimes on rocks (i.e. epilithic) and occurs in coastal districts and nearby ranges, extending from Queensland to its southern distributional limit in the lower Blue Mountains in New South Wales (NSW). In NSW, it is currently known from seven recent collections (OEH 2012). Stems are spreading to drooping, thin and wiry in the basal half, succulent, swollen and square in cross section in the upper half, tapering towards the tip, rooting only at the base. This species grows frequently as an arboreal epiphyte of *Melaleuca styphelioides*, less commonly on rainforest trees or on rocks. Flowering occurs between July and October. It is listed as 'endangered' under the BC Act, but is not listed under the EPBC Act.

In terms of identification and morphology, *D. melaleucaphilum* is very similar to the closely related *D. tetragonum*, which has dorsal sepals 19 – 30 mm long and labellum only up to 10 mm long. *D. melaleucaphilum* was previously known as the 'large-flowered paperbark form' of *D. tetragonum* (PlantNET 2015a). Hence, these two species cannot, strictly speaking, be distinguished unless in flower.

One orchid specimen with similar characteristics to the Spider Orchid *Dendrobium melaleucaphilum* was recorded growing on the trunk of a Prickly-leaved Paperbark *Melaleuca styphelioides* on the western limit of the proposed quarry expansion area (see **Photo 1**). The identity of the *Dendrobium* was initially uncertain, as the specimen recorded was not in flower at the time of the survey. However, photographic evidence of the orchid collected during flowering in August and September 2016 revealed that the specimen was *Dendrobium gracilicaule* or possibly a hybrid *Dendrobium gracilicaule* x *D. tarberi* (see **Photo 2**). *Dendrobium gracilicaule* or its hybrid forms are not listed as a threatened species in the BC Act or EPBC Act. Hence, no threatened orchids have been recorded on the site as part of the current investigation.

Photo 1 Specimen of *Dendrobium gracilicaule* x *D. tarberi* (post-flowering, October 2015)

Photo 2 Specimen of *Dendrobium gracilicaule* x *D. tarberi* (flowering, September 2016)

BioNet search results have identified one record of *Dendrobium melaleucaphilum* within 10 km of the site. The species has not been recorded within five km of the site.

6.4.3 Southern Swamp Orchid *Phaius australis*

The Southern Swamp-orchid *Phaius australis* (Family Orchidaceae) is a terrestrial (ground dwelling) orchid and produces the largest flowers of any Australian orchid (TSSC 2014). Each plant has 4–8 large, pleated leaves and 1–2 flower stalks. The leaves are long (approx. 70 cm) and narrow, in relation to width (3–10 cm wide). The flowers are red-brown with yellow veins inside the flower and grow in spikes on stalks that are 70–110 cm long (TSSC 2014).

P. australis grows in *Melaleuca quinquenervia* swamps and in sclerophyll forest, on the coast, at or near sea level (PlantNET 2015). It has been reported north from Lake Cathie, but chiefly north from the Evans Head district (PlantNET 2015). OEH (2014) notes that the species “Occurs in Queensland and north-east NSW as far south as Coffs Harbour". Historically, it extended farther south, to Port Macquarie”. On this basis, the site at Sancrox is outside of the range limit of this species.

BioNet search results have identified one record of *P. australis* within 10 km of the site. The species has not been recorded within five kilometres of the site. Potential habitat for *P. australis* occurs within the small patch of Blackbutt-Pink Bloodwood shrubby open forest (NR117) beyond the southern boundary of the Development Site and within stands of swamp forest and paperbark forest within the proposed Offset Site. No individuals were recorded during targeted orchid surveys conducted during the flowering period of this species. Given that the distributional limit of the species doesn’t include the study area at Sancrox and the lack of evidence for the species on the site, there is a low likelihood that this species could potentially occur on the site.

6.4.4 Impacts Requiring Further Consideration – General

There are no other impacts that require further consideration by the consent authority for the proposed development at Sancrox. With reference to the thresholds for such impacts in **Table 4** and Section 9.2 of the FBA:

- There are no significant rivers and streams, important wetlands or estuarine areas within the study area; hence there will be no impacts that substantially reduce the width of the riparian buffer zone of such features;
- There are no State significant biodiversity links within (or adjoining) the study area. Hence, the proposal will have no effect on the movement (of native fauna) along such links (corridors);
- The estimated impacts on native vegetation, as described in **Section 5.3** of this report, are in no way likely to cause the extinction (or significantly reduce the viability) of a threatened ecological community in the Macleay-Hastings IBRA subregion. ;
- There is no critical habitat within the study area;
- There are no threatened species or populations nominated in the SEARs as likely to become extinct (or have their viability reduced significantly) in the IBRA subregion if affected by the development; and
- The predicted impacts of the proposal on native vegetation are not likely to impact on a critically endangered species, or on any species that have not previously been recorded in the IBRA subregion on the *Atlas of NSW Wildlife* database.

6.5 Biodiversity Credit Requirement

The BioBanking Credit Calculator has been used to calculate the impacts of the proposed development and potential offset requirements, in accordance with Section 8 of the FBA. This section of the report provides a summary of the results of the credit calculations. A full copy of the credit profile for the impacts of the proposal is provided in **Appendix I**.

6.5.1 Ecosystem credits

The ecosystem credits required to offset the proposed development are listed by vegetation zone in **Table 22**. A total of 2,230 ecosystem credits would be required to offset the clearing of native vegetation as part of the proposed development. The Credit Calculator identifies matching ecosystem credits (and IBRA subregions) that can be used to offset these impacts (see **Section 6.6**).

Table 22 Vegetation zones requiring offset and credits required

Zone Name	Vegetation type name	Zone area (ha)	Current site value	Future site value	Credits
NR247_Mod-Good	Spotted Gum - Grey Ironbark open forest of the Macleay Valley lowlands of the NSW North Coast Bioregion	10.83	55.21	0	494
NR263_Mod-Good	Tallowwood - Small-fruited Grey Gum dry grassy open forest of the foothills of the NSW North Coast	27.10	78.00	0	1701
NR263_Mod-Good-Poor	Tallowwood - Small-fruited Grey Gum dry grassy open forest of the foothills of the NSW North Coast	0.84	32.89	0	24
NR247_Mod-Good-Poor	Spotted Gum - Grey Ironbark open forest of the Macleay Valley lowlands of the NSW North Coast Bioregion	0.25	51.04	0	11
	Total	**39.02**			**2230**

The ecosystem credit required for offsetting the proposed development is summarised further in **Table 23**.

Table 23 Ecosystem credits required for offsetting the proposed development

Biometric Code	Ecosystem Credit Type	Credits
NR247	Spotted Gum - Grey Ironbark open forest of the Macleay Valley lowlands of the NSW North Coast Bioregion	505
NR263	Tallowwood - Small-fruited Grey Gum dry grassy open forest of the foothills of the NSW North Coast	1725
	Total	**2230**

6.5.2 Landscape Value Score

Landscape score for the Development Site was calculated as described in **Section 2.9**. The loss in landscape value score has been calculated in Credit Calculator as 17, as per the Full Credit Report in **Appendix I**.

6.5.3 Species Credits

The proposed development will require the removal of 39.02 ha of Koala habitat. According to the FBA, this will necessitate the retirement of 1015 species credits to offset the loss of habitat. BioBanking credit reports showing the species credit requirement are provided in **Appendix I.**

No other species polygons are required for impacts on threatened species that attract species credits because either:

- the species credits are associated with breeding habitat that is not present on the site (i.e. in the case of the Grey-headed Flying Fox, Little Bentwing-bat and Eastern Bentwing-bat) and impacts on those species with 'split credits' are addressed through generation of ecosystem credits; or
- the species was not recorded on the site during threatened species surveys and is considered unlikely to occur on other than a transient or temporary basis.

6.6 Biodiversity Credit Report

Copies of the BioBanking credit reports are provided in **Appendix I**. **Table 24** lists the credit types required to offset the proposed development and the matching credits and IBRA subregions that can be used as 'offset options'. Any such credits can only be used as substitutes (or offset options) for credit types required if they belong to an IBRA subregion that adjoins the IBRA subregion in which the development occurs (i.e. Macleay-Hastings IBRA subregion).

Table 24 Ecosystem credits required for offset and matching credit types

Ecosystem Credit Required	No. Credits	Offset Options
Tallowwood Small fruited Grey Gum dry grassy open forest of the foothills of the NSW North Coast, (NR263)	1725	• Tallowwood Small fruited Grey Gum dry grassy open forest of the foothills of the NSW North Coast, (NR263) • Blackbutt Tallowwood dry grassy open forest of the central parts NSW North Coast Bioregion, (NR119) • Blackbutt Turpentine open forest of the foothills of the NSW North Coast Bioregion, (NR124) • Blackbutt grassy open forest of the lower Clarence Valley of the NSW North Coast Bioregion, (NR125) • Brush Box tall moist forest of the northern ranges of the NSW North Coast Bioregion, (NR144) • Red Mahogany open forest of the coastal lowlands of the NSW North Coast Bioregion and northern Sydney Basin Bioregion, (NR222) • Tallowwood dry grassy forest of the far northern ranges of the NSW North Coast Bioregion, (NR267)
Spotted Gum Grey Ironbark open forest of the Macleay Valley lowlands of the NSW North Coast Bioregion, (NR247)	505	• Spotted Gum Grey Ironbark open forest of the Macleay Valley lowlands of the NSW North Coast Bioregion, (NR247)
Total Credits	**2,230**	

7 Biodiversity Offset Strategy

This chapter provides the Biodiversity Offset Strategy, based on outputs of the BioBanking Credit Calculator, in accordance with Section 10 of the FBA.

7.1 Overview

The assessment completed as part of this BAR has determined that a biodiversity offset is required in accordance with the FBA and the *NSW Biodiversity Offsets Policy for Major Projects* (the 'Offsets Policy', NSW Government and OEH 2014).

According to the Offsets Policy, a *Biodiversity Offset Strategy* (BOS) is required to set out how the proponent intends to fulfil the project's offset requirement and is to be submitted to the Department of Planning & Environment with the project application. Offsets are generally required to be secured prior to commencement of construction, although this can be deferred if a Voluntary Planning Agreement (under the EP&A Act) is entered into prior to project approval.

In relation to the SEARs, OEH state that biodiversity offsets for the project should complement offset options discussed in the *Greater Sancrox Draft Structure Plan 2014-2034* for the lands adjacent to the quarry.

7.2 Biodiversity Matters Requiring Offsetting

The offset requirement for the project is described in **Section 6.5**. The following biodiversity credits (as calculated using the FBA) are required to offset the proposed development:

- A total of 2,230 ecosystem credits, with the type and number of required ecosystem credits, and matching credit options, listed in **Table 24**.
- A total of 1,015 Koala species credits.

7.3 Overview of Offset Options

A summary of the available offsetting options, listed in order of priority, for the proposed development at Sancrox are listed in **Table 25**.

According to the Offsets Policy, proponents can meet their offset obligations through one or a combination of the following offset options:

- Like-for-like credit purchase – the proponent purchases the required number and type of BioBanking credits from the BioBanking credit 'market' (publicly available through the BioBanking Credit Register);
- Like-for-like credit creation - the proponent establishes a Stewardship Agreement on their own land, which generates the required credits to fulfil their offset requirement; the proponent retires the required number and type of credits from their own portfolio of credits;
- Variations – where like-for-like offsets are not available, and the proponent can demonstrate that "reasonable steps" have been taken to find a suitable offset, proponents may apply the FBA 'variation rules' (as outlined in Appendix A of the Offsets Policy);
- Rehabilitation of mine sites, which is not relevant to the current project;
- Supplementary measures. Supplementary measures are not preferred by the proponent; and/or

- Payment to Biodiversity Conservation Fund (BCF). Under this scenario, the proponent calculates the equivalent monetary value of their offset credit requirement using the Biodiversity Offsets Payment Calculator and pays this amount into the Fund.

Table 25 Options for Biodiversity Offsets for SSD projects

Offset Option	Offset Options/Comments

Purchase and retire matching (like-for-like) ecosystem credits	• Like-for-like ecosystem credits comprise:
	  • Those of same PCT; or
	  • A PCT from the same vegetation class that has equal or higher percentage cleared value for the CMA;
	• See list of matching credit types in **Table 24**;
	• Number and type of credits must be available on credit register, or will become available prior to construction (or during timeframe specified in in the Conditions of Approval for the SSD project application)

Create ecosystem credits through Stewardship Agreement over Offset Site	• Requires proponent to find suitable properties for sale in the IBRA subregion, purchase property (or properties) and set up Stewardship Agreement (pursuant to BC Act) over the land; • A potential Offset Site under ownership of proponent adjoins the Development Site; • Proposed Offset Site contains one matching ecosystem credit type; • Number and type of species credits in Offset Site not known but can be confirmed through targeted surveys or expert report (optional); • Proponent retires ecosystem credits generated on Offset Site to partially offset current project.
Variation rules - Purchase and retire other credits within same vegetation formation	• Apply variation rules when matching credit types in **Table 24** not available; • Find ecosystem credits for PCTs that fall within same formation, with equal or greater % cleared value.
Supplementary measures	• Apply FBA variation rules • Apply when suitable credits and/or biobank site unavailable or cannot be secured within BOS and construction timeframe
Fund Payment	• Proponent uses BOPC# to calculate monetary value of credits, and then applies to make payment of this amount into Biodiversity Conservation Fund. Confirmation of payment is then used to comply with relevant Condition of Approval for the SSD.

Biodiversity Offsets Payment Calculator, established under the NSW Biodiversity Offsets Scheme pursuant to the NSW *Biodiversity Conservation Act 2016*.

Where the proponent has demonstrated "reasonable steps" have been taken to find a suitable like-for-like offset, but none are available, 'supplementary measures' can be used to fulfil offset obligations. The rules for applying and calculating supplementary measures are provided in Appendix B of the Policy.

With the advent of the BC Act, proponents of SSD applications can now fulfil their biodiversity offset obligations through payment of the equivalent value of the biodiversity credits to the NSW Biodiversity Conservation Fund. This option is discussed further in **Section 7.7**.

A proponent may use a combination of measures to fulfil an offset requirement. All feasible offsetting options, as applicable to the proposed development at Sancrox, have been considered and are discussed in the following sections.

7.4 Like-for-Like Offsets

7.4.1 Purchase Like-for-Like credits

The proponent may choose to purchase and retire some or all of the credits required for offsetting a project from the credit market ('BioBanking Credit Register'). Suitable like-for-like credits types that could be purchased for the Sancrox SSD project are listed in **Table 24.** However, at the time of writing, these credits are not available on the BioBanking Credit Register and no applicable expressions of interest are currently published showing an availability of these credit types within the Northern Rivers IBRA region.

7.4.2 Generate Credits via Stewardship Agreement[3]

The proponent may choose to create a Stewardship Agreement over a portion of land in order to generate biodiversity credits and retire these to fulfil an offset obligation (in part or in full) for an SSD application.

For the proposed development at Sancrox, the proponent owns surplus land adjacent to the Development Site, being the northern portion of Lot 2 (see **Figure 2**), that contains native vegetation, some of which comprises matching ecosystem credit types for those that are to be cleared within the Development Site. The proposed 'Offset Site' is described in **Section 7.8**.

7.5 Apply Variation Rules

In the case where the required credits are not available, and hence a 'like-for-like' offset is not achievable, proponents can apply the variation rules for matching ecosystem credits. However, a hierarchy of options must be followed, with the proponent demonstrating that "all reasonable steps have been taken…to secure a matching ecosystem credit".

The consent authority may approve a variation of the offset rules for matching ecosystem credits, by allowing ecosystem credits created for a PCT from the same vegetation formation as the required ecosystem credit to be proposed as part of the BOS, where in the consent authority's opinion the BOS demonstrates that:

- all "reasonable steps" to secure a matching ecosystem credit have been taken by the proponent, and
- the required ecosystem credit is not for a PCT associated with a CEEC listed on the BC Act or an ecological community listed on the EPBC Act, and
- the PCT from the same vegetation formation has a percent cleared value of the PCT in the major catchment area equal to or greater than the percent cleared of the PCT to which the required ecosystem credit relates, or

[3] Note: this BAR has been prepared according to the FBA, which refers to Biobanking Agreements established under the former NSW *Threatened Species Conservation Act 1995*. References to Biobanking Agreements in this version of the BAR have been replaced with 'Stewardship Agreements' which are established under the BC Act.

- where the required ecosystem credit is for a PCT that is associated with a CEEC/EEC, the PCT from the same formation is also associated with a CEEC/EEC.

"Reasonable steps" to locate like-for-like offsets are listed in Appendix A of the Offset Policy and summarised as follows:

- investigating land already owned by the proponent within the IBRA subregion, whether the development site or other properties;
- liaising with an OEH office and local council to obtain a list of potential sites that meet the requirements for offsetting;
- placing an Expression of Interest for the credits wanted on the BioBanking public register (i.e. the 'Credits Wanted Register') for at least six months, whilst regularly checking the register to see if the required credits have become available;
- considering properties for sale in the "required area" (i.e. within the IBRA subregion); and
- providing evidence of why offset sites are not feasible (e.g. unwillingness of a landowner to sell).

By applying the variation rules, the proponent may purchase and retire ecosystem credits from the same vegetation formation (see **Table 10**), as follows:

- Spotted Gum - Grey Ironbark open forest of the Macleay Valley lowlands of the NSW North Coast Bioregion (NR247), ecosystem credits for PCTs within the 'Dry Sclerophyll Forests' formation, with >35 % cleared value for the CMA.
- Tallowwood - Small-fruited Grey Gum dry grassy open forest of the foothills of the NSW North Coast (NR263), ecosystem credits for PCTs that fall within the 'Dry Sclerophyll Forests' formation, and that have >30% cleared value for the Northern Rivers CMA.

At the time of writing, no ecosystem credits within the vegetation formations listed above are available on the credit register or through the EOI web page. To demonstrate reasonable steps, the proponent should advertise the credit requirement via an Expression of Interest.

7.6 Supplementary Measures

Where a proponent can demonstrate that all reasonable steps have been taken to obtain like-for-like credits or a suitable offset site (as per the steps listed above), they can choose to use 'supplementary measures'. A formula for calculating the monetary contribution of supplementary measures is provided in Appendix B of the Offset Policy. Supplementary measures are not preferred as an offsetting option for the project application.

7.7 Fund Payment

The *Biodiversity Conservation Act 2016* and the *Biodiversity Conservation Regulation 2017* established the Biodiversity Offsets Scheme, which provides a mechanism to avoid, minimise and offset biodiversity impacts through land use planning and during the development assessment process. Under the Scheme, proponents can choose to make payments into the Biodiversity Conservation Fund to discharge an offset obligation, calculated using the Biodiversity Offsets Payment Calculator. The NSW Biodiversity Conservation Trust will then secure the biodiversity offsets.

It is proposed that a Fund payment would be made if the like-for-like or variation credits are not available during, or at the end of, the EOI period.

As the biodiversity credits required for offsetting the project presented herein have been calculated according to the FBA, it will be necessary (following approval of the SSD application) to submit an application to the Biodiversity Conservation Trust to have the credits converted into an equivalent number of BAM credits[4]. Upon receipt of the 'statement of equivalence' from the Trust, the proponent can then apply to the Trust pay the required monetary value into the Biodiversity Conservation Fund.

7.8 Preferred Offsetting Option

7.8.1 Proposed Offset Site – Generate Credits for Offsetting

The proposed Offset Site is the northern portion of Lot DP 574308. The site is located immediately north of the proposed quarry expansion area is approximately 49 ha and occupies low lying land containing swampy vegetation types and open cleared grassland that is used for cattle grazing.

Native Vegetation on the Offset Site

Vegetation mapping for the Port Macquarie-Hastings LGA (Phillips *et al.* 2013) was applied to develop a preliminary vegetation map for the Offset Site. The vegetation types mapped by Phillips *et al.* (2013) within the Offset Site are shown in **Figure 10** and the mapped areas are listed in **Table 26**.

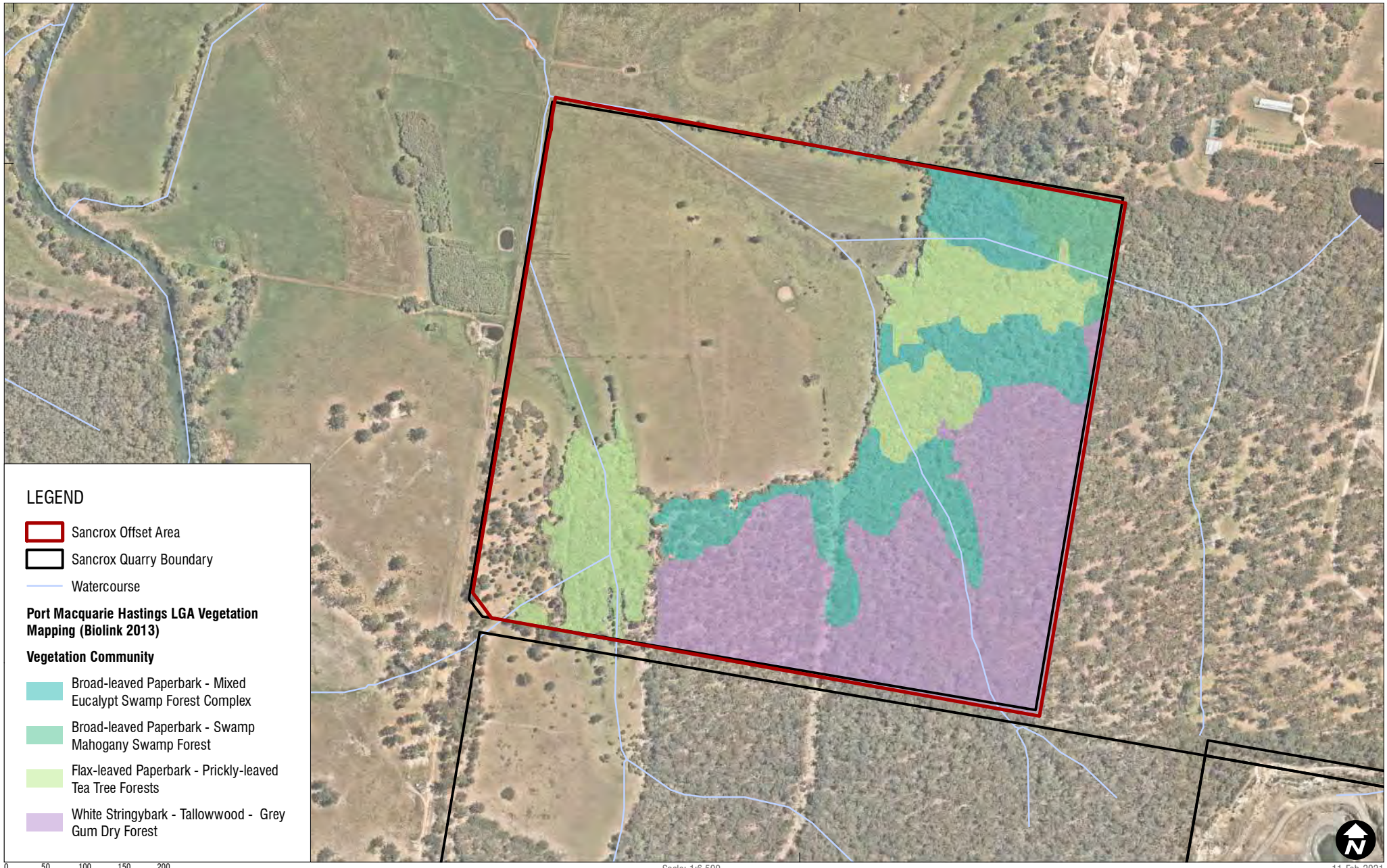
Table 26 Vegetation types mapped within the Offset site

Code	Broad Vegetation Type #	Area (ha)
PMVC_062	Broad-leaved Paperbark – Mixed Eucalypt Swamp Forest Complex	12.3
PMVC_063	Broad-leaved Paperbark – Swamp Mahogany Swamp Forest	1.3
PMVC_037	White Stringybark - Tallowwood - Grey Gum Dry Forest	12.3
PMVC_062	Broad-leaved Paperbark – Mixed Eucalypt Swamp Forest Complex	23.1
	Total	**49**

Source: Phillips *et al.* (2013)

The Council vegetation types were converted into PCTs according to the BioNet Vegetation Classification database. The equivalent PCTs mapped within the Offset Site, including vegetation formation and vegetation class, are listed in **Table 27.**

[4] If a development proponent holds an offset obligation that was calculated using the BioBanking Assessment Methodology (BBAM) or Framework for Biodiversity Assessment (FBA), they will need to seek a 'statement of reasonable equivalence of biodiversity credits' from the Department of Planning, Industry and Environment (DPIE) before paying into the Biodiversity Conservation Fund.



Sheet Size : A4

SLR
www.slrconsultingaustralia.com.au

Data Source: NSW SS 2020
Aerial imagery supplied by Nearmap (November, 2020)

Council Vegetation Mapping within Proposed Offset Area

FIGURE 10

Table 27 PCTs, Formations and Classes Mapped within the Offset Site

Veg Formation	Veg Class	PCT Code	PCT Name	Area (ha)
Forested Wetlands	Coastal Swamp Forests	1064	Paperbark swamp forest of the coastal lowlands of the NSW North Coast Bioregion and Sydney Basin Bioregion	35.4
Forested Wetlands	Coastal Swamp Forests	1230	Swamp Mahogany swamp forest on coastal lowlands of the NSW North Coast Bioregion and northern Sydney Basin Bioregion	1.3
Dry Sclerophyll Forests (grassy)	Hunter-Macleay Dry Sclerophyll Forests	1548	Tallowwood - Small-fruited Grey Gum dry grassy open forest of the foothills of the NSW North Coast	12.3
			Total Area (ha)	**49**

An indicative map of PCTs within the Offset Site is presented in **Figure 11.** It is noted that only one of the PCTs mapped within the Offset Site, *Tallowwood - Small-fruited Grey Gum dry grassy open forest* (NR263), also occurs within the Development Site.

Ecosystem Credits

Based on Council vegetation mapping, vegetation zones have been identified within the Offset Site and are shown in **Figure 12**. A Stewardship Agreement will be placed over the Offset Site to generate part of the credit requirement for the Development. The following tasks were completed to estimate the likely ecosystem credits that would be created in a Stewardship Site:

- Application of the *BioBanking Assessment Methodology 2014* (BBAM 2014; OEH 2014b);
- Landscape value calculations using available vegetation mapping, aerial imagery and GIS techniques, as per the BBAM 2014;
- Calculation of site value score in the Credit Calculator using benchmark data for each PCT (noting that no plot data has been collected from the Offset Site); and
- Assuming standard rehabilitation and site management would be applied, with commensurate uplift in site value score in the Credit Calculator.

The ecosystem credits that have been estimated in the Credit Calculator for the Offset Site are listed in **Table 28**. It should be noted that the ecosystem credit estimates for the Offset Site will need to be re-calculated according to the BAM, including preparation of a Biodiversity Stewardship Site Assessment Report (BSSAR) following approval of the SSD Application to allow creation of a Stewardship Site and the associated credits.

Table 28 Ecosystem Credits potentially created in the Proposed Offset Site

PCT	Biometric Code	Vegetation type name	BBAM Credits Created
1064	NR217	Paperbark swamp forest of the coastal lowlands of the NSW North Coast Bioregion and Sydney Basin Bioregion	353
1230	NR254	Swamp Mahogany swamp forest on coastal lowlands of the NSW North Coast Bioregion and northern Sydney Basin Bioregion	14
1548	NR263	Tallowwood - Small-fruited Grey Gum dry grassy open forest of the foothills of the NSW North Coast	135
		Total	**502**

Species Credits

The three PCTs within the proposed Offset Site (see **Table 27**) all contain Koala feed trees; accordingly the forested parts of the site contains around 26.9 ha of Koala habitat. On this basis, Koala species credits have been calculated for the Offset Site using the BioBanking method, although it is noted that targeted surveys for the Koala have not been conducted as part of this BAR. On this basis, the proposed Offset Site could generate 191 Koala species credits.

Targeted surveys for other threatened species credit species identified in the Credit Calculator have not been completed as part of this BAR, but would be considered as part of a future application for a Stewardship Agreement.

7.8.2 Offset Strategy Proposed

The preferred offsetting option for the proposed development is a combination of Options 1a and 1b, being:

Ecosystem credits:

- Generate available ecosystem credits from the proposed Offset Site – create a Stewardship Agreement under the BC Act. This action will only provide some of the ecosystem credits required, as per **Table 29**.
- Purchase like-for-like ecosystem credits from Credit Register (or approach potential credit sellers through the Expressions of Interest register).
- Purchase 'variation credits' by applying the variation rules under the FBA, in the scenario that like-for-like credit cannot be found after completing "reasonable steps". In this regard, an Expression of Interest for the required ecosystem credits will be published on the OEH BioBanking 'Credits Wanted' register.
- Pay the monetary of the remaining credit obligation into the BCF.

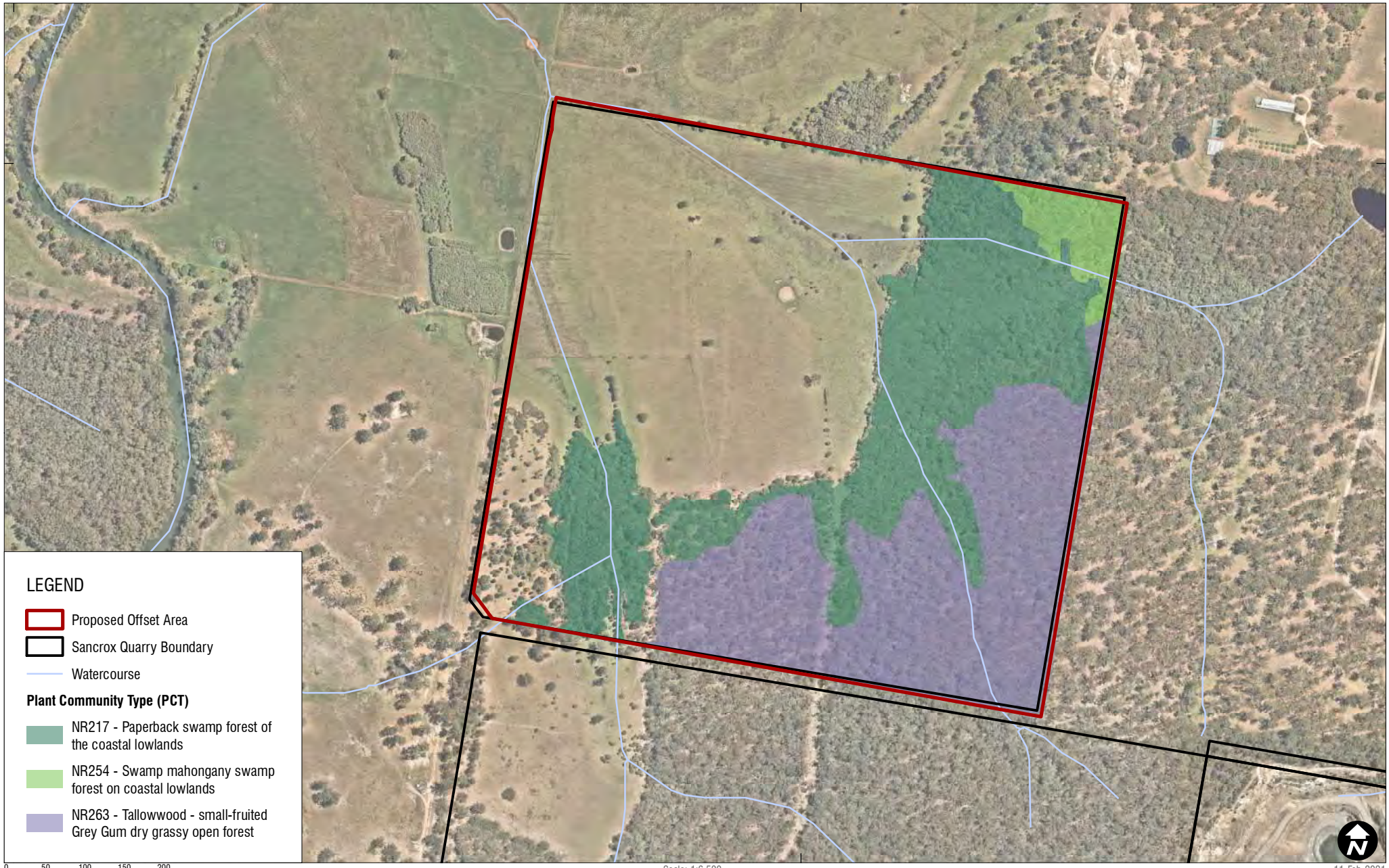
Species credits:

- Generate available Koala species credits from the proposed Offset Site by establishing a Stewardship Agreement under the BC Act. This action will provide some of the species credits required, as per **Table 29**.
- Purchase Koala species credits from the BioBanking or BAM credit registers; and/or:

- Pay the equivalent monetary value (as calculated using the BOPC[5]) into the Biodiversity Conservation Fund

Under the NSW Biodiversity Offsets Scheme (BOS), development proponents may choose to pay into the Biodiversity Conservation Fund as an alternative to retiring biodiversity credits to meet their project offset obligation.

[5] Biodiversity Offsets Payment Calculator



Sheet Size : A4

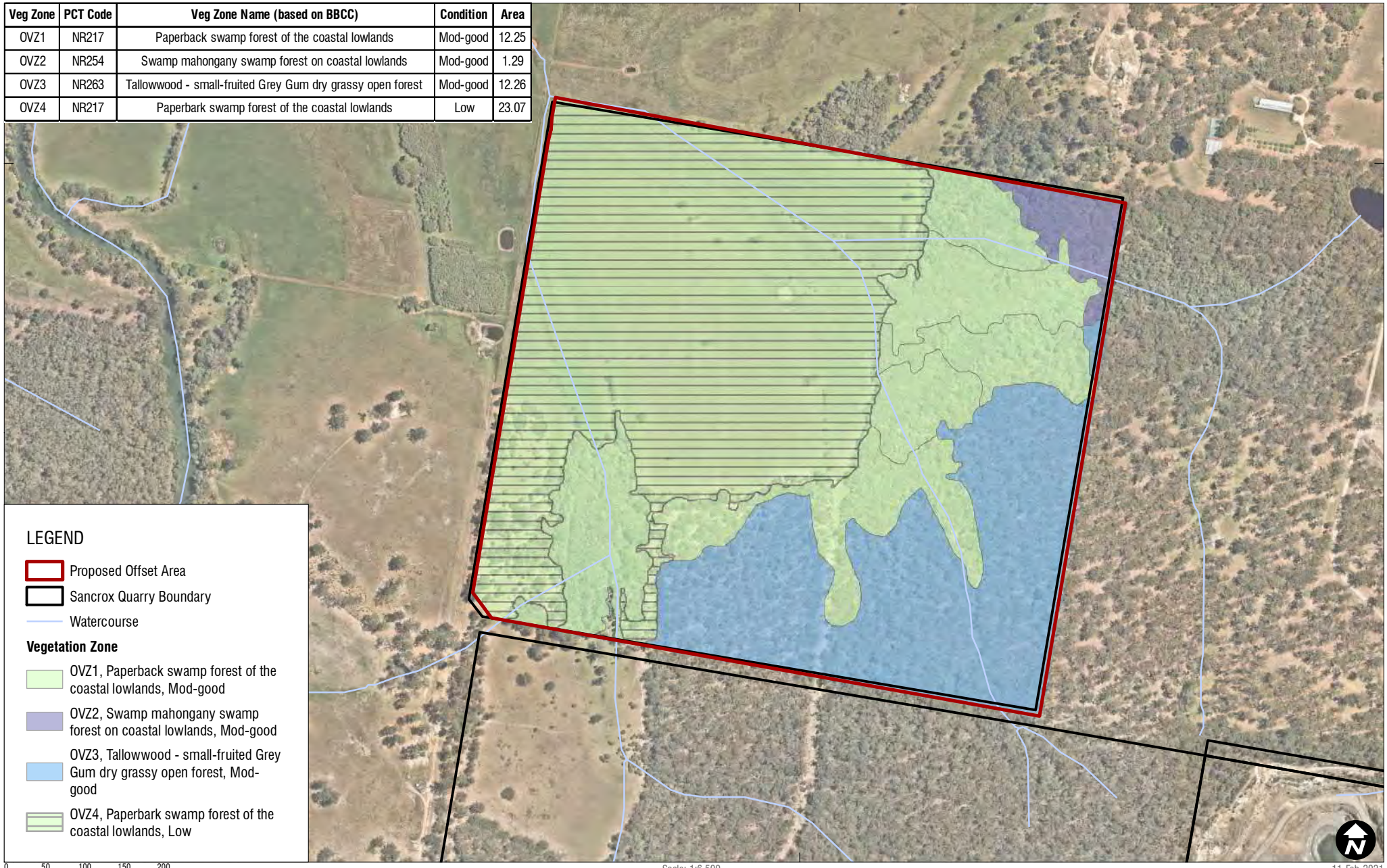
SLR
www.slrconsultingaustralia.com.au

Data Source: NSW SS 2020
Aerial imagery supplied by Nearmap (November, 2020)

Plant Community Types (PCTs) - Within Proposed Offset Area

FIGURE 11

Veg Zone	PCT Code	Veg Zone Name (based on BBCC)	Condition	Area
OVZ1	NR217	Paperback swamp forest of the coastal lowlands	Mod-good	12.25
OVZ2	NR254	Swamp mahongany swamp forest on coastal lowlands	Mod-good	1.29
OVZ3	NR263	Tallowwood - small-fruited Grey Gum dry grassy open forest	Mod-good	12.26
OVZ4	NR217	Paperbark swamp forest of the coastal lowlands	Low	23.07



Scale: 1:6,500
GDA 1994 MGA Zone 56

11-Feb-2021
630.11478

H:\Projects-SLR\660-SrvWOL\630-NTL\630.11478 Sancrox Quarry Expansion\ArcGIS\Biodiversity Assessment Report\SLR63011478_F12_ VegZones_OffsetArea_02.mxd

Sheet Size : A4

SLR
www.slrconsultingaustralia.com.au

Data Source: NSW SS 2020
Aerial imagery supplied by Nearmap (November, 2020)

Vegetation Zones - Within Proposed Offset Area

FIGURE 12

A comparison of the ecosystem credits required for offsetting the proposed development and those potentially available in the Offset Site is provided in **Table 29** .

Table 29 Biodiversity Credit Balance – Credits Required vs Credits Generated in Offset

Biometric Code	Vegetation Type Name	FBA Credits Required	Credits in Offset	Remaining Credits to Purchase
NR247	Spotted Gum - Grey Ironbark open forest of the Macleay Valley lowlands of the NSW North Coast Bioregion	505	0	505
NR263	Tallowwood - Small-fruited Grey Gum dry grassy open forest of the foothills of the NSW North Coast	1725	135	1590
NR254	Swamp Mahogany swamp forest on coastal lowlands of the NSW North Coast Bioregion and northern Sydney Basin Bioregion	0	14	0
NR217	Paperbark swamp forest of the coastal lowlands of the NSW North Coast Bioregion and Sydney Basin Bioregion	0	353	0
	Koala Species Credits	1,015	191	824

The ecosystem credits that form the offset obligation for the proposed development, as listed in **Table 29**, would either be sourced from the Offset Site and/or purchased from the BioBanking Credit Register (if available), with remainder converted into a monetary value using the BOPC and that value paid into the Biodiversity Conservation Fund. As the number and type of credits that will be available for purchase from the credit register following development approval is not known, the final payment into the Fund will be determined at the completion of the EOI period.

A total of 1,015 Koala species credits are required for offsetting the proposed development, and around 191 could be generated in the Offset Site. This would leave a balance of 824 species credits still required to be purchased (and retired) or an equivalent BCF payment (**Table 29**).

It is important to note that targeted threatened species surveys have not been conducted in the proposed Offset Site; however, given the habitats and vegetation type present, it is likely that one or more threatened species could be present. Hence, the Offset Site is likely to generate the some species credit types, although this will need to be confirmed through targeted surveys (during the appropriate season) as part of any future Stewardship Agreement application. For the purposes of this BOS, the number of species credits available in the Offset Site is presumed to be zero.

An Expression of Interest (EOI), listing the biodiversity credits required for offsetting the proposed development, will be published prior to finalisation of the BAR to commence the process of obtaining the required like-for-like credits. At the completion of the six month exhibition period, the proponent will have completed the 'reasonable steps' and may choose to seek other credit types under the variation rules.

7.8.3 Offset Strategy Actions

Actions proposed to fulfil the offset requirement for the project will involve:

- Subject to receipt of Minister's Conditions of Approval, apply to the Biodiversity Conservation Trust to have the ecosystem credits presented in this BAR converted into an equivalent number of BAM credits;
- Uploading an EOI for the required biodiversity credits on the 'Credit Wanted' register of the BioBanking Credit Register;

- Monitor the availability of matching ecosystem credits during the six month advertisement period (as required by OEH), including regularly checking the credit register for credits that match the required type and number of credits for the project (**Table 24**);
- During, or at the end of, the advertisement (EOI) period, either:
  - Purchase like-for-like credits or if not available purchase variation credits; if neither like-for-like nor variation credit types available, then:
  - pay fund deposit into Biodiversity Conservation Fund (calculated using BOPC).

8 EPBC ACT Matters

This chapter identifies matters of national environmental significance listed under the EPBC Act that are of potential relevance to the proposed development.

8.1 Predicted Matters of NES

The PMST database provides an indicative list of matters of national environmental significance (matters of NES) listed under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). A copy of the PMST results is provided in **Appendix K**. The PMST results indicate the following matters (and/or or their habitats) are either present or are predicted to occur within the locality:

- 62 threatened species;
- 56 listed migratory species;
- three listed threatened ecological communities; and
- no wetlands of international importance (Ramsar Wetlands).

Of the above listed matters of NES that are predicted to occur within the locality of the site, those of potential relevance to the site and the proposed development are discussed in the following sections.

8.2 Relevant Matters of NES

8.2.1 Listed Threatened Species

The 62 threatened species (and/or their habitats) listed under the EPBC Act that are predicted to occur within the locality comprise 29 bird species, one fish species, eight mammal species, five reptile species, three amphibian, one insect and 15 plant species (**Appendix K**). These species and their legal status within NSW and at a national level are listed in **Table 30**.

Table 30 PMST Results – Listed Threatened Species

Common Name	Scientific Name	EPBC Act Listing	BC Act Listing
Regent Honeyeater	*Anthochaera phrygia*	Critically Endangered	Critically Endangered
Australasian Bittern	*Botaurus poiciloptilus*	Endangered	Endangered
Red Knot, Knot	*Calidris canutus*	Endangered	Not Listed
Curlew Sandpiper	*Calidris ferruginea*	Critically Endangered	Endangered
Lesser Sand Plover, Mongolian Plover	*Charadrius mongolus*	Endangered	Vulnerable
Eastern Bristlebird	*Dasyornis brachypterus*	Endangered	Endangered
Antipodean Albatross	*Diomedea antipodensis*	Vulnerable	Vulnerable
Gibson's Albatross	*Diomedea antipodensis gibsonii*	Vulnerable	Vulnerable
Southern Royal Albatross	*Diomedea epomophora (sensu stricto)*	Vulnerable	Not Listed
Wandering Albatross	*Diomedea exulans (sensu lato)*	Vulnerable	Endangered
Northern Royal Albatross	*Diomedea sanfordi*	Endangered	Not Listed

Common Name	Scientific Name	EPBC Act Listing	BC Act Listing
Red Goshawk	*Erythrotriorchis radiatus*	Vulnerable	Critically Endangered
Painted Honeyeater	*Grantiella picta*	Vulnerable	Vulnerable
Swift Parrot	*Lathamus discolor*	Critically Endangered	Endangered
Bar-tailed Godwit (baueri), Western Alaskan Bar-tailed Godwit	*Limosa lapponica baueri*	Vulnerable	Not Listed
Northern Siberian Bar-tailed Godwit, Bar-tailed Godwit)	*Limosa lapponica menzbieri*	Critically Endangered	Not Listed
Southern Giant-Petrel, Southern Giant Petrel	*Macronectes giganteus*	Endangered	Endangered
Northern Giant Petrel	*Macronectes halli*	Vulnerable	Vulnerable
Eastern Curlew, Far Eastern Curlew	*Numenius madagascariensis*	Critically Endangered	Not Listed
Fairy Prion (southern)	*Pachyptila turtur subantarctica*	Vulnerable	Not Listed
Australian Painted Snipe	*Rostratula australis*	Endangered	Endangered
Buller's Albatross, Pacific Albatross	*Thalassarche bulleri*	Vulnerable	Not Listed
Northern Buller's Albatross, Pacific Albatross	*Thalassarche bulleri platei*	Vulnerable	Not Listed
Shy Albatross, Tasmanian Shy Albatross	*Thalassarche cauta cauta*	Vulnerable	Vulnerable
White-capped Albatross	*Thalassarche cauta steadi*	Vulnerable	Not Listed
Chatham Albatross	*Thalassarche eremita*	Endangered	Not Listed
Campbell Albatross, Campbell Black-browed Albatross	*Thalassarche impavida*	Vulnerable	Not Listed
Black-browed Albatross	*Thalassarche melanophris*	Vulnerable	Vulnerable
Salvin's Albatross	*Thalassarche salvini*	Vulnerable	Not Listed
Black Rockcod, Black Cod, Saddled Rockcod	*Epinephelus daemelii*	Vulnerable	Not Listed
Green and Golden Bell Frog	*Litoria aurea*	Vulnerable	Endangered
Stuttering Frog, Southern Barred Frog	*Mixophyes balbus*	Vulnerable	Endangered
Giant Barred Frog, Southern Barred Frog	*Mixophyes iteratus*	Endangered	Endangered
Australian Fritillary	*Argynnis hyperbius inconstans*	Critically Endangered	Endangered
Large-eared Pied Bat, Large Pied Bat	*Chalinolobus dwyeri*	Vulnerable	Vulnerable
Spot-tailed Quoll, Spotted-tail Quoll, Tiger Quoll (southeastern mainland population)	*Dasyurus maculatus maculatus* (SE mainland population)	Endangered	Vulnerable
Greater Glider	*Petauroides volans*	Vulnerable	Not Listed
Brush-tailed Rock-wallaby	*Petrogale penicillata*	Vulnerable	Endangered

Common Name	Scientific Name	EPBC Act Listing	BC Act Listing
Koala (combined populations of Queensland, New South Wales and the Australian Capital Territory)	*Phascolarctos cinereus* (combined populations of Qld, NSW and the ACT)	Vulnerable	Vulnerable
Long-nosed Potoroo (SE mainland)	*Potorous tridactylus tridactylus*	Vulnerable	Vulnerable
New Holland Mouse, Pookila	*Pseudomys novaehollandiae*	Vulnerable	Not Listed
Grey-headed Flying-fox	*Pteropus poliocephalus*	Vulnerable	Vulnerable
Scented Acronychia	*Acronychia littoralis*	Endangered	Endangered
Dwarf Heath Casuarina	*Allocasuarina defungens*	Endangered	Endangered
	Allocasuarina thalassoscopica	Endangered	Not Listed
Hairy-joint Grass	*Arthraxon hispidus*	Vulnerable	Vulnerable
Trailing Woodruff	*Asperula asthenes*	Vulnerable	Vulnerable
Leafless Tongue-orchid	*Cryptostylis hunteriana*	Vulnerable	Vulnerable
White-flowered Wax Plant	*Cynanchum elegans*	Endangered	Endangered
	Euphrasia arguta	Critically Endangered	Critically Endangered
	Hakea archaeoides	Vulnerable	Vulnerable
Macadamia Nut	*Macadamia integrifolia*	Vulnerable	Not Listed
Biconvex Paperbark	*Melaleuca biconvexa*	Vulnerable	Vulnerable
Milky Silkpod	*Parsonsia dorrigoensis*	Endangered	Vulnerable
Lesser Swamp-orchid	*Phaius australis*	Endangered	Endangered
Magenta Lilly Pilly	*Syzygium paniculatum*	Vulnerable	Endangered
Austral Toadflax	*Thesium australe*	Vulnerable	Vulnerable
Loggerhead Turtle	*Caretta caretta*	Endangered	Endangered
Green Turtle	*Chelonia mydas*	Vulnerable	Vulnerable
Leatherback Turtle	*Dermochelys coriacea*	Endangered	Endangered
Hawksbill Turtle	*Eretmochelys imbricata*	Vulnerable	Not Listed
Flatback Turtle	*Natator depressus*	Vulnerable	Not Listed

Most of the species listed in **Table 30** are also listed under the BC Act and therefore are considered in Chapter 4 of this report, as well as in the likelihood of occurrence table in **Appendix G**.

Many of the EPBC Act listed species in **Table 30** are marine birds (21) or marine reptiles (i.e. five turtles). Being located inland from the coast, the site at Sancrox is of no relevance to marine species. The single threatened fish species, the Black Rockcod, is a marine species that occurs in rocky reef and inshore areas along the NSW coast. It is therefore not relevant to the site at Sancrox.

With regard to the EPBC Act listed threatened species that are not predicted to occur in the Credit Calculator or the NSW Wildlife Atlas:

- They are not predicted to occur in the Credit Calculator and therefore not likely to occur (i.e. suitable vegetation or habitat features is not present or their distributional range lies outside of the IBRA subregion); or

- They have not been recorded on the Wildlife Atlas within the locality.

The study area contains suitable foraging habitat for the Swift Parrot and Regent Honeyeater, in the form of winter flowering gums, such as Spotted Gum and Swamp Mahogany (which occurs in the Offset Site). Both species breed elsewhere in Australia (the Swift Parrot in Tasmania and the Regent Honeyeater in certain parts of central NSW) but migrate to coastal NSW during winter to feed on winter-flowering tree species. Accordingly, individual Regent Honeyeaters and Swift Parrots may utilise the site for foraging purposes seasonally during winter, although the site would not form a large or important area of winter forage for these species. As the Swift Parrot breeds in Tasmania and the Regent Honeyeater breeds elsewhere in NSW, the Development Site does not contain breeding habitat for these two species.

Similarly, the forest habitat across the Development Site represents potential foraging habitat for the Grey-headed Flying Fox, Spotted-tail Quoll, Koala, Greater Glider, Large-eared Pied Bat, Painted Honeyeater and Long-nosed Potoroo. These species are addressed in Chapter 4.

8.2.2 Listed Threatened Communities

The listed threatened communities that have been recorded or are predicted to occur within the locality (**Appendix K**) include:

- Coastal Swamp Oak (*Casuarina glauca*) Forest of New South Wales and South East Queensland ecological community;
- Lowland Rainforest of Subtropical Australia; and
- Subtropical and Temperate Coastal Saltmarsh;

None of these listed threatened communities is present within the study area.

8.2.3 Wetlands of National Significance

No Wetlands of International Importance or of National Significance were identified within the 10 km radius of the study area.

8.2.4 Migratory species

A total of 56 migratory species (and/or their habitats) are predicted to occur within the locality, 22 of which are wetland species (**Appendix K**). A total of 18 migratory marine birds are predicted to occur within the locality as well as 10 migratory marine species. The remaining six species are terrestrial and include the White-throated Needletail, Satin Flycatcher, Oriental Cuckoo, Black-faced Monarch, Spectacled Monarch and Rufous Fantail.

The study area does not contain suitable habitat for the listed wetland species, with the exception that large or sustained rainfall events could create periodic and temporary soaks or ponds within the low lying parts of the Development Site. Regardless of this, due to their large ranges, such species would not be dependent on the study area (if they use it at all) for foraging, breeding or other life cycle processes.

The terrestrial species all occupy a large variety of habitats and similarly have very large ranges. The vegetation within the study area does not constitute 'important habitat' for such species, as defined by DoE (2013), most of which utilise more intact and structurally complex woodlands.

The study area does not contain suitable habitat for the listed marine species. The only open water within the subject area is a retention dam which does not provide suitable habitat for the listed species. The site contains only relatively small first order steams which traverse the site. These watercourses do not provide suitable habitat or foraging area for the listed species.

8.3 Impacts on Relevant Matter of NES

8.3.1 Listed Threatened Species

The threatened species identified in **Section 8.2** have been considered in accordance with the 'significant impact criteria' for 'vulnerable' and 'endangered' species in the *Significant Impact Guidelines 1.1* (DoE 2013).

Taking into consideration all stages and components of the proposal, and all related activities and infrastructure, there is the potential for impacts, including indirect impacts, on matters of national environmental significance, being mainly loss of a potential foraging habitat for mobile threatened fauna species, including birds, bats and mammals. However, it is highly unlikely that any of such species will be adversely impacted by the proposal, because:

- suitable breeding habitat for most of the species is absent within the study area. For those species that have either been recorded or could utilise the habitats within the study area, there are not likely to be local populations present wholly within the study area or reliant on the study area for their survival in isolation. Any such populations present within the locality will not be rendered locally extinct by the proposed development. This is based on the large ranges of these species, the poor quality and condition of the habitats present within the study area.
- the study area is not assessed as likely to contain habitat critical to the survival of a species;
- the study area is not likely to support an 'important population' (as defined by DoE 2015) of any threatened species; and
- the proposed mitigation measures (see **Section 5.5**) will mitigate or reduce impacts on threatened species.

With reference to the criteria for vulnerable and endangered species, the proposal is not likely to:

- lead to a long-term decrease in the size of an important population of a species;
- reduce the area of occupancy of an important population;
- fragment an existing important population into two or more populations;
- adversely affect habitat critical to the survival of a species;
- disrupt the breeding cycle of an important population;
- modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that a species is likely to decline;
- result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat;
- introduce disease that may cause a species to decline; or
- interfere substantially with the recovery of any of these species.

8.3.2 Migratory species

The study area contains no habitat for the 22 listed migratory wetland species and only marginal habitat for the six listed terrestrial migratory species predicted to occur in the locality (**Appendix K)**.

In regard to the terrestrial migratory species, the forested and open areas of the site represent potential foraging habitat. It is theoretically possible that these highly mobile species could utilise the subject temporarily during foraging, dispersal or migration. Conversely, the study area constitutes only a relatively small proportion of the large ranges of these species and does not contain breeding habitat for these species.

With reference to the criteria for migratory species in the *Significant Impact Guidelines 1.1*, the study area does not contain an area of 'important habitat' for any migratory species. Furthermore, the proposal is highly unlikely to disrupt the lifecycle (breeding, feeding, migration or resting behaviour) of an ecologically significant proportion of the population of a migratory species. Hence the proposal is not likely to have a significant impact on any listed migratory species under the EPBC Act.

9 References

Bishop, T (2000) *Field Guide to the Orchids of New South Wales and Victoria*. UNSW Press Sydney.

BoM. 2015. GDE Atlas. Available at: http://www.bom.gov.au/water/groundwater/gde/index.shtml (viewed March 2015)

DECCW. 2002. Descriptions for NSW (Mitchell) Landscapes Version 2 (2002). NSW Department of Environment, Climate Change and Water, Sydney.

DPIE. 2021. *Northern Hinterland Wet Sclerophyll Forest*. url: https://www.environment.nsw.gov.au/threatenedspeciesapp/VegClass.aspx?vegClassName=Northern%20Hinterland%20Wet%20Sclerophyll%20Forests, accessed 08/02/2021

DoE (2013) *Draft Survey Guidelines for Australia's Threatened Orchids. Guidelines for detecting Orchids listed as 'Threatened' under the Environment Protection and Biodiversity Conservation Act 1999*. Department of the Environment, Canberra, ACT.

DoE. 2013. *Matters of National Environmental Significance. Significant impact guidelines 1.1. Environment Protection and Biodiversity Conservation Act 1999*. Department of the Environment, Canberra, ACT.

DoP. 2009. *Mid North Coast Regional Strategy*. Department of Planning, Canberra, ACT.

Griffith, S. J. 1993. *Conservation status of coastal plant communities in northern New South Wales*. NPWS, Sydney.

Hager, T. and Benson, J.S. (1996) Review of the conservation status of vegetation communities in New South Wales – Part 3. Assessment of the conservation status of Forest Plant Communities in Northern New South Wales. Final report to the Australian Heritage Commission (NPWS), Sydney.

Hanson. 2015. *Sancrox Quarry Expansion Project. Preliminary Environmental Impact Statement.* , Hanson Heidelberg Cement Group, Sydney.

Jones, D. and B. (2000*) A Field Guide to the Native Orchids of Southern Australia*. Bloomings Books, Hawthorn, Vic.

NSW Government and OEH. 2014a. Framework *for Biodiversity Assessment. NSW Biodiversity Offsets Policy for Major Projects.* NSW Office of Environment and Heritage, Sydney.

NSW Government and OEH. 2014b. NSW *Biodiversity Offsets Policy for Major Projects.* NSW Office of Environment and Heritage, Sydney.

OEH, Threatened Species Profiles http://www.environment.nsw.gov.au/threatenedspeciesapp/VegClass.aspx?vegClassName=Coastal%20Floodplain%20Wetlands

OEH. 2017a. Coastal Floodplain Wetlands. Web site accessed 27 June 2017. http://www.environment.nsw.gov.au/threatenedspeciesapp/VegClass.aspx?vegClassName=Coastal%20Floodplain%20Wetlands.

OEH. 2017b. Hunter-Macleay Dry Sclerophyll Forests. Web site accessed 27 June 2017. http://www.environment.nsw.gov.au/threatenedspeciesapp/VegClass.aspx?vegClassName=Coastal%20Floodplain%20Wetlands.

OEH. 2016. North Coast Bioregion (In) NSW - the bioregional landscape. http://www.environment.nsw.gov.au/bioregions/NSWNorthCoastBioregion.htm.

OEH. 2014a. *Southern Swamp Orchid – profile*. NSW Office of Environment and Heritage, Sydney. Available at: http://www.environment.nsw.gov.au/threatenedSpeciesApp/profile.aspx?id=10610.

OEH. 2014b. BioBanking *Assessment Methodology 2014*. NSW Office of Environment and Heritage, Sydney.

OEH. 2012. *Spider orchid – profile*. NSW Office of Environment and Heritage, Sydney. Available at: http://www.environment.nsw.gov.au/threatenedSpeciesApp/profile.aspx?id=10213.

OEH. 2012. *Subtropical Coastal Floodplain Forest of the New South Wales North Coast Bioregion – profile*. . NSW Office of Environment and Heritage, Sydney.

OEH. 2011. North Coast Bioregion (In) Bioregions of NSW. http://www.environment.nsw.gov.au/bioregions/Bioregions.htm. NSW Office of Environment and Heritage, Sydney.

Phillips, S., Chang, M., and Kordas, G. 2013. *Vegetation of the Port Macquarie Hastings Local Government Area Version 1.08*. Report to Port Macquarie Hastings Council. Biolink Ecological Consultants, Uki. NSW.

Phillips, S. and Hopkins, M. 2011. *Greater Sancrox Ecological Assessment.* Report to Port Macquarie Hastings Council. Biolink Ecological Consultants, Uki. NSW.

PMHC. 2015. *Greater Sancrox Structure Plan 2014-2034*. Port Macquarie-Hastings Council, Port Macquarie.

PMHC. 2017. *Port Macquarie Hastings Urban Growth Management Strategy 2017-2036*. Port Macquarie-Hastings Council, Port Macquarie.

PlantNET. 2015a. *New South Wales Flora Online. Dendrobium melaleucaphilum. M.A. Clem. & D.L. Jones*. PlantNET (The NSW Plant Information Network System). Royal Botanic Gardens and Domain Trust, Sydney. http://plantnet.rbgsyd.nsw.gov.au [accessed 5 November 2015].

PlantNET. 2015b. *New South Wales Flora Online. Phaius australis.* F. Muell. PlantNET (The NSW Plant Information Network System). Royal Botanic Gardens and Domain Trust, Sydney. http://plantnet.rbgsyd.nsw.gov.au [accessed 5 November 2015]

Specht R.L. *et al.* 1995. *Conservation Atlas of Plant Communities in Australia*. Centre for Coastal Management, Southern Cross University Press, Lismore

TSSC. 2014. Approved Conservation Advice for *Phaius australis* (Common Swamp-orchid). (s266B of the *Environment Protection and Biodiversity Conservation Act 1999*). Threatened Species Scientific Committee, Canberra. Available at: http://www.environment.gov.au/cgibin/sprat/public/publicspecies.pl?taxon_id=5872.

APPENDIX A

SEARS (Biodiversity)

Planning Services
Resource Assessments
Contact: Anthony Barnes
Phone: 8289 6709
Email: anthony.barnes@planning.nsw.gov.au

Matt Errington
Principal Environmental Consultant
Environmental Resources Management Australia
Locked Bag 3012 Australia Square
NSW 1215

Dear Mr Errington

Reissue of State Significant Development - Secretary's Requirements
Sancrox Quarry Extension Project (SSD 7293)

I have enclosed updated Secretary's requirements for the preparation of an Environmental Impact Statement (EIS) for the Sancrox Quarry Extension Project which replace the Secretary's requirements issued on 19 October 2015.

These requirements are based on the information you have previously provided, and reflect previous consultation with relevant government agencies.

Your attention is drawn to the environmental planning instruments (EPI), policies and guidelines to be addressed in your EIS (see Attachment 1). Please note that where these EPIs, guidelines and policies have changed or been updated, your EIS will need to address the latest available version.

The agencies' previous comments are attached for your information (see Attachment 2). You must have regard to these comments in the preparation of the EIS.

Please note that the Department may alter these requirements at any time, and that you must consult further with the Department if you do not lodge a development application and EIS for the project within the next two years.

You should establish whether the proposal requires a separate approval under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) as soon as possible. If such an approval is required, please notify the Department immediately, as the Commonwealth approval process is likely to be integrated with the NSW approval process (under the bilateral agreement), and supplementary requirements will need to be issued.

Please contact the Department at least two weeks before you plan to submit the development application and EIS for the project. This will enable the Department to:

- confirm the applicable fee (see Division 1AA, Part 15 of the *Environmental Planning and Assessment Regulation 2000*); and
- determine the required number of copies of the EIS (hard copy and digital).

It is important for you to recognise that the Department will review the EIS for the project carefully before putting it on public exhibition. If it fails to adequately address these requirements, then you will be required to submit an amended EIS.

If you have any enquiries about these requirements, please contact Anthony Barnes on the details listed above.

Yours sincerely

Howard Reed

Howard Reed 18.9.17
Director
Resource Assessments
as the Secretary's delegate

Secretary's Environmental Assessment Requirements

State Significant Development

Section 78A(8A) of the *Environmental Planning and Assessment Act 1979*
Schedule 2 of the *Environmental Planning and Assessment Regulation 2000*

Application Number	SSD 7293
Proposal	The Sancrox Quarry Extension Project, which involves: • extending the approved extraction boundary by approximately 52 hectares, • extending the quarry life by ten years (from 20 to 30 years), • increasing the production limit from 455,000 tonnes per annum (tpa) to 750,000 tpa, • constructing and operating a concrete batching plant producing 20,000m^3 per annum (p/a), • constructing and operating a concrete recycling facility processing 20,000 tonnes p/a, • increasing truck movements and equipment loading from 7am–11pm weekdays, and 7am–1pm weekends and public holidays to 24 hours per day 7 days per week, • increasing quarry operations from 7am–5pm weekdays, and 7am–1pm Saturday to 24 hours per day 7 days per week, • transporting material off-site via public roads; and • Constructing and operating an asphalt plant producing 50,000 tonnes per annum.
Location	Sancrox Road Sancrox, Lot 2 DP 574308 Lot 353 DP 754434 Lot 1 DP 704890 Lot 1 DP 720807
Applicant	Hanson Construction Materials Pty Ltd (Hanson)
Date of Issue	18 September 2017
General Requirements	The Environmental Impact Statement (EIS) for the development must comply with the requirements in Clauses 6 and 7 of Schedule 2 of the *Environmental Planning and Assessment Regulation 2000.* In particular, the EIS must include: • a stand-alone executive summary; • a full description of the development, including: – the resource to be extracted, including the amount, type and composition; – the site layout and extraction plan, including cross-sectional plans; – the production process and processing activities, including the in-flow and out-flow of materials and points of discharge to the environment; – surface infrastructure and facilities (including any infrastructure that would be required for the development, but the subject of a separate approvals process); – a waste (overburden, rejects, tailings etc) management strategy; – a water management strategy; – a rehabilitation strategy to apply during, and after completion of, extraction operations, and proposed final use of site; and – the likely interactions between the development and any existing, approved or proposed development in the vicinity of the site; • a strategic justification of the development focusing on site selection and the suitability of the proposed site; • a list of any approvals that must be obtained before the development may

	commence; • an assessment of the likely impacts of the development on the environment, focussing on the key issues identified below, including: – a description of the existing environment likely to be affected by the development, using sufficient baseline data; – an assessment of the likely impacts of all stages of the development, including any cumulative impacts, taking into consideration any relevant laws, environmental planning instruments, guidelines, policies, plans and industry codes of practice; – a description of the measures that would be implemented to avoid, minimise, mitigate and/or offset the likely impacts of the development, and an assessment of: o whether these measures are consistent with industry best practice, and represent the full range of reasonable and feasible mitigation measures that could be implemented; o the likely effectiveness of these measures; and o whether contingency measures would be necessary to manage any residual risks; and – a description of the measures that would be implemented to monitor and report on the environmental performance of the development; • a consolidated summary of all the proposed environmental management and monitoring measures, identifying all the commitments in the EIS; • consideration of the development against all relevant environmental planning instruments (including Part 3 of the *State Environmental Planning Policy (Mining, Petroleum Production and Extractive Industries) 2007)*; • the reasons why the development should be approved, having regard to: - relevant matters for consideration under the *Environmental Planning and Assessment Act 1979*, including the objects of the Act; - the biophysical, economic and social impacts of the project, including the principles of ecologically sustainable development; - the suitability of the site with respect to potential land use conflicts with existing and future surrounding land uses; - feasible alternatives to the development (and its key components), including the consequences of not carrying out the development; • a signed declaration from the author of the EIS, certifying that the information contained within the document is neither false nor misleading. While not exhaustive, Attachment 1 contains a list of some of the environmental planning instruments, guidelines, policies, and plans that may be relevant to the environmental assessment of this development. In addition to the matters set out in Schedule 1 of the *Environmental Planning and Assessment Regulation 2000*, the development application must be accompanied by a signed report from a suitably qualified expert that includes an accurate estimate of the capital investment value (as defined in Clause 3 of the *Environmental Planning and Assessment Regulation 2000*) of the development, including details of all the assumptions and components from which the capital investment value calculation is derived.
Key Issues	The EIS must address the following key issues: • **Noise & Blasting** – including: - 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*; - 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*; - proposed blasting hours, frequency and methods; - 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; - reasonable and feasible mitigation measures to minimise noise emissions; and - monitoring and management measures, in particular real-time and attended noise monitoring; • **Air Quality** – including: - a detailed assessment of potential construction and operational impacts, in accordance with the *Approved Methods for the Modelling and Assessment of Air Pollutants in NSW,* and with a particular focus on dust emissions including $PM_{2.5}$ and PM_{10}, and having regard to the *Voluntary Land Acquisition and Mitigation Policy*; - an assessment of potential dust and other emissions generated from processing, operational activities and transportation of quarry products; - reasonable and feasible mitigation measures to minimise dust and emissions; and - monitoring and management measures, in particular, real-time air quality monitoring; • **Water** – including: - a detailed site water balance, including a description of site water demands, water disposal methods (inclusive of volume and frequency of any water discharges), water supply infrastructure and water storage structures; - identification of any licensing requirements or other approvals under the *Water Act 1912* and/or *Water Management Act 2000*; - demonstration that water for the construction and operation of the development can be obtained from an appropriately authorised and reliable supply in accordance with the operating rules of any relevant Water Sharing Plan (WSP); - a description of the measures proposed to ensure the development can operate in accordance with the requirements of any relevant WSP or water source embargo; - an assessment of any likely flooding impacts of the development; - an assessment of the likely impacts on the quality and quantity of existing surface and ground water resources, including a detailed assessment of proposed water discharge quantities and quality against receiving water quality and flow objectives; - an assessment of the likely impacts of the development on aquifers, watercourses, riparian land, water-related infrastructure, and other water users; and - a detailed description of the proposed water management system (including sewage), water monitoring program and other measures to mitigate surface and groundwater impacts; • **Biodiversity** – including: - accurate predictions of any vegetation clearing on site; - a detailed assessment of the likely biodiversity impacts of the development, paying particular attention to threatened species, populations and ecological communities and groundwater dependent ecosystems, and having regard to the *NSW Biodiversity Offsets Policy for Major Projects* and the *Framework for Biodiversity Assessment*; and - a strategy to offset any residual impacts of the development in accordance with the *NSW Biodiversity Offsets Policy for Major Projects*, including evidence that the appropriate type and quantum of offsets will be available; • **Heritage** – including: - an assessment of the potential impacts on Aboriginal heritage (cultural and archaeological), including evidence of appropriate consultation with relevant Aboriginal communities/parties and documentation of the views of these stakeholders regarding the likely impact of the development on their cultural heritage; and - identification of historic heritage in the vicinity of the development and an assessment of the likelihood and significance of impacts on heritage items, having regard to the relevant policies and guidelines listed in

	Attachment 1; • **Traffic & Transport** – including: - accurate predictions of the road traffic generated by the construction and operation of the development, including a description of the types of vehicles likely to be used for transportation of quarry products; - a detailed assessment of potential traffic impacts on the capacity, condition, safety and efficiency of the local and State road network (as identified above), including a road safety audit; and - a description of the measures that would be implemented to mitigate any impacts, including concept plans of any proposed upgrades, developed in consultation with the relevant road and rail authorities (if required); • **Land Resources** – including a detailed assessment of: - potential impacts on soils and land capability (including potential erosion and land contamination) and the proposed mitigation, management and remedial measures (as appropriate); - potential impacts on landforms (topography), paying particular attention to the long term geotechnical stability of any new landforms (such as overburden dumps, bunds etc); and - the compatibility of the development with other land uses in the vicinity of the development in accordance with the requirements in Clause 12 of *State Environmental Planning Policy (Mining, Petroleum Production and Extractive Industries)* 2007, paying particular attention to the agricultural land use in the region; • **Waste –** including estimates of the quantity and nature of the waste streams that would be generated or received by the development and any measures that would be implemented to minimise, manage or dispose of these waste streams; • **Hazards –** including an assessment of the likely risks to public safety, paying particular attention to the transport, handling and use of any hazardous or dangerous goods; • **Visual** – including a detailed assessment of the likely visual impacts of the development on private landowners in the vicinity of the development and key vantage points in the public domain, paying particular attention to any new landforms, and to minimising the lighting impacts of the development; • **Social & Economic** – including: - a detailed assessment of the likely social impacts of the development on the local and regional community in accordance with the *Social impact assessment guideline for State significant mining, petroleum production and extractive industry development*; and - a detailed assessment of the likely economic impacts of the development, paying particular attention to: o the significance of the resource; o the costs and benefits of the project; identifying whether the development as a whole would result in a net benefit to NSW, including consideration of fluctuation in commodity markets and exchange rates; and o the demand for the provision of local infrastructure and services; and • **Rehabilitation** – including the proposed rehabilitation strategy for the site having regard to the key principles in the *Strategic Framework for Mine Closure*, including: - rehabilitation objectives, progressive rehabilitation commitments, methodology, monitoring programs, performance standards and proposed completion criteria; - nominated final land use, having regard to any relevant strategic land use planning or resource management plans or policies; and - the potential for integrating this strategy with any other rehabilitation and/or offset strategies in the region.
Consultation	During the preparation of the EIS, you must consult with relevant local, State and Commonwealth Government authorities, service providers, Aboriginal stakeholders, community groups and affected landowners. You must:

	• consult with: - affected landowners; - community groups; - Port Macquarie-Hastings Council; - Office of Environment and Heritage (including the Heritage Branch); - Environment Protection Authority; - Division of Resources and Geoscience within the Department; - Department of Primary Industries (including the DPI Water, NSW Forestry, Agriculture and Fisheries sections and Crown Lands division); - North Coast Local Land Services; - Roads and Maritime Services; - NSW Rural Fire Service; and • establish a Community Consultative Committee for the project in accordance with the *Community Consultative Committee Guidelines for State Significant Projects,* and consult with the committee during the preparation of the EIS.
Further consultation after 2 years	If you do not lodge a development application and EIS for the development within 2 years of the issue date of these requirements, you must consult further with the Secretary in relation to the preparation of the EIS.

ATTACHMENT 1

Environmental Planning Instruments, Policies, Guidelines & Plans

Air	
	Voluntary Land Acquisition and Mitigation Policy for State Significant Mining, Petroleum and Extractive Industry Developments (DP&E)
	Approved Methods for the Modelling and Assessment of Air Pollutants in NSW (EPA)
	Approved Methods for the Sampling and Analysis of Air Pollutants in NSW (EPA)
	Generic Guidance and Optimum Model Settings for the CALPUFF Modelling System for Inclusion into the 'Approved Methods for the Modelling and Assessments of Air Pollutants in NSW, Australia'
	National Greenhouse Accounts Factors (Commonwealth)
Noise & Blasting	
	Voluntary Land Acquisition and Mitigation Policy for State Significant Mining, Petroleum and Extractive Industry Developments (DP&E)
	NSW Industrial Noise Policy (EPA)
	Interim Construction Noise Guideline (DECC)
	NSW Road Noise Policy (EPA)
	Technical basis for guidelines to minimise annoyance due to blasting overpressure and ground vibration (ANZEC)
Water	
Groundwater	NSW State Groundwater Policy Framework Document (NOW)
	NSW State Groundwater Quality Protection Policy (NOW)
	NSW State Groundwater Quantity Management Policy (NOW)
	NSW Aquifer Interference Policy 2012 (NOW)
	Office of Water Guidelines for Controlled Activities (2012)
	Groundwater Monitoring and Modelling Plans – Information for prospective mining and petroleum exploration activities (NOW)
	Australian Groundwater Modelling Guidelines 2012 (Commonwealth)
	National Water Quality Management Strategy Guidelines for Groundwater Protection in Australia (ARMCANZ/ANZECC)
	Guidelines for the Assessment & Management of Groundwater Contamination (EPA)
Surface Water	NSW Government Water Quality and River Flow Objectives (EPA)
	Using the ANZECC Guideline and Water Quality Objectives in NSW (EPA)
	National Water Quality Management Strategy: Australian Guidelines for Fresh and Marine Water Quality (ANZECC/ARMCANZ)
	National Water Quality Management Strategy: Australian Guidelines for Water Quality Monitoring and Reporting (ANZECC/ARMCANZ)
	National Water Quality Management Strategy: Guidelines for Sewerage Systems – Effluent Management (ARMCANZ/ANZECC)
	NSW Water Conservation Strategy (2000)
	State Water Management Outcomes Plan
	NSW State Rivers and Estuary Policy (1993)
	Approved Methods for the Sampling and Analysis of Water Pollutants in NSW (EPA)
	Managing Urban Stormwater: Soils & Construction (Landcom) and associated Volume 2E: Mines and Quarries (EPA)
	Managing Urban Stormwater: Treatment Techniques (EPA)
	Managing Urban Stormwater: Source Control (EPA)
	Technical Guidelines: Bunding & Spill Management (EPA)
	Environmental Guidelines: Use of Effluent by Irrigation (EPA)
	A Rehabilitation Manual for Australian Streams (LWRRDC and CRCCH)
	NSW Guidelines for Controlled Activities on Waterfront Land (NOW)

Land	
	Soil and Landscape Issues in Environmental Impact Assessment (NOW)
	Agfact AC.25: Agricultural Land Classification (NSW Agriculture)
	Agricultural Issues for Extractive Industries (NSW Trade and Investment)
	State Environmental Planning Policy No. 55 – Remediation of Land
	Australian and New Zealand Guidelines for the Assessment and Management of Contaminated Sites (ANZECC)
Traffic	
	Guide to Traffic Generating Development (RMS)
	Road Design Guide (RMS) & relevant Austroads Standards
Biodiversity	
	Biodiversity Offsets Scheme (OEH)
	Guidelines for Threatened Species Assessment (DP&E)
	NSW State Groundwater Dependent Ecosystem Policy (NOW)
	Risk Assessment Guidelines for Groundwater Dependent Ecosystems (NOW)
	State Environmental Planning Policy No. 44 – Koala Habitat Protection
Heritage	
	The Burra Charter (The Australia ICOMOS charter for places of cultural significance)
	Draft Guidelines for Aboriginal Cultural Heritage Assessment and Community Consultation (DP&E)
	Aboriginal Cultural Heritage Consultation Requirements for Proponents (OEH)
	Code of Practice for Archaeological Investigation of Aboriginal Objects in NSW (OEH)
	Guide to Investigating, Assessing and Reporting on Aboriginal Cultural Heritage in NSW (OEH)
	NSW Heritage Manual (OEH)
	Statements of Heritage Impact (OEH)
	Port Macquarie-Hastings Local Environmental Plan 2011
Hazards	
	State Environmental Planning Policy No. 33 – Hazardous and Offensive Development
	Hazardous and Offensive Development Application Guidelines – Applying SEPP 33
	Hazardous Industry Planning Advisory Paper No. 6 – Guidelines for Hazard Analysis
Waste	
	Waste Classification Guidelines (EPA)
Rehabilitation	
	Mine Rehabilitation – Leading Practice Sustainable Development Program for the Mining Industry (Commonwealth)
	Mine Closure and Completion – Leading Practice Sustainable Development Program for the Mining Industry (Commonwealth)
	Strategic Framework for Mine Closure (ANZMEC-MCA)
Social & Economic	
	Social impact assessment guideline for State significant mining, petroleum production and extractive industry development (DP&E)
Environmental Planning Instruments - General	
	State Environmental Planning Policy (Mining, Petroleum Production and Extractive Industries) 2007
	State Environmental Planning Policy (State and Regional Development) 2011
	State Environmental Planning Policy (Infrastructure) 2007
	State Environmental Planning Policy 55 – Remediation of Land
	Port Macquarie-Hastings Local Environmental Plan 2011

ATTACHMENT 2

Agency Correspondence

Department of Primary Industries

OUT17/34142

Ms Genevieve Seed
Resource Assessments
NSW Department of Planning and Environment
GPO Box 39
SYDNEY NSW 2001

genevieve.seed@planning.nsw.gov.au

Dear Ms Seed

Sancrox Quarry Extension (SSD 7293)
Request to re-issue SEARS

I refer to your email of 17 August 2017 to the Department of Primary Industries (DPI) in respect to the above matter. Comment has been sought from relevant branches of DPI.

Any further referrals to DPI can be sent by email to landuse.enquiries@dpi.nsw.gov.au.

DPI provides the following recommendations for matters to be addressed in the Environmental Impact Statement (EIS) for the proposal with additional comments at **Attachment A**.

Water

- Annual volumes of surface water and groundwater proposed to be taken by the activity (including through inflow and seepage) from each surface and groundwater source as defined by the relevant water sharing plan.
- Assessment of any volumetric water licensing requirements (including those for ongoing water take following completion of the project).
- The identification of an adequate and secure water supply for the life of the project. Confirmation that water can be sourced from an appropriately authorised and reliable supply. This is to include an assessment of the current market depth where water entitlement is required to be purchased.
- A detailed and consolidated site water balance.
- Assessment of impacts on surface and groundwater sources (both quality and quantity), related infrastructure, adjacent licensed water users, basic landholder rights, watercourses, riparian land, and groundwater dependent ecosystems, and measures proposed to reduce and mitigate these impacts.
- A detailed assessment against the NSW Aquifer Interference Policy (2012) using DPI Water's assessment framework.
- Full technical details and data of all surface and groundwater modelling, and an independent peer review.
- Proposed management and disposal of produced or incidental water.

- Works are to be in accordance with the "*Guidelines for Controlled Activities on Waterfront Land* (DPI Water 2012)". It is noted a number of first and second order watercourses are mapped within the proposed extension area.
- Details of the final landform of the site, including final void management (where relevant) and rehabilitation measures.
- Proposed surface and groundwater monitoring activities and methodologies.
- Assessment of any potential cumulative impacts on water resources, and any proposed options to manage the cumulative impacts.
- Consideration of relevant policies and guidelines.
- A statement of where each element of the SEARs is addressed in the EIS in the form of a table.

Land

Department of Industry – Lands & Forestry advises that in relation to the Crown road which traverses Lot 2 DP 574308, this proposal cannot be supported or approved whilst this land remains Crown road. To proceed, the adjoining land owner must make application to the Department for road closure and purchase. For further information and the relevant forms, please go to http://www.crownland.nsw.gov.au/crown_lands/roads.

The Crown road closure and purchase process can take a significant amount of time to complete and Lands & Forestry recommends early lodgement of the application. The applicant may request expedition of the application and should provide documentation to support any such request. This request will be assessed but priority cannot be guaranteed.

Yours sincerely

Mitchell Isaacs

Director, Planning Policy & Assessment Advice

1 September 2017

DPI appreciates your help to improve our advice to you. Please complete this three minute survey about the advice we have provided to you, here:

https://goo.gl/o8TXWz

ATTACHMENT A

Sancrox Quarry Extension (SSD 7293)
DPI Water General Assessment Requirements for State Significant Development and State Significant Infrastructure projects

The following detailed assessment requirements are provided to assist in adequately addressing the assessment requirements for State Significant Development (SSD) and State Significant Infrastructure (SSI) projects for Generic projects; Coal Mines and Gas projects; Quarries and Non Coal Mines and Linear projects respectively where relevant.

For further information visit the DPI Water website, www.water.nsw.gov.au

Key Relevant Legislative Instruments

This section provides a basic summary to aid proponents in the development of an Environmental Impact Statement (EIS), and should not be considered a complete list or comprehensive summary of relevant legislative instruments that may apply to the regulation of water resources for a project.

The EIS should take into account the objects and regulatory requirements of the *Water Act 1912* (WA 1912) and *Water Management Act 2000* (*WM Act*), and associated regulations and instruments, as applicable.

Water Management Act 2000 (WM Act)
Key points:

- Volumetric licensing in areas covered by water sharing plans
- Works within 40m of waterfront land
- SSD & SSI projects are exempt from requiring water supply work approvals and controlled activity approvals as a result of the *Environmental Planning & Assessment Act 1979 (EP&A Act)*.
- No exemptions for volumetric licensing apply as a result of the *EP&A Act*.
- Harvestable rights dams
- Aquifer interference activity approval provisions have not yet commenced and are regulated by the *Water Act 1912*
- Flood management work approval provisions have now commenced
- Maximum penalties of $ 2.2 million plus $ 264,000 for each day an offence continues apply under the *WM Act*

Water Act 1912 (WA 1912)
Key points:

- Monitoring bores
- Aquifer interference activities that are not regulated as a water supply work under the *WM Act*.
- No exemptions apply to licences or permits under the *WA 1912* as a result of the *EP&A Act*.
- Regulation of water bore driller licensing.

Water Management (General) Regulation 2011
Key points:

- Provides various exemptions for volumetric licensing and activity approvals
- Provides further detail on requirements for dealings and applications.

Access Licence Dealing Principles Order 2004

Harvestable Rights Orders

Water Sharing Plans these are considered regulations under the *WM Act*

It is important that the proponent understands and describes the ground and surface water sharing plans, water sources, and management zones that apply to the project. The relevant water sharing plans can be determined spatially at www.ourwater.nsw.gov.au. Multiple water sharing plans may apply and these must all be described.

The *Water Act 1912* applies to all water sources not yet covered by a commenced water sharing plan.

The EIS is required to:

- Demonstrate how the proposal is consistent with the relevant rules of the Water Sharing Plan including rules for access licences, distance restrictions for water supply works and rules for the management of local impacts in respect of surface water and groundwater sources, ecosystem protection (including groundwater dependent ecosystems), water quality and surface-groundwater connectivity.
- Provide a description of any site water use (amount of water to be taken from each water source) and management including all sediment dams, clear water diversion structures with detail on the location, design specifications and storage capacities for all the existing and proposed water management structures.
- Provide an analysis of the proposed water supply arrangements against the rules for access licences and other applicable requirements of any relevant WSP, including:
    - Sufficient market depth to acquire the necessary entitlements for each water source.
    - Ability to carry out a “dealing” to transfer the water to relevant location under the rules of the WSP.
    - Daily and long-term access rules.
    - Account management and carryover provisions.
- Provide a detailed and consolidated site water balance.
- Further detail on licensing requirements is provided below.

Relevant Policies and Guidelines

The EIS should take into account the following policies (as applicable):

- NSW Guidelines for Controlled Activities on Waterfront Land (NOW, 2012)
- NSW Aquifer Interference Policy (NOW, 2012)
- Risk Assessment Guidelines for Groundwater Dependent Ecosystems (NOW, 2012)
- Australian Groundwater Modelling Guidelines (NWC, 2012)
- NSW State Rivers and Estuary Policy (1993)
- NSW Wetlands Policy (2010)
- NSW State Groundwater Policy Framework Document (1997)
- NSW State Groundwater Quality Protection Policy (1998)
- NSW State Groundwater Dependent Ecosystems Policy (2002)
- NSW Water Extraction Monitoring Policy (2007)

DPI Water policies can be accessed at the following links:
http://www.water.nsw.gov.au/Water-management/Law-and-policy/Key-policies/default.aspx
http://www.water.nsw.gov.au/Water-licensing/Approvals/Controlled-activities/default.aspx

An assessment framework for the NSW Aquifer Interference Policy can be found online at: http://www.water.nsw.gov.au/Water-management/Law-and-policy/Key-policies/Aquifer-interference.

Licensing Considerations

The EIS is required to provide:

- Identification of water requirements for the life of the project in terms of both volume and timing (including predictions of potential ongoing groundwater take following the cessation of operations at the site – such as evaporative loss from open voids or inflows).
- Details of the water supply source(s) for the proposal including any proposed surface water and groundwater extraction from each water source as defined in the relevant Water Sharing Plan/s and all water supply works to take water.
- Explanation of how the required water entitlements will be obtained (i.e. through a new or existing licence/s, trading on the water market, controlled allocations etc.).
- Information on the purpose, location, construction and expected annual extraction volumes including details on all existing and proposed water supply works which take surface water, (pumps, dams, diversions, etc).
- Details on all bores and excavations for the purpose of investigation, extraction, dewatering, testing and monitoring. All predicted groundwater take must be accounted for through adequate licensing.
- Details on existing dams/storages (including the date of construction, location, purpose, size and capacity) and any proposal to change the purpose of existing dams/storages
- Details on the location, purpose, size and capacity of any new proposed dams/storages.
- Applicability of any exemptions under the *Water Management (General) Regulation 2011* to the project.

Water allocation account management rules, total daily extraction limits and rules governing environmental protection and access licence dealings also need to be considered.

The Harvestable Right gives landholders the right to capture and use for any purpose 10% of the average annual runoff from their property if in the Eastern and Central Divisions. The Harvestable Right has been defined in terms of an equivalent dam capacity called the Maximum Harvestable Right Dam Capacity (MHRDC). The MHRDC is determined by the area of the property (in hectares) and a site-specific run-off factor. The MHRDC includes the capacity of all existing dams on the property that do not have a current water licence. Storages capturing up to the harvestable right capacity are not required to be licensed but any capacity of the total of all storages/dams on the property greater than the MHRDC may require a licence.

For more information on Harvestable Right dams, including a calculator, visit:
http://www.water.nsw.gov.au/Water-licensing/Basic-water-rights/Harvesting-runoff/Harvesting-runoff

Dam Safety

Where new or modified dams are proposed, or where new development will occur below an existing dam, the NSW Dams Safety Committee should be consulted in relation to any safety issues that may arise. Conditions of approval may be recommended to ensure safety in relation to any new or existing dams.

See www.damsafety.nsw.gov.au for further information.

Surface Water Assessment

The predictive assessment of the impact of the proposed project on surface water sources should include the following:

- Identification of all surface water features including watercourses, wetlands and floodplains transected by or adjacent to the proposed project.
- Identification of all surface water sources as described by the relevant water sharing plan.
- Detailed description of dependent ecosystems and existing surface water users within the area, including basic landholder rights to water and adjacent/downstream licensed water users.
- Description of all works and surface infrastructure that will intercept, store, convey, or otherwise interact with surface water resources.
- Assessment of predicted impacts on the following:
    - flow of surface water, sediment movement, channel stability, and hydraulic regime,
    - water quality,
    - flood regime,
    - dependent ecosystems,
    - existing surface water users, and
    - planned environmental water and water sharing arrangements prescribed in the relevant water sharing plans.

Groundwater Assessment

To ensure the sustainable and integrated management of groundwater sources, the EIS needs to include adequate details to assess the impact of the project on all groundwater sources.

Where it is considered unlikely that groundwater will be intercepted or impacted (for example by infiltration), a brief site assessment and justification for the minimal impacts may be sufficient, accompanied by suitable contingency measures in place in the event that groundwater is intercepted, and appropriate measures to ensure that groundwater is not contaminated.

Where groundwater is expected to be intercepted or impacted, the following requirements should be used to assist the groundwater assessment for the proposal.

- The known or predicted highest groundwater table at the site.
- Works likely to intercept, connect with or infiltrate the groundwater sources.
- Any proposed groundwater extraction, including purpose, location and construction details of all proposed bores and expected annual extraction volumes.
- Bore construction information is to be supplied to DPI Water by submitting a “Form A” template. DPI Water will supply “GW” registration numbers (and licence/approval numbers if required) which must be used as consistent and unique bore identifiers for all future reporting.

- A description of the watertable and groundwater pressure configuration, flow directions and rates and physical and chemical characteristics of the groundwater source (including connectivity with other groundwater and surface water sources).
- Sufficient baseline monitoring for groundwater quantity and quality for all aquifers and GDEs to establish a baseline incorporating typical temporal and spatial variations.
- The predicted impacts of any final landform on the groundwater regime.
- The existing groundwater users within the area (including the environment), any potential impacts on these users and safeguard measures to mitigate impacts.
- An assessment of groundwater quality, its beneficial use classification and prediction of any impacts on groundwater quality.
- An assessment of the potential for groundwater contamination (considering both the impacts of the proposal on groundwater contamination and the impacts of contamination on the proposal).
- Measures proposed to protect groundwater quality, both in the short and long term.
- Measures for preventing groundwater pollution so that remediation is not required.
- Protective measures for any groundwater dependent ecosystems (GDEs).
- Proposed methods of the disposal of waste water and approval from the relevant authority.
- The results of any models or predictive tools used.

Where potential impact/s are identified the assessment will need to identify limits to the level of impact and contingency measures that would remediate, reduce or manage potential impacts to the existing groundwater resource and any dependent groundwater environment or water users, including information on:

- Any proposed monitoring programs, including water levels and quality data.
- Reporting procedures for any monitoring program including mechanism for transfer of information.
- An assessment of any groundwater source/aquifer that may be sterilised from future use as a water supply as a consequence of the proposal.
- Identification of any nominal thresholds as to the level of impact beyond which remedial measures or contingency plans would be initiated (this may entail water level triggers or a beneficial use category).
- Description of the remedial measures or contingency plans proposed.
- Any funding assurances covering the anticipated post development maintenance cost, for example on-going groundwater monitoring for the nominated period.

Groundwater Dependent Ecosystems

The EIS must consider the potential impacts on any Groundwater Dependent Ecosystems (GDEs) at the site and in the vicinity of the site and:

- Identify any potential impacts on GDEs as a result of the proposal including:
    - the effect of the proposal on the recharge to groundwater systems;
    - the potential to adversely affect the water quality of the underlying groundwater system and adjoining groundwater systems in hydraulic connections; and
    - the effect on the function of GDEs (habitat, groundwater levels, connectivity).

- Provide safeguard measures for any GDEs.

Watercourses, Wetlands and Riparian Land

The EIS should address the potential impacts of the project on all watercourses likely to be affected by the project, existing riparian vegetation and the rehabilitation of riparian land. It is recommended the EIS provides details on all watercourses potentially affected by the proposal, including:

- Scaled plans showing the location of:
  - wetlands/swamps, watercourses and top of bank;
  - riparian corridor widths to be established along the creeks;
  - existing riparian vegetation surrounding the watercourses (identify any areas to be protected and any riparian vegetation proposed to be removed);
  - the site boundary, the footprint of the proposal in relation to the watercourses and riparian areas; and
  - proposed location of any asset protection zones.
- Photographs of the watercourses/wetlands and a map showing the point from which the photos were taken.
- A detailed description of all potential impacts on the watercourses/riparian land.
- A detailed description of all potential impacts on the wetlands, including potential impacts to the wetlands hydrologic regime; groundwater recharge; habitat and any species that depend on the wetlands.
- A description of the design features and measures to be incorporated to mitigate potential impacts.
- Geomorphic and hydrological assessment of water courses including details of stream order (Strahler System), river style and energy regimes both in channel and on adjacent floodplains.

Drill Pad, Well and Access Road Construction (applies to Coal Mines and Gas projects and Quarries and Non Coal Mine projects)

- Any construction activity within 40m of a watercourse, should be designed by a suitably qualified person, consistent with the NSW *Guidelines for Controlled Activities on Waterfront Land* (July 2012).
- Construction of all wells must be undertaken in accordance with the *Minimum Construction Requirements for Water Bores in Australia* (3rd edition 2012) by a driller holding a bore drillers' licence valid in New South Wales.
- The length of time that a core hole is maintained as an open hole should be minimised.

Landform rehabilitation

Where significant modification to landform is proposed, the EIS must include:

- Justification of the proposed final landform with regard to its impact on local and regional surface and groundwater systems;
- A detailed description of how the site would be progressively rehabilitated and integrated into the surrounding landscape;
- Outline of proposed construction and restoration of topography and surface drainage features if affected by the project; and

- An outline of the measures to be put in place to ensure that sufficient resources are available to implement the proposed rehabilitation.

Additional Landform Rehabilitation Requirements for Coal mines and Gas projects and Quarries and Non Coal Mines (including final void management)

- Detailed modelling of potential groundwater volume, flow and quality impacts of the presence of an inundated final void (where relevant) on identified receptors specifically considering those environmental systems that are likely to be groundwater dependent;
- The measures that would be established for the long-term protection of local and regional aquifer systems and for the ongoing management of the site following the cessation of the project.

Consultation and general enquiries

Assessment of state significant development enquiries, or requests for review or consultation should be directed to the, Water Regulation Co-ordination Unit, water.referrals@dpi.nsw.gov.au.

A consultation guideline and further information is available online at:
www.water.nsw.gov.au/water-management/law-and-policy/planning-and-assessment

End Attachment A

Department of Primary Industries

OUT17/34142

Ms Genevieve Seed
Resource Assessments
NSW Department of Planning and Environment
GPO Box 39
SYDNEY NSW 2001

genevieve.seed@planning.nsw.gov.au

Dear Ms Seed

Sancrox Quarry Extension (SSD 7293)
Request to re-issue SEARS

I refer to your email of 17 August 2017 to the Department of Primary Industries (DPI) in respect to the above matter. Comment has been sought from relevant branches of DPI.

Any further referrals to DPI can be sent by email to landuse.enquiries@dpi.nsw.gov.au.

DPI provides the following recommendations for matters to be addressed in the Environmental Impact Statement (EIS) for the proposal with additional comments at **Attachment A**.

Water

- Annual volumes of surface water and groundwater proposed to be taken by the activity (including through inflow and seepage) from each surface and groundwater source as defined by the relevant water sharing plan.
- Assessment of any volumetric water licensing requirements (including those for ongoing water take following completion of the project).
- The identification of an adequate and secure water supply for the life of the project. Confirmation that water can be sourced from an appropriately authorised and reliable supply. This is to include an assessment of the current market depth where water entitlement is required to be purchased.
- A detailed and consolidated site water balance.
- Assessment of impacts on surface and groundwater sources (both quality and quantity), related infrastructure, adjacent licensed water users, basic landholder rights, watercourses, riparian land, and groundwater dependent ecosystems, and measures proposed to reduce and mitigate these impacts.
- A detailed assessment against the NSW Aquifer Interference Policy (2012) using DPI Water's assessment framework.
- Full technical details and data of all surface and groundwater modelling, and an independent peer review.
- Proposed management and disposal of produced or incidental water.

- Works are to be in accordance with the "*Guidelines for Controlled Activities on Waterfront Land* (DPI Water 2012)". It is noted a number of first and second order watercourses are mapped within the proposed extension area.
- Details of the final landform of the site, including final void management (where relevant) and rehabilitation measures.
- Proposed surface and groundwater monitoring activities and methodologies.
- Assessment of any potential cumulative impacts on water resources, and any proposed options to manage the cumulative impacts.
- Consideration of relevant policies and guidelines.
- A statement of where each element of the SEARs is addressed in the EIS in the form of a table.

Land

Department of Industry – Lands & Forestry advises that in relation to the Crown road which traverses Lot 2 DP 574308, this proposal cannot be supported or approved whilst this land remains Crown road. To proceed, the adjoining land owner must make application to the Department for road closure and purchase. For further information and the relevant forms, please go to http://www.crownland.nsw.gov.au/crown_lands/roads.

The Crown road closure and purchase process can take a significant amount of time to complete and Lands & Forestry recommends early lodgement of the application. The applicant may request expedition of the application and should provide documentation to support any such request. This request will be assessed but priority cannot be guaranteed.

Yours sincerely

Mitchell Isaacs

Director, Planning Policy & Assessment Advice

1 September 2017

DPI appreciates your help to improve our advice to you. Please complete this three minute survey about the advice we have provided to you, here:

https://goo.gl/o8TXWz

ATTACHMENT A

Sancrox Quarry Extension (SSD 7293)
DPI Water General Assessment Requirements for State Significant Development and State Significant Infrastructure projects

The following detailed assessment requirements are provided to assist in adequately addressing the assessment requirements for State Significant Development (SSD) and State Significant Infrastructure (SSI) projects for Generic projects; Coal Mines and Gas projects; Quarries and Non Coal Mines and Linear projects respectively where relevant.

For further information visit the DPI Water website, www.water.nsw.gov.au

Key Relevant Legislative Instruments

This section provides a basic summary to aid proponents in the development of an Environmental Impact Statement (EIS), and should not be considered a complete list or comprehensive summary of relevant legislative instruments that may apply to the regulation of water resources for a project.

The EIS should take into account the objects and regulatory requirements of the *Water Act 1912* (WA 1912) and *Water Management Act 2000* (*WM Act*), and associated regulations and instruments, as applicable.

Water Management Act 2000 (WM Act)
Key points:

- Volumetric licensing in areas covered by water sharing plans
- Works within 40m of waterfront land
- SSD & SSI projects are exempt from requiring water supply work approvals and controlled activity approvals as a result of the *Environmental Planning & Assessment Act 1979 (EP&A Act)*.
- No exemptions for volumetric licensing apply as a result of the *EP&A Act*.
- Harvestable rights dams
- Aquifer interference activity approval provisions have not yet commenced and are regulated by the *Water Act 1912*
- Flood management work approval provisions have now commenced
- Maximum penalties of $ 2.2 million plus $ 264,000 for each day an offence continues apply under the *WM Act*

Water Act 1912 (WA 1912)
Key points:

- Monitoring bores
- Aquifer interference activities that are not regulated as a water supply work under the *WM Act*.
- No exemptions apply to licences or permits under the *WA 1912* as a result of the *EP&A Act*.
- Regulation of water bore driller licensing.

Water Management (General) Regulation 2011
Key points:

- Provides various exemptions for volumetric licensing and activity approvals
- Provides further detail on requirements for dealings and applications.

Access Licence Dealing Principles Order 2004

Harvestable Rights Orders

Water Sharing Plans these are considered regulations under the *WM Act*

It is important that the proponent understands and describes the ground and surface water sharing plans, water sources, and management zones that apply to the project. The relevant water sharing plans can be determined spatially at www.ourwater.nsw.gov.au. Multiple water sharing plans may apply and these must all be described.

The *Water Act 1912* applies to all water sources not yet covered by a commenced water sharing plan.

The EIS is required to:

- Demonstrate how the proposal is consistent with the relevant rules of the Water Sharing Plan including rules for access licences, distance restrictions for water supply works and rules for the management of local impacts in respect of surface water and groundwater sources, ecosystem protection (including groundwater dependent ecosystems), water quality and surface-groundwater connectivity.
- Provide a description of any site water use (amount of water to be taken from each water source) and management including all sediment dams, clear water diversion structures with detail on the location, design specifications and storage capacities for all the existing and proposed water management structures.
- Provide an analysis of the proposed water supply arrangements against the rules for access licences and other applicable requirements of any relevant WSP, including:
    - Sufficient market depth to acquire the necessary entitlements for each water source.
    - Ability to carry out a “dealing” to transfer the water to relevant location under the rules of the WSP.
    - Daily and long-term access rules.
    - Account management and carryover provisions.
- Provide a detailed and consolidated site water balance.
- Further detail on licensing requirements is provided below.

Relevant Policies and Guidelines

The EIS should take into account the following policies (as applicable):

- NSW Guidelines for Controlled Activities on Waterfront Land (NOW, 2012)
- NSW Aquifer Interference Policy (NOW, 2012)
- Risk Assessment Guidelines for Groundwater Dependent Ecosystems (NOW, 2012)
- Australian Groundwater Modelling Guidelines (NWC, 2012)
- NSW State Rivers and Estuary Policy (1993)
- NSW Wetlands Policy (2010)
- NSW State Groundwater Policy Framework Document (1997)
- NSW State Groundwater Quality Protection Policy (1998)
- NSW State Groundwater Dependent Ecosystems Policy (2002)
- NSW Water Extraction Monitoring Policy (2007)

DPI Water policies can be accessed at the following links:
http://www.water.nsw.gov.au/Water-management/Law-and-policy/Key-policies/default.aspx
http://www.water.nsw.gov.au/Water-licensing/Approvals/Controlled-activities/default.aspx

An assessment framework for the NSW Aquifer Interference Policy can be found online at: http://www.water.nsw.gov.au/Water-management/Law-and-policy/Key-policies/Aquifer-interference.

Licensing Considerations

The EIS is required to provide:

- Identification of water requirements for the life of the project in terms of both volume and timing (including predictions of potential ongoing groundwater take following the cessation of operations at the site – such as evaporative loss from open voids or inflows).
- Details of the water supply source(s) for the proposal including any proposed surface water and groundwater extraction from each water source as defined in the relevant Water Sharing Plan/s and all water supply works to take water.
- Explanation of how the required water entitlements will be obtained (i.e. through a new or existing licence/s, trading on the water market, controlled allocations etc.).
- Information on the purpose, location, construction and expected annual extraction volumes including details on all existing and proposed water supply works which take surface water, (pumps, dams, diversions, etc).
- Details on all bores and excavations for the purpose of investigation, extraction, dewatering, testing and monitoring. All predicted groundwater take must be accounted for through adequate licensing.
- Details on existing dams/storages (including the date of construction, location, purpose, size and capacity) and any proposal to change the purpose of existing dams/storages
- Details on the location, purpose, size and capacity of any new proposed dams/storages.
- Applicability of any exemptions under the *Water Management (General) Regulation 2011* to the project.

Water allocation account management rules, total daily extraction limits and rules governing environmental protection and access licence dealings also need to be considered.

The Harvestable Right gives landholders the right to capture and use for any purpose 10% of the average annual runoff from their property if in the Eastern and Central Divisions. The Harvestable Right has been defined in terms of an equivalent dam capacity called the Maximum Harvestable Right Dam Capacity (MHRDC). The MHRDC is determined by the area of the property (in hectares) and a site-specific run-off factor. The MHRDC includes the capacity of all existing dams on the property that do not have a current water licence. Storages capturing up to the harvestable right capacity are not required to be licensed but any capacity of the total of all storages/dams on the property greater than the MHRDC may require a licence.

For more information on Harvestable Right dams, including a calculator, visit:
http://www.water.nsw.gov.au/Water-licensing/Basic-water-rights/Harvesting-runoff/Harvesting-runoff

Dam Safety

Where new or modified dams are proposed, or where new development will occur below an existing dam, the NSW Dams Safety Committee should be consulted in relation to any safety issues that may arise. Conditions of approval may be recommended to ensure safety in relation to any new or existing dams.

See www.damsafety.nsw.gov.au for further information.

Surface Water Assessment

The predictive assessment of the impact of the proposed project on surface water sources should include the following:

- Identification of all surface water features including watercourses, wetlands and floodplains transected by or adjacent to the proposed project.
- Identification of all surface water sources as described by the relevant water sharing plan.
- Detailed description of dependent ecosystems and existing surface water users within the area, including basic landholder rights to water and adjacent/downstream licensed water users.
- Description of all works and surface infrastructure that will intercept, store, convey, or otherwise interact with surface water resources.
- Assessment of predicted impacts on the following:
    - flow of surface water, sediment movement, channel stability, and hydraulic regime,
    - water quality,
    - flood regime,
    - dependent ecosystems,
    - existing surface water users, and
    - planned environmental water and water sharing arrangements prescribed in the relevant water sharing plans.

Groundwater Assessment

To ensure the sustainable and integrated management of groundwater sources, the EIS needs to include adequate details to assess the impact of the project on all groundwater sources.

Where it is considered unlikely that groundwater will be intercepted or impacted (for example by infiltration), a brief site assessment and justification for the minimal impacts may be sufficient, accompanied by suitable contingency measures in place in the event that groundwater is intercepted, and appropriate measures to ensure that groundwater is not contaminated.

Where groundwater is expected to be intercepted or impacted, the following requirements should be used to assist the groundwater assessment for the proposal.

- The known or predicted highest groundwater table at the site.
- Works likely to intercept, connect with or infiltrate the groundwater sources.
- Any proposed groundwater extraction, including purpose, location and construction details of all proposed bores and expected annual extraction volumes.
- Bore construction information is to be supplied to DPI Water by submitting a “Form A” template. DPI Water will supply “GW” registration numbers (and licence/approval numbers if required) which must be used as consistent and unique bore identifiers for all future reporting.

- A description of the watertable and groundwater pressure configuration, flow directions and rates and physical and chemical characteristics of the groundwater source (including connectivity with other groundwater and surface water sources).
- Sufficient baseline monitoring for groundwater quantity and quality for all aquifers and GDEs to establish a baseline incorporating typical temporal and spatial variations.
- The predicted impacts of any final landform on the groundwater regime.
- The existing groundwater users within the area (including the environment), any potential impacts on these users and safeguard measures to mitigate impacts.
- An assessment of groundwater quality, its beneficial use classification and prediction of any impacts on groundwater quality.
- An assessment of the potential for groundwater contamination (considering both the impacts of the proposal on groundwater contamination and the impacts of contamination on the proposal).
- Measures proposed to protect groundwater quality, both in the short and long term.
- Measures for preventing groundwater pollution so that remediation is not required.
- Protective measures for any groundwater dependent ecosystems (GDEs).
- Proposed methods of the disposal of waste water and approval from the relevant authority.
- The results of any models or predictive tools used.

Where potential impact/s are identified the assessment will need to identify limits to the level of impact and contingency measures that would remediate, reduce or manage potential impacts to the existing groundwater resource and any dependent groundwater environment or water users, including information on:

- Any proposed monitoring programs, including water levels and quality data.
- Reporting procedures for any monitoring program including mechanism for transfer of information.
- An assessment of any groundwater source/aquifer that may be sterilised from future use as a water supply as a consequence of the proposal.
- Identification of any nominal thresholds as to the level of impact beyond which remedial measures or contingency plans would be initiated (this may entail water level triggers or a beneficial use category).
- Description of the remedial measures or contingency plans proposed.
- Any funding assurances covering the anticipated post development maintenance cost, for example on-going groundwater monitoring for the nominated period.

Groundwater Dependent Ecosystems

The EIS must consider the potential impacts on any Groundwater Dependent Ecosystems (GDEs) at the site and in the vicinity of the site and:

- Identify any potential impacts on GDEs as a result of the proposal including:
    - the effect of the proposal on the recharge to groundwater systems;
    - the potential to adversely affect the water quality of the underlying groundwater system and adjoining groundwater systems in hydraulic connections; and
    - the effect on the function of GDEs (habitat, groundwater levels, connectivity).

- Provide safeguard measures for any GDEs.

Watercourses, Wetlands and Riparian Land

The EIS should address the potential impacts of the project on all watercourses likely to be affected by the project, existing riparian vegetation and the rehabilitation of riparian land. It is recommended the EIS provides details on all watercourses potentially affected by the proposal, including:

- Scaled plans showing the location of:
  - wetlands/swamps, watercourses and top of bank;
  - riparian corridor widths to be established along the creeks;
  - existing riparian vegetation surrounding the watercourses (identify any areas to be protected and any riparian vegetation proposed to be removed);
  - the site boundary, the footprint of the proposal in relation to the watercourses and riparian areas; and
  - proposed location of any asset protection zones.
- Photographs of the watercourses/wetlands and a map showing the point from which the photos were taken.
- A detailed description of all potential impacts on the watercourses/riparian land.
- A detailed description of all potential impacts on the wetlands, including potential impacts to the wetlands hydrologic regime; groundwater recharge; habitat and any species that depend on the wetlands.
- A description of the design features and measures to be incorporated to mitigate potential impacts.
- Geomorphic and hydrological assessment of water courses including details of stream order (Strahler System), river style and energy regimes both in channel and on adjacent floodplains.

Drill Pad, Well and Access Road Construction (applies to Coal Mines and Gas projects and Quarries and Non Coal Mine projects)

- Any construction activity within 40m of a watercourse, should be designed by a suitably qualified person, consistent with the NSW *Guidelines for Controlled Activities on Waterfront Land* (July 2012).
- Construction of all wells must be undertaken in accordance with the *Minimum Construction Requirements for Water Bores in Australia* (3rd edition 2012) by a driller holding a bore drillers' licence valid in New South Wales.
- The length of time that a core hole is maintained as an open hole should be minimised.

Landform rehabilitation

Where significant modification to landform is proposed, the EIS must include:

- Justification of the proposed final landform with regard to its impact on local and regional surface and groundwater systems;
- A detailed description of how the site would be progressively rehabilitated and integrated into the surrounding landscape;
- Outline of proposed construction and restoration of topography and surface drainage features if affected by the project; and

- An outline of the measures to be put in place to ensure that sufficient resources are available to implement the proposed rehabilitation.

Additional Landform Rehabilitation Requirements for Coal mines and Gas projects and Quarries and Non Coal Mines (including final void management)

- Detailed modelling of potential groundwater volume, flow and quality impacts of the presence of an inundated final void (where relevant) on identified receptors specifically considering those environmental systems that are likely to be groundwater dependent;
- The measures that would be established for the long-term protection of local and regional aquifer systems and for the ongoing management of the site following the cessation of the project.

Consultation and general enquiries

Assessment of state significant development enquiries, or requests for review or consultation should be directed to the, Water Regulation Co-ordination Unit, water.referrals@dpi.nsw.gov.au.

A consultation guideline and further information is available online at:
www.water.nsw.gov.au/water-management/law-and-policy/planning-and-assessment

End Attachment A

DOC17/427522-01; EF13/3037 (SSD 7293)

Department of Planning and Environment
GPO Box 39
SYDNEY NSW 2001

Attention: Genevieve Seed

By email: genevieve.seed@planning.nsw.gov.au

Dear Ms Seed

Sancrox Quarry Extension (SSD 7293)
Reissue of Secretary's Environmental Assessment Requirements

I refer to your email to the Environment Protection Authority (EPA), dated 17 August 2017, seeking the EPA's recommended Secretary Environmental Assessment Requirements (SEARS) for the Sancrox Quarry extension proposal, SSD 7293. Provided with your email is the report titled '*Sancrox Quarry Expansion Project – Preliminary Environmental Impact Statement*', dated August 2015.

The EPA notes the request is for the reissuing of the SEARS, as previous SEARS were provided in relation to this proposal in October 2015. As the proposal, has not been altered from the previous 2015 application, the EPA has reviewed the 2015 SEARS submitted and updated them accordingly. These updates primarily relate to the guideline references.

The updated SEARS have been provided at **Attachment A** and the updated guidance material list at **Attachment B**.

The EPA's key information requirements for the project are summarised below and include an adequate description and assessment of:

1. Project proposal including size of the operation, proposed processes, operational hours, maximum and average annual production rate, staging and timing of the proposal;
2. Air quality impacts including a description of all emissions and a specific description of proposed air pollution management strategies;
3. Noise and vibration impacts associated with the proposed construction and hours of operation.
4. Water management onsite including process and stormwater management, sedimentation ponds, details and justification for any proposed discharge(s) and the sensitivity of the receiving environment.
5. Waste generation, source location, classification, quantities, reuse and management measures for activities undertaken at the premises;
6. A proposed monitoring plan to assess the impact on the environment and surrounding receivers over time;
7. An assessment of the cumulative impacts associated with this proposal and other activities in the local area; and

PO Box 488G Newcastle NSW 2300
117 Bull Street, Newcastle West NSW 2302
Tel: (02) 4908 6800 Fax: (02) 4908 6810
ABN 43 692 285 758
www.epa.nsw.gov.au

8. Actions that will be taken to avoid or mitigate impacts or compensate for any unavoidable impacts associated with proposed operations.

In carrying out the assessment, the proponent should refer to the relevant guidelines listed in **Attachment B** and any relevant industry codes of practice and best practice management guidelines.

The proponent should also be aware that any commitments made in the EIS may be formalised as approval conditions and subsequently environment protection licence conditions. Pollution control measures should not be proposed if they are impractical, unrealistic or beyond the financial viability of the development. It is important that all conclusions are supported by adequate data.

If you require any further information regarding this matter, please contact me on 4908 6819 or by email to hunter.region@epa.nsw.gov.au.

Yours sincerely

30/8/17

MICHAEL HOWAT
A/Head Strategic Programs Unit - Hunter
Environment Protection Authority

Encl: **Attachment A** – EPA's Recommended Secretary's Environmental Assessment Requirements – Sancrox Quarry Extension Project (SSD 7293)

Attachment B – Guidance Material

ATTACHMENT A

EPA's Recommended Secretary's Environmental Assessment Requirements – Sancrox Quarry Extension Project (SSD 7293)

1 Environmental impacts of the project

Impacts related to the following environmental issues need to be assessed, quantified and reported on:

- Air Quality
- Noise and Vibration
- Water and Soil Quality and Management
- Waste Management
- Dangerous Goods, Chemical Storage and Bunding

The Environmental Impact Statement (EIS) should address the specific requirements outlined under each heading below and assess impacts in accordance with the relevant guidelines mentioned. A full list of guidelines is at Attachment B.

2 Licensing requirements

Should project approval be granted, the proponent will need to make a separate application to EPA for any variations to the existing Environment Protection Licence No. 5289 for the quarry. Additional information is available through EPA's *Guide to Licensing* document.
http://www.epa.nsw.gov.au/resources/licensing/licensing-guide-160369.pdf

General information on licence requirements can also be obtained from EPA's Environment Line on 131 555 during office hours, or can be found at the EPA web site at:
http://www.epa.nsw.gov.au/licensing/

3 The Proposal and Premises

The objectives of the proposal should be clearly stated and refer to:

- The size and type of the operation;
- The nature of the processes and the products, by-products and wastes produced;
- The types and quantities of any chemicals to be used and stored onsite;
- Proposed operational hours, including any heavy vehicle movements;
- Proposed maximum and average annual production rates that will occur at the premises; and
- Proposed staging and timing of the proposal.

The EIS will need to fully identify all the processes and activities intended for the site over the life of the development. This will include details of:

- The location of the proposed facility and details of the surrounding environment;
- The proposed layout of the site;
- Appropriate land use zoning;
- Ownership details of any residence and/or land likely to be affected by the proposed operations;
- Maps/diagrams showing the location of residences and properties likely to be affected and other industrial developments, conservation areas, wetlands, etc. in the locality that may be affected by the facility;
- All equipment proposed for use at the site;
- All chemicals, including fuel, used on the site and proposed methods for their transportation, storage, use and emergency management;
- Clearly detail the boundary of the premises; and
- Methods to mitigate any expected environmental impacts of the development.

4 Air Issues

Given the proposed extension of the extraction boundary and addition of potentially odorous activities such as asphalt production, the EIS should include a detailed assessment of air quality and odour impacts. The following matters should be addressed as part of the EIS.

- Assess the risk associated with potential discharges of fugitive and point source emissions for all stages of the proposal. Assessment of risk relates to environmental harm, risk to human health and amenity.

- Justify the level of assessment undertaken on the basis of risk factors, including but not limited to:
    - proposal location;
    - characteristics of the receiving environment; and
    - type and quantity of pollutants emitted.

- Describe the receiving environment in detail. The proposal must be contextualised within the receiving environment (local, regional and inter-regional as appropriate). The description must include but need not be limited to:
    - meteorology and climate;
    - topography;
    - surrounding land-use; receptors; and
    - ambient air quality.

- Include a detailed description of the proposal. All processes that could result in air emissions must be identified and described. Sufficient detail to accurately communicate the characteristics and quantity of all emissions must be provided.

- Include a consideration of 'worst case' emission scenarios and impacts at proposed emission limits.

- Account for cumulative impacts associated with existing emission sources as well as any currently approved developments linked to the receiving environment.

- Include air dispersion modelling where there is a risk of adverse air quality impacts, or where there is sufficient uncertainty to warrant a rigorous numerical impact assessment. Air dispersion modelling must be conducted in accordance with the Approved Methods for the Modelling and Assessment of Air Pollutants in NSW (2016).

- Demonstrate the proposal's ability to comply with the relevant regulatory framework, specifically the *Protection of the Environment Operations* (POEO) *Act* (1997) and the POEO (Clean Air) Regulation (2010).

- Provide an assessment of the project in terms of the priorities and targets adopted under the NSW State Plan 2010 and its implementation plan Action for Air.

- Detail emission control techniques/practices that will be employed by the proposal.

- Detail monitoring that will be conducted to assess the impacts of the proposal.

5 Noise and Vibration

The following matters should be addressed in relation to noise and vibration impacts associated with the proposal. This includes identification of the hours of operations, assessment of all activities where proposed, and impacts on sensitive receivers associated with the proposed hours of operation. The following matters should be addressed as part of the EIS.

General

- Construction noise associated with the proposed development should be assessed using the Interim Construction Noise Guideline (DECC, 2009).

- Vibration from all activities (including construction and operation) to be undertaken on the premises should be assessed using the guidelines contained in the Assessing Vibration: a technical guideline (DEC, 2006).

- Blast impacts should be demonstrated to be capable of complying with the guidelines contained in Australian and New Zealand Environment Council – Technical basis for guidelines to minimise annoyance due to blasting overpressure and ground vibration (ANZEC, 1990).

Industry

- Operational noise from all industrial activities (including private haul roads) to be undertaken on the premises should be assessed using the guidelines contained in the NSW Industrial Noise Policy (EPA, 2000) and Industrial Noise Policy Application Notes.

Road

- Noise on public roads from increased road traffic generated by land use developments should be assessed using the guidelines contained in the NSW Road Noise Policy (DECCW, 2011).

- Noise from new or upgraded public roads should be assessed using the NSW Road Noise Policy (DECCW, 2011).

Monitoring

- Detail monitoring that will be conducted to assess the impacts of the proposal.

6 Water and Soils

6.1 Water Quality

Describe Proposal

- Describe the proposal including position of any intakes and discharges, volumes, water quality and frequency of all water discharges.

- Demonstrate that all practical options to avoid discharges have been implemented and environmental impact minimised where discharge is necessary.

- Where relevant include a water balance for the development including water requirements (quantity, quality and source(s)) and proposed storm and wastewater disposal, including type, volumes, proposed treatment and management methods and re-use options.

Background Conditions

- Describe existing surface and groundwater quality. An assessment needs to be undertaken for any water resource likely to be affected by the proposal. Issues to be discussed should include but are not limited to:
  - a description of any impacts from existing industry or activities on water quality
  - a description of the condition of the local catchment e.g. erosion, soils, vegetation cover, etc.
  - an outline of baseline groundwater information, including, for example, depth to water table, flow direction and gradient, groundwater quality, reliance on groundwater by surrounding users and by the environment

- historic river flow data

- State the Water Quality Objectives for the receiving waters relevant to the proposal. These refer to the community's agreed environmental values and human uses endorsed by the NSW Government as goals for ambient waters (http://www.environment.nsw.gov.au/ieo/index.htm). Where groundwater may be impacted the assessment should identify appropriate groundwater environmental values.

- State the indicators and associated trigger values or criteria for the identified environmental values. This information should be based on the ANZECC (2000) Guidelines for Fresh and Marine Water Quality as a minimum but should also be based on advice from Hunter Water Corporation given the sensitive receiving environment of Grahamstown Dam water supply.

- State any locally specific objectives, criteria or targets which have been endorsed by the NSW Government.

Impact Assessment

- Describe the nature and degree of impact that any proposed discharges will have on the receiving environment, both surface water and groundwater.
- Detail contractual and other arrangements that will be put in place to prevent pollution from haul roads and unsealed roads per se, particularly rights of carriageways not owned by the proponent.
- Assess impacts against the relevant ambient water quality outcomes. Demonstrate how the proposal will be designed and operated to:
  - protect the Water Quality Objectives for receiving waters where they are currently being achieved; and
  - contribute towards achievement of the Water Quality Objectives over time where they are not currently being achieved.
- Where a discharge is proposed that includes a mixing zone, the proposal should demonstrate how wastewater discharged to waterways will ensure the ANZECC (2000) water quality criteria for relevant chemical and non-chemical parameters are met at the edge of the initial mixing zone of the discharge, and that any impacts in the initial mixing zone are demonstrated to be reversible.
- Propose water quality limits for any discharge(s) that adequately protects the receiving environment.
- Assess impacts on groundwater and groundwater dependent ecosystems.
- Describe how stormwater will be managed both during and after construction.

Monitoring

- Describe how predicted impacts will be monitored and assessed over time.

6.2 Soil

The EIS should include:

- An assessment of potential impacts on soil and land resources should be undertaken, being guided by Soil and Landscape Issues in Environmental Impact Assessment (DLWC 2000). The nature and extent of any significant impacts should be identified. Particular attention should be given to:
  - Soil erosion and sediment transport - in accordance with Managing urban stormwater: soils and construction, vol. 1 (Landcom 2004) and vol. 2 (A. Installation of services; B Waste landfills; C. Unsealed roads; D. Main Roads; E. Mines and quarries) (DECC 2008).

- Mass movement (landslides) – in accordance with Landslide risk management guidelines presented in Australian Geomechanics Society (2007).
- Urban and regional salinity – guidance given in the Local Government Salinity Initiative booklets which includes Site Investigations for Urban Salinity (DLWC, 2002).

- A description of the mitigation and management options that will be used to prevent, control, abate or minimise identified soil and land resource impacts associated with the project. This should include an assessment of the effectiveness and reliability of the measures and any residual impacts after these measures are implemented.

7 Waste

The EIS should:

- Include a detailed plan for in-situ classification of waste material, including the sampling locations and sampling regime that will be employed to classify the waste, particularly with regards to the identification of contamination hotspots.

- Identify, quantify, characterise and classify all waste that currently exists at the site. Identify the intended end use, for example reuse or disposal, and the end use location(s) for the waste. Also, specify the mechanism under which waste will be reused or disposed, such as a Resource Recovery Exemption. Note: All waste must be classified in accordance with EPA's Classification Guidelines.

- Identify, characterise and classify all waste that will be generated onsite through excavation, demolition or construction activities, including proposed quantities of the waste.
  Note: All waste must be classified in accordance with EPA's Waste Classification Guidelines.

- Identify, characterise and classify all waste that is proposed to be disposed of to an offsite location, including proposed quantities of the waste and the disposal locations for the waste. This includes waste that is intended for re-use or recycling.
  Note: All waste must be classified in accordance with EPA's Classification Guidelines.

- Include a commitment to retaining all sampling and classification results for the life of the project to demonstrate compliance with EPA's Waste Classification Guidelines.

- Provide details of how waste will be handled and managed onsite to minimise pollution, including:

  a) Stockpile location and management
     - Labelling of stockpiles for identification, ensuring that all waste is clearly identified and stockpiled separately from other types of material (especially the separation of any contaminated and non-contaminated waste).
     - Proposed height limits for all waste to reduce the potential for dust and odour.
     - Procedures for minimising the movement of waste around the site and double handling.
     - Measures to minimise leaching from stockpiles into the surrounding environment, such as sediment fencing, geofabric liners etc.

  b) Erosion, sediment and leachate control including measures to be implemented to minimise erosion, leachate and sediment mobilisation at the site during works. The EIS should show the location of each measure to be implemented. The Proponent should consider measures such as:
     - Sediment traps
     - Diversion banks
     - Sediment fences
     - Bunds (earth, hay, mulch)

- Geofabric liners
- Other control measures as appropriate

The Proponent should also provide details of:
- how leachate from stockpiled waste material will be kept separate from stormwater runoff;
- treatment of leachate through a wastewater treatment plant (if applicable); and
- any proposed transport and disposal of leachate off-site.

- Provide details of how the waste will be handled and managed during transport to a lawful facility. If the waste possesses hazardous characteristics, the Proponent must provide details of how the waste will be treated or immobilised to render it suitable for transport and disposal.

- Include details of all procedures and protocols to be implemented to ensure that any waste leaving the site is transported and disposed of lawfully and does not pose a risk to human health or the environment.

- Include a statement demonstrating that the Proponent is aware of EPA's requirements with respect to notification and tracking of waste.

- Include a statement demonstrating that the Proponent is aware of the relevant legislative requirements for disposal of the waste, including any relevant Resource Recovery Exemptions, as gazetted by EPA from time to time.

- Outline contingency plans for any event that affects operations at the site that may result in environmental harm, including: excessive stockpiling of waste, volume of leachate generated exceeds the storage capacity available on-site etc.

8 Dangerous Goods, Chemical storage and Bunding

- The EIS must outline all details regarding the transport, handling, storage and use of dangerous goods, chemicals and products, including fuel, both on site and with ancillary activities and describe the measures proposed to minimise the potential for leakage or the migration of pollutants into the soil/waters or from the site.

- The EIS should identify any fuel or chemical storage areas proposed for the site.

- The EIS should consider compliance with the following legislation, standards and guidelines where relevant:
  - Australian Standard AS1692:1989 Tanks for Flammable and combustible liquids;
  - The DECC's "Bunding and Spill Management" Technical Guideline (November 1997)
  - Australian Standard AS 1940:2004 The Storage and Handling of Flammable and Combustible Liquids
  - Australia Standard AS 4452-1997: The Storage and Handling of Toxic Substances;
  - Australian/New Zealand Standard AS/NZS 4452:1997: The Storage and Handling of Mixed Classes of Dangerous Goods in Packages and Intermediate Bulk Containers; and
  - Road and Rail Transport (Dangerous Goods) Act 1997

9 Monitoring Programs

The EIS should include a detailed assessment of any noise, air quality, weather, water or waste monitoring required during the construction and on-going operation of the site to ensure that the development achieves a satisfactory level of environmental performance. The evaluation should include a detailed description of the monitoring locations, sample analysis methods and the level of reporting proposed.

ATTACHMENT B

Guidance Material

Title	Web address
Relevant Legislation	
Protection of the Environment Operations Act 1997	http://www.legislation.nsw.gov.au/maintop/view/inforce/act+156+1997+cd+0+N
Protection of the Environment Operations (Clean Air) Regulation 2010	http://www.legislation.nsw.gov.au/maintop/view/inforce/subordleg+428+2010+cd+0+N
Licensing	
Guide to Licensing	http://www.epa.nsw.gov.au/resources/licensing/licensing-guide-160369.pdf
Air Issues	
Air Quality	
Approved methods for the Modelling and Assessment of Air Pollutants in NSW (2016)	http://www.epa.nsw.gov.au/resources/epa/approved-methods-for-modelling-and-assessment-of-air-pollutants-in-NSW-160666.pdf
Approved methods for the Sampling and Analysis of Air Pollutants in NSW (2016)	http://www.epa.nsw.gov.au/resources/air/07001amsaap.pdf
POEO (Clean Air) Regulation 2010	http://www.legislation.nsw.gov.au/maintop/view/inforce/subordleg+428+2010+cd+0+N
Noise and Vibration	
Interim Construction Noise Guideline (DECC, 2009)	http://www.epa.nsw.gov.au/resources/noise/09265cng.pdf
Assessing Vibration: a technical guideline (DEC, 2006)	http://www.epa.nsw.gov.au/resources/noise/vibrationguide0643.pdf
Australian and New Zealand Environment Council – Technical basis for guidelines to minimise annoyance due to blasting overpressure and ground vibration (ANZEC, 1990)	http://www.epa.nsw.gov.au/resources/noise/ANZECBlasting.pdf
NSW Industrial Noise Policy	http://www.epa.nsw.gov.au/resources/noise/ind_noise.pdf
NSW Road Noise Policy (DECCW, 2011)	http://www.epa.nsw.gov.au/resources/noise/2011236nswroadnoisepolicy.pdf
Waste	
Waste Classification Guidelines (EPA, 2014)	http://www.epa.nsw.gov.au/wasteregulation/classify-guidelines.htm
Resource recovery exemption	http://www.epa.nsw.gov.au/wasteregulation/recovery-exemptions.htm
Water and Soils	
Soils – general	
Soil and Landscape Issues in Environmental Impact Assessment (DLWC 2000)	http://www.dnr.nsw.gov.au/care/soil/soil_pubs/pdfs/tech_rep_34_new.pdf

Title	Web address
Managing urban stormwater: soils and construction, vol. 1 (Landcom 2004) and vol. 2 (A. Installation of services; B Waste landfills; C. Unsealed roads; D. Main Roads; E. Mines and quarries) (DECC 2008)	Vol 1 - Available for purchase at http://www.landcom.com.au/whats-new/publications-reports/the-blue-book.aspx Vol 2 - http://www.environment.nsw.gov.au/stormwater/publications.htm
Landslide risk management guidelines	http://www.australiangeomechanics.org/resources/downloads/
Site Investigations for Urban Salinity (DLWC, 2002)	http://www.environment.nsw.gov.au/resources/salinity/booklet3siteinvestigationsforurbansalinity.pdf
Local Government Salinity Initiative Booklets	http://www.environment.nsw.gov.au/salinity/solutions/urban.htm
Water	
Water Quality Objectives	http://www.environment.nsw.gov.au/ieo/index.htm
ANZECC (2000) Guidelines for Fresh and Marine Water Quality	http://www.mincos.gov.au/publications/australian_and_new_zealand_guidelines_for_fresh_and_marine_water_quality
Applying Goals for Ambient Water Quality Guidance for Operations Officers – Mixing Zones	http://deccnet/water/resources/AWQGuidance7.pdf
Approved Methods for the Sampling and Analysis of Water Pollutant in NSW (2004)	http://www.epa.nsw.gov.au/resources/legislation/approvedmethods-water.pdf

Level 6, 10 Valentine Avenue
Parramatta NSW 2150
Locked Bag 5020
Parramatta NSW 2124
DX 8225 PARRAMATTA

Telephone: 61 2 9873 8500
Facsimile: 61 2 9873 8599
heritagemailbox@environment.nsw.gov.au
www.heritage.nsw.gov.au

File No: EF17/9967
Ref No: DOC17/427040

Genevieve Seed
Senior Planning Officer - Resource Assessments
Department of Planning & Environment
23-33 Bridge Street
SYDNEY NSW 2000

E-mail:Genevieve.Seed@planning.nsw.gov.au

Dear Ms Seed

Request for Secretary's Environmental Assessment Requirements (SEARs) for Sancrox Quarry Extension Project (SSD 7293).

Reference is made to your correspondence received on 17 August 2017 requesting SEARs input from the Heritage Council of NSW (the Heritage Council) for the above proposal.

After a review of the documentation, it appears that the proposed State Significant Development (SSD) site does not include any items on the State Heritage Register. However, it is noted that an early grave is identified from the National Trust Register in the suburb of Sancrox and this area may have other historical archaeological potential associated with the development of the settlement of Port Macquarie Hastings Council LGA which requires consideration and management.

It is recommended that although the Proponent did not identify heritage as an issue, the following additional SEARS are included to address this potential:

- The Environmental Impact Statement (EIS) should identify if there are any potential heritage items within the proposed project area including historical archaeological potential. If any potential heritage items are likely to be affected, a Heritage Impact Statement (HIS) must be prepared in accordance with the guidelines in the NSW Heritage Manual 1996. The HIS should assess how the development would impact on any places of heritage significance in or surrounding the SSD site.
- A historical archaeological assessment should be prepared by a suitably qualified historical archaeologist in accordance with the Heritage Division, Office of Environment and Heritage Guidelines *'Assessing Significance for Historical Archaeological Sites and 'Relics'* 2009. This assessment should identify what relics, if any, are likely to be present, assess their significance and consider the impacts from the proposal on this potential resource. Where harm is likely to occur, it is recommended that the significance of the relics be considered in determining an appropriate mitigation strategy. If harm cannot be avoided in whole or part, an appropriate Research Design and Excavation Methodology should also be prepared to guide any proposed excavations.

If you have any questions regarding the above matter, please contact Felicity Barry, Senior Archaeologist, at the Heritage Division, Office of Environment and Heritage on telephone (02) 9995 6914 or by e-mail: Felicity.Barry@environment.nsw.gov.au.

Yours sincerely

25/08/2017

Katrina Stankowski
Acting Manager, Listings
Heritage Division
Office of Environment & Heritage
As Delegate of the Heritage Council of NSW

Office of Environment & Heritage

Our Ref: DOC17/428839
Your Ref: SSD 7293

Ms Genevieve Seed
Senior Planning Officer
Department of Planning & Environment
GPO Box 39
Sydney NSW 2001

Dear Ms Seed

Re: Request for OEH Environmental Assessment Requirements – Hanson Construction Materials Pty Ltd Sancrox Quarry Extension, within the Port Macquarie Hasting Council Local Government Area (SSD 7293)

Thank you for your e-mail of 18 August 2017 inviting input from the Office of Environment and Heritage (OEH) for the preparation of Secretary's Environmental Assessment Requirements (SEARs) for the Sancrox Quarry Extension proposal. I appreciate the opportunity to provide advice.

The OEH notes that the proposal will be assessed as State Significant Development/Infrastructure in accordance with Part 4 of the *Environmental Planning and Assessment Act 1979* (EP&A Act). The Environmental Impact Statement (EIS) SEARs provided by OEH are limited to Aboriginal cultural heritage, biodiversity, OEH estate, historic heritage, acid sulphate soils, flooding, stormwater and coastal erosion.

We also advise that the OEH SEARs, as it relates to biodiversity, have been issued with respect to the *Biodiversity Conservation Act 2016.*

The proponent should ensure that the EIS will be sufficiently comprehensive to enable unambiguous determination of the extent of the direct and indirect impact(s) of the proposal. The EIS should include an appropriate assessment of the potential impacts on biodiversity (threatened species, ecological communities, or their habitat), and Aboriginal cultural heritage. OEH considers that this information is necessary to assess an EIS for the proposal.

The full lists of OEH's standard and project specific requirements that may need to be addressed in the EIS are provided in **Attachment A** and **Attachment B** respectively. In preparing the EIS, the proponent should refer to the relevant guidance material listed in **Attachment C.**

If you have any further questions about this issue, Ms Rachel Binskin, Regional Operations Officer, Regional Operations, OEH, can be contacted on 6659 8247or at rachel.binskin@environment.nsw.gov.au.

Locked Bag 914 Coffs Harbour NSW 2450
Federation House, Level 8, 24 Moonee Street
Coffs Harbour NSW 2450
Tel: (02) 6659 8200 Fax: (02) 6651 5356
ABN 30 841 387 271
www.environment.nsw.gov.au

Yours sincerely

7.9.17

KRISTER WAERN
A/Senior Team Leader Planning, North East Region
Regional Operations

Contact officer: RACHEL BINSKIN
6659 8247

Enclosure: Attachment A – OEH Standard Environmental Assessment Requirements, Attachment B – OEH Project Specific Requirements, and Attachment C – Guidelines Materials

Attachment A – OEH Standard Environmental Assessment Requirements (SSD 7036)

Biodiversity
1. Biodiversity impacts related to the proposed project are to be assessed in accordance with the Biodiversity Offset Scheme (BOS), and documented in a Biodiversity Development Assessment Report (BDAR) in accordance with Part 6 of the *Biodiversity Conservation Act 2016* (BC Act). The BDAR is to be prepared by a person accredited in accordance with s6.10 of the BC Act.
Aboriginal cultural heritage
2. The EIS must identify and describe the Aboriginal cultural heritage values that exist across the whole area that will be affected by the project and document these in the EIS. This may include the need for surface survey and test excavation. The identification of cultural heritage values should be guided by the *Guide to investigating, assessing and reporting on Aboriginal Cultural Heritage in NSW* (DECCW, 2011) and consultation with OEH regional officers.
3. Where Aboriginal cultural heritage values are identified, consultation with Aboriginal people must be undertaken and documented in accordance with the *Aboriginal cultural heritage consultation requirements for proponents 2010* (DECCW). The significance of cultural heritage values for Aboriginal people who have a cultural association with the land must be documented in the EIS.
4. Impacts on Aboriginal cultural heritage values are to be assessed and documented in the EIS. The EIS must demonstrate attempts to avoid impact upon cultural heritage values and identify any conservation outcomes. Where impacts are unavoidable, the EIS must outline measures proposed to mitigate impacts. Any objects recorded as part of the assessment must be documented and notified to OEH.
Historic heritage
5. The EIS must provide a heritage assessment including but not limited to an assessment of impacts to *State and local heritage* including conservation areas, natural heritage areas, places of Aboriginal heritage value, buildings, works, relics, gardens, landscapes, views, trees should be assessed. Where impacts to State or locally significant heritage items are identified, the assessment shall: a. outline the proposed mitigation and management measures (including measures to avoid significant impacts and an evaluation of the effectiveness of the mitigation measures) generally consistent with the NSW Heritage Manual (1996), b. be undertaken by a suitably qualified heritage consultant(s) (note: where archaeological excavations are proposed the relevant consultant must meet the NSW Heritage Council's Excavation Director criteria), c. include a statement of heritage impact for all heritage items (including significance assessment), d. consider impacts including, but not limited to, vibration, demolition, archaeological disturbance, altered historical arrangements and access, landscape and vistas, and architectural noise treatment (as relevant), and e. where potential archaeological impacts have been identified develop an appropriate archaeological assessment methodology, including research design, to guide physical archaeological test excavations (terrestrial and maritime as relevant) and include the results of these test excavations.

Water and soils

6. The EIS must map the following features relevant to water and soils including:
   a. Acid sulfate soils (Class 1, 2, 3 or 4 on the Acid Sulfate Soil Planning Map).
   b. Rivers, streams, wetlands, estuaries (as described in s4 of the Biodiversity Assessment Method as part of the Landscape Context).
   c. Groundwater.
   d. Groundwater dependent ecosystems.
   e. Proposed intake and discharge locations.

7. The EIS must describe background conditions for any water resource likely to be affected by the project, including:
   a. Existing surface and groundwater.
   b. Hydrology, including volume, frequency and quality of discharges at proposed intake and discharge locations.
   c. Water Quality Objectives (as endorsed by the NSW Government http://www.environment.nsw.gov.au/ieo/index.htm) including groundwater as appropriate that represent the community's uses and values for the receiving waters.
   d. Indicators and trigger values/criteria for the environmental values identified at (c) in accordance with the ANZECC (2000) Guidelines for Fresh and Marine Water Quality and/or local objectives, criteria or targets endorsed by the NSW Government.

8. The EIS must assess the impacts of the project on water quality, including:
   a. The nature and degree of impact on receiving waters for both surface and groundwater, demonstrating how the project protects the Water Quality Objectives where they are currently being achieved, and contributes towards achievement of the Water Quality Objectives over time where they are currently not being achieved. This should include an assessment of the mitigating effects of proposed stormwater and wastewater management during and after construction.
   b. Identification of proposed monitoring of water quality.

9. The EIS must assess the impact of the project on hydrology, including:
   a. Water balance including quantity, quality and source.
   b. Effects to downstream rivers, wetlands, estuaries, marine waters and floodplain areas.
   c. Effects to downstream water-dependent fauna and flora including groundwater dependent ecosystems.
   d. Impacts to natural processes and functions within rivers, wetlands, estuaries and floodplains that affect river system and landscape health such as nutrient flow, aquatic connectivity and access to habitat for spawning and refuge (e.g. river benches).
   e. Changes to environmental water availability, both regulated/licensed and unregulated/rules-based sources of such water.
   f. Mitigating effects of proposed stormwater and wastewater management during and after construction on hydrological attributes such as volumes, flow rates, management methods and re-use options.
   g. Identification of proposed monitoring of hydrological attributes.

Flooding and coastal erosion
10. The EIS must map the following features relevant to flooding as described in the Floodplain Development Manual 2005 (NSW Government 2005) including: a. Flood prone land b. Flood planning area, the area below the flood planning level. c. Hydraulic categorisation (floodways and flood storage areas).
11. The EIS must describe flood assessment and modelling undertaken in determining the design flood levels for events, including a minimum of the 1 in 10 year, 1 in 100-year flood levels and the probable maximum flood, or an equivalent extreme event.
12. The EIS must model the effect of the proposed project (including fill) on the flood behaviour under the following scenarios: a. Current flood behaviour for a range of design events as identified in 8) above. The 1 in 200 and 1 in 500-year flood events as proxies for assessing sensitivity to an increase in rainfall intensity of flood producing rainfall events due to climate change.
13. Modelling in the EIS must consider and document: a. The impact on existing flood behaviour for a full range of flood events including up to the probable maximum flood. b. Impacts of the development on flood behaviour resulting in detrimental changes in potential flood affection of other developments or land. This may include redirection of flow, flow velocities, flood levels, hazards and hydraulic categories. c. Relevant provisions of the NSW Floodplain Development Manual 2005.
14. The EIS must assess the impacts on the proposed project on flood behaviour, including: a. Whether there will be detrimental increases in the potential flood affectation of other properties, assets and infrastructure. b. Consistency with Council floodplain risk management plans. c. Compatibility with the flood hazard of the land. d. Compatibility with the hydraulic functions of flow conveyance in floodways and storage in flood storage areas of the land. e. Whether there will be adverse effect to beneficial inundation of the floodplain environment, on, adjacent to or downstream of the site. f. Whether there will be direct or indirect increase in erosion, siltation, destruction of riparian vegetation or a reduction in the stability of river banks or watercourses. g. Any impacts the development may have upon existing community emergency management arrangements for flooding. These matters are to be discussed with the SES and Council. h. Whether the proposal incorporates specific measures to manage risk to life from flood. These matters are to be discussed with the SES and Council. i. Emergency management, evacuation and access, and contingency measures for the development considering the full range or flood risk (based upon the probable maximum flood or an equivalent extreme flood event). These matters are to be discussed with and have the support of Council and the SES. j. Any impacts the development may have on the social and economic costs to the community as consequence of flooding.

Attachment B – OEH Project-specific Environmental Assessment Requirements (SSD 7036)

Biodiversity

1. The species listed below as 1(a) and (b) are to be included, as part of the 'potential' serious and irreversible impacts, on other threatened entities as part of s10.2.1.5 of the *Biodiversity Assessment Method 2017* (BAM), not listed in the *Guidance and criteria to assist a decision maker to determine a serious and irreversible*. Should one of these entities be identified during survey, the proponent is required to provide additional information in accordance with section 10.2 of the BAM.
    a. *Dendrobium melaleucaphilum* – Spider Orchid
    b. *Phaius australis* – Southern Swamp Orchid
2. The EIS is to include relevant local planning undertaken by the Port Macquarie - Hastings Council for the Greater Sancrox Area, in the context of the greater landscape to assess existing, and future habitat connectivity, especially in regards to alignment of subregional corridors, and local habitat linkages in accordance with s4.2.1.3 (d) of the BAM.

Aboriginal cultural heritage

3. The assessment of cultural heritage values must include a surface survey undertaken by a qualified archaeologist in areas with potential for subsurface Aboriginal deposits. The result of the surface survey is to inform the need for targeted test excavation to better assess the integrity, extent, distribution, nature and overall significance of the archaeological record. The results of surface surveys and test excavations are to be documented in the EIS.
4. The EIS must outline procedures to be followed if Aboriginal objects are found at any stage of the life of the proposal to formulate appropriate measures to manage unforeseen impacts.
5. The EIS must outline procedures to be followed in the event Aboriginal burials or skeletal material is uncovered during construction to formulate appropriate measures to manage the impacts to this material.

Flooding and coastal erosion

6. The EIS must consider the effects of sea level rise on all flood risks on the site under the following scenarios:
    a. Current sea level.
    b. Projected sea levels in 2050 and 2100 which have been peer-reviewed and widely accepted by scientific opinion.

Attachment C – OEH Guidance Material (SSD 7036)

Title	Web address
Relevant Legislation	
Biodiversity Conservation Act 2016	https://www.legislation.nsw.gov.au/~/view/act/2016/63/full
Coastal Management Act 2016	https://www.legislation.nsw.gov.au/~/view/act/2016/20
Commonwealth Environment Protection and Biodiversity Conservation Act 1999	http://www.austlii.edu.au/au/legis/cth/consol_act/epabca1999588/
Environmental Planning and Assessment Act 1979	http://www.legislation.nsw.gov.au/maintop/view/inforce/act+203+1979+cd+0+N
Fisheries Management Act 1994	http://www.legislation.nsw.gov.au/maintop/view/inforce/act+38+1994+cd+0+N
Marine Parks Act 1997	http://www.legislation.nsw.gov.au/maintop/view/inforce/act+64+1997+cd+0+N
National Parks and Wildlife Act 1974	http://www.legislation.nsw.gov.au/maintop/view/inforce/act+80+1974+cd+0+N
Protection of the Environment Operations Act 1997	http://www.legislation.nsw.gov.au/maintop/view/inforce/act+156+1997+cd+0+N
Water Management Act 2000	http://www.legislation.nsw.gov.au/maintop/view/inforce/act+92+2000+cd+0+N
Wilderness Act 1987	http://www.legislation.nsw.gov.au/viewtop/inforce/act+196+1987+FIRST+0+N
Biodiversity	
Biodiversity Conservation Regulation 2017	https://www.legislation.nsw.gov.au/~/view/regulation/2017/432
Biodiversity Conservation (Savings and Transitional) Regulation 2017	https://www.legislation.nsw.gov.au/~/view/regulation/2017/433
Biodiversity Assessment Method (OEH, 2017)	http://www.environment.nsw.gov.au/biodiversity/assessmentmethod.htm
Online Biodiversity Assessment Method Calculator	https://www.lmbc.nsw.gov.au/bamcalc
Serious and irreversible impact (OEH, 2017)	http://www.environment.nsw.gov.au/biodiversity/seriousirreversibleimpacts.htm
Offset Rules	http://www.environment.nsw.gov.au/biodiversity/offsetrules.htm
Fisheries NSW policies and guidelines	http://www.dpi.nsw.gov.au/fisheries/habitat/publications/policies,-guidelines-and-manuals/fish-habitat-conservation
List of national parks	http://www.environment.nsw.gov.au/NationalParks/parksearchatoz.aspx
Revocation, re-categorisation and road adjustment policy (OEH, 2012)	http://www.environment.nsw.gov.au/policies/RevocationOfLandPolicy.htm
Guidelines for developments adjoining land and water managed by the Department of Environment, Climate Change and Water (DECCW, 2010)	http://www.environment.nsw.gov.au/protectedareas/developmntadjoiningdecc.htm
Heritage	

Title	Web address
The Burra Charter (The Australia ICOMOS charter for places of cultural significance)	http://australia.icomos.org/wp-content/uploads/The-Burra-Charter-2013-Adopted-31.10.2013.pdf
Statements of Heritage Impact 2002 (HO & DUAP)	http://www.environment.nsw.gov.au/resources/heritagebranch/heritage/hmstatementsofhi.pdf
NSW Heritage Manual (DUAP) (scroll through alphabetical list to 'N')	http://www.environment.nsw.gov.au/Heritage/publications/
Aboriginal Cultural Heritage	
Aboriginal Cultural Heritage Consultation Requirements for Proponents (DECCW, 2010)	http://www.environment.nsw.gov.au/resources/cultureheritage/commconsultation/09781ACHconsultreq.pdf
Code of Practice for the Archaeological Investigation of Aboriginal Objects in New South Wales (DECCW, 2010)	http://www.environment.nsw.gov.au/resources/cultureheritage/10783FinalArchCoP.pdf
Guide to investigating, assessing and reporting on Aboriginal cultural heritage in NSW (OEH 2011)	http://www.environment.nsw.gov.au/resources/cultureheritage/20110263ACHguide.pdf
Aboriginal Site Recording Form	http://www.environment.nsw.gov.au/resources/parks/SiteCardMainV1_1.pdf
Aboriginal Site Impact Recording Form	http://www.environment.nsw.gov.au/resources/cultureheritage/120558asirf.pdf
Aboriginal Heritage Information Management System (AHIMS) Registrar	http://www.environment.nsw.gov.au/contact/AHIMSRegistrar.htm
Care Agreement Application form	http://www.environment.nsw.gov.au/resources/cultureheritage/20110914TransferObject.pdf
Water and Soils	
Acid sulphate soils	
Acid Sulfate Soils Planning Maps via Data NSW	http://data.nsw.gov.au/data/
Acid Sulfate Soils Manual (Stone et al. 1998)	http://www.environment.nsw.gov.au/resources/epa/Acid-Sulfate-Manual-1998.pdf
Acid Sulfate Soils Laboratory Methods Guidelines (Ahern et al. 2004)	http://www.environment.nsw.gov.au/resources/soils/acid-sulfate-soils-laboratory-methods-guidelines.pdf This replaces Chapter 4 of the Acid Sulfate Soils Manual above.
Flooding and Coastal Erosion	
Reforms to coastal erosion management	http://www.environment.nsw.gov.au/coasts/coastalerosionmgmt.htm
Floodplain development manual	http://www.environment.nsw.gov.au/floodplains/manual.htm
Guidelines for Preparing Coastal Zone Management Plans	Guidelines for Preparing Coastal Zone Management Plans http://www.environment.nsw.gov.au/resources/coasts/130224CZMPGuide.pdf
NSW Climate Impact Profile	http://climatechange.environment.nsw.gov.au/
Climate Change Impacts and Risk Management	Climate Change Impacts and Risk Management: A Guide for Business and Government, AGIC Guidelines for Climate Change Adaptation
Water	
Water Quality Objectives	http://www.environment.nsw.gov.au/ieo/index.htm

Title	Web address
ANZECC (2000) Guidelines for Fresh and Marine Water Quality	www.environment.gov.au/water/publications/quality/australian-and-new-zealand-guidelines-fresh-marine-water-quality-volume-1
Applying Goals for Ambient Water Quality Guidance for Operations Officers – Mixing Zones	http://deccnet/water/resources/AWQGuidance7.pdf
Approved Methods for the Sampling and Analysis of Water Pollutant in NSW (2004)	http://www.environment.nsw.gov.au/resources/legislation/approvedmethods-water.pdf

NSW RURAL FIRE SERVICE

The Secretary
NSW Planning & Environment
GPO Box 39
Sydney NSW 2001

Your Ref: SSD 7293
Our Ref: D15/2871
DA17082308907 AB

ATTENTION: Genevieve Seed

31 August 2017

Dear Ms Seed,

Request for Secretary's Environmental Assessment Requirements - Sancrox Quarry Extension

I refer to your email from the NSW Department of Planning & Environment dated 17 August 2017 seeking comment from the NSW Rural Fire Service on matters to be included in the Secretary's Environmental Assessment Requirements for the proposed Sancrox Quarry extension.

The subject land is mapped as bushfire prone land by Port Macquarie - Hastings Council. The NSW Rural Fire Service considers that the environmental assessment for the proposed development should address the following:

- the aim and objectives of 'Planning for Bushfire Protection 2006';
- identification of bush fire prone land within 140 metres of the proposed development;
- identification of potential ignition sources during construction and operation of the development;
- storage of fuels and other hazardous materials (e.g. explosives for blasting);
- stockpiling of any mulched vegetation;
- proposed bushfire protection measures for the development, including vegetation management and fire suppression capabilities;
- operational access for fire fighting appliances to the site; and
- emergency and evacuation planning.

Postal address
Records
NSW Rural Fire Service
Locked Bag 17
GRANVILLE NSW 2142

Street address
NSW Rural Fire Service
Planning and Environment Services (North)
Suite 1, 129 West High Street
COFFS HARBOUR NSW 2450

T (02) 6691 0400
F (02) 6691 0499
www.rfs.nsw.gov.au
Email: pes@rfs.nsw.gov.au

For any queries regarding this correspondence please contact Alan Bawden on 6691 0400.

Yours sincerely,

Ian Cook
Acting Manager – Planning and Environment Services North

The RFS has made getting information easier. For general information on 'Planning for Bush Fire Protection, 2006', visit the RFS web page at www.rfs.nsw.gov.au and search under 'Planning for Bush Fire Protection, 2006'.

File No: NTH12/00067/06
Your Ref: SSD_7293

The Manager
Department of Planning and Environment
GPO Box 39
SYDNEY NSW 2001

Attention: Genevieve Seed – Senior Planning Officer

Dear Sir / Madam,

Secretary's Environmental Assessment Requirements for SSD 7293 – Sancrox Quarry, Sancrox Road, Sancrox

I refer to your email of 17 August 2017 requesting an updated to the Secretary's Environmental Assessment Requirements (EARs) for the abovementioned state significant development.

Roles and Responsibilities

The key interests for Roads and Maritime Services are the safety and efficiency of the road network, traffic management, the integrity of infrastructure assets and the integration of land use and transport.

Port Macquarie-Hastings Council is the Roads Authority for all public roads in the subject area pursuant to Section 7 of the *Roads Act 1993* Roads and Maritime is the roads authority for freeways and can exercise road authority functions for classified roads in accordance with the Roads Act. Council is responsible setting standards, determining priorities and carrying out works on public (local) roads.

Roads and Maritime Response

Roads and Maritime requests that the Environmental Assessment be supported by a Traffic Impact Assessment (TIA) prepared by a suitably qualified person in accordance with the Austroads Guide to Traffic Management Part 12, the complementary Roads and Maritime Supplement and RTA Guide to Traffic Generating Developments. The TIA is to address the following;

- The total impact of existing and proposed development on the road network with consideration for a 10 year horizon.
- The volume and distribution of traffic generated by the proposed development.
- Intersection sight distances at key intersections along the primary haul route.
- Existing and proposed site access standards.
- Details of proposed improvements to affected intersections.
- Details of servicing and parking arrangements.

- Impact on public transport (public and school bus routes) and consideration for alternative transport modes such as walking and cycling.
- Impacts of road traffic noise and/or dust generated along the primary haul route/s.
- Consideration for Clause 16(1) of the Mining SEPP regarding;
    - Impact on school zones and residential areas.
    - Code of Conduct for haulage operators
    - Road safety assessment of key haulage route/s

  Should Council wish to condition the preparation of a Code of Conduct for haulage operators, this could include, but not be limited to;

  a. A map of the primary haulage routes highlighting critical locations.
  b. Safety initiatives for haulage through residential areas and/or school zones.
  c. An induction process for vehicle operators & regular toolbox meetings.
  d. A complaint resolution and disciplinary procedure.
  e. Any community consultation measures for peak haulage periods.

Where road safety concerns are identified at a specific location along the identified haulage route/s, Roads and Maritime suggests that the TIA be supported by a targeted Road Safety Audit undertaken by suitably qualified persons.

The current Austroads Guidelines, Australian Standards and Roads and Maritime Supplements are to be adopted for any proposed works on the classified road network.

The Developer would be required to enter into a 'Works Authorisation Deed' (WAD) with Roads and Maritime for any works deemed necessary on the classified road network. The developer would be responsible for all costs associated with the works and administration for the WAD. Further information on undertaking private developments adjacent to classified roads can be accessed at:

http://www.rms.nsw.gov.au/projects/planning-principles/index.html

Advice to the Consent Authority

Roads and Maritime highlights the Consent Authority is responsible for considering the environmental impacts of any road works which are ancillary to the development. This includes any works which form part of the proposal and/or any works deemed necessary to include as requirements in the conditions of development consent.

If you have any further enquiries regarding the above comments please contact Bill Butler, A / Manager Land Use Assessment on (02) 6640 1362 or via email at: development.northern@rms.nsw.gov.au

Yours faithfully

W.R Butler

for Liz Smith
A / Network & Safety Manager, Northern Region

Port Macquarie-Hastings Council
PO Box 84
Port Macquarie
NSW Australia 2444
DX 7415
e council@pmhc.nsw.gov.au

ABN 11 236 901 601

PORT MACQUARIE HASTINGS COUNCIL

21 August 2017

Refers to: CRM 16196/2017
Your Ref: SSD 7293
Parcel No.: 18314, 18327, 28897 & 28898

Genevieve Seed
Senior Planning Officer
GPO Box 39
SYDNEY NSW 2001
genevieve.seed@planning.nsw.gov.au

Dear Genevieve

Updated Secretary's Environmental Assessment Requirements (SEARs) for Sancrox Quarry Extension Project (SSD 7293) at Sancrox Road, Sancrox

I refer to your email to Council dated 17 August 2017 regarding the above matter.

Please be advised that Council staff have reviewed the current proposal, the SEARs issued on 19 October 2015 and the previous requirements of the other Government Departments. A summary of the key Council matters for consideration include:

- The property is largely zoned RU1 Primary Production under the Port Macquarie Hastings Local Environmental Plan 2011. However, Lot 1 DP 704890 also contains IN1 General Industrial and SP2 Special Purposes zoning. Proposal to address permissibility of the quarry and associated aspects.
- Compliance with State Environmental Planning Policy (State and Regional Development) 2011 to be outlined.
- State Environmental Planning Policy No 33 - Hazardous and Offensive Development to be considered.
- State Environmental Planning Policy No 44 – Koala Habitat Protection to be considered.
- State Environmental Planning Policy No 55 – Remediation of Land to be considered.
- State Environmental Planning Policy No 62 – Sustainable Aquaculture to be considered given proximity to Hastings River and tributaries.
- State Environmental Planning Policy No 64 – Advertising and Signage to be considered if any signage proposed (ie quarry business identification signs).
- State Environmental Planning Policy No 71 – Coastal Protection applies to part of the land and is therefore to be considered.
- State Environmental Planning Policy (Infrastructure) 2007 to be considered. In particular, Division 17, Subdivision 2 provisions.
- State Environmental Planning Policy (Mining, Petroleum Production and Extractive Industries) 2007 to be considered.
- State Environmental Planning Policy (Rural Lands) 2007 to be considered.
- Proposal to have regard for the Port Macquarie Hastings Local Environmental Plan 2011 (LEP 2011).

PORT MACQUARIE OFFICE
17 Burrawan Street, Port Macquarie NSW 2444
t 02 6581 8111 f 02 6581 8123

WAUCHOPE OFFICE
49 High Street, Wauchope NSW 2446
t 02 6589 6500

LAURIETON OFFICE
9 Laurie Street, Laurieton NSW 2443
t 02 6559 9958

Parcel No.: 18314, 18327, 28897 & 28898

- Lot 2 DP 574308 contains potential acid sulphate soils and is flood prone. These aspects will need to be addressed.
- Proposal should consider consolidating all the parcels of land into one lot.
- Noise, air and vibration impacts from the quarry operations, concrete batching plant etc and associated flow on activities (ie truck movements) to be addressed. Any proposed buffers will need to be contained on the quarry site or an agreement in place with impacted neighbours.
- The applicant is to contact Council's Contribution Section to ascertain if any s94A contributions, s64 contributions and/or Voluntary Planning Agreement (VPA) is required to address impacts associated with the extension.
- Details of any staging to be included in the application.
- Details of any rehabilitation and final use to be detailed in the application.
- Confirmation on what will happen to the existing consents applying to the site, including their rehabilitation and proposed final use.
- Proposal to address potential fly rock impacts on surrounding industrial and rural residential land. Any proposed buffers will need to be contained on the quarry site or an agreement in place with impacted neighbours.
- Traffic impact assessment should be required.
- Proposal to detail any existing structures/buildings to be retained and or demolished.
- Consideration should be given to closing and obtaining all of the Crown Road that traverses the site, not just the northern section.
- Stormwater management plan required.
- All processes involved in the quarry, batching plants etc to be detailed in the EIS.
- The application is to outline the proposed water and sewer supply with any connection to Council's reticulated system requiring Council approval.
- At this stage, the Sancrox area is also being considered by Council as a potential long term urban growth area.

Should you have any questions in relation to the above, please call me on 65818538 or email clinton.tink@pmhc.nsw.gov.au.

Yours sincerely

Clinton Tink
Development Assessment Planner

APPENDIX B

Methods Statement

APPENDIX B

Field Survey Details

1 Overview

The following field surveys were conducted as part of preparation of the Biodiversity Assessment Report (BAR) for the proposed Sancrox Quarry Expansion State Significant Development. The survey methods and effort were generally in accordance with the relevant sections of the *Framework for Biodiversity Assessment* ('FBA'; OEH 2014):

- Threatened species surveys, in accordance with Section 6.6 of the FBA, as follows:
  - A targeted survey for locally occurring threatened orchid species, conducted during the flowering periods of candidate threatened orchid species by an SLR Principal Ecologist on the 16 October 2015;
  - a five-day four-night survey for threatened fauna species conducted by two SLR ecologists from 30 November – 4 December 2015;
  - an additional threatened species survey over one-night and one day, conducted by one SLR ecologist between 14 and 15 December 2015, to meet recommended survey effort for a selection of potentially occurring threatened species;
- a plot-based full floristic survey (or 'plot/transect survey') of the Development Site, conducted by two SLR ecologists over two days, to collect site value data for vegetation condition and habitat values, according to Section 5.2 of the FBA.

Further details of the above survey techniques and survey effort are provided below.

2 Assessing Site Value

2.1 Mapping native vegetation extent

Patches of native vegetation were identified on the site prior to field work using available regional vegetation data for the Northern Rivers catchment and for Port Macquarie-Hastings LGA and aerial imagery. Broad vegetation formations and vegetation classes were mapped across the site and their areas calculated. This mapping allowed a field survey design to be completed, and formed the starting point for identifying native vegetation types.

These patches were assessed during field surveys to ascertain the extent, type and distribution of native vegetation types within these patches. Other parts of the site, including especially those where the proposed PPUs are located, were inspected on foot or driven to determine whether additional areas of native vegetation are present. In accordance with the Biobanking Methodology (DECC 2009) "*Cleared land is land on which the native over-storey has been cleared, there is no native mid-storey, and less than 50% of the ground cover vegetation is indigenous species, or greater than 90% of the ground cover is cleared*".

Subsequent to field work the OEH (2011) vegetation mapping was reviewed. Detailed consideration was given to methods used in that mapping (eg validation effort, patch size, canopy cover) and it was determined that whilst various additional patches of native vegetation are included in that vegetation the field efforts by SLR are most reliable in determining the presence of vegetation patches across the site.

2.2 Stratifying native vegetation

Based on field survey results, vegetation types (or plant community types, PCTs) were identified by matching floristic results from plot surveys (see next section) to floristic descriptions for relevant vegetation types listed for the Northern Rivers CMA in the *NSW Vegetation Types Database* (OEH, 2012). Patches of native vegetation types were further stratified into broad condition states of 'low' condition and 'moderate to good condition' (definitions as per DECC 2009a and thereby identified as distinct vegetation zones, according to Section 5.2.2 of the FBA. Vegetation zones are mapped and described in the accompanying report.

2.3 Plot and transect surveys

A plot-based full floristic survey of the development site was undertaken according to the methods outlined in Chapter 5 of the FBA. Plot and transect surveys were conducted to gather data on 'site value' for each vegetation zone and sample the environmental variation encountered within each zone. The number of plots sampled per vegetation zone was done according to the minimum requirements of the FBA, as listed in **Table 1**.

Table 1 Plots/transects required and collected per vegetation zone

Vegetation zone name	Vegetation type name	Total area (ha)	Minimum plots	Plots done
NR117_Moderate/Good	Blackbutt - Pink Bloodwood shrubby open forest of the coastal lowlands of the NSW North Coast Bioregion	0.55	1	1
NR247_Moderate/Good	Spotted Gum - Grey Ironbark open forest of the Macleay Valley lowlands of the NSW North Coast Bioregion	10.61	3	3
NR263_Moderate/Good	Tallowwood - Small-fruited Grey Gum dry grassy open forest of the foothills of the NSW North Coast	30.32	4	4
NR263_Moderate/Good_Poor	Tallowwood - Small-fruited Grey Gum dry grassy open forest of the foothills of the NSW North Coast	1.37	1	1
NR247_Moderate/Good_Poor	Spotted Gum - Grey Ironbark open forest of the Macleay Valley lowlands of the NSW North Coast Bioregion	0.25	1	1
	Total:	**43.10**	**10**	**10**

As listed in Table 1, the minimum number of plots/transects was completed for each vegetation zone.

The surveys were standard biobanking plot surveys (see DECC 2009 and OEH 2014) and involved

- Establishing a plot location randomly within a given vegetation zone, based on marking points randomly within each zone on a map of vegetation types. The locations of all plot/transects are shown in **Figure 8** of the BAR;
- A full floristic survey based on a 'nested' 20 m X 20 m quadrat, with all species recorded within the plot, including species name, growth form, and cover-abundance score according to the Braun-Blanquet scoring system (see Poore 1955)
- Establishing a 50 m transect through the centre of the plot and collecting data on six variables at various intervals along the transect (as listed in Table 2 of the FBA). The start point of the 50 m transect was recorded using a hand held GPS unit to allow mapping of the locations of all plot/transects;
- Establishing a 20 m X 50 m plot using the boundaries of the 20 m X 20 m plot and the 50 m transect, and recording (i) total length of fallen logs (>10 cm diameter and over 50 cm in length) and (ii) number of trees with hollows;
- Estimating the proportion of canopy trees that are regenerating within the zone.

The above data were collected using biobanking field sheets (DECC 2009b). The completed field data sheets are attached to the accompanying report in **Appendix C**.

3 Threatened Species Surveys

3.1 Overview

A range of threatened species have previously been recorded within the locality of the site. Section 6.6 of the FBA specifies the requirements for threatened species surveys:

- should be carried out at the appropriate time of year, as specified in the Threatened Species Profile Database;
- adopt repeatable methods
- must target all 'candidate' species credit species identified according to Section 6.5 of the FBA.
- Be conducted according to DEC (2004) guidelines for all species excluding frogs (see below); and
- For frogs, be conducted according to DECC (2009) guidelines.

Based on our search for previous records of threatened species in the Atlas of NSW Wildlife database (within 10 km of the site), we have generated a table listing threatened flora and fauna for consideration in the BAR. The table is provided in Appendix A and provides the recommended survey techniques and survey effort for each of group of threatened fauna. In identifying survey requirements for the BAR, we have relied on the following key guidelines:

- DEC (2004) Threatened Biodiversity Survey and Assessment: Guidelines for Developments and Activities, for threatened species (excluding frogs) listed under the TSC Act.
- DECC (2009) Threatened species survey and assessment guidelines: field survey methods for fauna. Amphibians, for threatened frogs listed under the TSC Act.
- DEWHA survey guidelines for Australia's threatened birds, bats, frogs and mammals, for threatened fauna listed under the EPBC Act.

In the SEARs, OEH have also identified threatened species 'requiring further consideration' in the BAR, as noted above, which are the threatened plants *Melaleuca biconvexa*, *Dendrobium melaleucaphilum* and *Phaius australis*.

The aim of the surveys was to gather site data and observations to inform this *Biodiversity Assessment Report* and involved:

- inspecting areas of native vegetation to refine vegetation community mapping and conditions in accordance with the FBA (OEH 2014);
- collection of detailed floristic and habitat data within the plant community types in accordance with the requirements of the BioBanking methodology;
- Spotlighting surveys throughout bushland areas and around waterbodies to detect nocturnal fauna species
- Call playback of relevant threatened forest owls and threatened amphibian calls during nocturnal surveys.
- Infrared and motion sensing camera surveys across various woodland habitats on the site to detect ground mammals and other fauna;
- Amphibian surveys (searches and call playback as well as dipnetting for tadpoles) in all waterbodies of bushland areas and quarry area.
- Anabat monitoring and Harp trapping for microchiropteran bats, focusing on areas where bat activity would be highest;
- Arboreal hairtube surveys for arboreal mammals in woodland habitats across the site;
- Glider-tube trap surveys for arboreal mammals in woodland habitats across the site;
- Elliot trap surveys for ground mammals in woodland habitats across the site;
- Cage surveys for ground mammals;

- Dawn bird surveys, in particular to target threatened species of birds known to the locality; and
- Surveys for important fauna habitat features.

3.2 Details of Survey Techniques

3.2.1 ELLIOT TRAP SURVEYS

Elliot trap surveys were conducted throughout the Site, to target threated ground mammals. Traps were set in a variety of habitats on the site including woodland on the ridge as well as gully area. Traps were placed adjacent to favourable habitat features for ground mammals such as hollow logs or dense ground vegetation. The traps were checked each morning before or on sunrise to minimize disturbance or heat stress to any captured nocturnal mammals.

Table 2 Elliot trap surveys

Date (2015)	Survey Effort (trap Nights)	Fauna groups targeted	Threatened species targeted	Comments
30 November – 3 December (4 nights)	3 transects with 10 units	Ground mammals	Rufous Bettong, Eastern Chestnut Mouse, Common Planigale	15 traps baited with peanut butter/oats/honey; 15 traps baited with meat
Total	120 TN			

3.3 Arboreal Hair Tube Surveys

Arboreal hair tube traps were installed on tree trunks throughout the site, to target threatened arboreal mammals (primarily the Brush-tailed Phascogale and Squirrel glider).

Date (2015)	Survey Effort (Trap Nights)	Fauna groups targeted	Threatened species targeted	Comments
01 December- 15 December	30 units x 14 nights	Arboreal mammals	Squirrel glider, Yellow-bellied glider, Brush-tailed Phascogale	Traps baited with peanut butter/oats/honey and attached to trees 3m above ground height.
Total	420 TN			

3.4 Glider Tube Surveys

Glider tube surveys were conducted throughout the site, to target threatened arboreal mammals. Tubes were installed on tree trunks approximately 3m above ground height and were baited with a peanut butter/oats/honey mix. Tree trunks were also sprayed with molasses liquid to attract gliders. All habitat types were surveyed including ridge top woodland and the gully woodland.

Table 3 Glider tube surveys

Date (2015)	Survey Effort (Trap Nights)	Fauna groups targeted	Threatened species targeted	Comments
01 December- 15 December	17 units x 4 nights	Arboreal mammals	Squirrel glider, Brush-tailed Phascogale	Traps baited with peanut butter/oats/honey Tubes placed 3m above ground height Tree trunks sprayed with molasses/water mixture
Total	68 TN			

3.5 Cage Trap Surveys

Cage trap surveys were conducted throughout the site, to target a range of threatened ground mammals. Priority was given to areas of the site with denser vegetation and favourable habitat features such as hollow logs. Such areas were more likely occurring in the various gullies across the site.

Table 4 Cage trap surveys

Date (2015)	Survey Effort (Trap Nights)	Fauna groups targeted	Threatened species targeted	Comments
30 November-3 December	5 units x 4 nights	Ground Mammals	Spotted-tailed Quoll, Common Planigale, Rufous Bettong, Eastern Chestnut Mouse	Traps baited with dog food and banana 2 cages set on ridge top 3 cages set in gully habitat
Total	20 TN			

3.6 Infrared Camera Surveys

Infrared cameras were set up throughout the site to target threatened ground mammals. Cameras were installed adjacent to favourable habitat features such as hollow logs or near to evidence of ground mammal activity (burrows or scratchings). Cameras are also motion sensing which allowed constant monitoring during day and night.

Table 5 Infrared Camera surveys

Date (2015)	Survey Effort (Trap Nights)	Fauna groups targeted	Threatened species targeted	Comments
30 November-3 December	5 units x 4 nights	Ground mammals	Spotted-tailed Quoll, Common Planigale, Rufous Bettong, Eastern Chestnut Mouse	Cameras baited with dog food, banana and molasses. Installed near favourable habitat features such as hollow logs.
04– 14 December-	4 units x10 nights	As above	As above	As above
Total	60 TN			

3.7 Spotlighting

Spotlighting surveys were conducted throughout the site, to target nocturnal mammals, owls, amphibians and other nocturnal fauna. All vegetation types were surveyed and special attention was given to areas of higher habitat value. Fauna species were detected both visually and aurally.

Table 6 Spotlighting surveys

Date (2015)	Survey Effort (person-hours)	Survey notes	Fauna groups targeted	Threatened species targeted
30 November (8-9pm; 9.30-10pm)	4.5	3 persons surveyed western area of site	Forest Owls, arboreal mammals, ground mammals	Powerful Owl, Sooty Owl, Masked Owl, Barking Owl, Brush-tailed Phascogale, Squirrel Glider, Yellow-bellied Glider, Grey-headed Flying-fox, Koala, Common Planigale, Spotted-tailed Quoll, Eastern Chestnut Mouse and Rufous Bettong.
01 December (9.10 – 10.30pm)	2.7	2 persons surveyed ridge top and gully near quarry	Forest Owls, arboreal mammals, ground mammals	As above
02 December (10.30- 11pm)	0.5	1 person surveyed southeast area	Forest Owls, arboreal mammals, ground mammals	As above
03 December (9-10pm)	3	3 persons surveyed northern/central area and southern gully	Forest Owls, arboreal mammals, ground mammals	As above
14 December (9-9.45pm)	1.5	2 persons surveyed western area	Forest Owls, arboreal mammals, ground mammals	As above
Total	12.2			

3.8 Call Playback

Pre-recorded calls of the Masked Owl, Powerful Owl Sooty Owl, Barking Owl, and Grass Owl were broadcast on numerous locations during the 2015 field surveys. Surveys commenced after dusk with each call being broadcast for 5 minutes followed by a two-minute listening period. Ten minutes were spent listening for calls prior to and after playback. Call playback was conducted within three hours after sunset.

Table 7 Call playback surveys

Date (2015)	Survey Effort (hrs)	Calls Broadcast	Survey Area	Comments
30 November (9.30-10pm)	1.0	Powerful Owl, Sooty Owl, Masked Owl, Grass Owl, Barking Owl	Western area of site	Broadcast during final half-hour of spotlight; 2 persons observing
01 December (9-10pm)	1.0	Powerful Owl, Sooty Owl, Masked Owl, Grass Owl, Barking Owl	Central area of site	2 persons broadcast at random throughout spotlight
02 December (10.30- 11pm)	0.5	Powerful Owl, Sooty Owl, Masked Owl, Grass Owl, Barking Owl	Southeast area of site	1 person broadcasting and spotlight
03 December (9.30-10pm)	0.5	Powerful Owl, Sooty Owl, Masked Owl, Grass Owl, Barking Owl	Central area of site	1 person broadcasting and spotlight
14 December(9.30 – 10.15)	1.5	Powerful Owl, Masked Owl, Barking Owl	Western bushland area	Broadcast during final 45 minutes of spotlight; 2 persons observing
TOTAL	**4.5 hours (5 nights)**			

3.9 Stag-watching

Table 8 Stag-watching survey effort and details

Date	Survey Effort (person-hours)	Survey notes	Fauna groups targeted	Threatened species targeted
01 December (7.40-9.10pm)	3.0	2 persons. Large grey gum and large stag near ridge	Forest owls, arboreal mammals, microchiropteran bats	Powerful Owl, Sooty Owl, Masked Owl, Barking Owl, Brush-tailed Phascogale, Squirrel Glider, Yellow-bellied Glider and microchiropteran bats.
02 December (7.30- 9pm)	3.0	2 persons. Large Blackbutt on ridge (near quarry) and large Bloodwood in western area.	As above	As above
03 December (7.30- 9 pm)	4.5	3 persons. Large Grey Gum near central disturbed area, large stag in northern area and large Grey Gum closer to Quarry.	As above	As above
14 December (7.30- 9pm)	3.0	2 persons. Large stag and large Spotted Gum, both in central northern area.	As above	As above
Total	13.5 hrs			

3.10 Amphibian Surveys

Diurnal and Nocturnal searches including broadcasts of pre-recorded calls of threatened amphibians including Green and Golden Bell Frog, Giant Barred Frog, Green-thighed Frog, Wallum Froglet. All waterbodies were surveyed including three large retention dams in quarry. Various soaks and depressions were also surveyed during rain periods. Tadpoles were surveyed for using dip-netting in shallow areas although due to the man-made nature of the waterbodies (farm and quarry dams) access was sometimes difficult and due to deep centres, only edges of waterbodies could be sampled.

Table 9 Amphibian surveys

Date	Survey Effort (person-hours)	Method	Surveyed Area	Species targeted	Comments
30 November (7 -8pm; 9-9.30pm)	4.5	Diurnal survey and call playback	Western farm dam	Green and Golden Bell Frog, Giant Barred Frog, Green-thighed Frog, Wallum Froglet	3 persons observing
01 December (5 - 6.45pm)	3.5	Diurnal survey and call playback	Large dams inside quarry	As above	2 persons observing
02 December(6-7pm & 9-10:30pm)	2	Call playback and dip netting	Western farm dam	As above	2 persons observing
02 December(9-10.30pm)	3	Dip netting, Call playback and spotlighting	central disturbed area depressions and 2 large quarry dams	As above	2 persons observing
3rd December (5:30-7:30pm)	6	Dip netting, Call playback and	Main quarry dams.	As above	3 persons observing
3rd December (9 – 9:15pm)	0.25	Brief call playback	Soak in southern gully area	Green-thighed Frog, Wallum Froglet	1 person

Date	Survey Effort (person-hours)	Method	Surveyed Area	Species targeted	Comments
14th December (6-7:30pm)	3	Diurnal searches and call playback	Two large dams in quarry and farm dam in western area	Green and Golden Bell Frog, Giant Barred Frog	2 persons observing
Total	**22.25 hrs**				

3.11 Microchiropteran Bat Surveys

Harp Traps and Anabat recorders were employed to detect microchiropteran bats. Harp Traps were placed in appropriate areas for bat detection including coastal woodland and dry sclerophyll forest. Traps were left for a minimum of two nights. Anabat recorders are useful in detecting high flying microchiropteran bats that are often under sampled by bat (harp) trapping. Anabat surveys were conducted passively using three units at stationary points from dusk until dawn.

In addition to electronic monitoring, Harp traps were deployed in various locations of the site to physically catch low-flying microchiropteran bats. Harp traps were set at dusk each night in some of the small roads/trails found across the site. These trails act as 'fly ways' for bats and are more likely to be frequented during the night.

Table 10 Microchiropteran bat surveys.

Survey Type	Date (2015)	Survey (hours)	Survey effort (Detector nights)	Area Surveyed
Anabat	30/11-01/12	(7pm -6am)	3	3 units placed in western area of site; one on edge of farm dam
	01/12-02/12	(7pm -6am)	3	As above
	02/12-03/12	(7pm -6am)	3	One unit remain at farm dam. Two units moved to woodland areas near ridge and central disturbed area.
	03/12-04/12	(7pm -6am)	3	As above except for one unit moved to large southern dam in quarry.
	TOTAL		**12 'Detector Nights'**	
Harp Trap	03/12 –	6pm -5:30am	2 trap nights	One unit near western farm dam. One unit on fire trail on ridge (eastern area).
	04/12	6pm -5:30am	2 trap nights	Same as above
	TOTAL		**4 TN**	

3.12 Avifauna Surveys

Diurnal bird surveys involved visual observation of species as well as identification of calls. Terrestrial bird surveys were conducted at dawn while aquatic bird surveys were conducted at random times of day.

In addition, bird species were also recorded on an opportunistic basis throughout all surveys.

Table 11 Avifauna surveys

Date (2015)	Survey Effort (person-hours)	Surveyed Area
01 December (5.30 -7.30am)	4	Opportunistic survey across site during trap checks at dawn. Searches for nests.
02 December (5am-7:30am)	5	Opportunistic survey across site during trap checks at dawn. Searches for nests. Active searches on ridge and in southern gully.
03 December (6am-8am)	6	Opportunistic survey across site during trap checks at dawn.
TOTAL	**15 person hours**	

3.13 Koala Spot Assessment Technique

During the SLR 2015 studies, the SPOT assessment technique was conducted in all areas and habitat types of the site. Koala scats were searched for at the bases of 30 trees within each plot (10 plots were completed). Evidence of other threatened fauna was also targeted such as, Powerful Owl roost sites and microchiropteran bat roost sites *etc*.

Table 12 Spot Assessments

Date (2015)	Survey Effort (person-hours)	Surveyed Area
02 December	6	Plots in western woodland areas (2 persons)
03 December	9	Plots in central and eastern woodland areas (3 persons)
TOTAL	**15 person hours**	

3.14 Habitat searches

During the surveys, the subject site was thoroughly examined for the occurrence of habitat features including hollow-bearing trees, dead stags, ground logs and debris as well as suitable vegetation types. Habitat features suitable for threatened species were also targeted. The presence of old growth hollows / dead stags favourable for threatened owl species were mapped and were also targeted in Spotlighting and stag-watching surveys. Field ecologists carried out random, opportunistic log and debris searches, targeting reptiles and small mammals.

The methods by which candidate 'species credit' threatened species of potential relevance to the site were identified are described in Section 4 of the accompanying BAR. Targeted surveys for species credit species were conducted, where possible for relevant species, during the January and February field surveys described above.

3.15 Weather

Weather conditions during days of the detailed survey were hot and sunny with gentle north winds (gusty at times) and intermittent occasional rainfall events ( ).

Table 13 Weather conditions during the survey period1

Date (2015)	24-hr Rainfall (mm)	Humidity (%)	Max Wind (km/hr)	Temp Range (ºC)	Moon phase
Nov 30 (diurnal)	0	68	18 S	28 clear sky	_
Nov 30 (nocturnal)	0	88	11 NNE	18 - 22	77% moon waning gibbous
Dec 01 (diurnal)	0	56	NE winds strengthening throughout morning	22 – 32 Morning fog becoming hot and sunny	_
Dec 01 (nocturnal)	0.2 evening shower	76	19 NW	20 - 24	68% moon waning gibbous
Dec 02 (diurnal)	0	88	9 W	20 – 28 overcast	_
Dec 02 (nocturnal)	2 light showers continuing overnight	76	17 S	20 - 24	58% moon waning gibbous
Dec 03 (diurnal)	20	53	24 S	23 overcast	_
Dec 03 (nocturnal)	0	62	13 SSW	16 – 19 clear sky	
Dec 04 (diurnal)					
Dec 14 (diurnal)					
Dec 14 (nocturnal)	Last rain 13mm on 10/12/15	79	19 N	20 Clear sky	10% moon waxing crescent

1 Recorded at the nearest BOM weather station (Port Macquarie, approximately 6 kilometres from Sancrox)

4 References

Cropper, SC. 1993. Management of endangered plants. CSIRO Publishing, East Melbourne.

DECC. 2009a. BioBanking Assessment Methodology and Credit Calculator Operational Manual. Department of Environment and Climate Change NSW, Sydney.

DECC. 2009b. Field data sheets for BioBanking: biobank / development site proposal package February 2009. Department of Environment and Climate Change NSW, Sydney.

OEH. 2014. Framework for Biodiversity Assessment. State of NSW and Office of Environment and Heritage, Sydney.

OEH. 2012. NSW BioMetric Vegetation Types CMA. State of NSW and Office of Environment and Heritage, Sydney.

ASIA PACIFIC OFFICES

BRISBANE
Level 2, 15 Astor Terrace
Spring Hill QLD 4000
Australia
T: +61 7 3858 4800
F: +61 7 3858 4801

CANBERRA
GPO 410
Canberra ACT 2600
Australia
T: +61 2 6287 0800
F: +61 2 9427 8200

DARWIN
Unit 5, 21 Parap Road
Parap NT 0820
Australia
T: +61 8 8998 0100
F: +61 8 9370 0101

GOLD COAST
Level 2, 194 Varsity Parade
Varsity Lakes QLD 4227
Australia
M: +61 438 763 516

MACKAY
21 River Street
Mackay QLD 4740
Australia
T: +61 7 3181 3300

MELBOURNE
Level 11, 176 Wellington Parade
East Melbourne VIC 3002
Australia
T: +61 3 9249 9400
F: +61 3 9249 9499

NEWCASTLE
10 Kings Road
New Lambton NSW 2305
Australia
T: +61 2 4037 3200
F: +61 2 4037 3201

NEWCASTLE CBD
Suite 2B, 125 Bull Street
Newcastle West NSW 2302
Australia
T: +61 2 4940 0442

PERTH
Ground Floor, 503 Murray Street
Perth WA 6000
Australia
T: +61 8 9422 5900
F: +61 8 9422 5901

SYDNEY
Tenancy 202 Submarine School
Sub Base Platypus
120 High Street
North Sydney NSW 2060
Australia
T: +61 2 9427 8100
F: +61 2 9427 8200

TOWNSVILLE
12 Cannan Street
South Townsville QLD 4810
Australia
T: +61 7 4722 8000
F: +61 7 4722 8001

WOLLONGONG
Level 1, The Central Building
UoW Innovation Campus
North Wollongong NSW 2500
Australia
T: +61 2 4249 1000

AUCKLAND
Level 4, 12 O'Connell Street
Auckland 1010
New Zealand
T: 0800 757 695

NELSON
6/A Cambridge Street
Richmond, Nelson 7020
New Zealand
T: +64 274 898 628

APPENDIX C

Plot and Transect Data

No.	Species	Cover/abundance Score (see table above)
1	Carex appressa	3
2	Gahnia clarkei	4
3	Melaleuca linariifolia	3
4	Melaleuca styphelioides	3
5	Corymbia intermedia	3
6	Lomandra longifolia	3
7	Geitonoplesium cymosum	3
8	* Cinnamomum camphora	1
9	Hibbertia scandens	2
10	Dichondra repens	2
11	Entolasia marginata	2
12	Glochid. ferd. var. ferd.	4
13	Echinopogon ovatus	2
14	Centella asiatica	2
15	Rubus moluc. s. trilob.	2
16	Platycerium bifurc. s. bifurc.	1
17	Pandorea pandorana	3
18	Microlaena stip. v. stip.	3
19	Phyllanthus (?) gunnii	1
20	Jagera pseudorhus	1
21	Doodia aspera	3
22	Oplismenus hirtellus	3
23	Callistemon salignus	3
24	Parsonsia straminea	2
25	Adiantum hispidulum	2
26	Smilax australis	1
27	Lophostemon confertus	4
28	Hypolepis muelleri	3
29	Euca. microcorys	3
30	Dianella caerulea	2
	Poa sieb.	2
	Glycine clandestina	2

Total species	37
Total native species	36
Total exotic species	1
% perennial native understorey cover*	80

* Perennial understorey vegetation cover includes vascular plant species of the ground and shrub layers with a lifecycle of more than two growing seasons

Viola (?) banksii 2
Myrsine variabilis 3
Euca. carnea 3
Euca. propinqua 3
Maclura cochinchinensis 2

Site value: Transect tally table

BioBanking
Biodiversity Banking and Offsets Scheme

CMA area	CMA subregion	Recorder	Date
Northern Ri		V. Pepper	01/12

Proposal ID	Proposal name	Zone ID
VZ1	Sancrox Quarry	VZ1 P1

Vegetation formation Forested Wetlands

Vegetation class Coastal Floodplain Wetlands

Vegetation type PMVC_73 Flax-leaved Paper - Mixed Euc.

Condition (low or mod/good): Mod-good

Zone descriptor (optional): Good

Geographic/habitat features (tick after printing step 2 of Credit Calculator): ☐

Transect number VZ1 P1	Number of hits (tally)	%
Native over-storey cover (%)	225	22.5
Native mid-storey cover (%)	580	58
Native ground cover (grasses) (%)	29	58
Native ground cover (shrubs) (%)	2	4
Native ground cover (other) (%)	46	92
Exotic plant cover (%)	1	2

Transect number	Number of hits (tally)	%
Native over-storey cover (%)		
Native mid-storey cover (%)		
Native ground cover (grasses) (%)		
Native ground cover (shrubs) (%)		
Native ground cover (other) (%)		
Exotic plant cover (%)		

Transect number	Number of hits (tally)	%
Native over-storey cover (%)		
Native mid-storey cover (%)		
Native ground cover (grasses) (%)		
Native ground cover (shrub) (%)		
Native ground cover (other) (%)		
Exotic plant cover (%)		

Transect number	Number of hits (tally)	%
Native over-storey cover (%)		
Native mid-storey cover (%)		
Native ground cover grasses (%)		
Native ground cover shrubs (%)		
Native ground cover other (%)		
Exotic plant cover (%)		

VZ1 P1

Transect plot worksheet

Full species IDs are not required for BioBanking, but may be useful for identification of correct vegetation type and for monitoring and audit purposes.

BioBanking
Biodiversity Banking and Offsets Scheme

Site type: Development / BioBank **Proposal ID:** VZ1 P1 **Date:** 01/12/15 **Recorder(s):** J. Pepper

Vegetation type: Flax-leaved Paperbark **AMG Zone** 56 **Easting/Northing:** 31.42844 / +152.81408 **Photos:**

Native over-storey species list At 10 points along the 50-m transect		Regen-eration (√) (zone)	Native mid-storey species list (>1m to <over-storey) At 10 points along the 50-m transect	Native ground cover (grasses) species list (ground stratum <1m) At 50 points along the 50-m transect		Native ground cover (shrubs) species list (ground stratum <1m) At 50 points along the 50-m transect		Native ground cover (other) species list (ground stratum <1m) At 50 points along the 50-m transect		Exotic plants species list At 50 points along the 50-m transect	Fallen logs (min. 10 cm diameter x 50 cm long) (20 x 50m plot)
5	10%	50	50%	/	1			/ / / / /	5		2.5
10	10	50		/ / / /	4			/ / / / /	5		6.0
15	10	60		/ / /	3			/ / / / /	5		6.5
20	10	60		*				/ / /	3		4.0
25	20	70		/ /	2			/ / / /	4		4.5
30	25	70		/ / / /	4			/ / / / /	5		7.0
35	50	40		/ / / /	4			/ / / / /	5	/	5.0
40	40	40		/ / / /	4			/ / / /	4		
45	60	70		/ / / /	4	/	1	/ / / / /	5		
50	10	70		/ / /	3	/	1	/ / / / /	5		
	225										
		0.75									

Total number of species = 37
Foliage cover (%) =
Benchmark value (%FC) =
Average crown diameter =
Average foliage cover (%) = 22.5%
Number of trees =
Sample area = 20x50

Whole zone
Number of trees with hollows = 0
Sample area = 20x50
Benchmark value =

Total no of species = 580	Total no of species = 29	Total no of species = 2	Total no of species = 46	Total no of species = 1	Total (m) = 35.5
Foliage cover (%) = 50	Foliage cover (%) = 58	Foliage cover (%) = 1	Foliage cover (%) = 92	Foliage cover (%) = 2	Benchmark (m) =

SITE AND OTHER NOTES:

NB: Transects / plots should be placed randomly with the minimum number required for the zone in accordance with Table 4 of the Operational Manual.

Field data sheets for BioBanking : Biobank site proposal package February 2009

bearing 351° slope +2°

Myrsine variabilis
Eclipta platyglossa

VZ1

Site value:
Transect plot data sheet

(Start a new sheet for each vegetation zone)

BioBanking
Biodiversity Banking and Offsets Scheme

CMA area	CMA subregion	Recorder	Date
Northern Ri.		J. Pepper	01/12

Proposal ID	Proposal name	Zone ID
VZ1	Sancrox Quarry	VZ1 P1

Vegetation formation Forested Wetlands / Wet Sclerophyll Forest

Vegetation class Coastal Floodplain Wetlands

Vegetation type PMVC 73 Flax-leaved Paperbark PCT 886

Condition (low or mod/good) Mod-good

Zone descriptor (optional)

Geographic/habitat features (tick after printing step 2 of Credit Calculator) ☐

NR117 (686) Blackbutt - Pink Bloodwood shrubby open forest

Coordinates (GPS datum GDA94:_____)

Transect / plot number	P1	2	3	4	5	6	7	8	9	10
Easting										
Northing										
Zone AMG										

Transect 10 points along 50-m transect (see transect tally table for % foliage cover variables)

Native over-storey cover (%)	22.5									
Native mid-storey cover (%)	58									
Native ground cover (grasses) (%)	58									
Native ground cover (shrubs) (%)	4									
Native ground cover (other) (%)	92									
Exotic plant cover	2									

Larger sampling area

Native plant species richness [1]	~~37~~ 36									
Number of trees with hollows [2]	0									
Over-storey regeneration [3]	0.75									
Total length of fallen logs (m) [2]	35.5									

Comments/additional conservation values (riparian areas, special features, geology, etc.):

- Southern swamp forest patch
- Cryptostylis erecta recorded on Wedge

[1] 20 x 20 m plot [2] 20 x 50 m plot [3] whole zone

Floristic datasheet – 20 m X 20 m quadrat

V2 2 P1

No.	Species	Cover/abundance Score (see table above)
1	Lepidosperma laterale	2
2	Euca siderophloia	5
3	Corymbia maculata	4
4	Entolasia marginata	3
5	Imperata cylindri var. maj.	4
6	Brunonella pumilio	2
7	Adenostemma lavenia	3
8	Eclipta platyglossa	2
9	Lomandra hystrix	3
10	Allocasuarina torulosa	3
11	Eucalyptus globoidea	3
12	Hibbertia dentata	1
13	Bidens pilosa	2
14	Dichelachne micrantha	3
15	Hibbertia aspera	1
16	Breynia oblongifolia	1
17	Persoonia stradbrokensis	1
18	Desmodium rhytidophylu	2
19	Polyscias sambucifolia	2
20	Dianella caerulea	2
21	Lissanthe strigosa	2
22	Dipodium variegatum	2
23	Dampiera stricta	2
24	Platylobium formosum	2
25	Lomandra longifolia	2
26	Hypoxis exilis	2
27	Cheilanthes sieberi	2
28	Panicum simile	3
29	Echinopogon ovatus	3
30	Glycine clandestina	2
	Pratia purpurascens	2
	Desmodium varians	2

Total species	35
Total native species	35
Total exotic species	
% perennial native understorey cover*	75

* Perennial understorey vegetation cover includes vascular plant species of the ground and shrub layers with a lifecycle of more than two growing seasons

Themeda triandra 2
Hardenbergia violacea 2
Corymbia intermedia 3

VZ2

Site value:
Transect plot data sheet

(Start a new sheet for each vegetation zone)

BioBanking
Biodiversity Banking and Offsets Scheme

CMA area	CMA subregion	Recorder	Date
Northern Ri		T. Pepper	01/12

Proposal ID	Proposal name	Zone ID
VZ2	Sancrox Quarry	VZ2

Vegetation formation Dry Sclerophyll Forests

Vegetation class Hunter-Macleay Dry Sclerophyll

Vegetation type PMVC_35 Spotted Gum Grassy Dry Forest

Condition (low or mod/good)	Zone descriptor (optional)	Geographic/habitat features (tick after printing step 2 of Credit Calculator)
Mod-good	good	☐

Coordinates (GPS datum GDA94:_____)

Transect / plot number	P1	P2	P3	4	5	6	7	8	9	10
Easting										
Northing										
Zone AMG										

Transect 10 points along 50-m transect (see transect tally table for % foliage cover variables)

Native over-storey cover (%)	25.5	28	18							
Native mid-storey cover (%)	5.5	6.5	3.5							
Native ground cover (grasses) (%)	70	84	68							
Native ground cover (shrubs) (%)	2	4	4							
Native ground cover (other) (%)	48	52	32							
Exotic plant cover	0	0	0							

Larger sampling area

Native plant species richness [1]	35	32	35							
Number of trees with hollows [2]	0	0	0							
Over-storey regeneration [3]	1.0	0.5	0.5							
Total length of fallen logs (m) [2]	78	64	112							

Comments/additional conservation values (riparian areas, special features, geology, etc.):

[1] 20 x 20 m plot [2] 20 x 50 m plot [3] whole zone

VZ2P1

[folded] JP 01/12

Transect plot worksheet

Full species IDs are not required for BioBanking, but may be useful for identification of correct vegetation type and for monitoring and audit purposes.

BioBanking
Biodiversity Banking and Offsets Scheme

Site type: Development / BioBank **Proposal ID:** VZ2P1 **Date:** 30/11 **Recorder(s):** J. Pepper

Vegetation type: Spotted Gum **AMG Zone** 56 **Easting/Northing:** -31.43471/+152.81524 **Photos:**

Native over-storey species list At 10 points along the 50-m transect	Regen-eration (√) (zone)	Native mid-storey species list (>1m to <over-storey) At 10 points along the 50-m transect	Native ground cover (grasses) species list (ground stratum <1m) At 50 points along the 50-m transect	Native ground cover (shrubs) species list (ground stratum <1m) At 50 points along the 50-m transect	Native ground cover (other) species list (ground stratum <1m) At 50 points along the 50-m transect	Exotic plants species list At 50 points along the 50-m transect	Fallen logs (min. 10 cm diameter x 50 cm long) (20 x 50m plot)
5 30		30	/ / 2		/ / 2		9
10 5		0	/ / / 3		/ / / 3		1.5
15 30		0	/ 1		/ 1		25
20 25		25	/ / / / / 5		/ / / / / 5		13
25 40		0	/ / / / / 5		/ / 2		6
30 35		0	/ / / / 4		/ / / 3		3.5
35 25		0	/ / / / / 5		/ / 2		7
40 20		0	/ / 2		/ 1		1.0
45 25		0	/ / / / 4	/	/ / / / 4		1.0
50 20		0	/ / / / 4		/ 1		1.5
255	1.0	55					1.0
							8.5

Total number of species =
Foliage cover (%) =
Benchmark value (%FC) =
Average crown diameter =
Average foliage cover (%) = 25.5
Number of trees =
Sample area = 20x50

Whole zone
Number of trees with hollows = 0
Sample area = 20x50
Benchmark value =

Native mid-storey species list	Native ground cover (grasses) species list	Native ground cover (shrubs) species list	Native ground cover (other) species list	Exotic plants species list	Fallen logs
Total no of species = 55	Total no of species = 35	Total no of species = 1	Total no of species = 24	Total no of species = 0	Total (m) = 78
Foliage cover (%) = 5.5	Foliage cover (%) = 70	Foliage cover (%) = 2	Foliage cover (%) = 48	Foliage cover (%) = 0	Benchmark (m) =

SITE AND OTHER NOTES:

NB: Transects / plots should be placed randomly with the minimum number required for the zone in accordance with Table 4 of the Operational Manual.

Field data sheets for BioBanking : Biobank site proposal package February 2009

bearing 295° slope - 7.5°

VZ2P2

[tallied] JP 01/12

Transect plot worksheet

Full species IDs are not required for BioBanking, but may be useful for identification of correct vegetation type and for monitoring and audit purposes.

BioBanking
Biodiversity Banking and Offsets Scheme

Site type: Development / BioBank **Proposal ID:** VZ2P2 **Date:** 30.11.15 **Recorder(s):** J. Pepper

Vegetation type: Spotted Gum **AMG Zone** 56 **Easting/Northing:** -31.43585° / +152.81419 **Photos:**

Native over-storey species list At 10 points along the 50-m transect	Regen-eration (√) (zone)	Native mid-storey species list (>1m to <over-storey) At 10 points along the 50-m transect	Native ground cover (grasses) species list (ground stratum <1m) At 50 points along the 50-m transect	Native ground cover (shrubs) species list (ground stratum <1m) At 50 points along the 50-m transect	Native ground cover (other) species list (ground stratum <1m) At 50 points along the 50-m transect	Exotic plants species list At 50 points along the 50-m transect	Fallen logs (min. 10 cm diameter x 50 cm long) (20 x 50m plot)
~~0 25 %~~		~~20~~	1 5 / 1 10	1	1 / 1		25
5 10		30	1 5 / 1 60		1 / 1		6
10 30		0	1 25 / 30		1		6
15 35		0	1 35 / 1 40		1		3
20 50		0	1 40 / 1 50		1 / 1		3.5
25 45		0	1 / 1		1 / 1		4
30 50		0	1 / 1				3
35 60		0	1 / 1				1.5
40 0		35	1 / 1		1 / 1		12
45 0		0	1 / 1				
50			1 / 1		1		
280	0.5	65	1 / 1	1	1		
			1 / 1		1		
			1 / 1		1		
			1 / 1		1 / 1		
			1 / 1		1 / 1		
			1 / 1		1 / 1		
			1 / 1		1 / 1		
			1 / 1		1 / 1		
			1 / 1		1 / 1		
		Total no of species = 65	Total no of species = 42	Total no of species = 2	Total no of species = 26	Total no of species = 0	Total (m) = 64
		Foliage cover (%) = 6.5	Foliage cover (%) = 84	Foliage cover (%) = 4	Foliage cover (%) = 52	Foliage cover (%) = 0	Benchmark (m) =

Total number of species =
Foliage cover (%) =
Benchmark value (%FC) =
Average crown diameter =
Average foliage cover (%) = 28.0
Number of trees =
Sample area = 20 x 50 = 1000 m²

Whole zone
Number of trees with hollows = 0
Sample area = 20x50m
Benchmark value =

SITE AND OTHER NOTES:

NB: Transects / plots should be placed randomly with the minimum number required for the zone in accordance with Table 4 of the Operational Manual.

Field data sheets for BioBanking : Biobank site proposal package February 2009

Slope 7° bearing 304°

VZ2P3

Transect plot worksheet

[tallied] JP 01/12

Full species IDs are not required for BioBanking, but may be useful for identification of correct vegetation type and for monitoring and audit purposes.

BioBanking
Biodiversity Banking and Offsets Scheme

Site type: Development / BioBank **Proposal ID:** VZ2P3 **Date:** 01/12 **Recorder(s):** J. Pepper

Vegetation type: Spotted Gum **AMG Zone** 56 **Easting/Northing:** -31.43849/+152.81654 **Photos:**

Native over-storey species list At 10 points along the 50-m transect		Regen-eration (√) (zone)	Native mid-storey species list (>1m to <over-storey) At 10 points along the 50-m transect	Native ground cover (grasses) species list (ground stratum <1m) At 50 points along the 50-m transect	Native ground cover (shrubs) species list (ground stratum <1m) At 50 points along the 50-m transect	Native ground cover (other) species list (ground stratum <1m) At 50 points along the 50-m transect	Exotic plants species list At 50 points along the 50-m transect	Fallen logs (min. 10 cm diameter x 50 cm long) (20 x 50m plot)
5	10		1 6	1 1 1 1 4	1	1 1 2		3.
10	30		0	1 1 1 1 1 5				15
15	10		0	1 1 1 1 4	1	1 1 2		1.0
20	25		0	1 1 1 1 1 5		1 1 2		10.0
25	25		0	1 1 1 3		1 1 2		4.5
30	5		0			1 1 2		3.5
35	5		0	1 1 1 3		1 1 1 3		3.0
40	20		35	1 1 1 1 4		1 1		10.0
45	25		0	1 1 1 1 4		1 1 2		10.0
50	25		0	1 1 2				14.0
	180	0.5						18.0
Total number of species =								5.0
Foliage cover (%) =								5.0
Benchmark value (%FC) =								4.0
Average crown diameter =								1.0
Average foliage cover (%) = 18%								4.0
Number of trees =								
Sample area = 20 x 50								
Whole zone								
Number of trees with hollows = 0								
Sample area = 20x 50								
Benchmark value =			Total no of species = 35	Total no of species = 34	Total no of species = 2	Total no of species = 16	Total no of species = 0	Total (m) = 112
			Foliage cover (%) = 3.5	Foliage cover (%) = 68	Foliage cover (%) = 4	Foliage cover (%) = 22	Foliage cover (%) = 0	Benchmark (m) =

SITE AND OTHER NOTES:

NB: Transects / plots should be placed randomly with the minimum number required for the zone in accordance with Table 4 of the Operational Manual.

bearing 350° slope +5°

VZ2

Site value: Transect tally table

BioBanking
Biodiversity Banking and Offsets Scheme

CMA area	CMA subregion	Recorder	Date
Northern R		J. Pepper	01/12

Proposal ID	Proposal name	Zone ID
VZ2	Sancrox Quarry	VZ2

Vegetation formation Dry Sclerophyll Forests

Vegetation class Hunter_Macleay Dry Sclerophyll

Vegetation type PMVC_35 Spotted Gum Grassy Dry Forest

Condition (low or mod/good)	Zone descriptor (optional)	Geographic/habitat features (tick after printing step 2 of Credit Calculator)
Mod-good	Good	☐

Transect number VZ2 P1	Number of hits (tally)	%
Native over-storey cover (%)	255	25.5
Native mid-storey cover (%)	55	5.5
Native ground cover (grasses) (%)	35	70
Native ground cover (shrubs) (%)	1	2
Native ground cover (other) (%)	24	48
Exotic plant cover (%)	0	0

Transect number VZ2 P2	Number of hits (tally)	%
Native over-storey cover (%)	280	28
Native mid-storey cover (%)	65	6.5
Native ground cover (grasses) (%)	42	84
Native ground cover (shrubs) (%)	2	4
Native ground cover (other) (%)	26	52
Exotic plant cover (%)	0	0

Transect number VZ2 P3	Number of hits (tally)	%
Native over-storey cover (%)	180	18
Native mid-storey cover (%)	35	3.5
Native ground cover (grasses) (%)	34	68
Native ground cover (shrub) (%)	2	4
Native ground cover (other) (%)	16	32
Exotic plant cover (%)	0	0

Transect number_____	Number of hits (tally)	%
Native over-storey cover (%)		
Native mid-storey cover (%)		
Native ground cover grasses (%)		
Native ground cover shrubs (%)		
Native ground cover other (%)		
Exotic plant cover (%)		

Floristic datasheet – 20 m X 20 m quadrat

V2 2 P 2

No.	Species	Cover/abundance Score (see table above)
1	Brunon. pumilio	2
2	Imperata cyl. var. mag.	3
3	Adiantum aethiopic.	2
4	Oplismenus imbecil	3
5	Entolasia stricta	2
6	Entolasia marginata	2
7	Oxalis perennans	2
8	Glycine clandestina	2
9	Desmodium rhytidoph.	2
10	Dianella caerulea	2
11	Corymbia maculata	4
12	Allocasuarina torulosa	3
13	Adenostemma lavenia	2
14	Breynia oblongifolia	2
15	Hydrocotyl pedunculare	3
16	Pandorea pandorana	3
17	Hibbertia aspera	2
18	Echinopogon ovatus	2
19	Hypoxis exilis	2
20	* Paspalum urvillei	2
21	Platylobium formosum	2
22	Eucalyptus globoidea	3
23	Acacia floribunda	1
24	* Conyza bonariensis	2
25	Polyscias sambucif.	3
26	Eucalyptus acmenoides	3
27	Pratia purpurascens	2
28	Poa sieberiana	2
29	Hardenbergia violacea	2
30	Lophostemon confertus	3
	Glochid. ferdin. var. ferdin.	1
	Calotis (?) dentex	2

Total species	34
Total native species	32
Total exotic species	2
% perennial native understorey cover*	65

* Perennial understorey vegetation cover includes vascular plant species of the ground and shrub layers with a lifecycle of more than two growing seasons

Melichrus urceolatus 1
Billardiera scandens 2

Floristic datasheet – 20 m X 20 m quadrat

VZ 32 P 2b

No.	Species	Cover/abundance Score (see table above)
1	Corymbia intermedia	3
2	Allocasuarina torulosa	3
3	Alphitonia excelsa	1
4	Parsonsia straminea	1
5	Rubus moluc. tril.	3
6	Themeda triandra	3
7	Hibbertia scandens	2
8	Polyscias sambuc.	3
9	Imperata cyl. var. major	4
10	Breynia oblongif.	2
11	Euc. acmenoides	3
12	Euc. propinqua	3
13	Euc. carnea	3
14	Dianella caerulea	3
15	Euc. siderophloia	4
16	Oplismenus aemulus	3
17	Brunonella pumil.	2
18	Desmodium rhytidophyllum	2
19	Allocas. torulosa	2
20	Entolasia marginata	3
21	Pandorea pandorana	2
22	Pimelea ligustrina	2
23	Desmodium varians	2
24	Hydrocotyle pedunculata	2
25	Geitonopl. cymo.	2
26	Eustrephus latif.	2
27	Bidens pilosa	2
28	Paspalum orbiculare	2
29	Cheilanthes sieberi subsp sie	1
30	Glycine clandestina	2
	Adinostemma laevenia	2
	Oplismenus imbecillus	3

Total species	35
Total native species	35
Total exotic species	
% perennial native understorey cover*	85

* Perennial understorey vegetation cover includes vascular plant species of the ground and shrub layers with a lifecycle of more than two growing seasons

Cassytha glab. 1
Hardenbergia violac. 1
Callistemon salignus 1

Floristic datasheet – 20 m X 20 m quadrat

V23P1

No.	Species	Cover/abundance Score (see table above)
1	Centella asiatica	3
2	Carex appressa	3
3	Microlaena stip. var. stip.	4
4	Hydrocotyle peduncularis	3
5	Entolasia marginata	2
6	Oplismenus undulatifolius	2
7	Oxalis perennans	2
8	Echinopogon ovatus	3
9	Oplismenus imbecillis	3
10	Callistemon salignus	4
11	Glochidion ferd. var. ferd.	3
12	Allocasuarina littoralis	4
13	Melaleuca linariifolia	3
14	Viola hederacea	3
15	Eucalyptus globoidea	3
16	Corymbia gummifera	3
17	Alphitonia excelsa	2
18	Pteridium esculentum	2
19	Geitonoplesium cymosum	2
20	Breynia oblongifolia	2
21	Lomandra longifolia	2
22	Hibbertia scandens	3
23	Pittosporum undulatum	2
24	Dichondra repens	3
25	Eucalyptus microcorys	3
26	Billardiera scandens	2
27	Eucalyptus siderophloia	3
28	Glycine clandestina	2
29	* Cinnamomum camphora	2
30	Lysanthe strigosa	2
	Pandorea pandorana	2
	Imperata cylind. var. major	3

Total species	33
Total native species	32
Total exotic species	1
% perennial native understorey cover*	80

* Perennial understorey vegetation cover includes vascular plant species of the ground and shrub layers with a lifecycle of more than two growing seasons

Cassytha glabra 2

VZ3P1

[data tallied] JP 01/12

Transect plot worksheet

Full species IDs are not required for BioBanking, but may be useful for identification of correct vegetation type and for monitoring and audit purposes.

BioBanking
Biodiversity Banking and Offsets Scheme

Site type: Development / BioBank **Proposal ID:** VZ3P1 **Date:** 30.11.15 **Recorder(s):** J. Pepper

Vegetation type: White Stringy bark **AMG Zone** 56 **Easting/Northing:** -31.43494 / +152.81037 **Photos:**

Native over-storey species list At 10 points along the 50-m transect		Regen-eration (√) (zone)	Native mid-storey species list (>1m to <over-storey) At 10 points along the 50-m transect	Native ground cover (grasses) species list (ground stratum <1m) At 50 points along the 50-m transect	Native ground cover (shrubs) species list (ground stratum <1m) At 50 points along the 50-m transect	Native ground cover (other) species list (ground stratum <1m) At 50 points along the 50-m transect	Exotic plants species list At 50 points along the 50-m transect	Fallen logs (min. 10 cm diameter x 50 cm long) (20 x 50m plot)
5	0		35	5		5		8
10	10		5	4	1	5		22
15	30		10	5		4		14
20	35		0	4		4		2.5
25	40		0	4	1	4		4
30	30		0	5	3	4		13
35	20		0	5		3		6
40	25		0	5		5		2.5
45	30		0	4		2		2
50	30		5	5		2		2
	240/10							3
	= 24%	0.25						4
								6
								15
Total number of species = 34								
Foliage cover (%) = 24%								
Benchmark value (%FC) =								
Average crown diameter = –								
Average foliage cover (%) = 24%								
Number of trees =								
Sample area = 20 x 50								
Whole zone								
Number of trees with hollows = 0								
Sample area = 20x50								
Benchmark value =								
			Total no of species = 55	Total no of species = 46	Total no of ~~species~~ hits = 5	Total no of species = 38	Total no of species = 0	Total (m) = 104
			Foliage cover (%) = 5.5	Foliage cover (%) = 92	Foliage cover (%) = 10	Foliage cover (%) = 72	Foliage cover (%) = 0	Benchmark (m) =

SITE AND OTHER NOTES:

NB: Transects / plots should be placed randomly with the minimum number required for the zone in accordance with Table 4 of the Operational Manual.

Field data sheets for BioBanking : Biobank site proposal package February 2009

bearing 168° slope +5°

VZ3P2

Transect plot worksheet

[Halliday] JP 01/12

Full species IDs are not required for BioBanking, but may be useful for identification of correct vegetation type and for monitoring and audit purposes.

BioBanking
Biodiversity Banking and Offsets Scheme

Site type: Development / BioBank **Proposal ID:** VZ 3P2 **Date:** 30/11 **Recorder(s):** J Peppe

Vegetation type: White Stringybark **AMG Zone** 56 **Easting/Northing:** – 31.43482 / +152.81595 **Photos:**

Native over-storey species list At 10 points along the 50-m transect		Regen-eration (√) (zone)	Native mid-storey species list (>1m to <over-storey) At 10 points along the 50-m transect	Native ground cover (grasses) species list (ground stratum <1m) At 50 points along the 50-m transect		Native ground cover (shrubs) species list (ground stratum <1m) At 50 points along the 50-m transect		Native ground cover (other) species list (ground stratum <1m) At 50 points along the 50-m transect		Exotic plants species list At 50 points along the 50-m transect	Fallen logs (min. 10 cm diameter x 50 cm long) (20 x 50m plot)
5	0		5	1 1 1 1 1	5	1	1	1 1 1	3		14
10	50		70	1 1 1	3	1 1	2	1 1	2		12
15	40		0	1 1 1 1	4	1	1				20
20	50		50	1 1 1 1 1	5	1 1	2	1 1	2		3
25	20		0	1 1 1 1	4	1	1	1 1 1 1	4		9
30	0		0	1 1 1 1 1	5			1 1 1 1	4		23
35	25		35	1 1 1 1	4			1	1		81
40	0		50	1	1			1 1 1 1 1	5		
45	0		70	1 1 1 1	4			1 1 1	3		
50	0		40	1 1 1 1 1	5	1	1	1 1 1 1 1	5		
	185										
		1.0									

Total number of species =
Foliage cover (%) = 18.5
Benchmark value (%FC) =
Average crown diameter =
Average foliage cover (%) = 18.5%
Number of trees =
Sample area = 20 x 50

Whole zone
Number of trees with hollows = 1
Sample area = 20x50
Benchmark value =

Total no of species = 320	Total no of species = 40	Total no of species = 8	Total no of species = 29	Total no of species = 0	Total (m) = 81
Foliage cover (%) = 32%	Foliage cover (%) = 80	Foliage cover (%) = 16	Foliage cover (%) = 58	Foliage cover (%) = 0	Benchmark (m) =

SITE AND OTHER NOTES:

NB: Transects / plots should be placed randomly with the minimum number required for the zone in accordance with Table 4 of the Operational Manual.

bearing 20° Slope -12°

VZ3P3

[tallied 30/4]

Transect plot worksheet

Full species IDs are not required for BioBanking, but may be useful for identification of correct vegetation type and for monitoring and audit purposes.

BioBanking
Biodiversity Banking and Offsets Scheme

Site type: Development / BioBank **Proposal ID:** VZ3P3 **Date:** 30/11 **Recorder(s):** J. Pepper

Vegetation type: White Stringybark **AMG Zone** 56 **Easting/Northing:** -31.43793 / +152.81008 **Photos:**

Native over-storey species list At 10 points along the 50-m transect	Regen-eration (√) (zone)	Native mid-storey species list (>1m to <over-storey) At 10 points along the 50-m transect	Native ground cover (grasses) species list (ground stratum <1m) At 50 points along the 50-m transect	Native ground cover (shrubs) species list (ground stratum <1m) At 50 points along the 50-m transect	Native ground cover (other) species list (ground stratum <1m) At 50 points along the 50-m transect	Exotic plants species list At 50 points along the 50-m transect	Fallen logs (min. 10 cm diameter x 50 cm long) (20 x 50m plot)
5 30		0	/ 1		/ 1		1.5
10 0		0	//// 4		// 2		3.5
15 25		0	///// 5		///// 5		0.5
20 25		0	///// 5		///// 5		11
25 50		0	//// 4		/// 3		5
30 30		0	///// 5	/	// 2		1
35 10		20	///// 5	/	/ 1		13
40 25		0	/// 3		/// 3		3
45 10		0	//// 5		/// 3		3
50 0		0	/// 3		/ 1		3.5
	0.5						10
							3
							9
							8.5
							5
							8
							1
							10
Total number of species =		Total no of species =	Total no of species = 40	Total no of species = 2	Total no of species = 26	Total no of species = 0	Total (m) = 98.5
Foliage cover (%) =		Foliage cover (%) =	Foliage cover (%) = 80%	Foliage cover (%) = 4	Foliage cover (%) = 52	Foliage cover (%) = 0	Benchmark (m) =

Total number of species =
Foliage cover (%) =
Benchmark value (%FC) =
Average crown diameter =
Average foliage cover (%) =
Number of trees =
Sample area = 20x50

Whole zone
Number of trees with hollows = 1.0
Sample area = 20x50
Benchmark value =

SITE AND OTHER NOTES:

NB: Transects / plots should be placed randomly with the minimum number required for the zone in accordance with Table 4 of the Operational Manual.

bearing 187° Slope +3°

VZ3P4

[tallied] JP 01/12

Transect plot worksheet

Full species IDs are not required for BioBanking, but may be useful for identification of correct vegetation type and for monitoring and audit purposes.

BioBanking
Biodiversity Banking and Offsets Scheme

Site type: Development / BioBank **Proposal ID:** VZ3P4 **Date:** 01/12 **Recorder(s):** J. Pepper

Vegetation type: White Stringybark **AMG Zone** 56 **Easting/Northing:** -31.43889 / +152.81824 **Photos:**

Native over-storey species list At 10 points along the 50-m transect		Regen-eration (√) (zone)	Native mid-storey species list (>1m to <over-storey) At 10 points along the 50-m transect	Native ground cover (grasses) species list (ground stratum <1m) At 50 points along the 50-m transect		Native ground cover (shrubs) species list (ground stratum <1m) At 50 points along the 50-m transect	Native ground cover (other) species list (ground stratum <1m) At 50 points along the 50-m transect		Exotic plants species list At 50 points along the 50-m transect	Fallen logs (min. 10 cm diameter x 50 cm long) (20 x 50m plot)
5	40		0	1 1 1 1 1	5		1 1 1	3		3.0
10	30		30	1 1 1 1 1	5					10.0
15	10		50	1 1 1	3		1 1 1	3		5.0
20	10		5	1 1 1	3		1 1 1 1 1	5		
25	50		10				1 1 1	3		5.0
30	30		40	1 1 1	3		1 1 1	3		
35	40		30	1 1 1 1 1	5		1	1		
40	30		50	1 1 1 1 1	5		1 1 1	3		
45	10		0				1 1	2		
50	60		50	1	1		1 1 1	3		
	310	1.0								

Total number of species = 30
Foliage cover (%) =
Benchmark value (%FC) =
Average crown diameter =
Average foliage cover (%) = 31%
Number of trees =
Sample area = 20x50

Whole zone
Number of trees with hollows = 0
Sample area = 20x50
Benchmark value =

Total no of species = 26.5	Total no of species = 30	Total no of species = 0	Total no of species = 26	Total no of species = 0	Total (m) = 23
Foliage cover (%) = 26.5	Foliage cover (%) = 60	Foliage cover (%) = 0	Foliage cover (%) = 52	Foliage cover (%) = 0	Benchmark (m) =

SITE AND OTHER NOTES:

NB: Transects / plots should be placed randomly with the minimum number required for the zone in accordance with Table 4 of the Operational Manual.

bearing 136° slope -3°

added rule 0 cm 10 cm VZ3P5

Transect plot worksheet

Full species IDs are not required for BioBanking, but may be useful for identification of correct vegetation type and for monitoring and audit purposes.

BioBanking
Biodiversity Banking and Offsets Scheme

Site type: Development / BioBank **Proposal ID:** VZ3P5 **Date:** 30/11/15 **Recorder(s):** J Pepper

Vegetation type: White Stringybark/Tall **AMG Zone** 56 **Easting/Northing:** -31.43566 / +152.81531 **Photos:**

Native over-storey species list At 10 points along the 50-m transect	Regen-eration (√) (zone)	Native mid-storey species list (>1m to <over-storey) At 10 points along the 50-m transect	Native ground cover (grasses) species list (ground stratum <1m) At 50 points along the 50-m transect	Native ground cover (shrubs) species list (ground stratum <1m) At 50 points along the 50-m transect	Native ground cover (other) species list (ground stratum <1m) At 50 points along the 50-m transect	Exotic plants species list At 50 points along the 50-m transect	Fallen logs (min. 10 cm diameter x 50 cm long) (20 x 50m plot)
5 · 40		25	1 1 1 1 4		1 1 1 3		16
10 · 5		50	1 1		1 1 2		25
15 · 30		0	1 1 1 3		1 1 1 1 1 5		4
20 · 60		0	1 1 1 1 4		1 1 1 3		11
25 · 20		0	1 1 1 1 4		1 1 2		13
30 · 10		0	1 1 1 1 4	1	1 1 1 1 4		12
35 · 70		0	1 1 1 1 1 5		1 1 2		4
40 · 50		0	1 1 1 1 4		1 1		4
45 · 50		0	1 1 1 1 1 5	1			6
50 · 30		0	1 1 1 1 1 5				
355							
	1.0						

Total number of species =
Foliage cover (%) = 36.5
Benchmark value (%FC) =
Average crown diameter =
Average foliage cover (%) = 36.5
Number of trees =
Sample area = 20x50 m

Whole zone
Number of trees with hollows = 0
Sample area = 20x50m
Benchmark value =

Total no of species = 15	Total no of species = 39	Total no of species = 2	Total no of species = 22	Total no of species = 0	Total (m) = 97
Foliage cover (%) = 7.5	Foliage cover (%) = 78	Foliage cover (%) = 4	Foliage cover (%) = 44	Foliage cover (%) = 0	Benchmark (m) =

SITE AND OTHER NOTES:

NB: Transects / plots should be placed randomly with the minimum number required for the zone in accordance with Table 4 of the Operational Manual.

Field data sheets for BioBanking : Biobank site proposal package February 2009

slope 6° down 18° bearing

Site value: Transect tally table

BioBanking
Biodiversity Banking and Offsets Scheme

CMA area	CMA subregion	Recorder	Date
Northern Rivers		J. Pepper	30. 11. 15

Proposal ID	Proposal name	Zone ID
VZ3	Sancrox Quarry	VZ3

Vegetation formation Dry Sclerophyll Forest (Grassy)

Vegetation class Hunter Macleay Dry Sclerophyll Forests

Vegetation type White Stringybark

Condition (low or mod/good)	Zone descriptor (optional)	Geographic/habitat features (tick after printing step 2 of Credit Calculator)
Mod-good	good	☐

Transect number VZ3P3	Number of hits (tally)	%
Native over-storey cover (%)	(30+25+25+50+30+10+25+10)	20.5
Native mid-storey cover (%)	20%	2
Native ground cover (grasses) (%)	1+4+5+1 5+4+5+5+3+5+3	80
Native ground cover (shrubs) (%)	2	4
Native ground cover (other) (%)	1+2+5+5+3+2+1+3+3+1	52
Exotic plant cover (%)	0	0

Transect number VZ3 P5	Number of hits (tally)	%
Native over-storey cover (%)	40+5+30+60+20+10+70+50+50+30	365
Native mid-storey cover (%)	(25+50)/10	7.5
Native ground cover (grasses) (%)	39	78
Native ground cover (shrubs) (%)	2	4
Native ground cover (other) (%)	22	44
Exotic plant cover (%)	0	0

Transect number VZ3P1	Number of hits (tally)	%
Native over-storey cover (%)	240/10	24
Native mid-storey cover (%)	55/10	5.5
Native ground cover (grasses) (%)	46	92
Native ground cover (shrub) (%)	5	10
Native ground cover (other) (%)	38	72
Exotic plant cover (%)	0	0

Transect number VZ3P2	Number of hits (tally)	%
Native over-storey cover (%)	185	18.5
Native mid-storey cover (%)	320	32
Native ground cover grasses (%)	40	80
Native ground cover shrubs (%)	8	16
Native ground cover other (%)	29	58
Exotic plant cover (%)	0	0

VZ3

Transect number VZ3P4	Number of hits (tally)	%
Native over-storey cover (%)	310	31
Native mid-storey cover (%)	265	265
Native ground cover (grasses) (%)	30	60
Native ground cover (shrubs) (%)	0	0
Native ground cover (other) (%)	26	52
Exotic plant cover (%)	0	0

Transect number_____	Number of hits (tally)	%
Native over-storey cover (%)		
Native mid-storey cover (%)		
Native ground cover (grasses) (%)		
Native ground cover (shrubs) (%)		
Native ground cover (other) (%)		
Exotic plant cover (%)		

Transect number_____	Number of hits (tally)	%
Native over-storey cover (%)		
Native mid-storey cover (%)		
Native ground cover (grasses) (%)		
Native ground cover (shrubs) (%)		
Native ground cover (other) (%)		
Exotic plant cover (%)		

Transect number_____	Number of hits (tally)	%
Native over-storey cover (%)		
Native mid-storey cover (%)		
Native ground cover (grasses) (%)		
Native ground cover (shrubs) (%)		
Native ground cover (other) (%)		
Exotic plant cover (%)		

Transect number_____	Number of hits (tally)	%
Native over-storey cover (%)		
Native mid-storey cover (%)		
Native ground cover (grasses) (%)		
Native ground cover (shrubs) (%)		
Native ground cover (other) (%)		
Exotic plant cover (%)		

Transect number_____	Number of hits (tally)	%
Native over-storey cover (%)		
Native mid-storey cover (%)		
Native ground cover (grasses) (%)		
Native ground cover (shrubs) (%)		
Native ground cover (other) (%)		
Exotic plant cover (%)		

VZ3

Site value:
Transect plot data sheet

(Start a new sheet for each vegetation zone)

BioBanking
Biodiversity Banking and Offsets Scheme

CMA area	CMA subregion	Recorder	Date
Northern Rivers		J. Pepper	30.11.15

Proposal ID	Proposal name	Zone ID
	Sancrox Quarry	VZ3

Vegetation formation Dry Sclerophyll Forest (Grassy)

Vegetation class Hunter-Macleay Dry Sclerophyll Forests

Vegetation type White Stringybark

Condition (low or mod/good)	Zone descriptor (optional)	Geographic/habitat features (tick after printing step 2 of Credit Calculator)
Mod-good	good	☐

Coordinates (GPS datum GDA94:_____)

Transect / plot number	P3	2 P5	3 P1	4 P2	5 P4	6	7	8	9	10
Easting										
Northing										
Zone AMG	56	56	56	56	56					

Transect 10 points along 50-m transect (see transect tally table for % foliage cover variables)

Native over-storey cover (%)	20.5	36.5	24	18.5	31					
Native mid-storey cover (%)	2	7.5	5.5	32	26.5					
Native ground cover (grasses) (%)	80	78	92	80	60					
Native ground cover (shrubs) (%)	4	4	10	16	0					
Native ground cover (other) (%)	52	44	72	58	52					
Exotic plant cover	0	0	0	0	0					

Larger sampling area

Carry →

Native plant species richness [1]	30	35	32	33	29					
Number of trees with hollows [2]	1	0	1	1	0					
Over-storey regeneration [3]	0.5	1.0	0.25	1.0	1.0					
Total length of fallen logs (m) [2]	98.5	97	104	81	23					

Comments/additional conservation values (riparian areas, special features, geology, etc.):

[1] 20 x 20 m plot [2] 20 x 50 m plot [3] whole zone

VZ3

Site value: Transect tally table

BioBanking
Biodiversity Banking and Offsets Scheme

CMA area	CMA subregion	Recorder	Date
Northern Rivers		J. Pepper	30. 11. 15

Proposal ID	Proposal name	Zone ID
VZ3	Sancrox Quarry	VZ3

Vegetation formation Dry Sclerophyll Forest (Grassy)

Vegetation class Hunter Macleay Dry Sclerophyll Forests

Vegetation type White Stringybark

Condition (low or mod/good)	Zone descriptor (optional)	Geographic/habitat features (tick after printing step 2 of Credit Calculator)
Mod-good	good	☐

Transect number VZ3P3	Number of hits (tally)	%
Native over-storey cover (%)	(30+25+25+50+30+10+25+10)	20.5
Native mid-storey cover (%)	20%	2
Native ground cover (grasses) (%)	1+4+5+5+4+5+5+3+5+3	80
Native ground cover (shrubs) (%)	2	4
Native ground cover (other) (%)	1+2+5+5+3+2+1+3+3+1	52
Exotic plant cover (%)	0	0

Transect number VZ3 P5	Number of hits (tally)	%
Native over-storey cover (%)	40+5+30+60+20+10+70+50+50+30	365
Native mid-storey cover (%)	(25+50)/10	7.5
Native ground cover (grasses) (%)	39	78
Native ground cover (shrubs) (%)	2	4
Native ground cover (other) (%)	22	44
Exotic plant cover (%)	0	0

Transect number VZ3P1	Number of hits (tally)	%
Native over-storey cover (%)	240/10	24
Native mid-storey cover (%)	55/10	5.5
Native ground cover (grasses) (%)	46	92
Native ground cover (shrub) (%)	5	10
Native ground cover (other) (%)	38	72
Exotic plant cover (%)	0	0

Transect number VZ3P2	Number of hits (tally)	%
Native over-storey cover (%)	185	18.5
Native mid-storey cover (%)	320	32
Native ground cover grasses (%)	40	80
Native ground cover shrubs (%)	8	16
Native ground cover other (%)	29	58
Exotic plant cover (%)	0	0

Floristic datasheet – 20 m X 20 m quadrat

V23P2

No.	Species	Cover/abundance Score (see table above)
1	Veronica calycina	3
2	Echinopogon ovatus	2
3	Dichondra repens	3
4	Lomandra hystrix	2
5	Melichrus urceol.	2
6	Pandorea pandorana	2
7	Imperata cylindrica v. m.	4
8	Desmodium rhytidop.	2
9	Oxalis perennans	2
10	Hardenbergia violacea	2
11	Pratia purpurascens	2
12	Lomandra longifolia	3
13	Adenostemma lavenia	2
14	Dianella caerulea	2
15	Cayratia clematidea	2
16	Glycine clandestina	2
17	Calotis (?) dentex	2
18	Bunnanella pumilio	2
19	Allocasuarina torulosa	3
20	Euca. sideroph.	4
21	Entolasia marginata	3
22	Oplismenus aemulus	3
23	Eustrephus latifolius	2
24	Geitonoplesium cymosum	2
25	Desmodium varians	3
26	Euca. propinqua	3
27	Themeda triandra	2
28	Cassinia (?) uncata	2
29	Euca. acmenoides	4
30	* Lantana camara	1
	Allocas. littoralis	2
	Polyscias sambucif.	2

Total species	34
Total native species	1
Total exotic species	33
% perennial native understorey cover*	75

* Perennial understorey vegetation cover includes vascular plant species of the ground and shrub layers with a lifecycle of more than two growing seasons

Rytidosperma (?) longifolium 2
Aphanopetalum resinosum 1

Floristic datasheet – 20 m X 20 m quadrat

V23 P3

No.	Species	Cover/abundance Score (see table above)
1	Alphitonia excelsa	2
2	Euca. microc.	3
3	Euca. acmenoid.	4
4	Euca. globoidea	4
5	Centella asiatica	3
6	Microl. styp. var. styp.	3
7	Cyperus umbecillis	3
8	Kanandra longifolia	3
9	Imperata cylind. v. marg.	3
10	Euca. propinqua	4
11	Sonnantia similis	2
12	Paspalum orbiculare	2
13	Oxalis perennans	2
14	Breynia oblongifolia	2
15	Oplismenus aemulus	3
16	Melaleuca linariifolia	3
17	Acacia floribunda	3
18	Melichrus urceolatus	2
19	Echinopogon ovatus	2
20	Oplismenus umbecillis.	2
21	Glochidion ferd. var ferd.	2
22	Entolasia marginata	2
23	Hibbertia scandens	2
24	Brunonella pumilio	2
25	Hydrocotyle pedunculo.	2
26	Cheilanthes sieberi and sieb.	2
27	Adenostemma lav.	2
28	Panicum simile	2
29	Entolasia stricta	2
30	Arthropodium minus	2

Total species	30
Total native species	30
Total exotic species	
% perennial native understorey cover*	85

* Perennial understorey vegetation cover includes vascular plant species of the ground and shrub layers with a lifecycle of more than two growing seasons

Floristic datasheet – 20 m X 20 m quadrat

V23 P4

No.	Species	Cover/abundance Score (see table above)
1	* Solanum mauritianum	2
2	* Lantana camara	3
3	* Paspalum urvillei	2
4	* Passiflora edulis	1
5	Solanum (?) prinophyllum	2
6	Euca. microcorys	4
7	Allocas. torulosa	3
8	Rubus moluc. trib.	2
9	Calochlaena dubia	3
10	Acacia floribunda	2
11	Gahnia clarkei	2
12	Parsonsia straminea	2
13	Persoonia stradbrokena	2
14	Desmodium varians	2
15	Microlaena stipoides v. step.	3
16	Oplismenus imbecillis	3
17	Adenostem lav.	2
18	Pratia purpurascens	2
19	Hydrocotyl peduncular	2
20	Lepidosperma laterale	2
21	Poa sieberiana	3
22	Echinopogon ovatus	2
23	Entolasia marginata	3
24	Desmodium rhytidoph	2
25	Euca. sideroph loia	3
26	Corymbia intermedia	4
27	Lomandra longifolia	2
28	Platylobium formosum	2
29	Euca. globoidea	3
30	Cordyline stricta	2
	Brunoniella pumilio	2
	Lomandra hystrix	2

Total species	33
Total native species	4
Total exotic species	29
% perennial native understorey cover*	75

* Perennial understorey vegetation cover includes vascular plant species of the ground and shrub layers with a lifecycle of more than two growing seasons

Imperata cylind. v. raj. 2

V4/V5

Floristic datasheet – 20 m X 20 m quadrat

VZ 32 P 2b

No.	Species	Cover/abundance Score (see table above)
1	Corymbia intermedia	3
2	Allocasuarina torulosa	3
3	Alphitonia excelsa	1
4	Parsonsia straminea	1
5	Rubus moluc. tril.	3
6	Themeda triandra	3
7	Hibbertia scandens	2
8	Polyscias sambuc.	3
9	Imperata cyl. var. major	4
10	Breynia oblongif.	2
11	Euc. acmenoides	3
12	Euc. propinqua	3
13	Euc. carnea	3
14	Dianella caerulea	3
15	Euc. siderophloia	4
16	Oplismenus aemulus	3
17	Brunonella pumil.	2
18	Desmodium rhytidophyllum	2
19	Allocas. torulosa	2
20	Entolasia marginata	3
21	Pandorea pandorana	2
22	Pimelea ligustrina	2
23	Desmodium varians	2
24	Hydrocotyle pedunculata	2
25	Geitonopl. cymo.	2
26	Eustrephus latif.	2
27	Bidens pilosa	2
28	Paspalum orbiculare	2
29	Cheilanthes sieberi subsp sie	1
30	Glycine clandestina	2
	Adinostemma laevenia	2
	Oplismenus imbecillus	3

Total species	35
Total native species	35
Total exotic species	
% perennial native understorey cover*	85

* Perennial understorey vegetation cover includes vascular plant species of the ground and shrub layers with a lifecycle of more than two growing seasons

Cassytha glab. 1
Hardenbergia violac. 1
Callistemon salignus 1

Floristic datasheet – 20 m X 20 m quadrat

V2 4 (old quarry)

No.	Species	Cover/abundance Score (see table above)
1	* Andropogon virginicus	4
2	Euca. globoidea	3
3	Euca. carnea	3
4	Entdasia stricta	2
5	Platylobium formosum	2
6	Hardenbergia violacea	2
7	Daviesia ulicifolia	2
8	Ozothamnus diosmifolius	1
9	Calotis (?) lappulacea	2
10	Melichrus urceolatus	2
11	Dianella caerulea	2
12	Desmodium rhytidophyllum	2
13	Entolasia marginata	2
14	Gomphocarpus pinnatum	1
15	Eucalyptus propinqua	1
16	*Cyperus eragrostis	2
17	Cyperus umbellatus	2
18	Juncus usitatus	3
19	Schoenus apogon	2
20	Allocasuarina littoralis	2
21	Echinopogon ovatus	2
22	Philydrum lanuginosum	2
23	* Paspalum urvillei	3
24	Cassinia (?) uncata	1
25		
26		
27		
28		
29		
30		

Total species	24
Total native species	21
Total exotic species	3
% perennial native understorey cover*	15

* Perennial understorey vegetation cover includes vascular plant species of the ground and shrub layers with a lifecycle of more than two growing seasons

Transect plot worksheet

Full species IDs are not required for BioBanking, but may be useful for identification of correct vegetation type and for monitoring and audit purposes.

BioBanking
Biodiversity Banking and Offsets Scheme

Site type: Development / BioBank **Proposal ID:** V2 4 **Date:** 1/12/15 **Recorder(s):** G.L.

Vegetation type: Quarry – regen **AMG Zone** **Easting/Northing:** **Photos:**

Native over-storey species list At 10 points along the 50-m transect	Regen-eration (√) (zone)	**Native mid-storey species list** (>1m to <over-storey) At 10 points along the 50-m transect	**Native ground cover (grasses) species list** (ground stratum <1m) At 50 points along the 50-m transect	**Native ground cover (shrubs) species list** (ground stratum <1m) At 50 points along the 50-m transect	**Native ground cover (other) species list** (ground stratum <1m) At 50 points along the 50-m transect	**Exotic plants species list** At 50 points along the 50-m transect	**Fallen logs** (min. 10 cm diameter x 50 cm long) (20 x 50m plot)
5 15		10	II 2	0	1 1	1 1	
10 10		5	IIII 4	0	0	II 2	
15 5		0	~~IIII~~ 5	1 1	1 1	~~IIII~~ 5	
20 0		0	II 2	0	II 2	~~IIII~~ 5	
25 0		10	IIII 4	0	1 1	II 2	
30 10		10	III 3	1 1	0	III 3	
35 0		0	II 2	0	1 1	0	
40 0		0	IIII 4	II 2	III 3	1 1	
45 5		0	III 3	0	1 1	1 1	
50 10		0	II 2	0	1 1	III 3	1.5
55	2.0						

Total number of species =
Foliage cover (%) =
Benchmark value (%FC) =
Average crown diameter =
Average foliage cover (%) = 5.5
Number of trees =
Sample area = 20x50

Whole zone
Number of trees with hollows = 0
Sample area =
Benchmark value =

Total no of species = 21	Total no of species =	Total no of species =	Total no of species =	Total no of species = 23	Total (m) = 1.5
Foliage cover (%) = 3.5	Foliage cover (%) =	Foliage cover (%) =	Foliage cover (%) =	Foliage cover (%) =	Benchmark (m) =

SITE AND OTHER NOTES:

NB: Transects / plots should be placed randomly with the minimum number required for the zone in accordance with Table 4 of the Operational Manual.

old quarry

VZ 4

Site value:
Transect plot data sheet

(Start a new sheet for each vegetation zone)

BioBanking
Biodiversity Banking and Offsets Scheme

CMA area	CMA subregion	Recorder	Date
Northern Ri.		C. Leonard	01/12

Proposal ID	Proposal name	Zone ID
VZ 4	Sancrox Quarry	VZ 4

Vegetation formation Dry Sclerophyll Forests (Shrub/grass)

Vegetation class Hunter – Macleay Dry Sclerophyll Forests

Vegetation type White Stringybark – Tallowwood – Grey Gum

Condition (low or mod/good)	Zone descriptor (optional)	Geographic/habitat features (tick after printing step 2 of Credit Calculator)
Low		☐

Coordinates (GPS datum GDA94: _____)

Transect / plot number	P1	2	3	4	5	6	7	8	9	10
Easting										
Northing										
Zone AMG										

Transect 10 points along 50-m transect (see transect tally table for % foliage cover variables)

Native over-storey cover (%)	5.5									
Native mid-storey cover (%)	3.5									
Native ground cover (grasses) (%)	62									
Native ground cover (shrubs) (%)	8									
Native ground cover (other) (%)	22									
Exotic plant cover	46									

Larger sampling area

Native plant species richness [1]	21									
Number of trees with hollows [2]	0									
Over-storey regeneration [3]	0.7									
Total length of fallen logs (m) [2]	1.5									

Comments/additional conservation values (riparian areas, special features, geology, etc.):

[1] 20 x 20 m plot [2] 20 x 50 m plot [3] whole zone

Floristic datasheet – 20 m X 20 m quadrat

V2 5 (near office)

No.	Species	Cover/abundance Score (see table above)
1	Dodonaea triquetra	2
2	Corymbia maculata	5
3	Lophostemon confertus	3
4	Daviesia ulicifolia	2
5	Ozothamnus diosmif.	2
6	Euca. pilularis	3
7	Acacia floribunda	3
8	* Paspalum urvillei	2
9	* Gomphocarpus fruti.	2
10	Dianella caerulea	2
11	Pteridium esculentum	2
12	Platylobium formosum	2
13	Entolasia stricta	3
14	Imperata cylind. v. major	3
15	Bidens pilosa	2
16	Euca. siderophloia	3
17	Euca. microcorys	3
18	Hardenbergia violacea	2
19	Brunonella pumilio	2
20	Glycine clandestina	2
21	* Conyza bonariensis	2
22	* Hypochaeris radicata	2
23	Dichondra repens	2
24	Lomandra longifolia	2
25	Microlaena stip. var. stip.	2
26		
27		
28		
29		
30		

Total species	25
Total native species	21
Total exotic species	4
% perennial native understorey cover*	20

* Perennial understorey vegetation cover includes vascular plant species of the ground and shrub layers with a lifecycle of more than two growing seasons

VZ 5

Site value:
Transect plot data sheet

(Start a new sheet for each vegetation zone)

BioBanking
Biodiversity Banking and Offsets Scheme

CMA area	CMA subregion	Recorder	Date
Northern Ri		J. Pepper	01/12

Proposal ID	Proposal name	Zone ID
VZ 5	Sancrox Quarry	VZ5

Vegetation formation Dry Sclerophyll Forests

Vegetation class Hunter - Macleay Dry Sclerophyll

Vegetation type PMVC_35 Spotted Gum Grassy Dry Forest

Condition (low or mod/good): Low

Zone descriptor (optional):

Geographic/habitat features (tick after printing step 2 of Credit Calculator) ☐

Coordinates (GPS datum GDA94:_____)

Transect / plot number	P1	2	3	4	5	6	7	8	9	10
Easting										
Northing										
Zone AMG										

Transect 10 points along 50-m transect (see transect tally table for % foliage cover variables)

Native over-storey cover (%)	13.5									
Native mid-storey cover (%)	3									
Native ground cover (grasses) (%)	46									
Native ground cover (shrubs) (%)	20									
Native ground cover (other) (%)	26									
Exotic plant cover	20									

Larger sampling area

Native plant species richness [1]	21									
Number of trees with hollows [2]	0									
Over-storey regeneration [3]	1.0									
Total length of fallen logs (m) [2]	36									

Comments/additional conservation values (riparian areas, special features, geology, etc.):

[1] 20 x 20 m plot [2] 20 x 50 m plot [3] whole zone

Transect plot worksheet

Full species IDs are not required for BioBanking, but may be useful for identification of correct vegetation type and for monitoring and audit purposes.

BioBanking
Biodiversity Banking and Offsets Scheme

Site type: Development / BioBank **Proposal ID:** V2 5 **Date:** 1/12/15 **Recorder(s):** GC

Vegetation type: Patch near office **AMG Zone** _____ **Easting/Northing:** _____ **Photos:** _____

Native over-storey species list At 10 points along the 50-m transect	Regen-eration (√) (zone)	**Native mid-storey species list** (>1m to <over-storey) At 10 points along the 50-m transect	**Native ground cover (grasses) species list** (ground stratum <1m) At 50 points along the 50-m transect	**Native ground cover (shrubs) species list** (ground stratum <1m) At 50 points along the 50-m transect	**Native ground cover (other) species list** (ground stratum <1m) At 50 points along the 50-m transect	**Exotic plants species list** At 50 points along the 50-m transect	**Fallen logs** (min. 10 cm diameter x 50 cm long) (20 x 50m plot)
5 35		5	II 2	I 1	0	I 1	
10 35		5	II 2	I 1	0	II 2	
15 10		0	I 1	0	II 2	II 2	2.5
20 0		5	0	I 1	II 2	III 3	
25 0		5	II 2	III 3	I 1	I 1	1.0
30 20		5	0	I 1		I 1	
35 30		0	IIII 4	II 2	0	0 0	>30m
40 5		0	IIII 4	0	II 2	0 0	
45 0		0	IIII 4	I 1	III 3	0 0	
50 0		5	IIII 4	0	III 3	0 0	
135	3.0						
Total number of species =							
Foliage cover (%) =							
Benchmark value (%FC) =							
Average crown diameter =							
Average foliage cover (%) = 13.5							
Number of trees =							
Sample area =							
Whole zone							
Number of trees with hollows =							
Sample area =							>33.5
Benchmark value =		Total no of species = 21	Total no of species =	Total no of species =	Total no of species =	Total no of species =	Total (m) =
		Foliage cover (%) = 3.0	Foliage cover (%) =	Foliage cover (%) =	Foliage cover (%) =	Foliage cover (%) =	Benchmark (m) =

SITE AND OTHER NOTES:

NB: Transects / plots should be placed randomly with the minimum number required for the zone in accordance with Table 4 of the Operational Manual.

APPENDIX D

Greater Sancrox Structure Plan Area (Map)

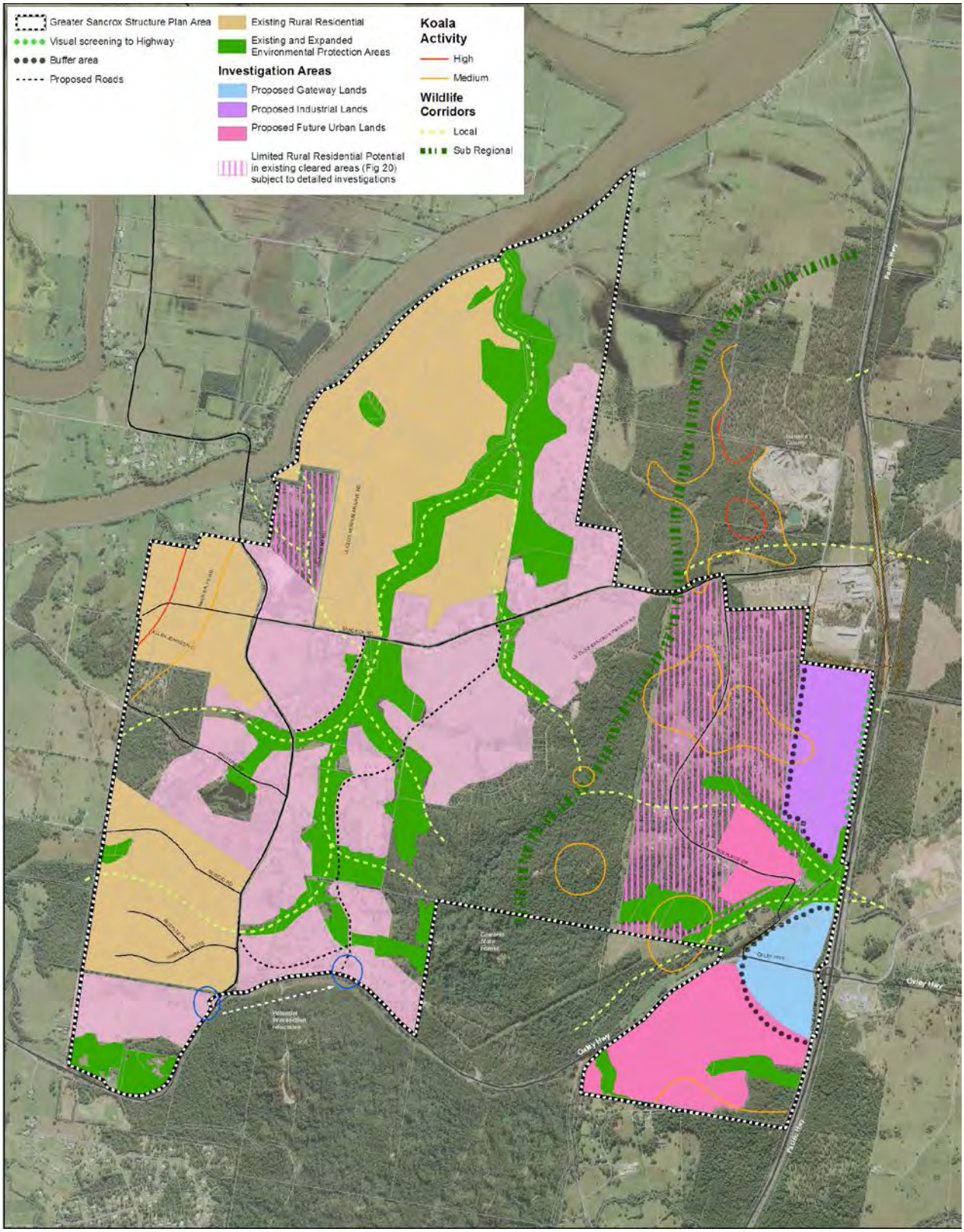


Figure 19 - Structure Plan map

APPENDIX E

Council BVT Profiles

PMVC_035. Spotted Gum Grassy Dry Forest

Formation	Dry Sclerophyll Forests
Sub-formation	Shrub/Grass
Class	Hunter-Macleay Dry Sclerophyll Forests
EEC analog	na
No. field sites	16
Total area	569.36 ha

Floristic Type	*Corymbia citriodora*
Association	*Corymbia citriodora - Allocasuarina torulosa - Themeda australis*

Community description

Tallest stratum

A tall to extremely tall open forest dominated by Spotted Gum *Corymbia citriodora.* Common associates include Grey Ironbark *Eucalyptus siderophloia*, Broad-leaved White Mahogany *Eucalyptus carnea,* Tallowwood *Eucalyptus microcorys* and Grey Gum *Eucalyptus propinqua* with scattered Pink Bloodwood *Corymbia intermedia*, White Stringybark *Eucalyptus globoidea* and the occasional Blackbutt *Eucalyptus pilularis*.

Mid stratum

A low to mid-high open woodland dominated by Forest Oak *Allocasuarina torulosa.* Common associates include Blackwood *Acacia melanoxylon* Brushbox *Lophostemon confertus*, Turpentine *Syncarpia glomulifera* and other species.

Lowest stratum

A mid-high to tall open grassland or sedgeland dominated by Blady Grass *Imperata cylindrica*, Spiny-headed Mat-rush *Lomandra longifolia* or Kangaroo Grass *Themeda australis*. Common associates include Coffee Bush *Breynia oblongifolia* Blue Flax-lily *Dianella caerulea*, Wiry Panic *Entolasia stricta*, *Persoonia stradbrokensis, Ottochloa gracillima* and Tussock Grass *Poa labillardieri* and other species.

Climbers and epiphytes include Large-leaved Staff Vine *Celastrus subspicata*, Water Vine *Cissus hypoglauca*, Yaroong *Cissus sterculifolia*, Wombat Berry *Eustrephus latifolius*, Scrambling Lily *Geitonoplesium cymosum*, Purple Coral Pea *Hardenbergia violacea*, Climbing Guinea Flower *Hibbertia scandens*, Elkhorn Fern *Platycerium bifurcatum*, Lawyer Vine *Smilax australis* and Thin-leaved Tylophora *Tylophora paniculata.*

Community Distribution	Additional Information
	NRCMA AG-ID: na
	Soil landscape: to be detailed
	Occurs with or near: PMVC_026 & 037
	General Distribution: This community is restricted to the Cooperabung and Beechwood erosional soil landscapes at Red Hill and Sancrox.
	Recorded weeds: to be detailed

PMVC_037. White Stringybark – Tallowwood – Grey Gum Dry Forest

Formation	Dry Sclerophyll Forests	
Sub-formation	Grassy	
Class	Hunter-Macleay Dry Sclerophyll Forests	
EEC analog	na	
No. field sites	11	
Total area	950.14 ha	
Floristic Type	*Eucalyptus globoidea*	
Association	*Eucalyptus globoidea - Allocasuarina torulosa - Themeda australis*	

Community description

Tallest stratum

A tall to very tall open forest dominated by White Stringybark *Eucalyptus globoidea* growing in association with Tallowwood *Eucalyptus microcorys*. Common associates include Broad-leaved White Mahogany *Eucalyptus carnea*, which occurs occasionally as a sub-dominant, Grey Gum *Eucalyptus propinqua* and Turpentine *Syncarpia glomulifera*, less commonly Red Bloodwood *Corymbia gummifera* and Grey Ironbark *Eucalyptus siderophloia*.

Mid stratum

A low to mid-high woodland dominated by Forest Oak *Allocasuarina torulosa* and to a lesser extent Black She-oak *Allocasuarina littoralis* growing in association with *Eucalyptus* saplings of the above species, Cheese Tree *Glochidion ferdinandi*, Large-leaf Hop-bush *Dodonaea triquetra*, Narrow-leaved Geebung *Persoonia linearis* and other species.

Lowest stratum

A mid-high to tall grassland and/or sedgeland dominated by Blady Grass *Imperata cylindrica* or Spiny-headed Mat-rush *Lomandra longifolia* growing in association with Common Bracken *Pteridium esculentum*, Kangaroo Grass *Themeda australis*, Wiry Panic *Entolasia stricta* and other species.

Climbers include Purple Coral Pea *Hardenbergia violacea*, Climbing Guinea Flower *Hibbertia scandens*, Dusky Coral Pea *Kennedia rubicunda* and Common Silkpod *Parsonsia straminea.*

Community Distribution	**Additional Information**
	NRCMA AG-ID: none applicable
	Soil landscape: to be detailed
	Occurs with or near: PMVC_028, 035 & 038
	General Distribution: coastal hinterland between Sancrox and Heron's Creek
	Recorded weeds: Introduced species recorded in this community include Lantana *Lantana camara*, Small Leaved Privet *Ligustrum sinense* and Jacaranda *Jacaranda mimosifolia.*

APPENDIX F

BioNet PCT Profiles

BioNet Vegetation Classification - Community Profile Report

Plant Community Type ID (PCT ID): 1215

PCT Name: Spotted Gum - Grey Ironbark open forest of the Macleay Valley lowlands of the NSW North Coast Bioregion

Classification Confidence Level: 5-Very Low

Vegetation Description: Other Diagnostics Features: None; LandscapePosition: Occurs slopes and ridges of coastal foothills

Variation and Natural Disturbance:

Vegetation Formation: Dry Sclerophyll Forests (Shrub/grass sub-formation);

Vegetation Class: Hunter-Macleay Dry Sclerophyll Forests;

IBRA Bioregion(s): NSW North Coast; South Eastern Queensland;

IBRA Sub-region(s): Dalmorton; Chaelundi; Macleay Hastings; Karuah Manning; Clarence Sandstones;

LGA: Not Assessed

Lithology: Not Assessed

Landform Pattern: Not Assessed

Landform Element: Not Assessed

Emergent species: None

Upper Stratum Species: Corymbia maculata; Eucalyptus siderophloia; Eucalyptus carnea; Eucalyptus tereticornis; Eucalyptus moluccana; Eucalyptus microcorys;

Mid Stratum Species: Acacia implexa; Allocasuarina littoralis; Allocasuarina torulosa; Jacksonia scoparia; Xanthorrhoea johnsonii;

Ground Stratum Species: Aristida vagans; Dianella caerulea; Entolasia stricta; Themeda australis; Imperata cylindrica var. major;

Diagnostic Species: Not Assessed

Fire Regime:

TEC Assessed: Has associated TEC

TEC List: Listed BC Act,E: Subtropical Coastal Floodplain Forest of the New South Wales North Coast Bioregion (Part);

Associated TEC Comments:

PCT Percent Cleared: 35.00

PCT Definition Status: Approved

BioNet Vegetation Classification - Community Profile Report

Plant Community Type ID (PCT ID): 1262

PCT Name: Tallowwood - Small-fruited Grey Gum dry grassy open forest of the foothills of the NSW North Coast
Classification Confidence Level: 5-Very Low
Vegetation Description: Other Diagnostics Features: Tall to very tall open forest.; LandscapePosition: Occurs on the coastal lowlands and foothills of the southern parts of the North Coast.
Variation and Natural Disturbance:
Vegetation Formation: Wet Sclerophyll Forests (Grassy sub-formation);
Vegetation Class: Northern Hinterland Wet Sclerophyll Forests;
IBRA Bioregion(s): NSW North Coast;
IBRA Sub-region(s): Macleay Hastings; Upper Manning; Mummel Escarpment; Tomalla; Upper Hunter; Karuah Manning;
LGA: Not Assessed
Lithology: Not Assessed
Landform Pattern: Not Assessed
Landform Element: Not Assessed
Emergent species: None
Upper Stratum Species: Eucalyptus microcorys; Eucalyptus propinqua; Eucalyptus siderophloia; Eucalyptus carnea; Syncarpia glomulifera; Lophostemon confertus;
Mid Stratum Species: Allocasuarina torulosa; Breynia oblongifolia;
Ground Stratum Species: Desmodium rhytidophyllum; Desmodium varians; Dianella caerulea; Glycine clandestina; Hibbertia scandens; Lomandra longifolia; Pseuderanthemum variabile; Themeda australis; Vernonia cinerea; Imperata cylindrica var. major;
Diagnostic Species: Not Assessed
Fire Regime:
TEC Assessed: No associated TEC
TEC List: Not Assessed
Associated TEC Comments:
PCT Percent Cleared: 30.00
PCT Definition Status: Approved

APPENDIX G

Threatened Species Likelihood of Occurrence

KEY	
Status	The “threatened species” listing in the *Threatened Species Conservation Act 1995* (TSC Act)
V	Species listed as “vulnerable”, as defined under the TSC Act.
E1	Species listed as “endangered”, as defined under the TSC Act.
E4A	Species listed as “critically endangered”, as defined under the TSC Act.
E2	An “endangered population”, as defined under the TSC Act.
Records	The number of records of the relevant “threatened species” listed in the search area
Likelihood of Occurrence	The likelihood of occurrence (LoO) of threatened species.
P	Present on the subject land
H	High potential occurrence
M	Moderate potential occurrence
L	Low potential occurrence
N	No relevance
Credit Type	According to Threatened Species Profile Database
Ecosystem	Ecosystem credit species
Species	Species credit species
NOTES	

Species listed in the table below are derived from the BioBanking Credit Calculator (Proposal ID 0107/2015/2368MP) and the *Atlas of NSW Wildlife* website http://www.bionet.nsw.gov.au/. The following notes accompany this database:

- Data from the BioNet Atlas of NSW Wildlife website, which holds records from a number of custodians. The data are only indicative and cannot be considered a comprehensive inventory, and may contain errors and omissions.
- Species listed under the Sensitive Species Data Policy may have their locations denatured (^ rounded to 0.1°; ^^ rounded to 0.01°).
- Copyright - the State of NSW through the Office of Environment & Heritage.
- Search criteria: Licensed Report of all Valid Records of Threatened (listed on TSC Act 1995) Entities in selected area [North: -31.36 West: 152.75 East: 152.98 South: -31.55] returned a total of 2,423 records of 80 species.
- Report generated on 15/10/2015 4:00 PM.

Threatened Species of Plants

Species	Habitat Description	Habitat on site	Records	Credit Type	BC Act Status	EPBC Act Status	Likelihood of Occurrence
Cryptostylis hunteriana Leafless Tongue Orchid	• Occurs in a range of communities, including swamp-heath and woodland • The larger populations typically occur in woodland dominated by Scribbly Gum (*Eucalyptus sclerophylla*), Silvertop Ash (*E. sieberi*), Red Bloodwood (*Corymbia gummifera*) and Black Sheoak (*Allocasuarina littoralis*)	• Marginal potential habitat occurs on site in very restricted locations in paperbark swamp forest margins • No presence of species detected on site	_	Species	V	V	Low
Acacia courtii North Brother Wattle	• Occurs on steep, dry, rocky slopes and in mixed dry forests on shallow soils, often under White Mahogany (*Eucalyptus acmenoides*) and Grey Gum (*Eucalyptus punctata*). • Only found in the Laurieton district occurring on North Brother, Middle Brother and South Brother Mountains	• Outside distribution range		Species	V	V	None
Diuris disposita Willawarrin Doubletail	• Requires grassy open forest • Known only from Willawarrin near Kempsey, NSW, where it is rare	• Outside distribution range	_	Species	E	_	None
Cynanchum elegans White-flowered Wax Plant	• Typical habitat is rainforest and littoral rainforest	• Habitat does not occur on site	1	Species	E1,P	E	None
Allocasuarina defungens	• Typical habitat is tall heath on sand	• Habitat does not occur on site	9	Species	E1,P	E	None

Species	Habitat Description	Habitat on site	Records	Credit Type	BC Act Status	EPBC Act Status	Likelihood of Occurrence
Dwarf Heath Casuarina							
Hibbertia hexandra Tree Guinea Flower	• Typically grows in heath, open forest or rainforest.	• Marginal potential habitat occurs, primary occurrence in Far Northern NSW, however separate occurrence in nearby Wauchope-Kendall area.		Species	E		Low
Maundia triglochinoides	• Grows in swamps, channels, creeks or shallow freshwater 30 - 60 cm deep on heavy clay, low nutrients.	• Marginal potential habitat occurs on site in very restricted locations in paperbark swamp forest margins • No presence of species detected on site	3	Species	V,P	_	Low
Eucalyptus nicholii Narrow-leaved Black Peppermint	• Typical habitat is dry grassy woodland • Distribution range is NE tablelands	• Outside distribution range	3	Species	V	V	None
Marsdenia longiloba Slender Marsdenia	• Subtropical and warm temperate rainforest, lowland moist or open eucalypt forest adjoining rainforest and, sometimes, in areas with rock outcrops • Scattered sites on the north coast of NSW north from Barrington Tops; also occurs in south-east Queensland • Associated species include Eucalyptus crebra, E. microcorys, E. acmenoides, E. saligna, E. propinqua, Corymbia intermedia, and Lophostemon confertus	• Marginal potential habitat occurs on site in very restricted locations in paperbark swamp forest margins • Not recorded on site during flora survey	_	Species	E	V	Low

Species	Habitat Description	Habitat on site	Records	Credit Type	BC Act Status	EPBC Act Status	Likelihood of Occurrence
Melaleuca groveana Grove's Paperbark	• Grows in heath and shrubland, often in exposed sites, in low coastal hills, escarpment ranges and tablelands on outcropping granite, rhyolite and sandstone on rocky outcrops and cliffs • Also occurs in dry scrubby open forest and woodlands • Widespread, scattered populations in coastal districts north of Yengo National Park (Southwest of Newcastle, NSW) to southeast Queensland	• Habitat does not occur on site	_	Species	V	_	Low
Melaleuca biconvexa Biconvex Paperbark	• Typically grows in damp places, often near streams or low-lying areas on alluvial soils of low slopes or sheltered aspect • Only found in NSW, with scattered and dispersed populations found in the Jervis Bay area in the south and the Gosford- • Wyong area in the north.	• Outside distribution range	27	Species	V	V	Low
Niemeyera whitei Rusty Plum	• Found in gullies of warm temperate or littoral rainforests and the adjacent understorey of moist eucalypt forest • Occurs on poorer soils in areas below 600 m above sea level • Rusty Plum occurs in the coast and adjacent ranges of northern NSW from the Macleay River into southern Queensland • Its distributional stronghold is on the mid north coast around Coffs Harbour	• Marginal potential habitat occurs on site in very restricted locations in paperbark swamp forest margins • Not recorded onsite during flora survey	_	Species	V	_	Low

Species	Habitat Description	Habitat on site	Records	Credit Type	BC Act Status	EPBC Act Status	Likelihood of Occurrence
Parsonsia dorrigoensis Milky Silkpod	• Found in subtropical and warm-temperature rainforest, on rainforest margins, and in moist eucalypt forest up to 800m, on brown clay soils • Found only within NSW, with scattered populations in the north coast region between Kendall and Woolgoolga	• Marginal potential habitat occurs on site in very restricted locations in paperbark swamp forest margins	_	Species	V	E	Low
Dendrobium melaleucaphilum Spider orchid	• Typical habitat is swamp – specifically parasitic on *Melaleuca styphelioides* • Flowers from July to October	• One specimen of an epiphytic *Dendrobium* orchid was recorded on an individual *Melaleuca styphelioides* near the western edge of the site • Identification to species level not possible until next flowering period July 2016	1	Species	E1	_	Low
Phaius australis Southern swamp orchid	• Typical habitat is Melaleuca quinquenervia swamps and sclerophyll forest on the coast. • Occurs in Queensland and north-east NSW as far south as Coffs Harbour. Historically, it extended farther south, to Port Macquarie. • Flowers October-November	• Moderate potential habitat occurs on site in the paperbark swamp forest and dry sclerophyll forest • One record within 10km of site only • No occurrence detected during flora survey	1	Species	E1	E	Moderate
Pomaderris queenslandica Scant Pomaderris	• Found in moist eucalypt forest or sheltered woodlands with a shrubby understorey, and occasionally along creeks • Widely scattered but not common in north-east NSW and in Queensland • Known from several locations on the NSW north coast and a few locations on	• Habitat does not occur on site	_	Species	E	_	Low

Species	Habitat Description	Habitat on site	Records	Credit Type	BC Act Status	EPBC Act Status	Likelihood of Occurrence
	the New England Tablelands and North West Slopes • Flowers during spring/summer						
Senna acclinis Rainforest Cassia	• Grows on the margins of subtropical, littoral and dry rainforests • Occurs in coastal districts and adjacent tablelands of NSW from the Illawarra in NSW to Queensland • Flowering occurs in spring and summer; fruit is ripe summer and autumn	• Potential habitat occurs on site in the paperbark swamp forest • No occurrence detected during flora survey	_	Species	E	_	Low

Threatened Species of Animal

Species	Habitat Description	Habitat on site	Records	Credit Type	NSW Status	EPBC Act	LoO
AMPHIBIANS							
Crinia tinnula Wallum Froglet	• Typical habitat is acidic swamps on coastal sand plains - sedgelands, wet heathlands, paperbark swamps and drainage lines • Also persist in disturbed areas • Breeding occurs in winter months and can occur in permanent water in swamps or more ephemeral habitats • Shelter under leaf litter, vegetation, other debris or in burrows of other species often located near the water's edge	• Marginal potential habitat occurs on site in paperbark swamp forest and low lying areas • No occurrence detected on site during fauna survey (noting that rain fell during survey period)	52	Species	V,P	_	Low

Species	Habitat Description	Habitat on site	Records	Credit Type	NSW Status	EPBC Act	LoO
Litoria aurea Green & Golden Bell Frog	• Typical habitat includes marshes, dams and stream-sides – particularly with *Typha* and *Eleocharis* spp. • Prefers unshaded waterbodies, with a grassy area nearby and diurnal sheltering sites • Active by day and usually breeds in summer when conditions are warm and wet	• Suitable habitat may exist on site in paperbark swamp forest areas, quarry water dam and western farm dam • Presence of *Gambusia holbrooki* found in all ponds may prevent establishment on site • No occurrence detected on site during fauna survey (noting that rain fell during survey period)	2	Species	E1,P	V	Low
Litoria brevipalmata Green-thighed Frog	• Occurs in a range of habitats from rainforest and moist eucalypt forest to dry eucalypt forest and heath – typically in areas that pond after rain • Breeding occurs following heavy rainfall from spring to autumn • Isolated localities along the coast and ranges from just north of Wollongong to south-east Queensland	• Suitable habitat may exist on site in paperbark swamp areas and low lying areas • No occurrence detected on site during fauna survey (noting that rain fell during survey period)	20	Species	V,P	_	Low
Mixophyes iteratus Giant Barred Frog	• Associated with flowing streams, often in rainforest or wet sclerophyll forest • Generally lives in large streams or rivers with a width of at least 5 metres	• No suitable habitat exists on site as it prefers flowing streams	1	Species	E1,P,2	E	Low
BIRDS							
Amaurornis moluccana	• Key elements of their habitat are dense undergrowth 2 to 4 metres	• Suitable habitat may exist on site in paperbark swamp forest		Species	V		Low

Species	Habitat Description	Habitat on site	Records	Credit Type	NSW Status	EPBC Act	LoO
Pale-vented Bush-hen	tall and within 300 metres of water.	areas, quarry water dam and western farm dam					
Anthochaera phrygia Regent Honeyeater	• Mostly occur in Dry Box-Ironbark eucalypt woodland and dry sclerophyll forest associations in areas of low to moderate relief • Inhabit woodlands with significantly large numbers of mature trees, high canopy cover and abundance of mistletoes. • In NSW, riparian forests containing River Oak *Casuarina cunninghamiana*, and with Needle-leaf Mistletoe *Amyema cambagei*, are important for feeding and breeding. • Known to breed in three areas, two of them in NSW - Capertee Valley and Bundarra-Barraba regions • Breeds between July and January in Box-Ironbark and other temperate woodlands and riparian gallery forest dominated by River Sheoak.	• Low breeding habitat potential onsite due to small number of mature trees, open canopy, and lack of preferred woodland tree species • May be suitable foraging habitat in winter	2	Species	E4A,P	CE	Low
Botaurus poiciloptilus Australasian Bittern	• Favours permanent freshwater wetlands with tall, dense vegetation, particularly bull rushes (*Typha* spp.) and spike rushes (*Eleocharis* spp.). • Nests in secluded places in densely vegetated wetlands on a platform of reeds	• Limited habitat occurs on site around fringes of freshwater dams • Not recorded on site during fauna survey	4	Species	E1,P	E	Low

Species	Habitat Description	Habitat on site	Records	Credit Type	NSW Status	EPBC Act	LoO
Burhinus grallarius Bush Stone-curlew	• Inhabits open forests and woodlands with a sparse grassy groundlayer and fallen timber. • Nests on ground in scrape or small bare patch. Lays two eggs in spring or early summer • Largely nocturnal, being especially active on moonlit nights. • Feed on insects and small vertebrates, such as frogs, lizards and snakes	• Potential habitat occurs on site in Spotted Gum Grassy Dry Forest • Low breeding habitat potential as dense shrubs for nesting are predominantly absent	2	Ecosystem	E1, P	_	Low
Calyptorhynchus lathami Glossy Black Cockatoo	• Highly dependent on the distribution of *Allocasuarina* species, and is found in woodland dominated by *Allocasuarina* and in open forests where it forms a substantial middle layer. • Requires tree-hollows for breeding.	• Suitable potential habitat exists on site with presence of mid-canopy species *Allocasuarina littoralis* and *Allocasuarina torulosa* • Limited number of tree hollows available may limit breeding potential • Not recorded on site during fauna survey	65	Ecosystem	V,P,2	_	Moderate
Charadrius mongolus Lesser Sand-plover	• Coastal, favouring the beaches of sheltered bays, harbours and estuaries with large intertidal sandflats or mudflats	• Habitat does not occur on site	56	Species	V,P	C,J,K	None
Circus assimilis Spotted Harrier	• A widely dispersing species that prefers more open habitats, such as grassy open woodland, inland riparian woodland, grassland and shrub steppe	• Habitat available on site, largely vagrant - unlikely to occur apart from possible foraging activity • Found most commonly in native grassland.	2	Ecosystem	V,P	_	Low

Species	Habitat Description	Habitat on site	Records	Credit Type	NSW Status	EPBC Act	LoO
Climacteris picumnus victoriae Brown Treecreeper (Eastern subspecies)	• Typical habitat is dry open forests and woodlands dominated by stringybarks or other rough-barked eucalypts, usually with an open grassy understorey, sometimes with one or more shrub species. • Hollows >6cm in live trees or in dead standing or fallen timber necessary for breeding • Up to 80% of the diet is comprised of ants, then other invertebrates and nectar	• Potential habitat (White stringybark-Tallowwood-Grey Gum dry forest) occurs on site • Limited number of tree hollows available may limit breeding potential • Not recorded on site during fauna survey	3	Ecosystem	V,P	_	Low
Coracina lineata Barred Cuckoo-shrike	• Typical habitat is rainforest, eucalypt forests and woodlands, clearings in secondary growth, swamp woodlands and timber along watercourses. • Occur in coastal eastern Australia from Cape York to the Manning River in NSW; Generally uncommon in their range, and are rare in NSW.	• Mixed eucalypt woodland habitat occurs on site • Not recorded on site during fauna survey	1	Ecosystem	V,P	_	Moderate
Daphoenositta chrysoptera Varied Sittella	• Found in eucalypt woodlands and forests throughout their range • Prefer rough-barked trees (like Stringybarks and Ironbarks) or mature trees with hollows or dead branches • Usually seen in flocks, moving swiftly between trees or foraging busily over branches or the trunk • Often quite noisy while feeding	• Moderate potential habitat occurs throughout site • Limited number of tree hollows available may limit breeding potential	23	Ecosystem	V,P	_	Moderate

Species	Habitat Description	Habitat on site	Records	Credit Type	NSW Status	EPBC Act	LoO
Carterornis leucotis White-eared Monarch	• Occur in littoral rainforest, wet and dry sclerophyll forests, swamp forest, and regrowth forest • In NSW, White-eared Monarchs are generally found from the Queensland border south to Iluka at the mouth of the Clarence River, and inland as far as the Richmond Range. There are occasional records south of the Clarence River, near Woolgoolga and around Port Macquarie • Breed from Sept to March and nest high in the canopy	• Potential habitat occurs throughout site in mixed eucalypt woodland and paperbark swamp forest areas • Not recorded on site during fauna survey	_	Species	V	_	Moderate
Dromaius novaehollandiae Emu population in the New South Wales North Coast Bioregion and Port Stephens local government area	• The populations in NSW occur in a range of predominantly open lowland habitats - grasslands, heathland, shrubland, open and shrubby woodlands, forest, and swamp and sedgeland communities	• No suitable habitat occurs on site	1	Species	E2	_	None
Ephippiorhynchus asiaticus Black-necked Stork	• Floodplain wetlands (swamps, billabongs, watercourses and dams) of the major coastal rivers are the key habitat • Secondary habitat includes minor floodplains, coastal sandplain wetlands and estuaries.	• No suitable habitat occurs on site	45	Species	E1,P	_	Low
Esacus magnirostris Beach Stone-curlew	• Restricted to coastal habitats including beaches, islands, reefs and in estuaries	• No suitable habitat occurs on site	1	Species	E4A,P	_	None

Species	Habitat Description	Habitat on site	Records	Credit Type	NSW Status	EPBC Act	LoO
Glossopsitta pusilla Little Lorikeet	• Forages primarily in the canopy of open *Eucalyptus* forest and woodland, yet also finds food in *Angophora, Melaleuca* and other tree species • Roosts in treetops, often distant from feeding areas • Nesting season extends from May to September • Distributed widely across the coastal and Great Divide regions of eastern Australia from Cape York to South Australia. NSW provides a large portion of the species' core habitat, with lorikeets found westward as far as Dubbo and Albury • Nomadic movements are common, influenced by season and food availability	• Potential habitat (Eucalyptus woodland) occurs throughout the site • Not recorded on site during fauna survey	16	Ecosystem	V,P	_	Moderate
Haematopus fuliginosus Sooty Oystercatcher	• Typical habitat is rocky headlands, rocky shelves, exposed reefs with rock pools, beaches and muddy estuaries	• No suitable habitat occurs on site	3	Species	V,P	_	None
Haematopus longirostris Pied Oystercatcher	• Typical habitat is intertidal flats of inlets and bays, open beaches and sandbanks	• No suitable habitat occurs on site	13	Species	E1,P	_	None
Hieraaetus morphnoides Little Eagle	• A wide-ranging species that occurs in a variety of habitats, but mainly occupies open eucalypt forest, woodland or open woodland	• Potential habitat occurs in eucalypt woodland areas throughout site • Not recorded on site during fauna survey	1	Ecosystem	V,P	_	Moderate

Species	Habitat Description	Habitat on site	Records	Credit Type	NSW Status	EPBC Act	LoO
	• Nests in tall living trees within a remnant patch, where pairs build a large stick nest in winter	• One record of occurrence within 10km of site					
Irediparra gallinacean Comb-crested Jacana	• Inhabit permanent freshwater wetlands that are either still or slow-flowing, with a good surface cover of floating vegetation, especially water-lilies, or fringing and aquatic vegetation	• No suitable habitat occurs on site	1	Species	V,P	_	None
Ixobrychus flavicollis Black Bittern	• Inhabits both terrestrial and estuarine wetlands, generally in areas of permanent water and dense vegetation • Where permanent water is present, the species may occur in flooded grassland, forest, woodland, rainforest and mangroves	• No suitable habitat occurs on site	1	Species	V,P	_	None
Lathamus discolour Swift Parrot	• Breeds in Tasmania during spring and summer, migrating in the autumn and winter months to south-eastern Australia from Victoria and the eastern parts of South Australia to south-east Queensland. In NSW mostly occurs on the coast and south west slopes • Favoured feed trees include winter flowering species such as Eucalyptus robusta, Corymbia maculata, C. gummifera, East of the Divide; E. sideroxylon, and E. albens West of the Divide	• Potential but limited foraging habitat occurs on site- *Corymbia maculata* and *Corymbia gummifera* occur as secondary canopy species	4	Ecosystem	E1,P,3	E	Low

Species	Habitat Description	Habitat on site	Records	Credit Type	NSW Status	EPBC Act	LoO
Lophoictinia isura Square-tailed Kite	• This wide-ranging species is found in a variety of habitats including dry woodlands and open forests • Prefers timbered watercourses, particularly for nesting sites • Occupies large home range over 100km^2	• Theoretical habitat availability due to large home ranges • Low quality nesting habitat (preferred near to watercourses)	33	Ecosystem	V,P,3	_	Moderate
Melanodryas cucullata cucullata Hooded Robin	• Prefers lightly wooded country, usually open eucalypt woodland, acacia scrub and mallee, often in or near clearings or open areas • Requires structurally diverse habitats featuring mature eucalypts, saplings, some small shrubs and a ground layer of moderately tall native grasses • Found from Brisbane to Adelaide and throughout much of inland NSW, with the exception of the extreme north-west	• Limited potential habitat • Eucalyptus woodland occurs on site but is lacking structural diversity based on past logging history	_	Ecosystem	V	_	Low
Ninox connivens Barking Owl	• Inhabits woodland and open forest, including fragmented remnants and partly cleared farmland • Flexible in its habitat use and hunting can extend in to closed forest and more open areas • Larger trees and hollow trees facilitate more abundant prey base for hunting and breeding success • Sometimes able to successfully breed along timbered	• Moderate potential habitat occurs on site but large nesting hollows are scarce • Given a large home range, unlikely to occur apart from foraging activity	2	Ecosystem	V,P,3	_	Moderate

Species	Habitat Description	Habitat on site	Records	Credit Type	NSW Status	EPBC Act	LoO
	watercourses in heavily cleared habitats (e.g. western NSW) due to the higher density of prey on these fertile soils						
Ninox strenua Powerful Owl	• Found in open forests and woodlands, as well as along sheltered gullies in wet forests with dense understoreys, especially along watercourses. Will sometimes be found in open areas near forests such as farmland, parks and suburban areas, as well as in remnant bushland patches • Needs old growth trees to nest. • Occupies very large home ranges	• Moderate quality habitat occurs on site, but large nesting hollows are scarce • Given a large home range, unlikely to occur apart from foraging activity	12	Ecosystem	V,P,3	_	Low
Oxyura Australis Blue-billed Duck	• Completely aquatic species, preferring deep water in large permanent wetlands and swamps with dense aquatic vegetation • Semi-migratory, dispersing up to 300km to breed in deep swamps • Most common in the southern Murray-Darling Basin area - generally only in coastal areas during summer or dry years	• Potential habitat availability in large quarry dams (in disturbed quarry area), prefers dense aquatic vegetation • No habitat occurs in proposed expansion area	1	Ecosystem	V,P	_	Low
Pandion cristatus Eastern Osprey	• Favour coastal areas, especially the mouths of large rivers, lagoons and lakes	• No suitable habitat occurs on site	44	Species	V,P,3	_	Low
Petroica boodang Scarlet Robin	• Lives in open forests and woodlands • Active throughout the day	• Potential habitat (mixed eucalypt woodland) occurs on site	1	Ecosystem	V,P	_	Moderate

Species	Habitat Description	Habitat on site	Records	Credit Type	NSW Status	EPBC Act	LoO
	• During winter, it will visit more open habitats such as grasslands and farmland	• Not recorded on site during fauna survey					
Ptilinopus magnificus Wompoo Fruit-Dove	• Occurs in, or near rainforest, low elevation moist eucalypt forest and brush box forests • Occurs along the coast and coastal ranges from the Hunter River in NSW to Cape York Peninsula, though rare south of Coffs Harbour	• No suitable habitat occurs on site	_	Ecosystem	V	_	Low
Ptilinopus regina Rose-crowned Fruit-Dove	• Sub-tropical and dry rainforest and occasionally in moist eucalypt forest and swamp forest, where fruit is plentiful • Numbers increase in Spring and Summer in response to food availability in NE NSW	• No habitat availability, prefers rainforest and occasionally moist eucalypt forest, unlikely to occur	1	Ecosystem	V,P	_	None
Stagonopleura guttata Diamond Firetail	• Found in grassy eucalypt woodlands, including Box-Gum Woodlands and Snow Gum *Eucalyptus pauciflora* Woodlands • Endemic to south-eastern Australia, extending from central Queensland to the Eyre Peninsula in South Australia • Not commonly found in coastal districts	• Potential habitat (Spotted Gum Grassy Dry-Forest) occurs on site, dense shrubs for nesting predominantly absent	_	Ecosystem	V	_	Low
Sternula albifrons Little Tern	• Typical habitat is coastal, preferring sheltered environments • Nests in low dunes or on sandy beaches near estuary mouths, lakes and islands	• No habitat available on the site	12	Species	E1,P	C,J,K	None

Species	Habitat Description	Habitat on site	Records	Credit Type	NSW Status	EPBC Act	LoO
Turnix maculosus Red-backed Button Quail	• Mainly a species of coastal and subcoastal regions • In NSW, occurs in grasslands, heath and crops. Prefers sites close to water, especially when breeding. • The species has been observed associated with the following grasses (in various vegetation formations): Speargrass, Blady Grass, Triodia, Sorghum and Buffel Grass.	• No suitable habitat occurs on site, prefers grasslands, heath and crops	_	Species	V	_	None
Tyto longimembris Eastern Grass Owl	• Typical habitat is tall grass, including grass tussocks, in swampy areas, grassy plains, swampy heath, and in cane grass or sedges on flood plains	• Low habitat availability, prefers areas with tall grass, including tussocks, grassy plains, swampy areas or sedges on floodplains	22	Ecosystem	V,P,3	_	Low
Tyto novaehollandiae Masked Owl	• Typical habitat is dry eucalypt forest and woodland • Roosts and breeds in moist eucalypt forested gullies • Large home-range of 500 to 1000 hectares	• Habitat available on site, large hollow nesting habitat scarce, nearby records to site (within 2km). Unlikely to occur apart from foraging activity	18	Ecosystem	V,P,3	_	Moderate
Tyto tenebricosa Sooty Owl	• Typical habitat is rainforest, including dry rainforest, subtropical and warm temperate rainforest, as well as moist eucalypt forests • Requires very large tree-hollows for nesting	• Low habitat availability, large hollow nesting habitat scarce, prefers rainforest or moister forest types	3	Ecosystem	V,P,3	_	Low
Xenus cinereus Terek Sandpiper	• Typical habitat includes coastal mudflats, lagoons, creeks and estuaries	• No habitat available on the site	3	Species	V,P	C,J,K	None

Species	Habitat Description	Habitat on site	Records	Credit Type	NSW Status	EPBC Act	LoO
MAMMALS							
Aepyprymnus rufescens Rufous Bettong	• Inhabit a variety of forests from tall, moist eucalypt forest to open woodland, with a tussock grass understorey. A dense cover of tall native grasses is the preferred shelter • They sleep during the day in cone-shaped nests constructed of grass in a shallow depression at the base of a tussock or fallen log	• Potential habitat in woodland areas, native grasses in ground layer unlikely tall or dense enough for favourable habitat	1	Species	V,P	_	Moderate
Dasyurus maculatus Spotted-tailed Quoll	• Found in a range of forest habitats, from rainforest to open woodland but seem to prefer moist forests such as rainforests and closed eucalypt forest • Requires forest with suitable den sites such as rock crevices, caves, hollow logs, burrows and tree-hollows	• Potential habitat availability on site , more so in gullies. Foraging habitat available although den opportunities are scarce. Large home ranges.	32	Ecosystem	V,P	E	Low
Cercartetus nanus Eastern Pygmy Possum	• Found in a broad range of habitats from rainforest through sclerophyll (including Box-Ironbark) forest and woodland to heath • Found in south-eastern Australia, from southern Queensland to eastern South Australia and Tasmania • In Northern NSW, most often found in rainforest	• Possible habitat availability in woodland areas although lack of understorey and sparsity of trees may be a deterrent. Flowering shrubs are very sparse on the site and shelter habitat such as tree hollows is limited.	None	Species	V	_	Low

Species	Habitat Description	Habitat on site	Records	Credit Type	NSW Status	EPBC Act	LoO
	• Feeds largely on nectar and pollen collected from banksias, eucalypts and bottlebrushes • Shelters in tree hollows, rotten stumps, holes in the ground, abandoned bird-nests, Ringtail Possum dreys or thickets of vegetation.						
Chalinolobus nigrogriseus Hoary Wattled Bat	• Occurs in dry open eucalypt forests, favouring forests dominated by Spotted Gum, boxes and ironbarks, and heathy coastal forests where Red Bloodwood and Scribbly Gum are common. Because it flies fast below the canopy level, forests with naturally sparse understorey layers may provide the best habitat.	• Foraging habitat available on site. Limited roosting habitat available due to scarcity of hollow-bearing trees or rock crevices.	1	Ecosystem	V,P	_	Moderate
Falsistrellus tasmaniensis Eastern False Pipistrelle	• Prefers moist habitats, with trees taller than 20 m. • Generally roosts in eucalypt hollows, but has also been found under loose bark on trees or in buildings.	• Foraging habitat available on site, roosting habitat (hollow-bearing trees) are scarce. Recorded on site as possible identification (Anabat data likely to be confused with calls with those of other bat species)	2	Ecosystem	V,P	_	Present (AnaBat record, possible confidence)
Kerivoula papuensis Golden-tipped Bat	• Typical habitat is rainforest and adjacent wet and dry sclerophyll forest • Roosts on small steams in rainforest gullies – roosting in small in abandoned hanging bird nests, tree hollows, dense foliage and epiphytes	• Moderate habitat availability prefers rainforest or forest adjacent to rainforest. Roosts mainly in rainforest gullies - unlikely to occur apart from foraging activity.	5	Ecosystem	V,P	_	Moderate

Species	Habitat Description	Habitat on site	Records	Credit Type	NSW Status	EPBC Act	LoO
	• Specialist feeder on small web-building spiders						
Macropus parma Parma Wallaby	• Preferred habitat is moist eucalypt forest with thick, shrubby understorey, often with nearby grassy areas, rainforest margins and occasionally drier eucalypt forest	• Low habitat available, prefers moist eucalypt forests and rainforest margins.		Species	V		Low
Miniopterus australis Little Bentwing-bat	• Moist environments where it roosts in large numbers in caves, old mines, stormwater tunnels and occasionally buildings. • Forages in forests and woodlands and grassland.	• Foraging habitat available on site. Breeding and roosting habitat absent due to scarcity of caves or similar habitat. Recorded on site by Anabat detection.	68	Species	V,P	_	Present (AnaBat record, Confident confidence)
Miniopterus schreibersii oceanensis Eastern Bentwing-bat	• Caves are the primary roosting habitat, but also use derelict mines, storm-water tunnels, buildings and other man-made structures. • Hunt in forested areas, catching moths and other flying insects above the tree tops	• Foraging habitat available on site. Breeding and roosting habitat absent due to scarcity of caves or similar habitat. Recorded on site by Anabat detection as probable Identification. (Some possibility of confusion of calls with those of other bat species).	28	Ecosystem & Species	V,P	_	Present (AnaBat record, Probable confidence)
Mormopterus norfolkensis Eastern Freetail Bat	• Can be found in dry sclerophyll forest, woodland, swamp forests and mangrove forests east of the Great Dividing Range. • Roost mainly in tree-hollows, but will also roost under bark or in man-made structure.	• Foraging habitat available on site. Limited roosting habitat available due to scarcity of hollow-bearing trees. Recorded on site by Anabat detection.	20	Ecosystem	V,P	_	Present (AnaBat record, Confident confidence)

Species	Habitat Description	Habitat on site	Records	Credit Type	NSW Status	EPBC Act	LoO
	• Most active in summer months, just after dusk and during the night.						
Myotis macropus Southern Myotis	• Often roosts in groups of 10 - 15 close to water in caves, mine shafts, hollow-bearing trees, storm water channels, buildings, under bridges and in dense foliage. • Forages over streams and pools. • Most active in summer months, just after dusk and during the night.	• Foraging habitat available on site particularly near larger waterbodies in quarry area. Roosting habitat such as caves, mine shafts or hollow-bearing trees is rare or absent.	18	Ecosystem & Species	V,P	_	Moderate
Petaurus australis Yellow-bellied Glider	• Found in mature eucalypt forests in temperate to subtropical regions of eastern Australia. • Inhabits a wide range of forest types but prefers resource rich forests where mature trees provide nesting hollows. • Winter-flowering eucalypts provide nectar and pollen, and some eucalypts are suitable for tapping sap.	• Limited potential habitat occurs in woodland areas throughout site • Foraging habitat is available but large hollow bearing trees for nesting are scarce	9	Ecosystem	V,P	_	Low
Petaurus norfolcensis Squirrel Glider	• Typical habitat in coastal areas is Blackbutt-Bloodwood forest with heath understorey. • Prefers mixed species stands with a shrub or Acacia midstorey.	• Potential habitat in woodland areas but lack of understorey for foraging and tree hollows for shelter would likely be a deterrent	24	Species	V,P	_	Moderate
Phascogale tapoatafa Brush-tailed Phascogale	• Typical habitat is dry sclerophyll open forest with sparse groundcover of herbs, grasses, shrubs or leaf litter.	• Moderate potential habitat in woodland areas throughout site • Not recorded on site during fauna survey	5	Species	V,P	_	Moderate

Species	Habitat Description	Habitat on site	Records	Credit Type	NSW Status	EPBC Act	LoO
	• Also inhabit heath, swamps, rainforest and wet sclerophyll forest.						
Phascolarctos cinereus Koala	• Lives in eucalypt woodlands and forests. • Home range size varies according to quality of habitat, ranging from less than two hectares to several hundred hectares. • Most active in summer months during breeding season	• Potential koala habitat according to Clause 7 of SEPP 44 present on site. • No breeding population present (meaning no core koala habitat). • One group of old scats observed on ridgetop of site, numerous possible koala scratches (old) observed on Grey Gum trunks across the site	805	Species	V,P	V	Present (historical indirect evidence)
Potorous tridactylus Long-nosed Potoroo	• Inhabits coastal heaths and dry and wet sclerophyll forests; sandy loam soil is a common feature. • Dense understorey with occasional open areas is an essential part of habitat, and may consist of grass-trees, sedges, ferns or heath, or of low shrubs of tea-trees or melaleucas. • In NSW, generally restricted to coastal heaths and forests east of the Great Dividing Range, with an annual rainfall exceeding 760 mm	• Limited potential habitat occurs on site although lack of dense understory would likely be a deterrent for this species	_	Ecosystem	V	V	Low
Planigale maculate Common Planigale	• Typical habitat is rainforest, eucalypt forest, heathland, marshland, grassland and rocky areas where there is surface cover, and usually close to water	• Potential habitat occurs in woodland areas and paperbark swamp forest areas • Not detected on site during fauna survey	4	Species	V,P	_	Moderate

Species	Habitat Description	Habitat on site	Records	Credit Type	NSW Status	EPBC Act	LoO
	• Shelters and breeds in hollow logs, under bark, rocks, cracks in soil, grass tussocks or building debris • Distribution is Coastal north-eastern NSW, coastal east Queensland and Arnhem Land						
Pseudomys gracilicaudatus Eastern Chestnut Mouse	• Typical habitat is heathland mainly in dense, wet heath and swamps • Mainly occurs north from the Hawkesbury River area as scattered records along to coast and eastern fall of the Great Dividing Range extending north into Queensland	• Marginal potential habitat in paperbark swamp forest areas • Not detected on site during fauna survey	14	Species	V,P	_	Low
Pteropus poliocephalus Grey-headed Flying Fox	• Utilises vegetation communities including rainforests, open forests, closed and open woodlands. • Roost sites are typically located near water, such as lakes, rivers or the coast • Forages primarily for eucalypt blossom and related genera but in some areas it also utilises a wide range of rainforest and cultivated fruits.	• Foraging habitat available in flowering eucalypts on site • Species were detected during spotlight survey • No camps detected on site or adjacent survey	121	Ecosystem & Species	V,P	V	Present (foraging individuals observed and heard)
Saccolaimus flaviventris Yellow-bellied Sheathtail-bat	• Forages in most habitats (with and without trees) across its very wide range, • Roost in groups in tree hollows and buildings - also known to utilise mammal burrows	• Foraging habitat available on site • Limited roosting habitat available due to scarcity of hollow-bearing trees • Recorded on site by Anabat detection as a *possible*	2	Ecosystem	V,P	_	Present (AnaBat record, Confident confidence)

Species	Habitat Description	Habitat on site	Records	Credit Type	NSW Status	EPBC Act	LoO
		Identification (likely to be confused with calls with those of other bat species).					
Scoteanax rueppellii Greater Broad-nosed Bat	• Rainforest, wet and dry sclerophyll and woodland. • Usually roosts in tree-hollows. • Forages over streams and pools. • Most active in summer months, just after dusk and during the night.	• Foraging habitat available on site. Limited roosting habitat available due to scarcity of hollow-bearing trees. Recorded on site by Anabat detection.	18	Ecosystem	V,P	_	Present (AnaBat record, Probable confidence)
Thylogale stigmatica Red-legged Pademelon	• Inhabits forest with a dense understorey and ground cover, including rainforest, moist eucalypt forest and vine scrub. • Patchily distributed along coastal and subcoastal eastern Australia from Cape York to the Hunter Valley in NSW	• Limited potential habitat on site although lack of dense understory would likely be a deterrent for this species.	_	Ecosystem	V	_	Low
Vespadelus troughtoni Eastern Cave Bat	• A cave-roosting species that is usually found in dry open forest and woodland, near cliffs or rocky overhangs; has been recorded roosting in disused mine workings, occasionally in colonies of up to 500 individuals.	• Foraging habitat available on the site • Roosting habitat (caves) is absent.	10	Ecosystem & Species	V,P	_	Low
Syconycteris australis Common Blossom-bat	• Often roost in littoral rainforest and feed on nectar and pollen from flowers in adjacent heathland and paperbark swamps • Also recorded in subtropical rainforest, wet sclerophyll forest and other coastal forests	• Low habitat availability, prefers littoral rainforest for roosting and feeds in heath or paperbark swamps • Occasionally occurs in wet sclerophyll forests	1	Ecosystem	V,P	_	Low

Species	Habitat Description	Habitat on site	Records	Credit Type	NSW Status	EPBC Act	LoO
REPTILES							
Coeranoscincus reticulatis Three-toed Snake-tooth Skink	• Rainforest and occasionally moist eucalypt forest, on loamy or sandy soils • Occurs on the coast and ranges from the Macleay valley in NSW to south-eastern Queensland. • Very uncommon south of Grafton.	• Low habitat availability prefers rainforest and occasionally moist eucalypt forest, on loamy or sandy soils. • Outside normal distribution range	_	Species	V	V	Low
Hoplocephalus bitorquatus Pale-headed Snake	• Found mainly in dry eucalypt forests and woodlands, cypress forest and occasionally in rainforest or moist eucalypt forest • Patchy distribution from NE Queensland to NE quarter of NSW • Highly cryptic tree dwelling species that can spend weeks at a time hidden in tree hollows	• Potential habitat available though low occurrence of tree hollows would likely be a deterrent for this species	_	Species	V	_	Moderate
Hoplocephalus stephensii Stephens Banded Snake	• Occurs in rainforest and eucalypt forests and rocky areas up to 950 m in altitude • Coast and ranges from Southern Queensland to Gosford in NSW	• Low habitat availability, prefers rainforest and moist eucalypt forests and rocky areas	_	Species	V	_	Low

ASIA PACIFIC OFFICES

BRISBANE
Level 2, 15 Astor Terrace
Spring Hill QLD 4000
Australia
T: +61 7 3858 4800
F: +61 7 3858 4801

CANBERRA
GPO 410
Canberra ACT 2600
Australia
T: +61 2 6287 0800
F: +61 2 9427 8200

DARWIN
Unit 5, 21 Parap Road
Parap NT 0820
Australia
T: +61 8 8998 0100
F: +61 8 9370 0101

GOLD COAST
Level 2, 194 Varsity Parade
Varsity Lakes QLD 4227
Australia
M: +61 438 763 516

MACKAY
21 River Street
Mackay QLD 4740
Australia
T: +61 7 3181 3300

MELBOURNE
Level 11, 176 Wellington Parade
East Melbourne VIC 3002
Australia
T: +61 3 9249 9400
F: +61 3 9249 9499

NEWCASTLE
10 Kings Road
New Lambton NSW 2305
Australia
T: +61 2 4037 3200
F: +61 2 4037 3201

NEWCASTLE CBD
Suite 2B, 125 Bull Street
Newcastle West NSW 2302
Australia
T: +61 2 4940 0442

PERTH
Ground Floor, 503 Murray Street
Perth WA 6000
Australia
T: +61 8 9422 5900
F: +61 8 9422 5901

SYDNEY
Tenancy 202 Submarine School
Sub Base Platypus
120 High Street
North Sydney NSW 2060
Australia
T: +61 2 9427 8100
F: +61 2 9427 8200

TOWNSVILLE
12 Cannan Street
South Townsville QLD 4810
Australia
T: +61 7 4722 8000
F: +61 7 4722 8001

WOLLONGONG
Level 1, The Central Building
UoW Innovation Campus
North Wollongong NSW 2500
Australia
T: +61 2 4249 1000

AUCKLAND
Level 4, 12 O'Connell Street
Auckland 1010
New Zealand
T: 0800 757 695

NELSON
6/A Cambridge Street
Richmond, Nelson 7020
New Zealand
T: +64 274 898 628

APPENDIX H

Koala Survey Report

SANCROX QUARRY EXPANSION PROJECT (SSD 7293)

Koala Survey and Assessment

Prepared for:

Hanson Heidelberg Cement Group
Level 8, 2-12 Macquarie Street PARRAMATTA NSW 2150

SLR Ref: 630.11478-R01
Version No: -v2.2
December 2020

PREPARED BY

SLR Consulting Australia Pty Ltd
ABN 29 001 584 612
10 Kings Road
New Lambton NSW 2305 Australia
(PO Box 447 New Lambton NSW 2305)
T: +61 2 4037 3200
E: newcastleau@slrconsulting.com www.slrconsulting.com

BASIS OF REPORT

This report has been prepared by SLR Consulting Australia Pty Ltd (SLR) with all reasonable skill, care and diligence, and taking account of the timescale and resources allocated to it by agreement with Hanson Heidelberg Cement Group (the Client). Information reported herein is based on the interpretation of data collected, which has been accepted in good faith as being accurate and valid.

This report is for the exclusive use of the Client. No warranties or guarantees are expressed or should be inferred by any third parties. This report may not be relied upon by other parties without written consent from SLR.

SLR disclaims any responsibility to the Client and others in respect of any matters outside the agreed scope of the work.

DOCUMENT CONTROL

Reference	Date	Prepared	Checked	Authorised
630.11478-R01-v2.2	30 December 2020	Caitlin Cross and Amanda Lane (Biolink)	J Pepper	J Pepper

EXECUTIVE SUMMARY

Project Description and Background

Hanson Heidelberg Cement Group Pty Ltd (Hanson) is seeking project approval for the expansion of the existing Sancrox hard rock quarry. The Sancrox Quarry Expansion Project (SSD-7293) will involve extending the life of the quarry to 30 years and increasing approved extraction limits of 175, 00m^3. In their updated submission on the EIS, the Department of Planning, Industry and Environment requested the Biodiversity Assessment Report (BAR) should be amended to calculate required species credits for the Koala.

As part of the response to submissions on the EIS, Hanson has engaged SLR and Biolink to conduct supplementary surveys across the Sancrox project site to determine current Koala utilisation of the site and to update the assessment of impacts on the Koala. The aim of these surveys is to address the BCD concerns regarding impacts on the Koala and revaluate the ecological importance of the site for the local population of Koala.

Field Survey and results

Field surveys were conducted by SLR Consulting and Biolink on the 12-13 October 2020. These surveys included using RGb-SAT and nocturnal (spotlighting) surveys. Koala faecal pellets were recorded at eight of the 15 sampled field sites, and of the eight sites, four returned significant activity levels of 'medium' or 'high' use. One Koala was sighted during nocturnal spotlighting transects approximately 50 m west of the existing quarry wall. This is indicated the presence of one or more resident Koalas within the site.

Discussion

Ecological analysis of Koala activity levels identified two Koala activity cells adjoining the western edge of the quarry, reaching both the northern and southern boundary of the site, as well as another cell in the western portion of the site. Survey data implies the site as a high use area, with one or more resident Koalas within the study area.

Based on the current survey results and modelled activity levels, combined with previous Koala survey results, and the widespread occurrence of several Koala feed trees within the forested parts of the site, the site is considered to be habitat for the Koala, as a species credit species under the Framework for Biodiversity Assessment. The total area of Koala habitat within the site is estimated to be around 42.6 hectares.

The removal of Koala habitat associated with the proposed expansion of the Sancrox Quarry will reduce the availability of foraging and breeding habitat for the local Koala population and will increase barriers to local movement and dispersal of Koalas in the locality, particularly in a north-south direction.

Conclusion

On the basis of the current findings, and with reference to the procedures for calculating impacts on species credit species in the Framework for Biodiversity Assessment, a species polygon should be drawn for all areas of Koala habitat removal on the site and the associated species credits for the Koala calculated.

CONTENTS

1 INTRODUCTION 1
1.1 Background 1
1.2 Site Location and Description 1
1.3 Koala ecology and Habitat 3

2 KOALA ASSESSMENT METHODOLOGY 4
2.1 Overall assessment methodology 4
2.2 SAT survey 4
2.3 Nocturnal (spotlighting) surveys 6
2.4 Spatial modelling 6

3 SURVEY RESULTS 7
3.1 Previous Surveys 7
3.2 Koala Habitat 7
3.3 Koala Activity 9
3.4 Koala Sightings 11

4 DISCUSSION AND CONCLUSION 14

5 REFERENCES 15

CONTENTS

DOCUMENT REFERENCES

TABLES

Table 1 Categorisations of Koala activity# 6
Table 2 Tree species recorded as part of the SAT surveys within Sancrox Quarry 7
Table 3 Plant Community Types (PCTs) mapped within the study area 8
Table 4 Koala activity level amongst SAT sites 11

FIGURES

Figure 1 Study area and regional location 2
Figure 2 Koala Survey Locations 5
Figure 3 Koala habitat within Sancrox Quarry 10
Figure 4 Locations of positive SAT sites and Koala sighting 12
Figure 5 Koala Activity Contours 13

APPENDICES

Appendix A Koala SAT Field Sheets
Appendix B Koala Feed Trees for the North Coast Area

1 Introduction

1.1 Background

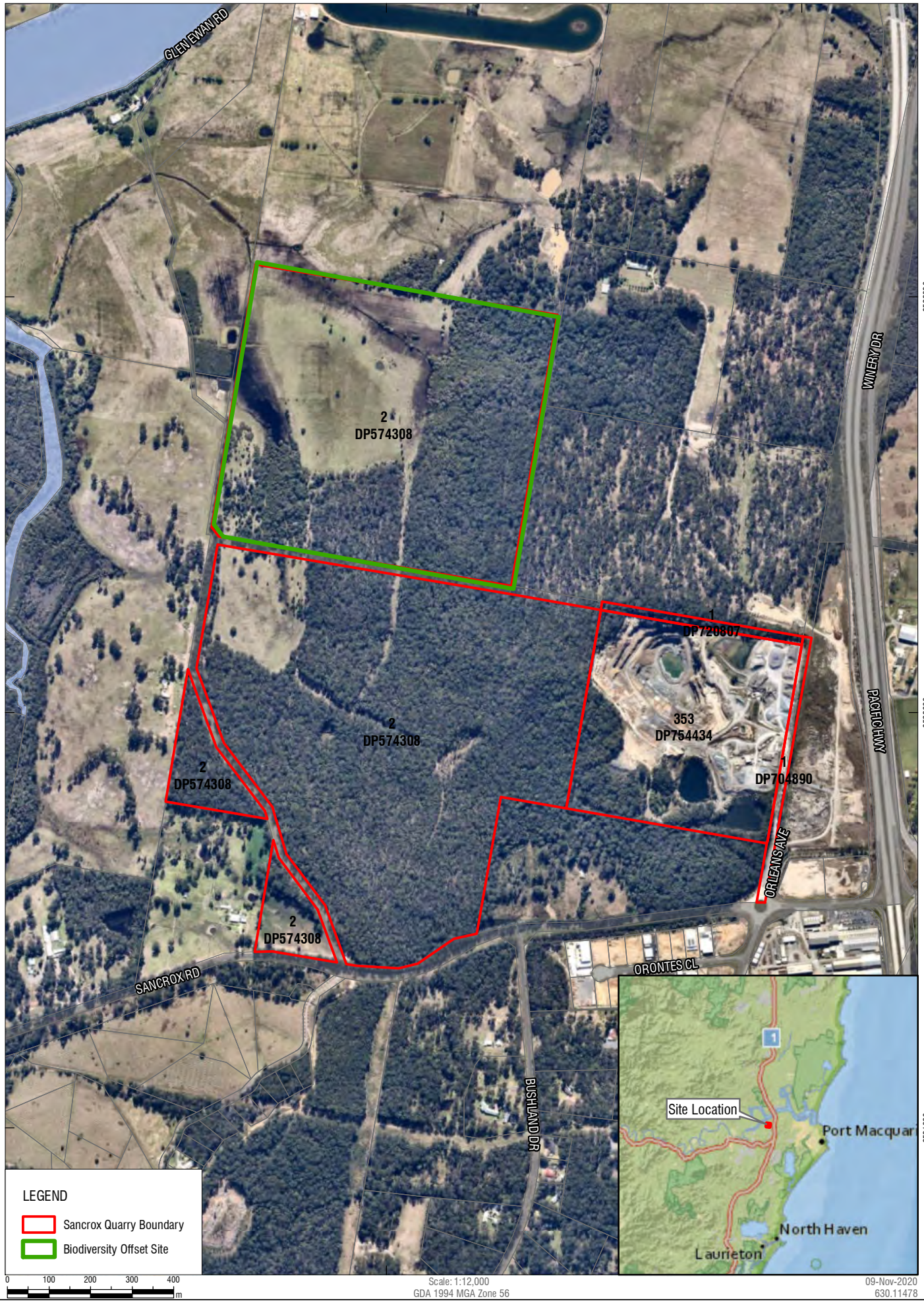
Hanson Heidelberg Cement Group Pty Ltd (Hanson) is seeking project approval for the expansion of the existing Sancrox hard rock quarry. The Sancrox Quarry Expansion Project will involve extending the life of the quarry to 30 years and increasing approved extraction limits by 175, 000 m^3. The Sancrox Quarry Expansion Project (SSD-7293) is a State Significant Development (SSD) as defined under *State Environmental Planning Policy (State and Regional Development) 2011* (SRD SEPP) and will require development consent under Part 4, Division 4.1 of the *NSW Environmental Planning and Assessment Act 1979* (EP&A Act). Hanson has prepared an environmental impact statement (EIS) according to the requirements for SSD projects and the EIS has been submitted and exhibited. As part of the preparation of the EIS, SLR prepared a Biodiversity Assessment Report in accordance with the *Framework for Biodiversity Assessment* (FBA, OEH 2014a).

In the updated submission on the EIS (see letter DOC20/211538, dated 3 April 2020), the Department of Planning, Industry and Environment (DPIE), Biodiversity Conservation Division (BCD) commented, *inter alia*, as follows: "As evidence of the koala has been previously recorded on site, the BAR should be amended to calculate the required species credits". In response to the BCD submission, Hanson has engaged SLR and Biolink to conduct supplementary surveys across the Sancrox project site ('the site') to determine current Koala utilisation of the site. The aim of these surveys is to address the BCD concerns regarding impacts and revaluate the ecological importance of the site for the local population of Koala. Subsequently, a determination can be made on whether the impacts of the project on Koala habitat will necessitate the generation and purchase of Koala species credits according to the FBA. The results and conclusions of the report are based on field surveys and data provided by Biolink in combination with the assistance of SLR ecology staff.

Several surveys targeting the Koala have been completed on the Sancrox site and within the wider Port Macquarie Hastings local government area over recent years (see **Section 3.1**). Most recently, Koala surveys were conducted by SLR in late 2015 as part of the Biodiversity Assessment Report (BAR) for the SSD application (see SLR 2019). The results of those surveys indicated that Koala activity levels were 'Low' according to the Spot Assessment Technique (SAT) criteria. On this basis, species credits for the Koala were not calculated (in accordance with the FBA) to address impacts on Koala habitat as a result of the proposed development.

1.2 Site Location and Description

Sancrox Quarry (the Study Area) is located on Lot 353 DP754434 and on Lot 2 DP574308, north-east of the Sancrox Road and Frogs Road intersection approximately 8 km west of Port Macquarie, in the Port Macquarie-Hastings Local Government Area (**Figure 1**). The majority of the study area is covered with natural forest vegetation that has been modified by past logging and grazing, with some cleared areas at the extremities of the study area. The proposed expansion of the quarry will result in the removal of approximately 42.6 ha of native vegetation.



Sheet Size : A4

SLR

www.slrconsultingaustralia.com.au

Study Area and Regional Location

FIGURE 1

1.3 Koala ecology and Habitat

The Koala (*Phascolarctos cinereus*) is listed as Vulnerable on both the NSW *Biodiversity Conservation Act 2016* (BC Act) and on the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). The Koala has a fragmented distribution throughout eastern Australia from the inhabiting a range of eucalypt forest and woodland communities usually where preferred browse species of eucalypt occur, from north-eastern Queensland to south-eastern South Australia and to the west of the Great Dividing Range. Port Macquarie is considered one of the important population centres for Koalas (Ecotone 2013).

Koalas are fundamentally solitary animals that occupy a small home range that may overlap with other individuals. In preferred habitat female Koalas have a home range of approximately 1 hectare, whereas males have approximately 1 to 1.5 hectares, depending on their age and size. Koala home ranges will vary in size depending on the quality of the habitat and suitability, with home range size varying from less than two hectares, to several hundred hectares during breeding season (DPIE 2019). The breeding season for the Koala peaks between September and February. The young spend the first six months in the pouch and are then carried on the mothers back. At 12 months of age the young are independent, but do not reach sexual maturity until they are two years of age (DPIE 2019).

Koalas are known to use a variety of eucalyptus and non-eucalyptus species throughout NSW (DPIE 2020). A review of Koala tree use identified approximately 137 tree species in 2018, but following consultation with Koala experts, the list was refined to 123 species in the *Koala Habitat Information Base Technical Guide* (DPIE 2020). These 123 tree species were categorised into nine distinct regions, according to feed tree preferences in each region. Port Macquarie (and the subject site at Sancrox) is located within the North Coast region and contains a total of 42 Koala use tree species (DPIE 2020).

.

2 Koala assessment methodology

2.1 Overall assessment methodology

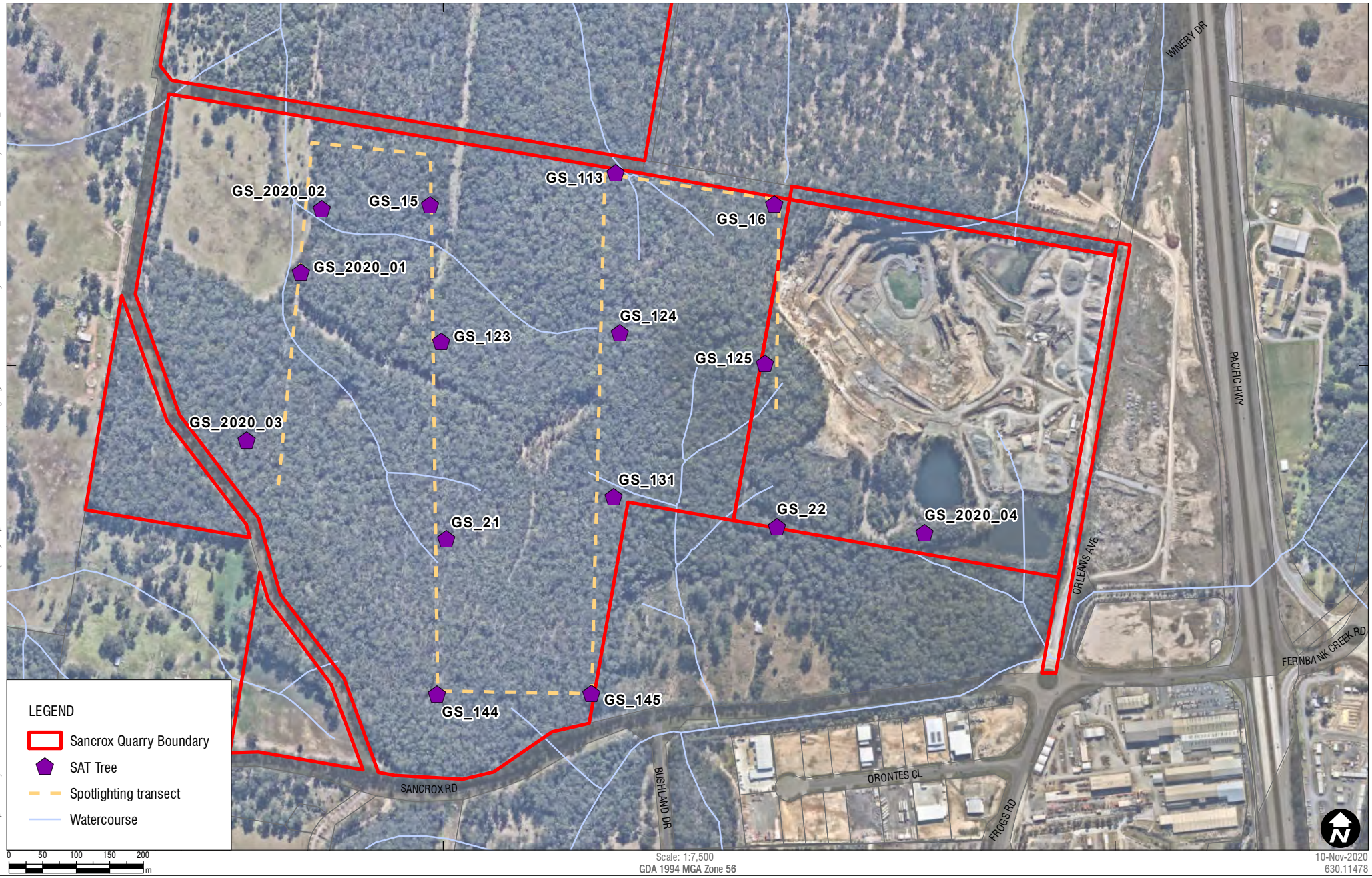
Field assessments were undertaken using RGb-SAT (Regularised Grid-based Spot Assessment Technique) underpinned by the protocols of Phillips and Callaghan (2011) and two consecutive nights of spotlight searches along a walking transect. Field transects were carried out by Biolink ecologists Dr. Amanda Lane and Kristen Wallis and SLR Ecologist Caitlin Cross.

Field survey assessments were undertaken across the study area on the 12-13 October 2020, during which time 15 SAT sites were assessed and a 3 km walking spotlight transect was undertaken on two consecutive nights.

2.2 SAT survey

The study area was initially overlain with a 250 m grid and aerial imagery to identify potential sampling points that are spatially independent and occur within an area of mapped eucalypt woodland/forest. Eleven of these 15 sites were previously surveyed by Biolink (2011). Coordinates (UTM) were determined for each corresponding sampling point and uploaded into a hand-held GPS to enable location in the field. Once a sampling point was located, Koala activity was measured using the SAT protocols of Phillips and Callaghan (2011). Koala activity (measured as a percentage, %) was determined based on the number of trees with Koala faecal pellets within a prescribed search area of 1 m around the base of a tree that has a stem diameter greater than 100 mm at breast height (DBH), accounting for the total number of trees sampled, up to a maximum of 30. By way of example, three positive trees (ie trees with scats present within 1 m of the base) out of 30 would yield a Koala activity score of 10 %.

The distribution of surveyed field sites (ie SAT sites) is illustrated in **Figure 2** and scanned copies of survey data sheets are provided in **Appendix A**.



\\AU\Corporate\Projects-SLR\630-Sty\NTL\630-NTL\630.11478 Sancrox Quarry Expansion\06 SLR Data\06 Drafting\Figures\ArcGIS\Koala Survey\SLR630114 78_F02_KoalaSurveyMethods_01.mxd

Sheet Size : A4

SLR

www.slrconsultingaustralia.com.au

Koala Survey Locations

FIGURE 2

2.3 Nocturnal (spotlighting) surveys

Spotlighting was undertaken from 7:30 pm to 10:30 pm on 12 and 13 October 2020. Nocturnal surveys consisted of spotlighting transects that were designed to sample the variety of vegetation types and hence Koala habitat types across the site. A series of walked traverses was completed across the site over two nights, with the same transect alignment repeated on the second night. The transect alignment is shown in **Figure 2.** The length of the transect totalled approximately 3 km; the precise location of the centreline of the transect was subject to minor variations based on local topography.

2.4 Spatial modelling

Habitat utilisation / naïve occupancy was calculated by Biolink according to the number of active sites (ie SAT sites) divided by the total number of sites. This value is reported with a standard error (SE).

Koala activity data from all SAT sites were interpolated using regularised, thin-plate splining techniques using the spatial analyst extension in ArcGIS 10.5, performed by Biolink. Output from the splining process was used to produce an activity contour model to delineate areas occupied by resident Koala populations by identifying contours greater than 10 % indicating significant activity thresholds of Phillips and Callaghan (2011) as detailed in **Table 1**. Lower activity contours were included in the activity model to assist with interpretation of connectivity. This process produces a meta-population model (or contour map) that delineates important 'source' areas supporting established resident Koala populations. These modelled areas of significant Koala activity tend to encapsulate most contemporary Koala records including 100 % of breeding families (Biolink 2007).

Given the occurrence of Preferred Koala Food Trees (PKFTs) such as grey gum across the study area, Koala activity was interpreted in the terms of the East Coast (low) population density level of utilisation as defined by Phillips and Callaghan (2011).

Table 1 Categorisations of Koala activity#

Activity category	Low use	Medium (normal) use	High use
East Coast (low)	<9.97%	≥ 9.97% but ≤ 12.59%	>12.59%

Based on use of mean activity level ± 99% confidence intervals. Activity levels in the medium (normal) and High use range for East Coast (low) activity categories indicates occupancy by resident koala populations

3 Survey Results

3.1 Previous Surveys

Several surveys targeting the Koala have been completed on the Sancrox site and also within the wider Port Macquarie Hastings local government area over the last 10 years. The ecological assessment completed for the *Greater Sancrox Structure Plan* (Biolink 2011) identified two small areas of significant Koala activity, of which both are located within the site. Although no Koalas were recorded on the site, the recording of scats provided enough data to model the distribution of core Koala habitat. Two populations of less than 10 to 15 individuals were predicted to utilise the bushland within and around the site and were considered to be restricted to these areas by the Pacific Highway to the east and extensive clearing to the west and north. Accordingly, the Sancrox area was identified and mapped as an area of 'generational persistence', meaning that records extend beyond the lifespan of individual animals (Biolink, 2011).

Koala habitat mapping conducted by Biolink in 2013 identified the Port Macquarie-Hastings local government area in which the Sancrox Quarry is located as an area of high generational persistence and a high likelihood of Koalas occurring within the area (OEH 2014).

In a previous survey for Koalas on the Sancrox Quarry site, Ecotone (2013) recorded evidence of Koala activity in the form of scats and scratches on tree bark. However, no Koalas were sighted and no males were heard calling. Ecotone (2013) state that the evidence for the presence of Koalas (ie scratches on bark and scats) was not recent and was likely to be several months old. On this basis, Ecotone conclude that Koalas still utilise the habitats within the site for dispersal between other areas of habitat in the locality.

Similarly, SLR recorded evidence of Koala activity during field surveys in November 2015, being a small number of older scats and possible tree scratches (see SLR 2019). However, despite comprehensive searches for Koalas using visual inspection of feed trees, listening for male calls, spotlighting and the Spot Assessment Technique (10 SAT sites in total), no evidence via sightings or calls was recorded. The results of the SAT assessment indicated that Koala activity on the site at the time was 'Low'.

3.2 Koala Habitat

Fir the current survey, SAT surveys were conducted at 15 sites comprising of a total of 16 tree species during the surveys (**Table 2**). Of these, 15 species are listed as Koala feed trees (DPIE 2020). The full list of Koala feed trees for the North Coast Management Area, which incorporates the Sancrox locality, is listed in **Appendix B**.

Table 2 Tree species recorded as part of the SAT surveys within Sancrox Quarry

Scientific name	Common name	Koala use trees#
Allocasuarina torulosa	Forest Oak	Yes
Corymbia intermedia	Pink Bloodwood	Yes
Corymbia maculata	Spotted Gum	Yes
Eucalyptus sp.		Yes
Eucalyptus acmenoides	White Mahogany	Yes
Eucalyptus carnea	Thick-leaved Mahogany	Yes
Eucalyptus crebra	Narrow-leaved Ironbark	Yes

Scientific name	Common name	Koala use trees#
Eucalyptus glaucina	Slaty Red Gum	Yes
Eucalyptus globoidea	White Stringybark	Yes
Eucalyptus microcorys	Tallowwood	Yes
Eucalyptus pilularis	Blackbutt	Yes
Eucalyptus propinqua	Small-fruited Grey Gum	Yes
Eucalyptus robusta	Swamp Mahogany	Yes
Eucalyptus tereticornis	Forest Red Gum	Yes
Lophostemon confertus	Brush box	No
Melaleuca sp.		Yes

Koala use trees as defined by DPIE (2020)

Vegetation mapping conducted as part of the BAR indicates that the forested parts of the site are classified into three plant community types (PCTs), as listed in **Table 3**.

Table 3 Plant Community Types (PCTs) mapped within the study area

PCT Code	PCT Name	TEC	Area (ha)
686	Blackbutt - Pink Bloodwood shrubby open forest of the coastal lowlands of the NSW North Coast Bioregion	Yes	0.6
1215	Spotted Gum - Grey Ironbark open forest of the Macleay Valley lowlands of the NSW North Coast Bioregion	No	11.0
1262	Tallowwood - Small-fruited Grey Gum dry grassy open forest of the foothills of the NSW North Coast	No	31.0
	Total Native Vegetation		**42.6**

Koala feed trees are present in all three PCTs and are distributed widely across the site. According to DPIE (2020), and based on the results of the BAR surveys and the current Koala survey, the site contains 13 Koala feed trees, as follows:

- Spotted Gum *Corymbia maculata*;
- Pink Bloodwood *Corymbia intermedia*;
- Small-fruited Grey Gum *Eucalyptus propinqua*;
- Blackbutt *Eucalyptus pilularis*;
- Tallowwood *Eucalyptus microcorys*;
- Thick-leaved Mahogany *Eucalyptus carnea;*
- White Stringybark *Eucalyptus globoidea*;
- Grey Ironbark *Eucalyptus siderophloia*;
- Flooded Gum *Eucalyptus grandis* (in offset site);
- Broad-leaved Paperbark *Melaleuca quinquenervia*;
- Forest Red Gum *Eucalyptus tereticornis* (in offset site);

- Narrow-leaved Red Gum *Eucalyptus seeana* (in offset site); and
- Forest Oak *Allocasuarina torulosa*.

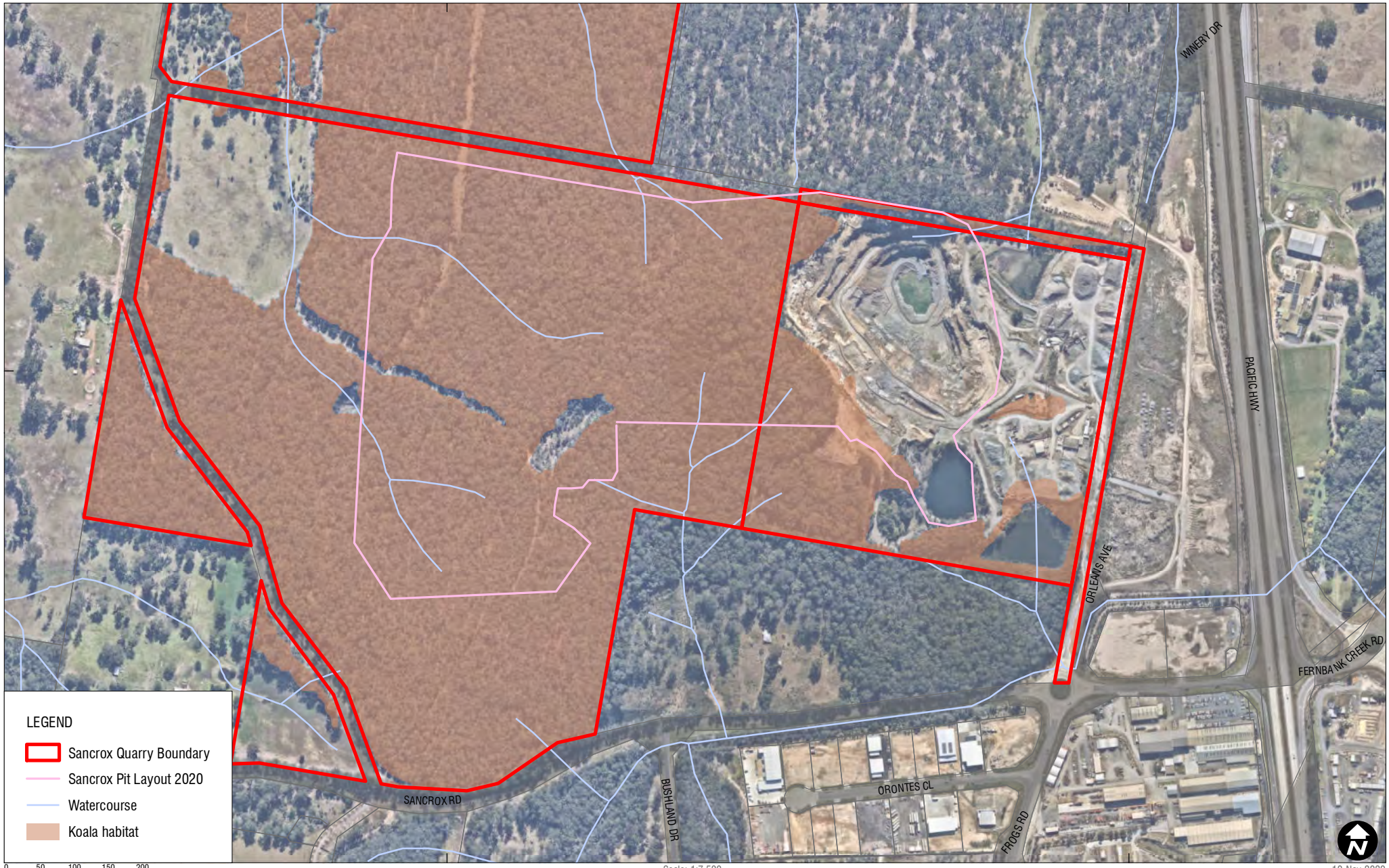
It is also noted that Koalas have been recorded feeding on Swamp Oak *Casuarina glauca* (which is more common in the offset site) at Bonville (G Leonard *pers. comm.* 2016), although Swamp Oak is not generally recognised as a Koala feed tree.

Given the widespread presence of Koala feed trees across the site, all PCTs mapped (in the BAR) as occurring on the site, comprising a total area of 42.6 hectares, are considered to constitute Koala habitat, in accordance with the methods for identification of species credits in the FBA. Consequently, a map of Koala habitat has been prepared by combining the PCTs mapped across the site, as shown **Figure 3**.

3.3 Koala Activity

Evidence of Koalas in the form of diagnostic faecal pellets was recorded at eight of the 15 sampled SAT sites (**Figure 4**) resulting in a habitat utilisation / naïve occupancy estimate of 53 % ± 13 % (SE) of the available habitat. Eight SAT sites yielded evidence of Koalas with activity levels ranging from 3.33% - 33.33% (**Table 4**). Three sites returned 'high' activity levels (13.33% - 33.33%) and one site returned 'medium' activity level (10.00%) in accordance with Phillips and Callaghan (2011) (**Table 1**). Four sites yielded 'low' activity levels (3.33% - 6.67%) and the remaining sites returned no activity levels.

Koala activity data collected from the current field survey was modelled by Biolink to produce a set of activity contours, which are displayed on **Figure 5**. The Koala activity contours show an activity cell adjoining the western edge of the quarry, reaching both the northern and southern boundary of the site, as well as another cell in the western portion of the site, centred around sampling point GS_2021 (see **Figure 2**). These cells indicate high use areas within Koala home ranges, which may extend beyond the bounds of the study area.



\\AU\Corporate\Projects-SLR\630-SYNTL\630-NTL\630.11478 Sancrox Quarry Expansion\06 SLR Data\06 Drafting\Figures\ArcGIS\Koala Survey\SLR630114478_F03_KoalaHabitat_01.mxd

Sheet Size : A4

SLR

www.slrconsultingaustralia.com.au

Koala Habitat within Sancrox Quarry

FIGURE 3

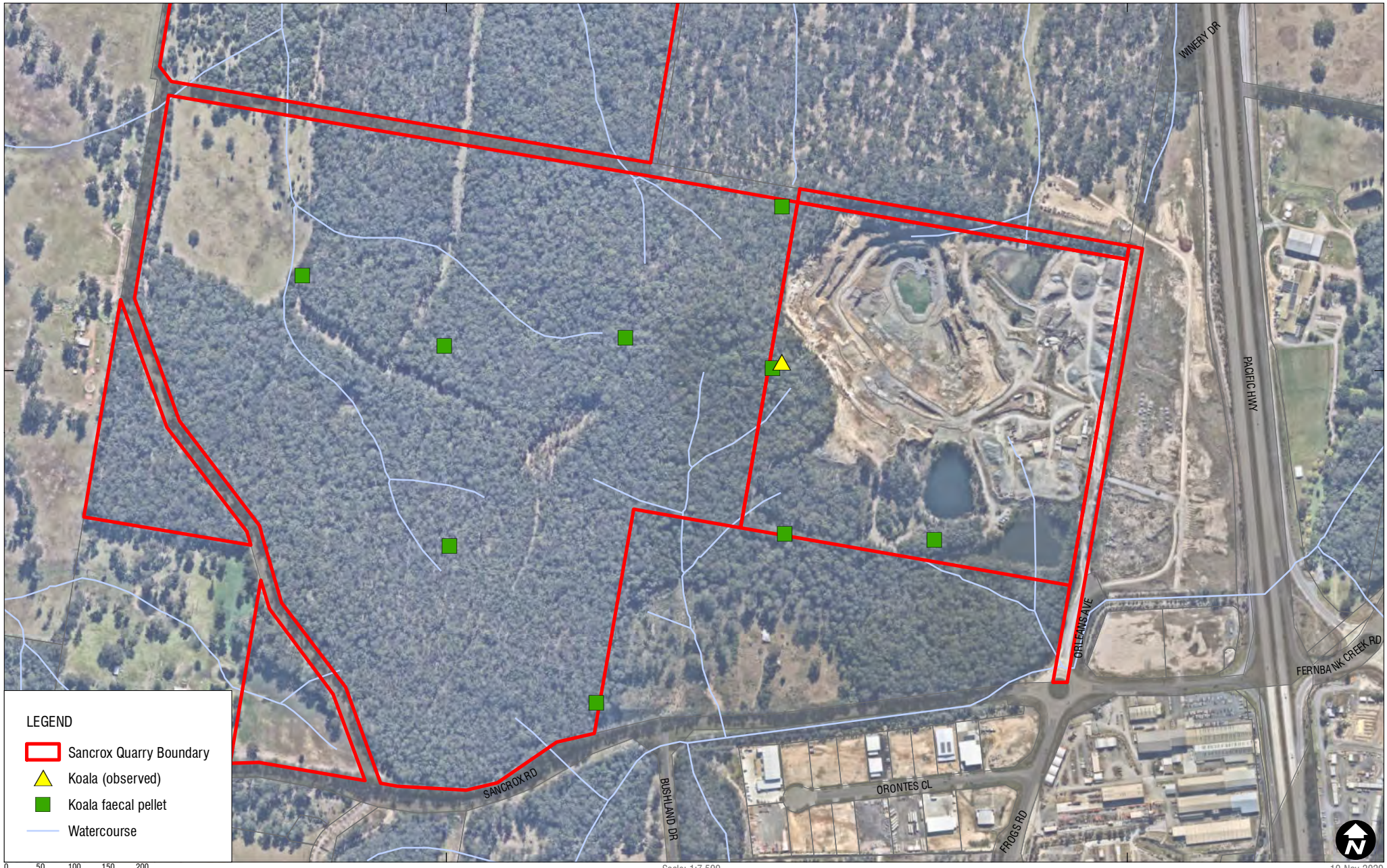
Table 4 Koala activity level amongst SAT sites

Site code	Total number of trees	Activity (as %)	Activity level	Easting	Northing
GS_113	30	0.00	Nil	482257	6522287
GS_123	30	10.00	Medium	481997	6522036
GS_124	31	6.45	Low	482263	6522048
GS_125	30	33.33	High	482479	6522003
GS_131	30	0.00	Nil	482254	6521805
GS_144	30	0.00	Nil	481991	6521511
GS_145	30	3.33	Low	482221	6521512
GS_15	30	0.00	Nil	481981	6522239
GS_16	30	13.33	High	482493	6522240
GS_2020_01	30	26.67	High	481789	6522139
GS_2020_02	30	0.00	Nil	481820	6522233
GS_2020_03	30	0.00	Nil	481708	6521889
GS_2020_04	30	3.33	Low	482717	6521751
GS_21	30	0.00	Nil	482005	6521742
GS_22	30	6.67	Low	482497	6521760

3.4 Koala Sightings

One Koala was sighted during nocturnal (spotlighting) surveys and the location of the sighting is shown in **Figure 4**. The young adult Koala sighted was found in a Spotted Gum *Corymbia maculata* approximately 50 m west of the existing pit wall.

No Koalas were sighted in previous surveys conducted by SLR in 2015 or by Ecotone in 2013.



Sheet Size : A4

SLR

www.slrconsultingaustralia.com.au

Locations of positive SAT sites and Koala sighting

FIGURE 4

\\AU\Corporate\Projects-SLR\630-SYVNTL\630-NTL\630.11478 Sancrox Quarry Expansion\06 SLR Data\06 Drafting\Figures\ArcGIS\Koala Survey\SLR630114 78_F05_KoalaActivityContours_01.mxd

Sheet Size : A4

SLR

www.slrconsultingaustralia.com.au

Koala activity contours

FIGURE 5

4 Discussion and Conclusion

The proposed expansion of the Sancrox quarry will remove approximately 42.6 ha of Koala habitat of the lands comprising of the Sancrox Quarry. Previous survey data conducted by SLR in 2015 and Ecotone in 2013 indicated that Koala activity levels on site were 'Low'. The ecological analysis of Koala activity levels during the current survey identified two Koala activity cells adjoining the western edge of the quarry, reaching both the northern and southern boundary of the site, as well as another cell in the western portion of the site.

Survey data of direct and indirect evidence of the site as defined by Phillips and Callaghan (2011) identified medium and high use SAT sites within the activity cells indicating the presence of one or more resident Koalas within the Sancrox quarry. Additionally, the site has previously been mapped as an area of 'generational persistence' by Port Macquarie Council (OEH 2014). Historical modelling indicates that two populations of less than 10 to 15 individuals have utilised the Sancrox locality; however, these populations are restricted to these areas by the Pacific Highway to the east and extensive clearing to the west and north (PMHC 2015). The current survey results combined with areas of modelled high Koala activity and widespread presence of several Koala feed trees across the site indicates that the forested parts of the site all qualify as Koala habitat within the meaning of the FBA.

The proposed expansion of the Sancrox quarry will require the removal of around 42 ha of Koala habitat and may have the potential to negatively impact on local Koala movements and the home ranges of resident Koalas within the Sancrox study area. The site is considered to provide habitat for Koalas, with the presence of one or more resident Koalas within the study area. On the basis of the current findings and following Section 6 of the FBA, a 'species polygon' is required to be drawn around all Koala habitat within the site and species credits calculated.

5 References

Biolink. (2007). *Koala Habitat and Population Assessment for the City of the Gold Coast*. Final Report to Gold Coast City Council. Biolink Ecological Consultants, Uki, NSW.

Biolink. (2011). *Greater Sancrox Ecological Assessment.* Final Report to Port Macquarie-Hastings Council. Biolink Ecological Consultants, Uki, NSW.

Biolink. (2020). *Proposed Expansion of the Brandy Hill Quarry: Habitat Utilisation by Koalas.* Final report to Department of Agriculture, Water and the Environment

Department of Planning, Industry and Environment (DPIE) (2019). *Koala*. Retrieved from https://www.environment.nsw.gov.au/topics/animals-and-plants/native-animals/native-animal-facts/koala

DPIE (2020) *Koala Habitat Information Base Technical Guide*. Department of Planning, Industry and Environment Sydney NSW 2000.

Department of Planning, Industry and Environment (DIPE) (2020). *Koala Habitat Protection Guideline: Implementing State Environmental Planning Policy (Koala Habitat Protection) 2019*. Ecotone (2013) *Preliminary Koala assessment for the proposed expansion of the Sancrox gravel quarry near Port Macquarie*. Ecotone Ecological Consultants Pty Ltd, Waratah NSW.

Phillips, S. and Callaghan, J. (2011). *The Spot Assessment Technique: a tool for determining localised levels of koala habitat use by koalas Phascolarctos cinereus*. Australian Zoologist, 35: 774-7890.

PMHC. (2015). *Greater Sancrox Structure Plan 2014-2034*. Port Macquarie-Hastings Council, Port Macquarie.

Office of Environment and Heritage (OEH) (2014). *A Preliminary Map of the Likelihood of Koala Occurrence in NSW*.

OEH (2014a) *Framework for Biodiversity Assessment*. Office of Environment and Heritage for the NSW Government, Sydney.

SLR Consulting (SLR) (2019) *Sancrox Quarry Extension Project; State Significant Development (SSD 7293) Biodiversity Assessment Report.* Prepared for Hanson Heidelberg Cement Group.

APPENDIX A

Koala SAT Field Sheets

PROJECT: Sancrox Quarry Koala Surveys 2020 **FULL SAT DATA SHEET**

SAT No: __GS 145__ **Staff:** Caitlin (SLR) Amanda Kirsty **Date:** 12 / 10/2020

SITE DATA

Datum	Zone		Easting						Northing							±
GDA 94	5	6	4	8	2	2	2	1	6	5	2	1	5	1	2	3
Elevation	Aspect								Slope							
18	N	NE	E	SE	S	SW	W	NW	0 - 10		10 - 30		>30			

SAT DATA

	Tree sp	DBH (mm)	K	FP
1 (CT)	E. Pro	288	—	
2	E. Pro	244	—	
3	E Cor	407	—	
4	E Pro	261	—	
5	E Pro	232	—	
6	E. Cor	522	—	
7	E. Pro	346	—	
8	E. Cor	124	—	
9	Allo. cos	128	—	
10	Ironbark	460	—	
11	E. Cor	271	—	
12	E. Cor	244	—	
13	E. Inc	194	—	
14	E. Glo	348	—	
15	E. Glo	263	—	
16	E. Mic	133	—	
17	E. Mic	~~150~~ 550		X
18	E. Glo	400	—	
19	E. Glo	281	—	
20	E. Pro	330	—	
21	E. Glo	375	—	
22	E. Mic	255	—	
23	Ironbark	256	—	
24	E. Prop	330	—	
25	E. Pro	403	—	
26	E. Inc	218	—	
27	E. Glo	185	—	
28	E. Mic	295	—	
29	E Glo	468	—	
30	E. Mic	410	—	

1. Soil Landscape: _____

2. SAT Criteria: 1 2 (3)

3. Age of pellets: (Old) Mixed Fresh

4. A/Level: __1__ / __30__ = __3.3__ %

5. Mean % groundcover in search area:

< 30% (30 – 70%) >70%

6. Comments:

_____

_____

_____

_____

_____

7. No Koalas within 25m of CT: N/A

Checked by: Kirsty **Date:** 19/10/20 **Entered by:** Kirsty **Date:** 19/10/20

DATA Checklist: Database ☑ Scanned ☑ Filed ☐

PROJECT: Sancrox Quarry Koala Surveys 2020 **FULL SAT DATA SHEET**

SAT No: GS 144 **Staff:** Caitlin (SLR), Amanda, Kirsty **Date:** 12 / 10 /2020

SITE DATA

Datum	Zone		Easting						Northing							±
GDA 94	5	6	4	8	1	9	9	1	6	5	2	1	5	1	1	3
Elevation	Aspect								Slope							
35	N	NE	E	SE	S	SW	W	NW	0 - 10		10 - 30		>30			

SAT DATA

	Tree sp	DBH (mm)	K	FP
1 (CT)	E. Glo	290	–	
2	E. Glo	275	–	
3	E. Glo	193	–	
4	E. Mic	145	–	
5	E. Glo	490	–	
6	E. Glo	321	–	
7	E. Glo	385	–	
8	E. Glo	175	–	
9	E. Glo	290	–	
10	E. Pro	298	–	
11	E. Glo	369	–	
12	E. Pro	255	–	
13	Ironbark	300	–	
14	E. Glo	513	–	
15	E. Glo	280	–	
16	E. Glo	436	–	
17	E. Intermedia	435	–	
18	E. Glo	267	–	
19	E. car	290	–	
20	E. mic	217	–	
21	E. Pro	275	–	
22	Ironbark	243	–	
23	E. Glo	360	–	
24	E. Glo	273	–	
25	E. Glo	169	–	
26	E. Pro	360	–	
27	E. car	117	–	
28	E. Glo	338	–	
29	E. Intermed	347	–	
30	E. Int	165	–	

1. Soil Landscape: _____

2. SAT Criteria: 1 2 (3)

3. Age of pellets: Old Mixed Fresh

4. A/Level: 0 / 30 = 0.0 %

5. Mean % groundcover in search area:

< 30% (30 – 70%) >70%

6. Comments:

- Possum scats present
- Large Macropod scats present

7. No Koalas within 25m of CT: N/A

Checked by: Kirsty **Date:** 19/10/20 **Entered by:** Kirsty **Date:** 12/10/20

DATA Checklist: Database ☑ Scanned ☑ Filed ☐

PROJECT: Sancrox Quarry Koala Surveys 2020 **FULL SAT DATA SHEET**

SAT No: __GS 21__ **Staff:** Caitlin (SLR) Amanda Kirsty **Date:** 12/ 10/2020

SITE DATA

Datum	Zone		Easting						Northing							±
GDA 94	5	6	4	8	2	0	0	5	6	5	2	1	7	4	2	3

Elevation	Aspect								Slope		
28	(N)	NE	E	SE	S	SW	W	NW	0 - 10	(10 - 30)	>30

SAT DATA

	Tree sp	DBH (mm)	K	FP
1 (CT)	E.Glo	330		X
2	E.Glo	245	—	
3	E.car	350	—	
4	E Glo	328	—	
5	Ironbark	410	—	
6	Ironbark	508	—	
7	White Mahog	523	—	
8	White Mahogy	417	—	
9	E.Glo	228	—	
10	E.Glo	220	—	
11	~~C.Inc~~ Cint	218	—	
12	E.Glo	192	—	
13	E.Glo	505	—	
14	~~C.Inc~~ Cint	317	—	
15	E.Glo	430	—	
16	Grey Gum	350		X
17	E.Pro	427	—	
18	E Pro	190	—	
19	E.car	487	—	
20	~~C.Inc~~ Cint	343	—	
21	Ironbark	500	—	
22	E.Pro	223	—	
23	E.Glo	135	—	
24	E.Glo	108	—	
25	~~E.Intermedia~~ Cint	122.	—	
26	~~E.Intermedia~~ Cint	138	—	
27	Ironbark	405	—	
28	E.Glo	200	—	
29	White Mahogan	304	—	
30	~~E.Intermedia~~ Cint	113	—	
	E.Pro	280	—	

1. Soil Landscape: _____

2. SAT Criteria: 1 2 (3)

3. Age of pellets: (Old) Mixed Fresh

4. A/Level: 2 / 30 = 6.67%

5. Mean % groundcover in search area:

(< 30%) 30 – 70% >70%

6. Comments:

Large Maropod Scats

7. No Koalas within 25m of CT: N/A

Checked by: Kirsty **Date:** 19/10/20 **Entered by:** Kirsty **Date:** 12/10/20.

DATA Checklist: Database ☑ Scanned ☑ Filed ☐

PROJECT: Sancrox Quarry Koala Surveys 2020 **FULL SAT DATA SHEET**

SAT No: __GS__15__ **Staff:** Caitlin (SLR) Amanda Kirsty **Date:** 12/10 /2020

SITE DATA

Datum	Zone		Easting						Northing							±
GDA 94	5	6	4	8	1	9	8	1	6	5	2	2	2	3	9	3
Elevation	Aspect								Slope							
11	N	NE	E	SE	S	SW	W	NW	0 - 10		10 - 30		>30			

SAT DATA

	Tree sp	DBH (mm)	K	FP
1 (CT)	Grey Gum	226	—	
2	E. Glo	283	—	
3	E. Glo	380	—	
4	Swamp Mahog	600	—	
5	E. Glo	398	—	
6	C. Inc	240	—	
7	E. Mic	604	—	
8	E. Car	400	—	
9	E. Car	180	—	
10	E. ~~Pop~~ Pro	310	—	
11	E. Pro	1011 (2)	—	
12	Mel. Spp	165	—	
13	Mel. Spp	161	—	
14	E. Int	229	—	
15	E. Int	303	—	
16	E. Mic	520	—	
17	E. Mic	312	—	
18	Ironbark	495	—	
19	E. Mic	152	—	
20	E. Mic	390	—	
21	E. Pro	286	—	
22	White Mahog	470	—	
23	Ironbark	174	—	
24	~~E. Inc~~ Cint	147	—	
25	~~E. Intermedia~~ Cint	205	—	
26	E. Mic	245	—	
27	White Mahog	326	—	
28	C. Inc	126	—	
29	White Mahog	442	—	
30	Ironbark	605	—	

1. Soil Landscape: _____

2. SAT Criteria: 1 2 3

3. Age of pellets: Old Mixed Fresh

4. A/Level: 0 / 30 = 0 %

5. Mean % groundcover in search area:

< 30% 30 – 70% >70%

6. Comments:

Brushtail Possum Scat

7. No Koalas within 25m of CT: N/A

Checked by: Kirsty **Date:** 19/10/20 **Entered by:** Kirsty **Date:** 12/10/20

DATA Checklist: Database ☑ Scanned ☑ Filed ☐

PROJECT: Sancrox Quarry Koala Surveys 2020 **FULL SAT DATA SHEET**

SAT No: GS 123 **Staff:** Caitlin (SLR), Amanda, Kirsty **Date:** 12 10 /2020

SITE DATA

Datum	Zone		Easting						Northing							±
GDA 94	5	6	4	8	1	9	9	7	6	5	2	2	0	3	6	3

Elevation	Aspect								Slope		
18	N	NE	E	SE	S	SW	W	NW	0 - 10	10 - 30	>30

SAT DATA

	Tree sp	DBH (mm)	K	FP
1 (CT)	E. Glo	217	—	
2	E. cor	349	—	
3	Ironbark	384		X
4	E Glo	290	—	
5	E. Pro	260	—	
6	E. Glo	352 (2)	—	
7	E cor	390	—	
8	E Glo	198	—	
9	E cor	722 (2)		X
10	E Pro	337	—	
11	E. Pro	339	—	
12	C Int	560		X
13	E. Glo	224	—	
14	E Glo	356	—	
15	E Glo	202	—	
16	E Pro	294	—	
17	E Pro	220	—	
18	E. Pro	345 (2)	—	
19	E Pro	435	—	
20	E. Pro	403	—	
21	E. Glo	355	—	
22	E Pro	243	—	
23	C Int	227	—	
24	E Pro	182	—	
25	E Glo	241	—	
26	Ironbark	357	—	
27	E Glo	234	—	
28	E cor	410	—	
29	E. Pro	373	—	
30	E. Pro	447	—	

1. Soil Landscape: _____

2. SAT Criteria: 1 2 3

3. Age of pellets: Old Mixed Fresh

4. A/Level: 3 / 30 = 10 . _ %

5. Mean % groundcover in search area:

< 30% 30 – 70% >70%

6. Comments:

7. No Koalas within 25m of CT: N/A

Checked by: Kirsty **Date:** 19/10/20 **Entered by:** Kirsty **Date:** 12/10/20

DATA Checklist: Database ☑ Scanned ☑ Filed ☐

PROJECT: Sancrox Quarry Koala Surveys 2020 **FULL SAT DATA SHEET**

SAT No: __GS_2020_02 **Staff:** Caitlin (SLR) Amanda Kirsty **Date:** 12 /10 /2020

SITE DATA

Datum	Zone		Easting						Northing							±
GDA 94	5	6	4	8	1	8	2	0	6	5	2	2	3	3	1	3
Elevation	Aspect								Slope							
8	N	NE	E	SE	S	SW	W	NW	0 - 10		10 - 30		>30			

SAT DATA

	Tree sp	DBH (mm)	K	FP
1 (CT)	E.Mic	530	—	
2	Ironbark	188	—	
3	Ironbark	191	—	
4	E.mic	249	—	
5	E.Mic	335	—	
6	Grey Gum	232	—	
7	C Gla	128	—	
8	C Int	162	—	
9	E.Car?	592	—	
10	~~C.Inc~~ Cint	167	—	
11	E. Car	444	—	
12	Grey Gum	175	—	
13	Grey Gum	471	—	
14	C.Int	186	—	
15	~~E.thro~~ Eglo	420	—	
16	E.Mic	207	—	
17	E.mic	177	—	
18	E.Car	255	—	
19	~~E.thro~~ Eglo	234	—	
20	~~E.thro~~ Eglo	198	—	
21	Grey Gum	441	—	
22	E.mic	312	—	
23	~~E.thro~~ Eglo	406	—	
24	~~C.Inc~~ Cint	163	—	
25	Ironbark	339	—	
26	E.Mic	339	—	
27	Grey Gum	430		
28	Grey Gum	343	—	
29	Ironbark	167	—	
30	~~E.Pop~~ Epro	540 (2)	—	

1. Soil Landscape: _____

2. SAT Criteria: 1 2 3

3. Age of pellets: Old Mixed Fresh

4. A/Level: 0 / 30 = 0 . _ %

5. Mean % groundcover in search area:

< 30% 30 – 70% >70%

6. Comments:

_____

_____

_____

_____

_____

7. No Koalas within 25m of CT: N/A

Checked by: Kirsty **Date:** 19/10/20 **Entered by:** Kirsty **Date:** 12/10/20

DATA Checklist: Database ☑ Scanned ☑ Filed ☐

PROJECT: Sancrox Quarry Koala Surveys 2020 **FULL SAT DATA SHEET**

SAT No: __GS__2020-01 **Staff:** Caitlin (SLR) Amanda Kirsty **Date:** 12 / 10 /2020

SITE DATA

Datum	Zone		Easting						Northing							±
GDA 94	5	6	4	8	1	7	8	9	6	5	2	2	1	3	9	3
Elevation	Aspect								Slope							
8	N	NE	E	SE	S	SW	(W)	NW	(0 - 10)		10 - 30		>30			

SAT DATA

	Tree sp	DBH (mm)	K	FP
1 (CT)	E. ter	481	✓	
2	Ironbark	635		x
3	C. int	591 (3)	✓	
4	Ironbark	552	✓	
5	C. int	265	✓	
6	C. int	479	✓	
7	E. Mic	240	✓	
8	C int	271	✓	
9	Mel. Spp	317 (2)	✓	
10	E. cor	378	✓	
11	C. int	442	✓	
12	Ironbark	130		x
13	~~C. Gla~~ Allo	239		x
14	~~C. Gla~~ Allo	125		x
15	Grey Gum	129		x
16	Ironbark	571	✓	
17	E. Mic	400 (3)		x
18	E. Mic	154	✓	
19	E. ter	428		x
20	Ironbark	169	✓	
21	C. int	485		x
22	E. Mic	511	✓	
23	Ironbark	460	✓	
24	Mel. Spp.	124	✓	
25	Mel Spp	134	✓	
26	Mel Spp.	118	✓	
27	~~Cas. tit~~ Allit	174	✓	
28	~~Cas. tit~~ Allit	280	✓	
29	Grey Gum	220	✓	
30	C int	345	✓	
	C. Gla	119		

1. **Soil Landscape:** _____

2. **SAT Criteria:** 1 2 (3)

3. **Age of pellets:** (Old) Mixed Fresh

4. **A/Level:** __8 / 30 = 26.67%

5. **Mean % groundcover in search area:**
(< 30%) 30 – 70% >70%

6. **Comments:**
Collected Scats Bag 2020_01

7. **No Koalas within 25m of CT:** N/A

Checked by: Kirsty **Date:** 19/10/20 **Entered by:** Kirsty **Date:** 12/10/20

DATA Checklist: Database ☑ Scanned ☑ Filed ☐

PROJECT: Sancrox Quarry Koala Surveys 2020 **FULL SAT DATA SHEET**

SAT No: __GS 2020_3 **Staff:** Amanda Caitlin (SLR) Jade, Steve Kirsty **Date:** 12/10/2020

SITE DATA

Datum	Zone		Easting						Northing							±
GDA 94	5	6	4	8	1	7	0	8	6	5	2	1	8	8	9	3

Elevation	Aspect								Slope		
14	N	NE	E	SE	S	SW	W	NW	0 - 10	10 - 30	>30

SAT DATA

	Tree sp	DBH (mm)	K	FP
1 (CT)	410	E. mic	x	x
2	385	E. glo	x	x
3	170	ironbark	x	x
4	292	E. mic	x	x
5	388	ironbark	x	x
6	271	grey gum	x	x
7	610	E. glo	x	x
8	185	C. int	x	x
9	505(2)	E. car	x	x
10	135	C. lit	x	x
11	515	E. glo	x	x
12	330	C. int	x	x
13	295	E. mic	x	x
14	637	E. glo	x	x
15	331	ironbark	x	x
16	640	E. glo	x	x
17	720	E. glo	x	x
18	343	E. glo	x	x
19	690	E. glo	x	x
20	180	greygum	x	x
21	428	E. mic	x	x
22	188	E. mic	x	x
23	328	C. int	x	x
24	400	C. int	x	x
25	450	E. mic	x	x
26	175	C. int	x	x
27	178	C. int	x	x
28	232	C. int	x	x
29	557	E. mic	x	x
30	234	E. glo	x	x

1. Soil Landscape: _____

2. SAT Criteria: 1 2 3

3. Age of pellets: Old Mixed Fresh

4. A/Level: 0/30 = 0.0 %

5. Mean % groundcover in search area:

< 30% 30 – 70% >70%

6. Comments:

7. No Koalas within 25m of CT: N/A

Checked by: Kirsty **Date:** 19/10/20 **Entered by:** Kirsty **Date:** 15/10/20

DATA Checklist: Database ☑ Scanned ☑ Filed ☐

PROJECT: ~~BRANDY HILL QUARRY~~ SANCROIX QUARRY

FULL SAT DATA SHEET

SAT No: ~~BHQ~~ GS 131

Recorder: Caitlin (SLR) Amanda Kirsty

Date: 13 / 10 /2020

SITE DATA

Datum	Zone		Easting						Northing							±
GDA	~~9~~ 56	~~47~~ 6	4	8	2	2	5	4	6	5	2	1	8	0	5	3

Elevation	Aspect								Slope		
29	N	NE	E	SE	S	SW	W	NW	0 - 10	10 - 30	>30

SAT DATA

	Tspp	DBH (mm)	K	FP
1 (CT)	E Mic	366		✓
2	Ironbark	234		—
3	Allocas	110		—
4	L. Con	560 (2)		—
5	L. Con	497 (2)		—
6	E. Glo	310		—
7	E Glo	212		—
8	Ironbark	362		—
9	E. Mic	334		—
10	E. Glo.	679		—
11	E. Mic	244		—
12	Ironbark	596		—
13	L. Con	153		—
14	E Glo	260		—
15	E Glo	224		—
16	E Glo	185		—
17	E. Glo	673		—
18	Ironbark	358		—
19	E Mic	387		—
20	L. Con	326		—
21	E. Mic	426		—
22	E Mic	468		—
23	E. Int	288		—
24	E. Mic	283		—
25	Ironbark	490		—
26	E. Glo	243		—
27	E Glo	115		—
28	E. Glo	242		—
29	E. Int	163		—
30	E Mic	479		—

1. Soil Landscape: _____

2. SAT Criteria: 1 2 3

3. Age of pellets: Old Mixed Fresh

4. A/Level: 0 / 30 = 0. %

5. Mean % groundcover in search area:

(< 30%) 30 – 70% >70%

6. Comments:

7. No Koalas within 25m of CT: N/A

Checked by: Kirsty Date: 19/10/20 Entered by: Kirsty Date: 15/10/20

DATA Checklist: Entered ☑ Scanned ☑ Filed ☐

PROJECT: ~~BRANDY HILL QUARRY~~ SAN CROOK QUARRY

FULL SAT DATA SHEET

SAT No: ~~BHQ~~ GS 124

Recorder: Caitlin (SLR) Amanda Kirsty

Date: 13 / 10 /2020

SITE DATA

Datum	Zone		Easting						Northing							±
GDA	~~3~~ 5	~~4~~ 6	4	8	2	2	6	3	6	5	2	2	0	4	8	3
Elevation	Aspect								Slope							
43	N	NE	E	SE	S	SW	W	NW	0 - 10		10 - 30		>30			

SAT DATA

	Tspp	DBH (mm)	K	FP
1 (CT)	E. Pro	342		X
2	Allo.cas	160	—	
3	E.Glo	530	—	
4	Allocas	135	—	
5	E. pro	332		X
6	Allocas	140	—	
7	Allocas	110	—	
8	C.Int	510	—	
9	C.Int	235	—	
10	E Glo	219	—	
11	E. Glo	183	—	
12	Allocas	135	—	
13	C.Cit	244	—	
14	E.Pro	358	—	
15	E Pro	323	—	
16	C.Cit	197	—	
17	C.Cit	466		
18	C.Int	255	—	
19	Allocas	167	—	
20	Allocas	214	—	
21	Allocas	177	—	
22	E.Pro	422	—	
23	C.Cit	395	—	
24	E.Glo	271	—	
25	E.Glo	520	—	
26	E. Pro	464	—	
27	Allocas	140	—	
28	C.cit	256	—	
29	Allocas	140	—	
30	Allocas	200	—	

1. Soil Landscape: _____

2. SAT Criteria: 1 2 3

3. Age of pellets: Old Mixed Fresh

4. A/Level: 2 / 30 = 6.6 %

5. Mean % groundcover in search area:

< 30% 30 – 70% >70%

6. Comments:

7. No Koalas within 25m of CT: N/A

Checked by: Kirsty Date: 19/10/20 Entered by: Kirsty Date: 15/10/20

DATA Checklist: Entered ☑ Scanned ☑ Filed ☐

PROJECT: Sancrox Quarry Koala Surveys 2020 **FULL SAT DATA SHEET**

SAT No: GS 113 **Staff:** Caitlin (SLR) Amanda Kirsty **Date:** 13 / 10 /2020

SITE DATA

Datum	Zone		Easting						Northing							±
GDA 94	5	6	4	8	2	2	5	7	6	5	2	2	2	8	7	3

Elevation	Aspect								Slope		
26	N	NE	E	SE	S	SW	(W)	NW	(0 - 10)	10 - 30	>30

SAT DATA

	Tree sp	DBH (mm)	K	FP
1 (CT)	E. Pro	274	✓	
2	E. Glo	316	—	
3	E. Glo	776	—	
4	L. con	101	—	
5	E. Glo	530	✓	
6	E. Mic	303	—	
7	C. int	263	—	
8	E. Mic	554	—	
9	E. Glo	575	—	
10	L. con	176	—	
11	E. Glo	445	—	
12	C. int	243	—	
13	Ironbark	600 (2)	—	
14	E. Glo	239	—	
15	C. int	235	—	
16	E. Glo	180	—	
17	E. Glo	895	—	
18	E. Glo	340	—	
19	E. Mic	388	—	
20	E. Pro	417	—	
21	E. Pro	417	—	
22	E. Glo	620	—	
23	Ironbark	385	✓	
24	E. Glo	522	—	
25	Ironbark	444	✓	
26	E. Mic	270	—	
27	E. Mic	380	—	
28	Allo. cas	100	—	
29	Mel. sp	165	✓	
30	E. Mic	291	—	

1. Soil Landscape: _____

2. SAT Criteria: 1 2 (3)

3. Age of pellets: Old Mixed Fresh

4. A/Level: 0 / 30 = 0. _ %

5. Mean % groundcover in search area:

< 30% (30 – 70%) >70%

6. Comments:

_____

7. No Koalas within 25m of CT: N/A

Checked by: Kirsty **Date:** 19/10/20 **Entered by:** Kirsty **Date:** 15/10/20.

DATA Checklist: Database ☑ Scanned ☑ Filed ☐

PROJECT: Sancrox Quarry Koala Surveys 2020 **FULL SAT DATA SHEET**

SAT No: __GS 2020_04 **Staff:** Kirsty. W Caitlin (SLR) Amanda. **Date:** 13 / 10 /2020

SITE DATA

Datum	Zone		Easting						Northing							±
GDA 94	5	6	4	8	2	7	1	7	6	5	2	1	7	5	1	3
Elevation	Aspect								Slope							
26	N	NE	(E)	SE	S	SW	W	NW	(0 - 10)		10 - 30		>30			

SAT DATA

	Tree sp	DBH (mm)	K	FP
1 (CT)	C. Int	299	—	
2	C Int	199	—	
3	E. Glo	160	—	
4	C Int	259	—	
5	Allo. cos	136	—	
6	E. Pro	279	—	
7	C. Int	308	—	
8	E. Mic	349	—	
9	C Int	363	—	
10	E. Glo	231	—	
11	C Pro	182	—	
12	Allo (co)	239	—	
13	E Glo	260	—	
14	Allo. cos	160	—	
15	E. Glo	205		X
16	E. Mic	190	—	
17	E Car	344	—	
18	Ironbark	303	—	
19	E. Glo	558 (2)	—	
20	Allo. cos	280	—	
21	E Glo	393	—	
22	E. Glo	602 (2)	—	
23	E. Glo	356	—	
24	Ironbark	517	—	
25	E. Glo	130	—	
26	E. Glo	316	—	
27	C. Int	218	—	
28	E. Glo	175	—	
29	C Int	475 (2)	—	
30	C Int	143	—	

1. Soil Landscape: _____

2. SAT Criteria: 1 2 (3)

3. Age of pellets: (Old) Mixed Fresh

4. A/Level: 1 / 30 = 3.33%

5. Mean % groundcover in search area:

(< 30%) 30 – 70% >70%

6. Comments:

7. No Koalas within 25m of CT: N/A

Checked by: Kirsty **Date:** 19/10/20 **Entered by:** Jade. K **Date:** 15/10/20

DATA Checklist: Database ☑ Scanned ☑ Filed ☐

PROJECT: Sancrox Quarry Koala Surveys 2020 **FULL SAT DATA SHEET**

SAT No: __GS 22__ **Staff:** Kirsty. W, Amanda, Caitlin (SLR) **Date:** 13 / 10 /2020

SITE DATA

Datum	Zone		Easting						Northing							±
GDA 94	5	6	4	8	2	4	9	7	6	5	2	1	7	6	0	3
Elevation	Aspect								Slope							
31	N	NE	E	SE	S	SW	W	NW	0 - 10		10 - 30		>30			

SAT DATA

	Tree sp	DBH (mm)	K	FP
1 (CT)	E.Glo	278	—	
2	Allo.cas	126	—	
3	E Glo	373	—	
4	C Int	215	—	
5	E Glo	690	—	
6	E.Glo	305	—	
7	C.Glo	216	—	
8	E Glo	351	—	
9	C.Int	400	—	
10	E.Cer	242	—	
11	E Mic	127	—	
12	E.Glo	353	—	
13	E Glo	206	—	
14	E Pro	382	—	
15	E Glo	306	—	
16	Allo.cas	158	—	
17	E.Glo	563		x
18	C.Int	787		x
19	Ironbark	324	—	
20	E.Glo	294	—	
21	Grey Gum	465	—	
22	E.Car	562	—	
23	C.Cit	219	—	
24	E.Glo	105	—	
25	E Glo	271	—	
26	E Glo	431	—	
27	E.Mic	124	—	
28	Ironbark	339	—	
29	E.Glo	623	—	
30	E.Mic	368		

1. Soil Landscape: _____

2. SAT Criteria: 1 2 3

3. Age of pellets: Old Mixed Fresh

4. A/Level: 2 / 30 = 6.67%

5. Mean % groundcover in search area:

< 30% 30 – 70% >70%

6. Comments:

7. No Koalas within 25m of CT: N/A

Checked by: Kirsty **Date:** 19/10/20 **Entered by:** Jade.K **Date:** 15/10/20

DATA Checklist: Database ☑ Scanned ☑ Filed ☐

PROJECT: Sancrox Quarry Koala Surveys 2020 **FULL SAT DATA SHEET**

SAT No: __GS 125__ **Staff:** Kirsty . W, Amanda, Caitlin (SLR) **Date:** 13 /10 /2020

SITE DATA

Datum	Zone		Easting						Northing							±
GDA 94	5	6	4	8	2	4	7	9	6	5	2	2	0	0	3	3
Elevation	Aspect								Slope							
52	N	NE	E	SE	S	SW	W	NW	0 - 10		10 - 30		>30			

SAT DATA

	Tree sp	DBH (mm)	K	FP
1 (CT)	C. Cit	532	—	
2	Allo. con	132	—	
3	C. Cit	278	—	
4	E. Glo	246	—	
5	C. Cit	283	—	
6	L. con	387		X
7	E. Mic	399		X
8	C. Cit	352		X
9	C. Cit	255		X
10	E. Mic	462		X
11	E. Glo	240	—	
12	Ironbark	393		X
13	Ironbark	205	—	
14	E. Glo	277	—	
15	C. Cit	271	—	
16	E. Glo	233	—	
17	C. Cit	370	—	
18	E. Glo	167	—	
19	C. Cit	321	—	
20	C. Cit	220		X
21	C. Cit	222	—	
22	E. Glo	190	—	
23	C. Cit	284	—	
24	E. Pil	593		X
25	C. Cit	235	—	
26	E. Glo	339		X
27	Ironbark	423		X
28	C. Cit	142	—	
29	E. Pil	526	—	
30	E. mel	389	—	

1. Soil Landscape: _____

2. SAT Criteria: 1 2 (3)

3. Age of pellets: Old Mixed (Fresh)

4. A/Level: 10 / 30 = 33.33%

5. Mean % groundcover in search area:

< 30% 30 – 70% >70%

6. Comments:

Next to Quarry walls
& Scats still Glossy

7. No Koalas within 25m of CT: N/A

Checked by: _____ **Date:** _____ **Entered by:** Jade. K **Date:** 15/10/20

DATA Checklist: Database ☐ Scanned ☐ Filed ☐

NB Koala found near here in spotlighting transect!

PROJECT: Sancrox Quarry Koala Surveys 2020

FULL SAT DATA SHEET

SAT No: GS16

Staff: Kirsty W, Amanda, Caitlin (SLR)

Date: 13/10/2020

SITE DATA

Datum	Zone		Easting						Northing							±
GDA 94	5	6	4	8	2	4	9	3	6	5	2	2	2	4	0	3

Elevation	Aspect								Slope		
32	N	NE	E	SE	S	SW	W	NW	0 - 10	10 - 30	>30

SAT DATA

	Tree sp	DBH (mm)	K	FP
1 (CT)	E. Pro	393		–
2	Allo cas	194		–
3	E. Pro	385		–
4	E Pro	288		–
5	C. Int	147		–
6	Allo cas	143		–
7	E Glo	820		–
8	E Glo	454		–
9	Ironbark	220		–
10	E Pil	757		–
11	Allo cas	175		X
12	Allo cas	195		–
13	E. Pil	500		–
14	Allo cas	177		–
15	E. Mac	570		X
16	E. Pil	720		–
17	C. int	268		X
18	Allo. cas	218		–
19	Allo. cas	115		–
20	All cas	145		–
21	Grey Gum	367		–
22	E. Glo	185		–
23	E. Pro	331		–
24	E. Pro	516		–
25	E Pil	600		–
26	E. Pro	381		–
27	E. Pil	1402 (3)		X
28	E. Pil	518		
29	Ironbark	352		–
30	Allo cas	135		–

1. Soil Landscape: _____

2. SAT Criteria: 1 2 3

3. Age of pellets: Old Mixed Fresh

4. A/Level: 4 / 30 = 13.33%

5. Mean % groundcover in search area:

< 30% 30 – 70% >70%

6. Comments:

7. No Koalas within 25m of CT: N/A

Checked by: Kirsty Date: 19/10/20

Entered by: Jade K Date: 15/10/20

DATA Checklist: Database ✓ Scanned ✓ Filed ☐

APPENDIX B

Koala Feed Trees for the North Coast Area

Species Name	Common Name
Allocasuarina torulosa	Forest Oak
Angophora floribunda	Rough-barked Apple
Corymbia gummifera	Red Bloodwood
Corymbia henryi	Large-leaved Spotted Gum
Corymbia intermedia	Pink Bloodwood
Corymbia maculata	Spotted Gum
Eucalyptus acmenoides	White Mahogany
Eucalyptus amplifolia	Cabbage Gum
Eucalyptus bancroftii	Orange Gum
Eucalyptus biturbinata	Grey Gum
Eucalyptus campanulata	New England Blackbutt
Eucalyptus canaliculata	Large-fruited Grey Gum
Eucalyptus carnea	Thick-leaved Mahogany
Eucalyptus crebra	Narrow-leaved Ironbark
Eucalyptus eugenioides	Narrow-leaved Stringybark
Eucalyptus fibrosa	Board-leaved Red Ironbark
Eucalyptus glaucina	Slaty Red Gum
Eucalyptus globoidea	White Stringybark
Eucalyptus grandis	Flooded Gum
Eucalyptus laevopinea	Silver-top Stringybark
Eucalyptus largeana	Craven Grey Box
Eucalyptus microcorys	Tallowwood
Eucalyptus moluccana	Grey Box
Eucalyptus nobilis	Forest Ribbon Gum
Eucalyptus pilularis	Blackbutt
Eucalyptus placita	Grey Ironbark
Eucalyptus planchoniana	Bastard Tallowwood
Eucalyptus propinqua	Small-fruited Grey Gum
Eucalyptus psammitica	Bastard White Mahogany
Eucalyptus punctata	Grey Gum
Eucalyptus resinifera	Red Mahogany
Eucalyptus robusta	Swamp Mahogany
Eucalyptus rummeryi	Steel Box
Eucalyptus saligna	Sydney Blue Gum
Eucalyptus scias	Large-fruited Red Mahogany
Eucalyptus seeana	Narrow-leaved Red Gum
Eucalyptus siderophloia	Grey ironbark
Eucalyptus signata/ Eucalyptus racemose	Scribbly gum/ Narrow-leaved Scribbly Gum

Species Name	Common Name
Eucalyptus tereticornis	Forest Red Gum
Eucalyptus tindaliae	Stringybark
Eucalyptus umbra	Bastard White Mahogany
Melaleuca quinquenervia	Board-leaved paperbark

ASIA PACIFIC OFFICES

BRISBANE
Level 2, 15 Astor Terrace
Spring Hill QLD 4000
Australia
T: +61 7 3858 4800
F: +61 7 3858 4801

CANBERRA
GPO 410
Canberra ACT 2600
Australia
T: +61 2 6287 0800
F: +61 2 9427 8200

DARWIN
Unit 5, 21 Parap Road
Parap NT 0820
Australia
T: +61 8 8998 0100
F: +61 8 9370 0101

GOLD COAST
Level 2, 194 Varsity Parade
Varsity Lakes QLD 4227
Australia
M: +61 438 763 516

MACKAY
21 River Street
Mackay QLD 4740
Australia
T: +61 7 3181 3300

MELBOURNE
Level 11, 176 Wellington Parade
East Melbourne VIC 3002
Australia
T: +61 3 9249 9400
F: +61 3 9249 9499

NEWCASTLE
10 Kings Road
New Lambton NSW 2305
Australia
T: +61 2 4037 3200
F: +61 2 4037 3201

PERTH
Ground Floor, 503 Murray Street
Perth WA 6000
Australia
T: +61 8 9422 5900
F: +61 8 9422 5901

SYDNEY
Tenancy 202 Submarine School
Sub Base Platypus
120 High Street
North Sydney NSW 2060
Australia
T: +61 2 9427 8100
F: +61 2 9427 8200

TOWNSVILLE
12 Cannan Street
South Townsville QLD 4810
Australia
T: +61 7 4722 8000
F: +61 7 4722 8001

WOLLONGONG
Level 1, The Central Building
UoW Innovation Campus
North Wollongong NSW 2500
Australia
T: +61 2 4249 1000

AUCKLAND
68 Beach Road
Auckland 1010
New Zealand
T: 0800 757 695

NELSON
6/A Cambridge Street
Richmond, Nelson 7020
New Zealand
T: +64 274 898 628

APPENDIX I

BioBanking Credit Reports

BioBanking Credit Calculator

Threatened species predicted on site

Proposal ID :	0107/2015/2368MP
Proposal name :	Sancrox Quarry Expansion (SSD) - Koala
Assessor name :	Jeremy Pepper
Assessor accreditation number :	0107
Tool version :	v4.0
Report created :	01/04/2021 12:59

Threatened species reliably predicted to utilise the site. No surveys are required for these species. Ecosystem credits apply to these species.

Common name	Scientific name	Vegetation type(s)
Barking Owl	Ninox connivens	NR247 - Spotted Gum - Grey Ironbark open forest of the Macleay Valley lowlands of the NSW North Coast Bioregion
		NR263 - Tallowwood - Small-fruited Grey Gum dry grassy open forest of the foothills of the NSW North Coast
Barred Cuckoo-shrike	Coracina lineata	NR247 - Spotted Gum - Grey Ironbark open forest of the Macleay Valley lowlands of the NSW North Coast Bioregion
		NR263 - Tallowwood - Small-fruited Grey Gum dry grassy open forest of the foothills of the NSW North Coast

Common name	Scientific name	Vegetation type(s)
Brown Treecreeper (eastern subspecies)	Climacteris picumnus subsp. victoriae	NR247 - Spotted Gum - Grey Ironbark open forest of the Macleay Valley lowlands of the NSW North Coast Bioregion
		NR263 - Tallowwood - Small-fruited Grey Gum dry grassy open forest of the foothills of the NSW North Coast
Bush Stone-curlew	Burhinus grallarius	NR247 - Spotted Gum - Grey Ironbark open forest of the Macleay Valley lowlands of the NSW North Coast Bioregion
		NR263 - Tallowwood - Small-fruited Grey Gum dry grassy open forest of the foothills of the NSW North Coast
Diamond Firetail	Stagonopleura guttata	NR247 - Spotted Gum - Grey Ironbark open forest of the Macleay Valley lowlands of the NSW North Coast Bioregion
		NR263 - Tallowwood - Small-fruited Grey Gum dry grassy open forest of the foothills of the NSW North Coast
Eastern False Pipistrelle	Falsistrellus tasmaniensis	NR263 - Tallowwood - Small-fruited Grey Gum dry grassy open forest of the foothills of the NSW North Coast
Eastern Freetail-bat	Mormopterus norfolkensis	NR247 - Spotted Gum - Grey Ironbark open forest of the Macleay Valley lowlands of the NSW North Coast Bioregion

Common name	Scientific name	Vegetation type(s)
Eastern Freetail-bat	Mormopterus norfolkensis	NR247 - Spotted Gum - Grey Ironbark open forest of the Macleay Valley lowlands of the NSW North Coast Bioregion
		NR263 - Tallowwood - Small-fruited Grey Gum dry grassy open forest of the foothills of the NSW North Coast
Glossy Black-Cockatoo	Calyptorhynchus lathami	NR247 - Spotted Gum - Grey Ironbark open forest of the Macleay Valley lowlands of the NSW North Coast Bioregion
		NR263 - Tallowwood - Small-fruited Grey Gum dry grassy open forest of the foothills of the NSW North Coast
Greater Broad-nosed Bat	Scoteanax rueppellii	NR247 - Spotted Gum - Grey Ironbark open forest of the Macleay Valley lowlands of the NSW North Coast Bioregion
		NR263 - Tallowwood - Small-fruited Grey Gum dry grassy open forest of the foothills of the NSW North Coast
Hoary Wattled Bat	Chalinolobus nigrogriseus	NR263 - Tallowwood - Small-fruited Grey Gum dry grassy open forest of the foothills of the NSW North Coast
Hooded Robin (south-eastern form)	Melanodryas cucullata subsp. cucullata	NR247 - Spotted Gum - Grey Ironbark open forest of the Macleay Valley lowlands of the NSW North Coast Bioregion

Common name	Scientific name	Vegetation type(s)
Little Eagle	Hieraaetus morphnoides	NR247 - Spotted Gum - Grey Ironbark open forest of the Macleay Valley lowlands of the NSW North Coast Bioregion
		NR263 - Tallowwood - Small-fruited Grey Gum dry grassy open forest of the foothills of the NSW North Coast
Little Lorikeet	Glossopsitta pusilla	NR247 - Spotted Gum - Grey Ironbark open forest of the Macleay Valley lowlands of the NSW North Coast Bioregion
		NR263 - Tallowwood - Small-fruited Grey Gum dry grassy open forest of the foothills of the NSW North Coast
Long-nosed Potoroo	Potorous tridactylus	NR263 - Tallowwood - Small-fruited Grey Gum dry grassy open forest of the foothills of the NSW North Coast
Masked Owl	Tyto novaehollandiae	NR247 - Spotted Gum - Grey Ironbark open forest of the Macleay Valley lowlands of the NSW North Coast Bioregion
		NR263 - Tallowwood - Small-fruited Grey Gum dry grassy open forest of the foothills of the NSW North Coast
Powerful Owl	Ninox strenua	NR247 - Spotted Gum - Grey Ironbark open forest of the Macleay Valley lowlands of the NSW North Coast Bioregion

Common name	Scientific name	Vegetation type(s)
Powerful Owl	Ninox strenua	NR247 - Spotted Gum - Grey Ironbark open forest of the Macleay Valley lowlands of the NSW North Coast Bioregion
		NR263 - Tallowwood - Small-fruited Grey Gum dry grassy open forest of the foothills of the NSW North Coast
Scarlet Robin	Petroica boodang	NR247 - Spotted Gum - Grey Ironbark open forest of the Macleay Valley lowlands of the NSW North Coast Bioregion
Spotted-tailed Quoll	Dasyurus maculatus	NR247 - Spotted Gum - Grey Ironbark open forest of the Macleay Valley lowlands of the NSW North Coast Bioregion
		NR263 - Tallowwood - Small-fruited Grey Gum dry grassy open forest of the foothills of the NSW North Coast
Square-tailed Kite	Lophoictinia isura	NR247 - Spotted Gum - Grey Ironbark open forest of the Macleay Valley lowlands of the NSW North Coast Bioregion
		NR263 - Tallowwood - Small-fruited Grey Gum dry grassy open forest of the foothills of the NSW North Coast
Swift Parrot	Lathamus discolor	NR247 - Spotted Gum - Grey Ironbark open forest of the Macleay Valley lowlands of the NSW North Coast Bioregion

Common name	Scientific name	Vegetation type(s)
Varied Sittella	Daphoenositta chrysoptera	NR247 - Spotted Gum - Grey Ironbark open forest of the Macleay Valley lowlands of the NSW North Coast Bioregion
		NR263 - Tallowwood - Small-fruited Grey Gum dry grassy open forest of the foothills of the NSW North Coast
Yellow-bellied Glider	Petaurus australis	NR247 - Spotted Gum - Grey Ironbark open forest of the Macleay Valley lowlands of the NSW North Coast Bioregion
		NR263 - Tallowwood - Small-fruited Grey Gum dry grassy open forest of the foothills of the NSW North Coast
Yellow-bellied Sheathtail-bat	Saccolaimus flaviventris	NR247 - Spotted Gum - Grey Ironbark open forest of the Macleay Valley lowlands of the NSW North Coast Bioregion
		NR263 - Tallowwood - Small-fruited Grey Gum dry grassy open forest of the foothills of the NSW North Coast

Biodiversity credit report

This report identifies the number and type of biodiversity credits required for a major project.

Date of report: 26/03/2021 Time: 1:10:59PM Calculator version: v4.0

Major Project details

Proposal ID:	0107/2015/2368MP
Proposal name:	Sancrox Quarry Expansion (SSD) - Koala
Proposal address:	Sancrox Road Sancrox NSW 2446
Proponent name:	Hanson Construction Materials Pty Ltd
Proponent address:	Locked Bag 5260 Parramatta NSW 2124
Proponent phone:	61 2 9354 2638
Assessor name:	Jeremy Pepper
Assessor address:	Level 3 10 Kings Road New Lambton NSW 2305
Assessor phone:	02 4037 3200
Assessor accreditation:	0107

Summary of ecosystem credits required

Plant Community type	Area (ha)	Credits created
Spotted Gum - Grey Ironbark open forest of the Macleay Valley lowlands of the NSW North Coast Bioregion	11.08	505.00
Tallowwood - Small-fruited Grey Gum dry grassy open forest of the foothills of the NSW North Coast	27.94	1,725.00
Total	39.02	2,230

Credit profiles

1. Tallowwood - Small-fruited Grey Gum dry grassy open forest of the foothills of the NSW North Coast, (NR263)

Number of ecosystem credits created	1,725
IBRA sub-region	Macleay Hastings - Northern Rivers

Offset options - Plant Community types	Offset options - IBRA sub-regions
Tallowwood - Small-fruited Grey Gum dry grassy open forest of the foothills of the NSW North Coast, (NR263) Blackbutt - Tallowwood dry grassy open forest of the central parts NSW North Coast Bioregion, (NR119) Blackbutt - Turpentine open forest of the foothills of the NSW North Coast Bioregion, (NR124) Blackbutt grassy open forest of the lower Clarence Valley of the NSW North Coast Bioregion, (NR125) Brush Box tall moist forest of the northern ranges of the NSW North Coast Bioregion, (NR144) Red Mahogany open forest of the coastal lowlands of the NSW North Coast Bioregion and northern Sydney Basin Bioregion, (NR222) Tallowwood dry grassy forest of the far northern ranges of the NSW North Coast Bioregion, (NR267)	Macleay Hastings - Northern Rivers and any IBRA subregion that adjoins the IBRA subregion in which the development occurs

2. Spotted Gum - Grey Ironbark open forest of the Macleay Valley lowlands of the NSW North Coast Bioregion, (NR247)

Number of ecosystem credits created	505
IBRA sub-region	Macleay Hastings - Northern Rivers

Offset options - Plant Community types	Offset options - IBRA sub-regions
Spotted Gum - Grey Ironbark open forest of the Macleay Valley lowlands of the NSW North Coast Bioregion, (NR247)	Macleay Hastings - Northern Rivers and any IBRA subregion that adjoins the IBRA subregion in which the development occurs

Summary of species credits required

Common name	Scientific name	Extent of impact Ha or individuals	Number of species credits created
Koala	Phascolarctos cinereus	39.02	1,015

BioBanking Credit Calculator

Ecosystem credits

Proposal ID :	0107/2015/2368MP
Proposal name :	Sancrox Quarry Expansion (SSD) - Koala
Assessor name :	Jeremy Pepper
Assessor accreditation number :	0107
Tool version :	v4.0
Report created :	26/03/2021 13:12

Assessment circle name	Landscape score	Vegetation zone name	Vegetation type name	Condition	Red flag status	Management zone name	Management zone area	Current site value	Future site value	Loss in site value	Credit required for bio diversity	Credit required for TS	TS with highest credit requirement	Average species loss	Species TG Value	Final credit requirement for management zone
Circle 1	17.00	NR247_Moderate/Good	Spotted Gum - Grey Ironbark open forest of the Macleay Valley lowlands of the NSW North Coast Bioregion	Moderate/Good	Yes	MZ2	10.83	55.21	0.00	55.21	0	494	Barking Owl	100.00	3.00	494
Circle 1	17.00	NR263_Moderate/Good	Tallowwood - Small-fruited Grey Gum dry grassy open forest of the foothills of the NSW North Coast	Moderate/Good	Yes	MZ3	27.10	78.00	0.00	78.00	0	1,701	Masked Owl	100.00	3.00	1,701
Circle 1	17.00	NR263_Moderate/Good_Poor	Tallowwood - Small-fruited Grey Gum dry grassy open forest of the foothills of the NSW North Coast	Moderate/Good_Poor	Yes	MZ4	0.84	32.89	0.00	32.89	0	24	Masked Owl	22.22	3.00	24
Circle 1	17.00	NR247_Moderate/Good_Poor	Spotted Gum - Grey Ironbark open forest of the Macleay Valley lowlands of the NSW North Coast Bioregion	Moderate/Good_Poor	Yes	MZ5	0.25	51.04	0.00	51.04	0	11	Barking Owl	66.67	3.00	11

BioBanking Credit Calculator

Species credits

Proposal ID :	0107/2015/2368MP
Proposal name :	Sancrox Quarry Expansion (SSD) - Koala
Assessor name :	Jeremy Pepper
Assessor accreditation number :	0107
Tool version :	v4.0
Report created :	26/03/2021 13:12

Scientific name	Common name	Species TG value	Identified population?	Can Id. popn. be offset?	Area / number of loss	Negligible loss	Red flag status	Number of credits
Phascolarctos cinereus	Koala	2.60	No		39.02	0.00	No	1,015

BioBanking Credit Calculator

Threatened species loss summary

Proposal ID :	0107/2015/2368MP
Proposal name :	Sancrox Quarry Expansion (SSD) - Koala
Assessor name :	Jeremy Pepper
Assessor accreditation number :	0107
Tool version :	v4.0
Report created :	01/04/2021 13:00

Common name	Scientific name	Is it an identified population?	Can identified population be offset?	Loss	Units	Red flagged?
Koala	Phascolarctos cinereus	No		39.02	ha	No

BioBanking Credit Calculator

Threatened species requiring survey

Proposal ID :	0107/2015/2368MP
Proposal name :	Sancrox Quarry Expansion (SSD) - Koala
Assessor name :	Jeremy Pepper
Assessor accreditation number :	0107
Tool version :	v4.0
Report created :	01/04/2021 12:58

List of species requiring survey

Common name	Scientific name	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Biconvex Paperbark	Melaleuca biconvexa	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Brush-tailed Phascogale	Phascogale tapoatafa	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Common Planigale	Planigale maculata	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Eastern Chestnut Mouse	Pseudomys gracilicaudatus	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Eastern Pygmy-possum	Cercartetus nanus	N	N	N	N	N	N	N	N	N	N	N	N
Giant Barred Frog	Mixophyes iteratus	Y	Y	Y	Y	N	N	N	N	N	Y	Y	Y
Green-thighed Frog	Litoria brevipalmata	Y	Y	Y	N	N	N	N	N	N	Y	Y	Y
Grove's Paperbark	Melaleuca groveana	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Koala	Phascolarctos cinereus	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Leafless Tongue Orchid	Cryptostylis hunteriana	Y	Y	N	N	N	N	N	N	N	N	Y	Y
Milky Silkpod	Parsonsia dorrigoensis	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
North Brother Wattle	Acacia courtii	Y	N	N	N	N	N	N	N	N	N	Y	Y
Pale-headed Snake	Hoplocephalus bitorquatus	Y	Y	Y	Y	N	N	N	N	N	Y	Y	Y
Pale-vented Bush-hen	Amaurornis moluccana	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Parma Wallaby	Macropus parma	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y

Common name	Scientific name	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Rainforest Cassia	Senna acclinis	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Red-backed Button-quail	Turnix maculosus	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Regent Honeyeater	Anthochaera phrygia	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Rufous Bettong	Aepyprymnus rufescens	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Rusty Plum, Plum Boxwood	Niemeyera whitei	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Scant Pomaderris	Pomaderris queenslandica	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Slender Marsdenia	Marsdenia longiloba	Y	Y	N	N	N	N	N	N	N	N	N	Y
Squirrel Glider	Petaurus norfolcensis	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Stephens' Banded Snake	Hoplocephalus stephensii	N	N	N	N	N	N	N	N	N	N	N	N
Three-toed Snake-tooth Skink	Coeranoscincus reticulatus	Y	Y	Y	Y	N	N	N	N	Y	Y	Y	Y
Tree Guinea Flower	Hibbertia hexandra	N	N	N	N	N	N	N	N	Y	Y	Y	Y
White-eared Monarch	Carterornis leucotis	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
White-flowered Wax Plant	Cynanchum elegans	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Willawarrin Doubletail	Diuris disposita	N	N	N	N	N	N	N	N	Y	Y	N	N

BioBanking Credit Calculator

Vegetation zones requiring transects/plots survey

Proposal ID :	0107/2015/2368MP
Proposal name :	Sancrox Quarry Expansion (SSD) - Koala
Assessor name :	Jeremy Pepper
Assessor accreditation number :	0107
Tool version :	v4.0
Report created :	01/04/2021 13:00

Vegetation zone name : NR247_Moderate/Good

Vegetation type: Spotted Gum - Grey Ironbark open forest of the Macleay Valley lowlands of the NSW North Coast Bioregion

Vegetation condition: Moderate/Good **Ancillary code:** NR247

Total area of zone (ha): 10.83 **Number of TS subzones in the zone:** 2

Minimum number of survey transects/plots required within the zone: 3

Vegetation zone name : NR263_Moderate/Good

Vegetation type: Tallowwood - Small-fruited Grey Gum dry grassy open forest of the foothills of the NSW North Coast

Vegetation condition: Moderate/Good **Ancillary code:** NR263

Total area of zone (ha): 27.10 **Number of TS subzones in the zone:** 2

Minimum number of survey transects/plots required within the zone: 4

Vegetation zone name : NR263_Moderate/Good_Poor

Vegetation type: Tallowwood - Small-fruited Grey Gum dry grassy open forest of the foothills of the NSW North Coast

Vegetation condition: Moderate/Good_Poor **Ancillary code:** NR263

Total area of zone (ha): 0.84 **Number of TS subzones in the zone:** 2

Minimum number of survey transects/plots required within the zone: 1

Vegetation zone name : NR247_Moderate/Good_Poor

Vegetation type: Spotted Gum - Grey Ironbark open forest of the Macleay Valley lowlands of the NSW North Coast Bioregion

Vegetation condition: Moderate/Good_Poor **Ancillary code:** NR247

Total area of zone (ha): 0.25 **Number of TS subzones in the zone:** 2

Minimum number of survey transects/plots required within the zone: 1

APPENDIX J

Orchid Survey Report

15 January 2016

630.11478.00000_Sancrox orchid survey_SLR report_D2.docx

Hanson Heidelberg Cement Group
Level 10, 35 Clarence Street
SYDNEY NSW 2000

Attention: Pip Cox

Dear Pip

Sancrox Quarry Expansion
State Significant Development Application
Targeted Orchid Survey - Final Report

Please find enclosed our final report describing the methods and results of our survey for threatened orchids on the proposed Quarry Expansion Area.

Please don't hesitate to call should you wish to discuss the results or recommendations at any convenient time.

Yours sincerely

JEREMY PEPPER
Technical Discipline Manager, Ecology

Checked/ G Leonard
Authorised by: JP

SLR Consulting Australia Pty Ltd 10 Kings Road New Lambton NSW 2305 Australia
(PO Box 447 New Lambton NSW 2305 Australia) T: +61 2 4037 3200 F: +61 2 4037 3201
E: newcastleau@slrconsulting.com www.slrconsulting.com
ABN 29 001 584 612

1 Introduction

Sancrox Quarry (the 'site') is located 8 kilometres (km) west of Port Macquarie, within the Port Macquarie Hastings local government area. The site compromises Lot 1 in DP 704890, Lot 1 in DP 720807, Lot 2 in DP 574308, Lot 353 in DP 754434 and an area of Crown land.

Hanson proposes to extend the life of the quarry by expanding the approved extraction boundary to facilitate the extraction and distribution of construction materials. The current annual extraction limit will be increased from 455,000 tonnes per annum (tpa) to 750,000 tpa. This will involve an expansion of the quarry footprint in a westerly direction into Lot 2, DP 574308. Construction of a concrete batching plant, asphalt plant and pug mil is also proposed. The project qualifies as State Significant Development pursuant to the NSW *Environmental Planning & Assessment Act 1979* (EP&A Act) and as such, an environmental impact statement (EIS) must accompany the project application.

In preparation for the forthcoming EIS, Hanson engaged SLR Consulting Australia Pty Ltd (SLR) to conduct threatened flora surveys, as the timing of surveys for some species is critical for their detection. In particular, there are several orchids and other cryptic plant species previously recorded in the Sancrox/Port Macquarie locality that can only be detected when in flower, and their flowering times fall generally in the August to October period. Details on these species and the survey techniques employed are provided in the following sections.

2 Scope and Aims

The primary aim of the current investigation was to conduct targeted searches for subject plant species during their known flowering periods. The specific objectives of the survey were to determine the presence (or likely occurrence) of cryptic threatened plant species within the proposed quarry expansion area and to identify recommendations for avoidance or management of threatened plants (where present).

The scope of the investigation was limited to the subject threatened plant species within those parts of the site that contain suitable habitat for these species within the timeframes specified.

3 Methods

The current investigation involved three main tasks:

- Desktop research
- Consultation
- Field survey

The methods and results of the investigation are described in detail in the following sections.

3.1 Desktop Research

Previous records of threatened species within 10 kilometres of the site were retrieved from the OEH BioNet *Atlas of NSW Wildlife* database. Threatened flora species previously recorded within 10 kilometres (km) of the site are listed in **Table 1**. A total of seven threatened species are listed, of which two species are 'cryptic', in that they must be in flower to enable detection: *Dendrobium melaleucaphilum* and *Phaius australis*.

Table 1 Threatened plant species recorded within the locality of Sancrox

Scientific Name	Common Name	NSW Status	EPBC Act	Flowering period	Habitat
Cynanchum elegans	White-flowered Wax Plant	E1,P	E	summer	Rainforest; littoral rainforest
Allocasuarina defungens	Dwarf Heath Casuarina	E1,P	E	N/A	Coastal heath
Maundia triglochinoides		V,P		spring/summer	Coastal wetlands
Eucalyptus nicholii	Narrow-leaved Black Peppermint	V,P	V	N/A	New England Tablelands
Melaleuca biconvexa	Biconvex Paperbark	V,P	V	N/A	Swampy ground; swamp forest
Dendrobium melaleucaphilum	Spider Orchid	E1,P,2		July – October	Swampy ground; swamp forest; Melaleuca swamp (esp. *M. styphelioides*)
Phaius australis	Southern Swamp Orchid	E1,P,2	E	September – October	Swampy ground; swamp forest; Melaleuca swamp

A copy of the full BioNet search results for threatened species within 10 kilometres of the site is attached in **Appendix A**.

Additionally, analysis of regional vegetation mapping data indicated that the site contained potential habitat for *Melaleuca biconvexa* and *Cynanchum elegans*, although these two species can be detected without flowering parts and therefore at any time of year. These species, along with the orchids *Dendrobium melaleucaphilum* and *Phaius australis*, were the 'subject species' for the investigation. The flowering periods for both orchid species overlap and are generally between August and October. Targeted surveys were therefore required before the end of October to allow detection of these orchid species and address recommended survey guidelines (Bishop 2000, Jones 2000, DoE 2013).

Conversely, the site does not provide suitable habitat for *Allocasuarina defungens*, *Maundia triglochinoides* or *Eucalyptus nicholii*.

3.2 Consultation (Reference Sites)

As part of the desktop research phase, SLR investigated potential 'reference sites' for the two orchid species, in order to determine the current flowering status and therefore assist in their detection on the site. SLR contacted the NSW Office of Environment and Heritage (OEH) Coffs harbour office and Tinonee Native Orchid Nursery. OEH were able to advise on the flowering status of a local population of *D. melaleucaphilum* in the Mid-north Coast region. An OEH officer inspected a known location of *D. melaleucaphilum* and advised that, as of 16 October, the population had already flowered and no flowering parts remained. The OEH advice (D Young, OEH, email dated 16 October 2015) is provided below:

> *"An officer from the OEH visited two sites west of Urunga this morning where Dendrobium melaleucaphilum is known to occur. Each site contains a mix of both D. melaleucaphilum and D. tetragonum. The officer advised that at each site, a small proportion of plants had already flowered for this year (maybe about 5-10% of plants). The officer was unable to tell if it had been D. melaleucaphilum, D. tetragonum or both species that had flowered - the flowers were too old and shrivelled to tell (see attached)."*

OEH were not in a position to offer advice on reference sites for *P. australis*.

Contact was made with a Tinonee Native Orchids, a local nursery known for propagating local (and rare) native orchid species. Potted specimens of *P. australis* and other *Phaius* species were inspected on 16 October 2015 (the day of the survey) and were observed to be in flower in the nursery. Potted specimens of *D. melaleucaphilum* and the closely related *D. tetragonum* were observed to have already flowered.

3.3 Field Survey

The field survey was completed by Jeremy Pepper, Principal Ecologist (SLR) and Pip Cox, Environmental Scientist (Hanson) on 16 October 2015. The survey involved walked transects through areas of potential habitat for the subject plant species, according to the random meander technique (Cropper 1993). A total of 14 person hours were employed in the targeted searches over the course of one day. The random meander transects are mapped in **Figure 1**.

4 Results

4.1 Species Profiles

4.1.1 Spider Orchid *Dendrobium melaleucaphilum*

The Spider Orchid *D. melaleucaphilum* (Family Orchidaceae) is an orchid which grows on other plants (ie epiphytic) and sometimes on rocks (ie epilithic) and occurs in coastal districts and nearby ranges, extending from Queensland to its southern distributional limit in the lower Blue Mountains in New South Wales (NSW). In NSW, it is currently known from seven recent collections (OEH 2012). Stems are spreading to drooping, thin and wiry in the basal half, succulent, swollen and square in cross section in the upper half, tapering towards the tip, rooting only at the base. Leaves are spreading to erect, elliptic, 4.5–9 cm long, 15–25 mm wide, conduplicate, acuminate, thin and smooth. Inflorescences are 0.7–4 cm long and 2–8-flowered. Sepals and lateral petals are green to deep dull yellow with reddish margins or other markings; dorsal sepals are 38–60 mm long, 2–5 mm wide. The labellum is cream with reddish striations, 10–16 mm long and 7–9 mm wide (PlantNET 2015a).

This species grows frequently as an arboreal epiphyte of Prickly-leaved Paperbark *Melaleuca styphelioides*, less commonly on rainforest trees or on rocks. Flowering occurs between July and October. It is listed as ‘endangered’ under the NSW *Threatened Species Conservation Act 1995* (TSC Act), but is not listed under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).

In terms of identification and morphology, *D. melaleucaphilum* is very similar to the closely related Tree Spider Orchid *D. tetragonum*, which has shorter dorsal sepals (19 – 30 mm long) and shorter labellum (up to 10 mm long). *D. melaleucaphilum* was previously known as the 'large-flowered paperbark form' of *D. tetragonum* (PlantNET 2015a). Hence, these two species cannot, strictly speaking, be distinguished unless in flower.

4.1.2 Southern Swamp-orchid *Phaius australis*

The Southern Swamp-orchid *Phaius australis* (Family Orchidaceae) is a terrestrial (ground dwelling) orchid and produces the largest flowers of any Australian orchid (TSSC 2014). Each plant has 4–8 large, pleated leaves and 1–2 flower stalks. The leaves are long (approx. 70 cm) and narrow, in relation to width (3–10 cm wide). The flowers are red-brown with yellow veins inside the flower and grow in spikes on stalks that are 70–110 cm long (TSSC 2014).

P. australis grows in *Melaleuca quinquenervia* swamps and in sclerophyll forest, on the coast, at or near sea level (PlantNET 2015b). It has been reported north from Lake Cathie, but chiefly north from the Evans Head district (PlantNET 2015b). OEH (2014) notes that the species “Occurs in Queensland and north-east NSW as far south as Coffs Harbour". Historically, it extended farther south, to Port Macquarie”. On this basis, the site at Sancrox is outside of the range limit of this species.

4.2 Survey Results

Survey results are listed in **Table 2**. A total of two orchid specimens were recorded during the survey, as follows:

- One specimen of Climbing Orchid *Erythrorchis cassythoides* was recorded on the northeastern portion of the site
- One specimen of a Spider Orchid *Dendrobium* sp. was recorded growing on the trunk of a Prickly-leaved Paperbark *Melaleuca styphelioides* (see **Photo 1**) located on the western margin of the quarry expansion area. The specimen is likely to be the threatened species *D. melaleucaphilum* (for reasons outlined below) but could also possibly be the closely related *D. tetragonum*.

The locations of the orchid records are displayed in **Figure 2**.

Table 2 Threatened plant survey results

Common Name	Species Name	TSC Act Status	EPBC Act	No. Stems
Climbing Orchid	*Erythrorchis cassythoides*	(not listed)	(not listed)	1
Spider Orchid	*Dendrobium* (?)* *melaleucaphilum*	E		1

* Identification to species level not possible until next flowering period.

No other threatened plant species were recorded during the survey. Notably, no evidence for the Southern Swamp-orchid *P australis* was recorded during the survey, despite the presence of 'marginal' habitat (in very restricted locations) and the timing of the survey during the flowering period for this orchid species. The quarry expansion area does not contain the primary habitat type being "*Melaleuca quinquenervia* swamps", for this species. There are, however, small stands of Flax-leaved Paperbark *Melaleuca linariifolia* occurring as a mid-canopy layer in small stands of mixed eucalypt forest in the far south of the site and in the far west of the site. These areas, whilst not ideal habitat for *P. australis*, were searched thoroughly during the survey and no individuals of this species were recorded.

The identity of the *Dendrobium* remains uncertain as the specimen recorded was not in flower and *D. melaleucaphilum* cannot be distinguished from *D. tetragonum* unless in flower. A positive identification of the *Dendrobium* specimen will not be possible until the next flowering period, which is likely to be July-August 2016. However, it is highly likely that the specimen is *D. melaleucaphilum*, rather than the closely related *D. tetragonum* given that:

- the specimen was recorded growing on *Melaleuca styphelioides*, the most common host species for *D. melaleucaphilum*, rather than a rainforest tree (the preferred habitat for *D. tetragonum*)
- the stems aren't pendulous (as with *D. tetragonum*)
- the site is not particularly shady (the location of the record is at the edge of a forest stand, with exposure to western sun)

Accordingly, future site planning and impact assessments for the EIS should be conducted on the assumption that the specimen is the threatened species *D. melaleucaphilum*, until such time as the specimen can be confidently identified to species level.

5 Discussion and Recommendations

Two orchid species were recorded during the current investigation. Of these, one specimen of an epiphytic *Dendrobium* orchid was recorded on an individual *Melaleuca styphelioides* near the western edge of the proposed quarry footprint. Until a positive identification can be made, it is recommended that the specimen be treated as the threatened species *D. melaleucaphilum*, which is listed as endangered in NSW under the TSC Act.

No other threatened plant species, notably *Melaleuca biconvexa* or *Cynanchum elegans*, or any other threatened plants previously recorded within the locality of the site, were recorded.

Further targeted surveys for threatened orchids are recommended during the known flowering period of *D. melaleucaphilum* (being approximately July-September). In this regard, confirmation of flowering of *D. melaleucaphilum* at a local reference population should be obtained from OEH and/or local nurseries, then inspection of the *Dendrobium* specimen recorded on the site should be conducted promptly to confirm flowering of the individual and then confirm species identity. To assist in identification, we recommend that high resolution photographs of the flowering parts and stems be taken and sent to the NSW Herbarium of the Royal Botanic Gardens, Sydney, for confirmation. No voucher samples (e.g. of flowering parts) should be physically removed from the plant, given its potential conservation status under the TSC Act and given the presence of only one individual on the site.

Additionally, opportunistic searches for threatened orchids should be conducted as part of any future ecological surveys within the proposed quarry expansion area as part of the investigation for the EIS.

Photo 1 Specimen of *Dendrobium* (?) *melaleucaphilum* recorded in western portion of site

6 References

Bishop, T (2000) *Field Guide to the Orchids of New South Wales and Victoria*. UNSW Press Sydney.

Jones, D. and B. (2000*) A Field Guide to the Native Orchids of Southern Australia*. Bloomings Books, Hawthorn, Vic.

OEH. 2014. *Southern Swamp Orchid – profile*. NSW Office of Environment and Heritage, Sydney. Available at: http://www.environment.nsw.gov.au/threatenedSpeciesApp/profile.aspx?id=10610.

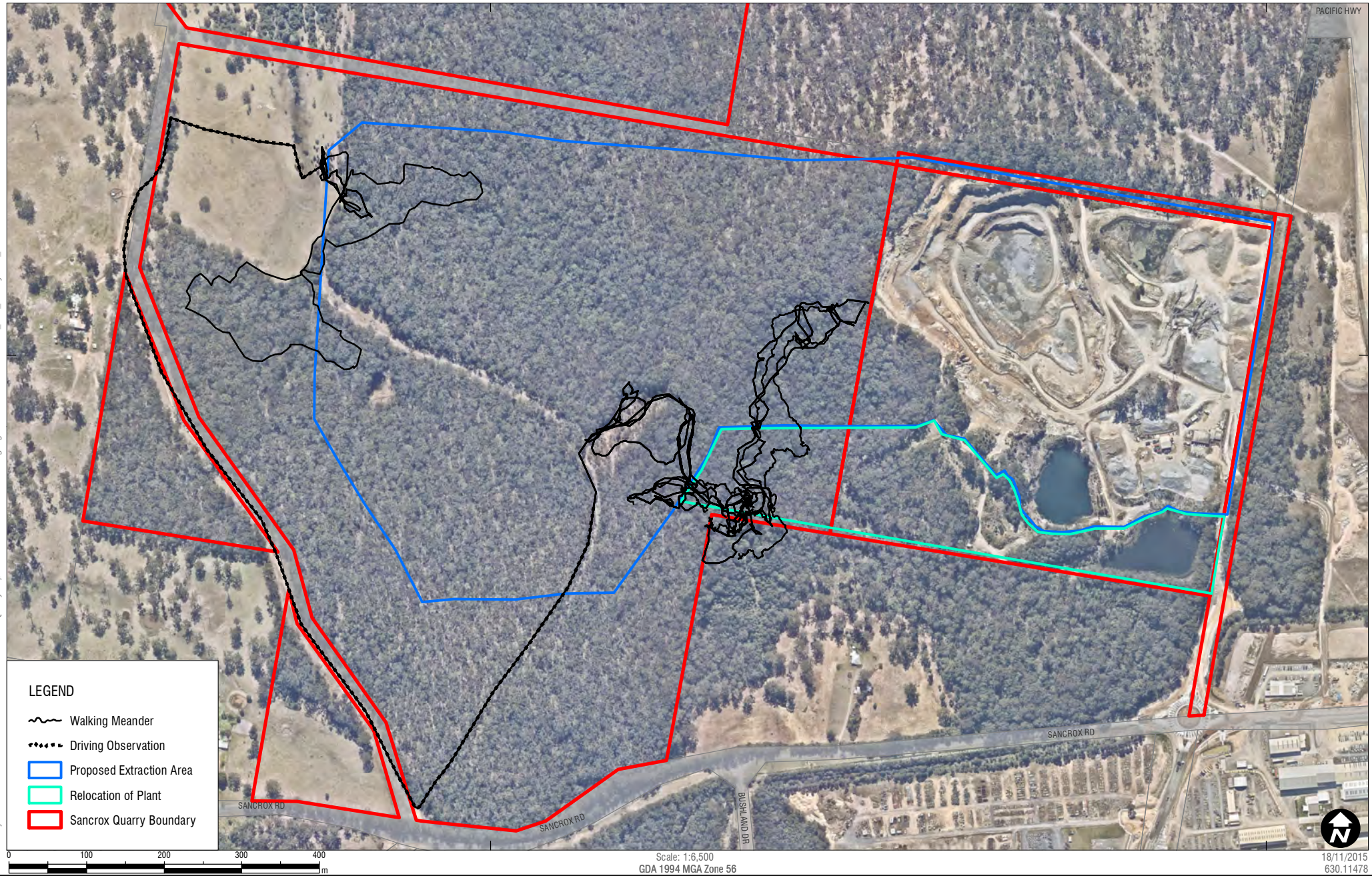
OEH. 2012. *Spider orchid – profile*. NSW Office of Environment and Heritage, Sydney. Available at: http://www.environment.nsw.gov.au/threatenedSpeciesApp/profile.aspx?id=10213.

DoE (2013) *Draft Survey Guidelines for Australia's Threatened Orchids. Guidelines for detecting Orchids listed as 'Threatened' under the Environment Protection and Biodiversity Conservation Act 1999*. Department of the Environment, Canberra, ACT.

PlantNET. 2015a. *New South Wales Flora Online. Dendrobium melaleucaphilum. M.A. Clem. & D.L. Jones*. PlantNET (The NSW Plant Information Network System). Royal Botanic Gardens and Domain Trust, Sydney. http://plantnet.rbgsyd.nsw.gov.au [accessed 5 November 2015]

PlantNET. 2015b. *New South Wales Flora Online. Phaius australis.* F. Muell. PlantNET (The NSW Plant Information Network System). Royal Botanic Gardens and Domain Trust, Sydney. http://plantnet.rbgsyd.nsw.gov.au [accessed 5 November 2015]

TSSC. 2014. Approved Conservation Advice for *Phaius australis* (Common Swamp-orchid). (s266B of the *Environment Protection and Biodiversity Conservation Act 1999*). Threatened Species Scientific Committee, Canberra. Available at: http://www.environment.gov.au/cgi-bin/sprat/public/publicspecies.pl?taxon_id=5872.



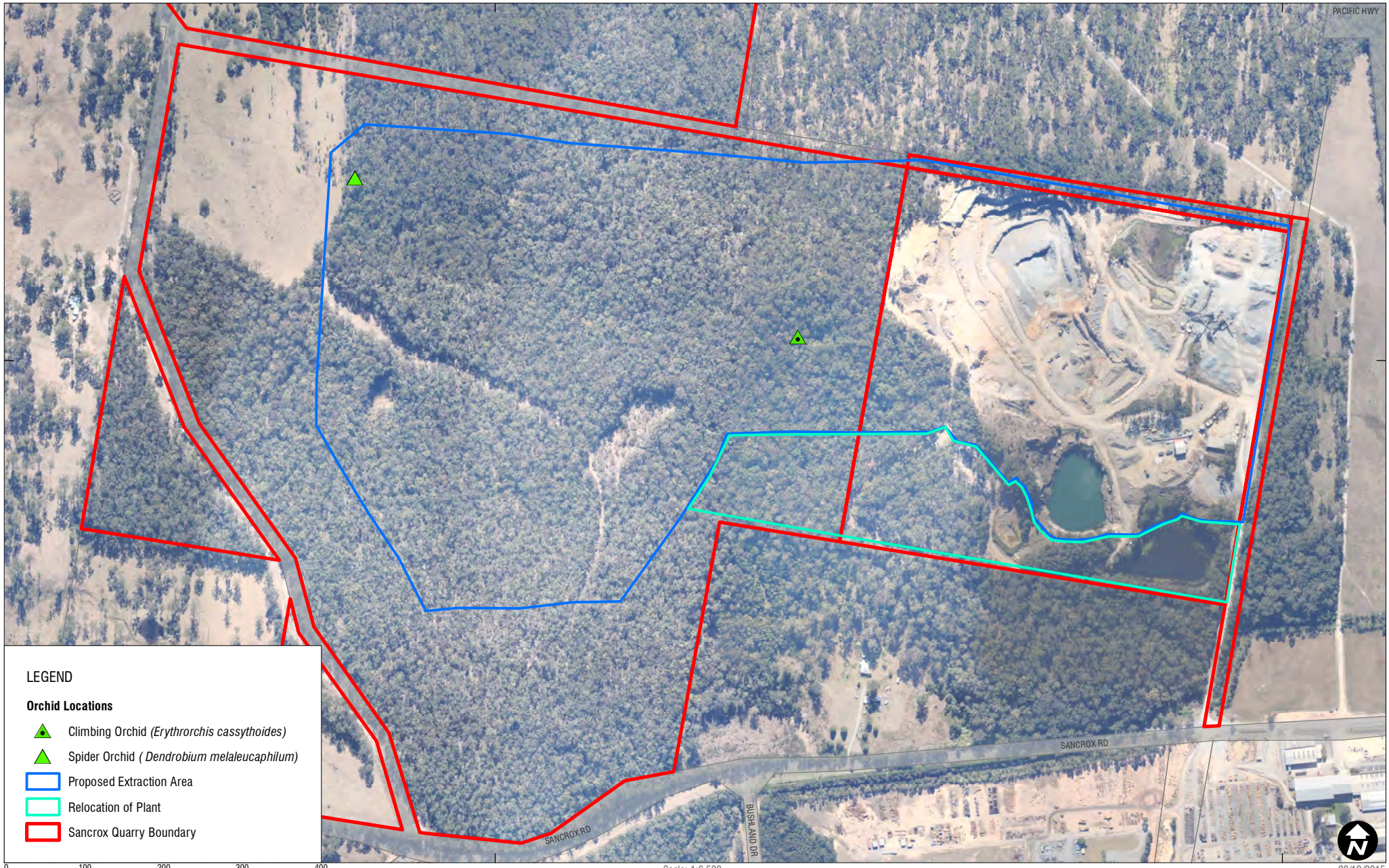
Sheet Size : A4

SLR

www.slrconsultingaustralia.com.au

Threatened Orchid Survey
Survey Sites

FIGURE 1



H:\Projects-SLR\630-Srv\NTL\630-NTL\630.11478 Sancrox Quarry Expansion\06 SLR Data\06 Drafting\Figures\ArcGIS\SLR630 11478_F02_OrchidRecords_01.mxd

Scale: 1:6,500
GDA 1994 MGA Zone 56

28/10/2015
630.11478

Sheet Size : A4

SLR
www.slrconsultingaustralia.com.au

Threatened Orchid Survey
Orchid Records

FIGURE 2

Threatened Species Database Search Results (BioNet 10 km)

Data from the BioNet Atlas of NSW Wildlife website, which holds records from a number of custodians. The data are only indicative and cannot be considered a comprehensive inventory, and may contain errors and omissions. Species listed under the Sensitive Species Data Policy may have their locations denatured (^ round to 0.1Â°; ^^ rounded to 0.01Â°). Copyright the State of NSW through the Office of Environment and Heritage. Search criteria : Licensed Report of all Valid Records o Threatened (listed on TSC Act 1995) Entities in selected area [North: -31.34 West: 152.71 East: 152.91 South: -31.52] returned a total of 1,705 records of 63 species. Report generated on 29/09/2015 11:56 AM

Kingdom	Class	Family	Species Code	Scientific Name	Exotic	Common Name	NSW status	Comm. status	Records
Animalia	Amphibia	Myobatrachidae	3137	*Crinia tinnula*		Wallum Froglet	V,P		52
Animalia	Amphibia	Myobatrachidae	3075	*^^Mixophyes iteratus*		Giant Barred Frog	E1,P,2	E	1
Animalia	Amphibia	Hylidae	3166	*Litoria aurea*		Green and Golden Bell Frog	E1,P	V	2
Animalia	Amphibia	Hylidae	3169	*Litoria brevipalmata*		Green-thighed Frog	V,P		20
Animalia	Aves	Casuariidae	0001	*Dromaius novaehollandiae*		Emu population in the New South Wales North Coast Bioregion and Port Stephens local government area	E2,P		1
Animalia	Aves	Anatidae	0216	*Oxyura australis*		Blue-billed Duck	V,P		1
Animalia	Aves	Columbidae	0021	*Ptilinopus regina*		Rose-crowned Fruit-Dove	V,P		1
Animalia	Aves	Ciconiidae	0183	*Ephippiorhynchus asiaticus*		Black-necked Stork	E1,P		45
Animalia	Aves	Ardeidae	0197	*Botaurus poiciloptilus*		Australasian Bittern	E1,P	E	4
Animalia	Aves	Ardeidae	0196	*Ixobrychus flavicollis*		Black Bittern	V,P		1
Animalia	Aves	Accipitridae	0218	*Circus assimilis*		Spotted Harrier	V,P		2
Animalia	Aves	Accipitridae	0225	*Hieraaetus morphnoides*		Little Eagle	V,P		1
Animalia	Aves	Accipitridae	0230	*Lophoictinia isura*		Square-tailed Kite	V,P,3		33
Animalia	Aves	Accipitridae	8739	*Pandion cristatus*		Eastern Osprey	V,P,3		44
Animalia	Aves	Burhinidae	0174	*Burhinus grallarius*		Bush Stone-curlew	E1,P		2
Animalia	Aves	Burhinidae	0175	*Esacus magnirostris*		Beach Stone-curlew	E4A,P		1
Animalia	Aves	Haematopodidae	0131	*Haematopus fuliginosus*		Sooty Oystercatcher	V,P		3
Animalia	Aves	Haematopodidae	0130	*Haematopus longirostris*		Pied Oystercatcher	E1,P		13
Animalia	Aves	Charadriidae	0139	*Charadrius mongolus*		Lesser Sand-plover	V,P	C,J,K	55
Animalia	Aves	Jacanidae	0171	*Irediparra gallinacea*		Comb-crested Jacana	V,P		1
Animalia	Aves	Scolopacidae	0160	*Xenus cinereus*		Terek Sandpiper	V,P	C,J,K	3
Animalia	Aves	Laridae	0117	*Sternula albifrons*		Little Tern	E1,P	C,J,K	12
Animalia	Aves	Cacatuidae	0265	*^^Calyptorhynchus lathami*		Glossy Black-Cockatoo	V,P,2		65
Animalia	Aves	Psittacidae	0260	*Glossopsitta pusilla*		Little Lorikeet	V,P		16
Animalia	Aves	Psittacidae	0309	*Lathamus discolor*		Swift Parrot	E1,P,3	E	4
Animalia	Aves	Strigidae	0246	*Ninox connivens*		Barking Owl	V,P,3		2
Animalia	Aves	Strigidae	0248	*Ninox strenua*		Powerful Owl	V,P,3		12
Animalia	Aves	Tytonidae	0252	*Tyto longimembris*		Eastern Grass Owl	V,P,3		22
Animalia	Aves	Tytonidae	0250	*Tyto novaehollandiae*		Masked Owl	V,P,3		18
Animalia	Aves	Tytonidae	9924	*Tyto tenebricosa*		Sooty Owl	V,P,3		3
Animalia	Aves	Climacteridae	8127	*Climacteris picumnus victoriae*		Brown Treecreeper (eastern subspecies)	V,P		3
Animalia	Aves	Meliphagidae	0603	*Anthochaera phrygia*		Regent Honeyeater	E4A,P	CE	2
Animalia	Aves	Neosittidae	0549	*Daphoenositta chrysoptera*		Varied Sittella	V,P		23
Animalia	Aves	Campephagidae	0428	*Coracina lineata*		Barred Cuckoo-shrike	V,P		1
Animalia	Aves	Petroicidae	0380	*Petroica boodang*		Scarlet Robin	V,P		1
Animalia	Mammalia	Dasyuridae	1008	*Dasyurus maculatus*		Spotted-tailed Quoll	V,P	E	32
Animalia	Mammalia	Dasyuridae	1017	*Phascogale tapoatafa*		Brush-tailed Phascogale	V,P		5
Animalia	Mammalia	Dasyuridae	1045	*Planigale maculata*		Common Planigale	V,P		4
Animalia	Mammalia	Phascolarctidae	1162	*Phascolarctos cinereus*		Koala	V,P	V	805
Animalia	Mammalia	Petauridae	1136	*Petaurus australis*		Yellow-bellied Glider	V,P		9
Animalia	Mammalia	Petauridae	1137	*Petaurus norfolcensis*		Squirrel Glider	V,P		24
Animalia	Mammalia	Potoroidae	1187	*Aepyprymnus rufescens*		Rufous Bettong	V,P		1
Animalia	Mammalia	Pteropodidae	1280	*Pteropus poliocephalus*		Grey-headed Flying-fox	V,P	V	121
Animalia	Mammalia	Pteropodidae	1294	*Syconycteris australis*		Common Blossom-bat	V,P		1
Animalia	Mammalia	Emballonuridae	1321	*Saccolaimus flaviventris*		Yellow-bellied Sheathtail-bat	V,P		2
Animalia	Mammalia	Molossidae	1329	*Mormopterus norfolkensis*		Eastern Freetail-bat	V,P		20
Animalia	Mammalia	Vespertilionidae	1354	*Chalinolobus nigrogriseus*		Hoary Wattled Bat	V,P		1
Animalia	Mammalia	Vespertilionidae	1372	*Falsistrellus tasmaniensis*		Eastern False Pipistrelle	V,P		2
Animalia	Mammalia	Vespertilionidae	1369	*Kerivoula papuensis*		Golden-tipped Bat	V,P		5
Animalia	Mammalia	Vespertilionidae	1346	*Miniopterus australis*		Little Bentwing-bat	V,P		68

Kingdom	Class	Family	Species Code	Scientific Name	Exotic	Common Name	NSW status	Comm. status	Records
Animalia	Mammalia	Vespertilionidae	1834	*Miniopterus schreibersii oceanensis*		Eastern Bentwing-bat	V,P		28
Animalia	Mammalia	Vespertilionidae	1357	*Myotis macropus*		Southern Myotis	V,P		18
Animalia	Mammalia	Vespertilionidae	1361	*Scoteanax rueppellii*		Greater Broad-nosed Bat	V,P		18
Animalia	Mammalia	Vespertilionidae	1025	*Vespadelus troughtoni*		Eastern Cave Bat	V,P		10
Animalia	Mammalia	Muridae	1466	*Pseudomys gracilicaudatus*		Eastern Chestnut Mouse	V,P		14
Animalia	Mammalia	Dugongidae	1558	*Dugong dugon*		Dugong	E1,P		2
Plantae	Flora	Apocynaceae	1226	*Cynanchum elegans*		White-flowered Wax Plant	E1,P	E	1
Plantae	Flora	Casuarinaceae	8980	*Allocasuarina defungens*		Dwarf Heath Casuarina	E1,P	E	9
Plantae	Flora	Juncaginaceae	3363	*Maundia triglochinoides*			V,P		3
Plantae	Flora	Myrtaceae	4134	*Eucalyptus nicholii*		Narrow-leaved Black Peppermint	V,P	V	3
Plantae	Flora	Myrtaceae	6809	*Melaleuca biconvexa*		Biconvex Paperbark	V,P	V	27
Plantae	Flora	Orchidaceae	6630	*^^Dendrobium melaleucaphilum*		Spider orchid	E1,P,2		1
Plantae	Flora	Orchidaceae	4480	*^^Phaius australis*		Southern Swamp Orchid	E1,P,2	E	1

APPENDIX K

EPBC Act PMST Search Results

Australian Government

Department of the Environment and Energy

EPBC Act Protected Matters Report

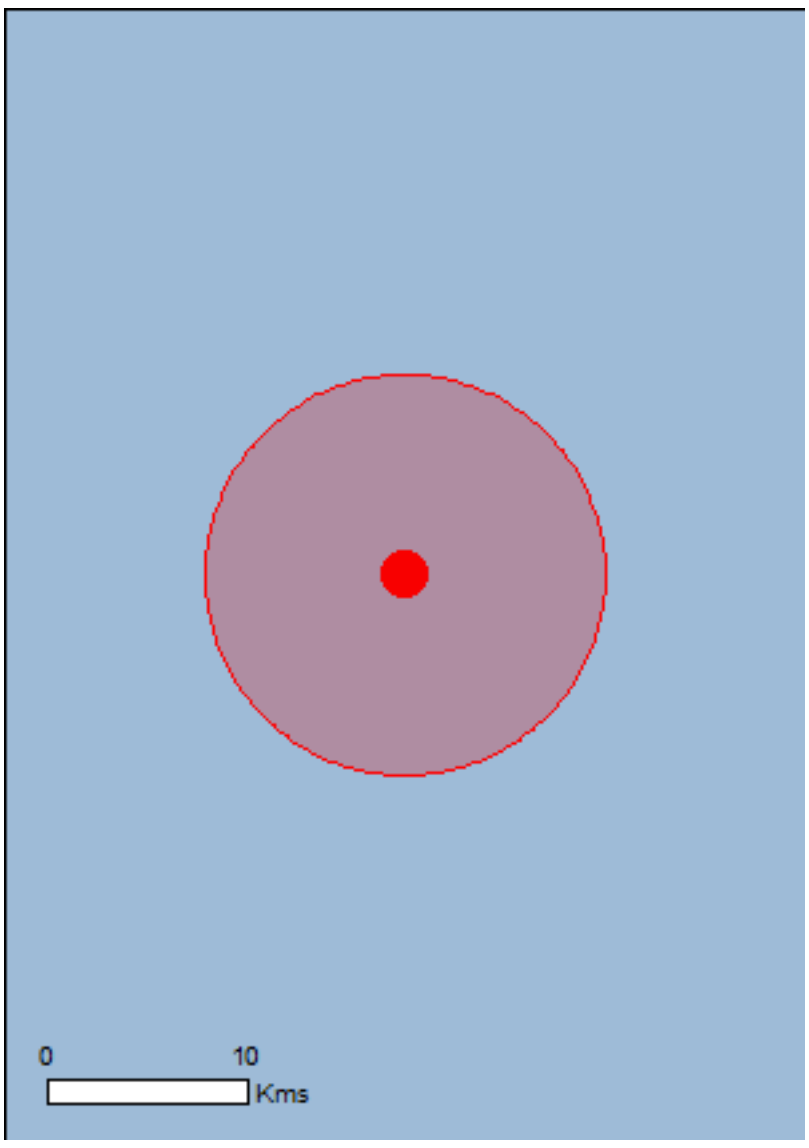
This report provides general guidance on matters of national environmental significance and other matters protected by the EPBC Act in the area you have selected.

Information on the coverage of this report and qualifications on data supporting this report are contained in the caveat at the end of the report.

Information is available about Environment Assessments and the EPBC Act including significance guidelines, forms and application process details.

Report created: 01/05/19 10:30:41

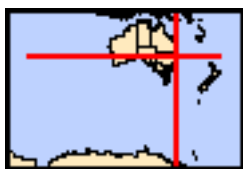
- Summary
- Details
  - Matters of NES
  - Other Matters Protected by the EPBC Act
  - Extra Information
- Caveat
- Acknowledgements



This map may contain data which are ©Commonwealth of Australia (Geoscience Australia), ©PSMA 2010

Coordinates

Buffer: 10.0Km



Summary

Matters of National Environmental Significance

This part of the report summarises the matters of national environmental significance that may occur in, or may relate to, the area you nominated. Further information is available in the detail part of the report, which can be accessed by scrolling or following the links below. If you are proposing to undertake an activity that may have a significant impact on one or more matters of national environmental significance then you should consider the Administrative Guidelines on Significance.

World Heritage Properties:	None
National Heritage Places:	None
Wetlands of International Importance:	None
Great Barrier Reef Marine Park:	None
Commonwealth Marine Area:	None
Listed Threatened Ecological Communities:	3
Listed Threatened Species:	62
Listed Migratory Species:	56

Other Matters Protected by the EPBC Act

This part of the report summarises other matters protected under the Act that may relate to the area you nominated. Approval may be required for a proposed activity that significantly affects the environment on Commonwealth land, when the action is outside the Commonwealth land, or the environment anywhere when the action is taken on Commonwealth land. Approval may also be required for the Commonwealth or Commonwealth agencies proposing to take an action that is likely to have a significant impact on the environment anywhere.

The EPBC Act protects the environment on Commonwealth land, the environment from the actions taken on Commonwealth land, and the environment from actions taken by Commonwealth agencies. As heritage values of a place are part of the 'environment', these aspects of the EPBC Act protect the Commonwealth Heritage values of a Commonwealth Heritage place. Information on the new heritage laws can be found at http://www.environment.gov.au/heritage

A permit may be required for activities in or on a Commonwealth area that may affect a member of a listed threatened species or ecological community, a member of a listed migratory species, whales and other cetaceans, or a member of a listed marine species.

Commonwealth Land:	5
Commonwealth Heritage Places:	None
Listed Marine Species:	61
Whales and Other Cetaceans:	1
Critical Habitats:	None
Commonwealth Reserves Terrestrial:	None
Australian Marine Parks:	None

Extra Information

This part of the report provides information that may also be relevant to the area you have nominated.

State and Territory Reserves:	8
Regional Forest Agreements:	1
Invasive Species:	36
Nationally Important Wetlands:	None
Key Ecological Features (Marine)	None

Details

Matters of National Environmental Significance

Listed Threatened Ecological Communities [Resource Information]

For threatened ecological communities where the distribution is well known, maps are derived from recovery plans, State vegetation maps, remote sensing imagery and other sources. Where threatened ecological community distributions are less well known, existing vegetation maps and point location data are used to produce indicative distribution maps.

Name	Status	Type of Presence
Coastal Swamp Oak (Casuarina glauca) Forest of New South Wales and South East Queensland ecological community	Endangered	Community likely to occur within area
Lowland Rainforest of Subtropical Australia	Critically Endangered	Community likely to occur within area
Subtropical and Temperate Coastal Saltmarsh	Vulnerable	Community likely to occur within area

Listed Threatened Species [Resource Information]

Name	Status	Type of Presence
Birds		
Anthochaera phrygia Regent Honeyeater [82338]	Critically Endangered	Species or species habitat known to occur within area
Botaurus poiciloptilus Australasian Bittern [1001]	Endangered	Species or species habitat known to occur within area
Calidris canutus Red Knot, Knot [855]	Endangered	Species or species habitat known to occur within area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat known to occur within area
Charadrius mongolus Lesser Sand Plover, Mongolian Plover [879]	Endangered	Roosting known to occur within area
Dasyornis brachypterus Eastern Bristlebird [533]	Endangered	Species or species habitat likely to occur within area
Diomedea antipodensis Antipodean Albatross [64458]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Diomedea antipodensis gibsoni Gibson's Albatross [82270]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Diomedea epomophora Southern Royal Albatross [89221]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Diomedea exulans Wandering Albatross [89223]	Vulnerable	Foraging, feeding or related behaviour likely

Name	Status	Type of Presence
		to occur within area
Diomedea sanfordi Northern Royal Albatross [64456]	Endangered	Foraging, feeding or related behaviour likely to occur within area
Erythrotriorchis radiatus Red Goshawk [942]	Vulnerable	Species or species habitat likely to occur within area
Grantiella picta Painted Honeyeater [470]	Vulnerable	Species or species habitat may occur within area
Lathamus discolor Swift Parrot [744]	Critically Endangered	Species or species habitat known to occur within area
Limosa lapponica baueri Bar-tailed Godwit (baueri), Western Alaskan Bar-tailed Godwit [86380]	Vulnerable	Species or species habitat likely to occur within area
Limosa lapponica menzbieri Northern Siberian Bar-tailed Godwit, Bar-tailed Godwit (menzbieri) [86432]	Critically Endangered	Species or species habitat may occur within area
Macronectes giganteus Southern Giant-Petrel, Southern Giant Petrel [1060]	Endangered	Species or species habitat may occur within area
Macronectes halli Northern Giant Petrel [1061]	Vulnerable	Species or species habitat may occur within area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat known to occur within area
Pachyptila turtur subantarctica Fairy Prion (southern) [64445]	Vulnerable	Species or species habitat known to occur within area
Rostratula australis Australian Painted-snipe, Australian Painted Snipe [77037]	Endangered	Species or species habitat may occur within area
Thalassarche bulleri Buller's Albatross, Pacific Albatross [64460]	Vulnerable	Species or species habitat may occur within area
Thalassarche bulleri platei Northern Buller's Albatross, Pacific Albatross [82273]	Vulnerable	Species or species habitat may occur within area
Thalassarche cauta cauta Shy Albatross, Tasmanian Shy Albatross [82345]	Vulnerable	Species or species habitat may occur within area
Thalassarche cauta steadi White-capped Albatross [82344]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Thalassarche eremita Chatham Albatross [64457]	Endangered	Species or species habitat may occur within area
Thalassarche impavida Campbell Albatross, Campbell Black-browed Albatross [64459]	Vulnerable	Species or species habitat may occur within area
Thalassarche melanophris Black-browed Albatross [66472]	Vulnerable	Species or species habitat may occur within area

Name	Status	Type of Presence
Thalassarche salvini Salvin's Albatross [64463]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Fish		
Epinephelus daemelii Black Rockcod, Black Cod, Saddled Rockcod [68449]	Vulnerable	Species or species habitat likely to occur within area
Frogs		
Litoria aurea Green and Golden Bell Frog [1870]	Vulnerable	Species or species habitat known to occur within area
Mixophyes balbus Stuttering Frog, Southern Barred Frog (in Victoria) [1942]	Vulnerable	Species or species habitat likely to occur within area
Mixophyes iteratus Giant Barred Frog, Southern Barred Frog [1944]	Endangered	Species or species habitat likely to occur within area
Insects		
Argynnis hyperbius inconstans Australian Fritillary [88056]	Critically Endangered	Species or species habitat likely to occur within area
Mammals		
Chalinolobus dwyeri Large-eared Pied Bat, Large Pied Bat [183]	Vulnerable	Species or species habitat likely to occur within area
Dasyurus maculatus maculatus (SE mainland population) Spot-tailed Quoll, Spotted-tail Quoll, Tiger Quoll (southeastern mainland population) [75184]	Endangered	Species or species habitat known to occur within area
Petauroides volans Greater Glider [254]	Vulnerable	Species or species habitat known to occur within area
Petrogale penicillata Brush-tailed Rock-wallaby [225]	Vulnerable	Species or species habitat may occur within area
Phascolarctos cinereus (combined populations of Qld, NSW and the ACT) Koala (combined populations of Queensland, New South Wales and the Australian Capital Territory) [85104]	Vulnerable	Species or species habitat known to occur within area
Potorous tridactylus tridactylus Long-nosed Potoroo (SE mainland) [66645]	Vulnerable	Species or species habitat likely to occur within area
Pseudomys novaehollandiae New Holland Mouse, Pookila [96]	Vulnerable	Species or species habitat likely to occur within area
Pteropus poliocephalus Grey-headed Flying-fox [186]	Vulnerable	Roosting known to occur within area
Plants		
Acronychia littoralis Scented Acronychia [8582]	Endangered	Species or species habitat likely to occur within area
Allocasuarina defungens Dwarf Heath Casuarina [21924]	Endangered	Species or species habitat known to occur within area
Allocasuarina thalassoscopica [21927]	Endangered	Species or species habitat known to occur within area

Name	Status	Type of Presence
Arthraxon hispidus Hairy-joint Grass [9338]	Vulnerable	Species or species habitat may occur within area
Asperula asthenes Trailing Woodruff [14004]	Vulnerable	Species or species habitat known to occur within area
Cryptostylis hunteriana Leafless Tongue-orchid [19533]	Vulnerable	Species or species habitat likely to occur within area
Cynanchum elegans White-flowered Wax Plant [12533]	Endangered	Species or species habitat known to occur within area
Euphrasia arguta [4325]	Critically Endangered	Species or species habitat may occur within area
Hakea archaeoides [66702]	Vulnerable	Species or species habitat likely to occur within area
Macadamia integrifolia Macadamia Nut, Queensland Nut Tree, Smooth-shelled Macadamia, Bush Nut, Nut Oak [7326]	Vulnerable	Species or species habitat may occur within area
Melaleuca biconvexa Biconvex Paperbark [5583]	Vulnerable	Species or species habitat known to occur within area
Parsonsia dorrigoensis Milky Silkpod [64684]	Endangered	Species or species habitat likely to occur within area
Phaius australis Lesser Swamp-orchid [5872]	Endangered	Species or species habitat may occur within area
Syzygium paniculatum Magenta Lilly Pilly, Magenta Cherry, Daguba, Scrub Cherry, Creek Lilly Pilly, Brush Cherry [20307]	Vulnerable	Species or species habitat may occur within area
Thesium australe Austral Toadflax, Toadflax [15202]	Vulnerable	Species or species habitat likely to occur within area
Reptiles		
Caretta caretta Loggerhead Turtle [1763]	Endangered	Foraging, feeding or related behaviour known to occur within area
Chelonia mydas Green Turtle [1765]	Vulnerable	Foraging, feeding or related behaviour known to occur within area
Dermochelys coriacea Leatherback Turtle, Leathery Turtle, Luth [1768]	Endangered	Foraging, feeding or related behaviour known to occur within area
Eretmochelys imbricata Hawksbill Turtle [1766]	Vulnerable	Species or species habitat known to occur within area
Natator depressus Flatback Turtle [59257]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area

Listed Migratory Species

[Resource Information]

* Species is listed under a different scientific name on the EPBC Act - Threatened Species list.

Name	Threatened	Type of Presence

Name	Threatened	Type of Presence
Migratory Marine Birds		
Anous stolidus Common Noddy [825]		Species or species habitat likely to occur within area
Apus pacificus Fork-tailed Swift [678]		Species or species habitat likely to occur within area
Calonectris leucomelas Streaked Shearwater [1077]		Species or species habitat may occur within area
Diomedea antipodensis Antipodean Albatross [64458]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Diomedea epomophora Southern Royal Albatross [89221]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Diomedea exulans Wandering Albatross [89223]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Diomedea sanfordi Northern Royal Albatross [64456]	Endangered	Foraging, feeding or related behaviour likely to occur within area
Fregata ariel Lesser Frigatebird, Least Frigatebird [1012]		Species or species habitat known to occur within area
Fregata minor Great Frigatebird, Greater Frigatebird [1013]		Species or species habitat likely to occur within area
Macronectes giganteus Southern Giant-Petrel, Southern Giant Petrel [1060]	Endangered	Species or species habitat may occur within area
Macronectes halli Northern Giant Petrel [1061]	Vulnerable	Species or species habitat may occur within area
Thalassarche bulleri Buller's Albatross, Pacific Albatross [64460]	Vulnerable	Species or species habitat may occur within area
Thalassarche cauta Tasmanian Shy Albatross [89224]	Vulnerable*	Species or species habitat may occur within area
Thalassarche eremita Chatham Albatross [64457]	Endangered	Species or species habitat may occur within area
Thalassarche impavida Campbell Albatross, Campbell Black-browed Albatross [64459]	Vulnerable	Species or species habitat may occur within area
Thalassarche melanophris Black-browed Albatross [66472]	Vulnerable	Species or species habitat may occur within area
Thalassarche salvini Salvin's Albatross [64463]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Thalassarche steadi White-capped Albatross [64462]	Vulnerable*	Foraging, feeding or related behaviour likely to occur within area

Name	Threatened	Type of Presence
Migratory Marine Species		
Caretta caretta Loggerhead Turtle [1763]	Endangered	Foraging, feeding or related behaviour known to occur within area
Chelonia mydas Green Turtle [1765]	Vulnerable	Foraging, feeding or related behaviour known to occur within area
Dermochelys coriacea Leatherback Turtle, Leathery Turtle, Luth [1768]	Endangered	Foraging, feeding or related behaviour known to occur within area
Dugong dugon Dugong [28]		Species or species habitat may occur within area
Eretmochelys imbricata Hawksbill Turtle [1766]	Vulnerable	Species or species habitat known to occur within area
Lamna nasus Porbeagle, Mackerel Shark [83288]		Species or species habitat may occur within area
Manta alfredi Reef Manta Ray, Coastal Manta Ray, Inshore Manta Ray, Prince Alfred's Ray, Resident Manta Ray [84994]		Species or species habitat may occur within area
Manta birostris Giant Manta Ray, Chevron Manta Ray, Pacific Manta Ray, Pelagic Manta Ray, Oceanic Manta Ray [84995]		Species or species habitat may occur within area
Natator depressus Flatback Turtle [59257]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Sousa chinensis Indo-Pacific Humpback Dolphin [50]		Species or species habitat likely to occur within area
Migratory Terrestrial Species		
Cuculus optatus Oriental Cuckoo, Horsfield's Cuckoo [86651]		Species or species habitat may occur within area
Hirundapus caudacutus White-throated Needletail [682]		Species or species habitat known to occur within area
Monarcha melanopsis Black-faced Monarch [609]		Species or species habitat known to occur within area
Monarcha trivirgatus Spectacled Monarch [610]		Species or species habitat known to occur within area
Myiagra cyanoleuca Satin Flycatcher [612]		Species or species habitat known to occur within area
Rhipidura rufifrons Rufous Fantail [592]		Species or species habitat known to occur within area
Migratory Wetlands Species		
Actitis hypoleucos Common Sandpiper [59309]		Species or species habitat known to occur within area
Arenaria interpres Ruddy Turnstone [872]		Roosting known to occur

Name	Threatened	Type of Presence
		within area
Calidris acuminata Sharp-tailed Sandpiper [874]		Species or species habitat known to occur within area
Calidris canutus Red Knot, Knot [855]	Endangered	Species or species habitat known to occur within area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat known to occur within area
Calidris melanotos Pectoral Sandpiper [858]		Species or species habitat may occur within area
Calidris ruficollis Red-necked Stint [860]		Roosting known to occur within area
Charadrius bicinctus Double-banded Plover [895]		Roosting known to occur within area
Charadrius mongolus Lesser Sand Plover, Mongolian Plover [879]	Endangered	Roosting known to occur within area
Gallinago hardwickii Latham's Snipe, Japanese Snipe [863]		Roosting may occur within area
Gallinago megala Swinhoe's Snipe [864]		Roosting likely to occur within area
Gallinago stenura Pin-tailed Snipe [841]		Roosting likely to occur within area
Limosa lapponica Bar-tailed Godwit [844]		Species or species habitat known to occur within area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat known to occur within area
Numenius minutus Little Curlew, Little Whimbrel [848]		Roosting likely to occur within area
Numenius phaeopus Whimbrel [849]		Roosting known to occur within area
Pandion haliaetus Osprey [952]		Breeding known to occur within area
Pluvialis fulva Pacific Golden Plover [25545]		Roosting known to occur within area
Pluvialis squatarola Grey Plover [865]		Roosting known to occur within area
Tringa brevipes Grey-tailed Tattler [851]		Roosting known to occur within area
Tringa nebularia Common Greenshank, Greenshank [832]		Species or species habitat known to occur within area
Xenus cinereus Terek Sandpiper [59300]		Roosting known to occur within area

Other Matters Protected by the EPBC Act

Commonwealth Land [Resource Information]

The Commonwealth area listed below may indicate the presence of Commonwealth land in this vicinity. Due to the unreliability of the data source, all proposals should be checked as to whether it impacts on a Commonwealth area, before making a definitive decision. Contact the State or Territory government land department for further information.

Name
Commonwealth Land - Australian Postal Commission
Commonwealth Land - Australian Postal Corporation
Commonwealth Land - Australian Telecommunications Commission
Commonwealth Land - Defence Service Homes Corporation
Commonwealth Land - Telstra Corporation Limited

Listed Marine Species [Resource Information]

* Species is listed under a different scientific name on the EPBC Act - Threatened Species list.

Name	Threatened	Type of Presence
Birds		
Actitis hypoleucos Common Sandpiper [59309]		Species or species habitat known to occur within area
Anous stolidus Common Noddy [825]		Species or species habitat likely to occur within area
Apus pacificus Fork-tailed Swift [678]		Species or species habitat likely to occur within area
Ardea alba Great Egret, White Egret [59541]		Species or species habitat known to occur within area
Ardea ibis Cattle Egret [59542]		Species or species habitat may occur within area
Arenaria interpres Ruddy Turnstone [872]		Roosting known to occur within area
Calidris acuminata Sharp-tailed Sandpiper [874]		Species or species habitat known to occur within area
Calidris canutus Red Knot, Knot [855]	Endangered	Species or species habitat known to occur within area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat known to occur within area
Calidris melanotos Pectoral Sandpiper [858]		Species or species habitat may occur within area
Calidris ruficollis Red-necked Stint [860]		Roosting known to occur within area
Calonectris leucomelas Streaked Shearwater [1077]		Species or species habitat may occur within area
Charadrius bicinctus Double-banded Plover [895]		Roosting known to occur within area
Charadrius mongolus Lesser Sand Plover, Mongolian Plover [879]	Endangered	Roosting known to occur

Name	Threatened	Type of Presence
		within area
Charadrius ruficapillus Red-capped Plover [881]		Roosting known to occur within area
Diomedea antipodensis Antipodean Albatross [64458]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Diomedea epomophora Southern Royal Albatross [89221]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Diomedea exulans Wandering Albatross [89223]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Diomedea gibsoni Gibson's Albatross [64466]	Vulnerable*	Foraging, feeding or related behaviour likely to occur within area
Diomedea sanfordi Northern Royal Albatross [64456]	Endangered	Foraging, feeding or related behaviour likely to occur within area
Fregata ariel Lesser Frigatebird, Least Frigatebird [1012]		Species or species habitat known to occur within area
Fregata minor Great Frigatebird, Greater Frigatebird [1013]		Species or species habitat likely to occur within area
Gallinago hardwickii Latham's Snipe, Japanese Snipe [863]		Roosting may occur within area
Gallinago megala Swinhoe's Snipe [864]		Roosting likely to occur within area
Gallinago stenura Pin-tailed Snipe [841]		Roosting likely to occur within area
Haliaeetus leucogaster White-bellied Sea-Eagle [943]		Species or species habitat known to occur within area
Heteroscelus brevipes Grey-tailed Tattler [59311]		Roosting known to occur within area
Hirundapus caudacutus White-throated Needletail [682]		Species or species habitat known to occur within area
Lathamus discolor Swift Parrot [744]	Critically Endangered	Species or species habitat known to occur within area
Limosa lapponica Bar-tailed Godwit [844]		Species or species habitat known to occur within area
Macronectes giganteus Southern Giant-Petrel, Southern Giant Petrel [1060]	Endangered	Species or species habitat may occur within area
Macronectes halli Northern Giant Petrel [1061]	Vulnerable	Species or species habitat may occur within area
Merops ornatus Rainbow Bee-eater [670]		Species or species habitat may occur within area

Name	Threatened	Type of Presence
Monarcha melanopsis Black-faced Monarch [609]		Species or species habitat known to occur within area
Monarcha trivirgatus Spectacled Monarch [610]		Species or species habitat known to occur within area
Myiagra cyanoleuca Satin Flycatcher [612]		Species or species habitat known to occur within area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat known to occur within area
Numenius minutus Little Curlew, Little Whimbrel [848]		Roosting likely to occur within area
Numenius phaeopus Whimbrel [849]		Roosting known to occur within area
Pachyptila turtur Fairy Prion [1066]		Species or species habitat known to occur within area
Pandion haliaetus Osprey [952]		Breeding known to occur within area
Pluvialis fulva Pacific Golden Plover [25545]		Roosting known to occur within area
Pluvialis squatarola Grey Plover [865]		Roosting known to occur within area
Rhipidura rufifrons Rufous Fantail [592]		Species or species habitat known to occur within area
Rostratula benghalensis (sensu lato) Painted Snipe [889]	Endangered*	Species or species habitat may occur within area
Thalassarche bulleri Buller's Albatross, Pacific Albatross [64460]	Vulnerable	Species or species habitat may occur within area
Thalassarche cauta Tasmanian Shy Albatross [89224]	Vulnerable*	Species or species habitat may occur within area
Thalassarche eremita Chatham Albatross [64457]	Endangered	Species or species habitat may occur within area
Thalassarche impavida Campbell Albatross, Campbell Black-browed Albatross [64459]	Vulnerable	Species or species habitat may occur within area
Thalassarche melanophris Black-browed Albatross [66472]	Vulnerable	Species or species habitat may occur within area
Thalassarche salvini Salvin's Albatross [64463]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Thalassarche sp. nov. Pacific Albatross [66511]	Vulnerable*	Species or species habitat may occur within area
Thalassarche steadi White-capped Albatross [64462]	Vulnerable*	Foraging, feeding or

Name	Threatened	Type of Presence
		related behaviour likely to occur within area
Tringa nebularia Common Greenshank, Greenshank [832]		Species or species habitat known to occur within area
Xenus cinereus Terek Sandpiper [59300]		Roosting known to occur within area
Mammals		
Dugong dugon Dugong [28]		Species or species habitat may occur within area
Reptiles		
Caretta caretta Loggerhead Turtle [1763]	Endangered	Foraging, feeding or related behaviour known to occur within area
Chelonia mydas Green Turtle [1765]	Vulnerable	Foraging, feeding or related behaviour known to occur within area
Dermochelys coriacea Leatherback Turtle, Leathery Turtle, Luth [1768]	Endangered	Foraging, feeding or related behaviour known to occur within area
Eretmochelys imbricata Hawksbill Turtle [1766]	Vulnerable	Species or species habitat known to occur within area
Natator depressus Flatback Turtle [59257]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area

Whales and other Cetaceans [Resource Information]

Name	Status	Type of Presence
Mammals		
Sousa chinensis Indo-Pacific Humpback Dolphin [50]		Species or species habitat likely to occur within area

Extra Information

State and Territory Reserves [Resource Information]

Name	State
Forestry Management Areas in Wauchope	NSW
LNE Special Management Zone No1	NSW
Lake Innes	NSW
Lake Innes	NSW
Limeburners Creek	NSW
Queens Lake	NSW
Rawdon Creek	NSW
Woregore	NSW

Regional Forest Agreements [Resource Information]

Note that all areas with completed RFAs have been included.

Name	State
North East NSW RFA	New South Wales

Invasive Species [Resource Information]

Weeds reported here are the 20 species of national significance (WoNS), along with other introduced plants that are considered by the States and Territories to pose a particularly significant threat to biodiversity. The following feral animals are reported: Goat, Red Fox, Cat, Rabbit, Pig, Water Buffalo and Cane Toad. Maps from Landscape Health Project, National Land and Water Resouces Audit, 2001.

Name	Status	Type of Presence
Birds		

Name	Status	Type of Presence
Acridotheres tristis Common Myna, Indian Myna [387]		Species or species habitat likely to occur within area
Anas platyrhynchos Mallard [974]		Species or species habitat likely to occur within area
Carduelis carduelis European Goldfinch [403]		Species or species habitat likely to occur within area
Columba livia Rock Pigeon, Rock Dove, Domestic Pigeon [803]		Species or species habitat likely to occur within area
Lonchura punctulata Nutmeg Mannikin [399]		Species or species habitat likely to occur within area
Passer domesticus House Sparrow [405]		Species or species habitat likely to occur within area
Pycnonotus jocosus Red-whiskered Bulbul [631]		Species or species habitat likely to occur within area
Streptopelia chinensis Spotted Turtle-Dove [780]		Species or species habitat likely to occur within area
Sturnus vulgaris Common Starling [389]		Species or species habitat likely to occur within area
Turdus merula Common Blackbird, Eurasian Blackbird [596]		Species or species habitat likely to occur within area
Frogs		
Rhinella marina Cane Toad [83218]		Species or species habitat known to occur within area
Mammals		
Bos taurus Domestic Cattle [16]		Species or species habitat likely to occur within area
Canis lupus familiaris Domestic Dog [82654]		Species or species habitat likely to occur within area
Felis catus Cat, House Cat, Domestic Cat [19]		Species or species habitat likely to occur within area
Feral deer Feral deer species in Australia [85733]		Species or species habitat likely to occur within area
Lepus capensis Brown Hare [127]		Species or species habitat likely to occur within area
Mus musculus House Mouse [120]		Species or species habitat likely to occur within area
Oryctolagus cuniculus Rabbit, European Rabbit [128]		Species or species habitat likely to occur

Name	Status	Type of Presence
		within area
Rattus norvegicus Brown Rat, Norway Rat [83]		Species or species habitat likely to occur within area
Rattus rattus Black Rat, Ship Rat [84]		Species or species habitat likely to occur within area
Vulpes vulpes Red Fox, Fox [18]		Species or species habitat likely to occur within area
Plants		
Alternanthera philoxeroides Alligator Weed [11620]		Species or species habitat likely to occur within area
Anredera cordifolia Madeira Vine, Jalap, Lamb's-tail, Mignonette Vine, Anredera, Gulf Madeiravine, Heartleaf Madeiravine, Potato Vine [2643]		Species or species habitat likely to occur within area
Asparagus aethiopicus Asparagus Fern, Ground Asparagus, Basket Fern, Sprengi's Fern, Bushy Asparagus, Emerald Asparagus [62425]		Species or species habitat likely to occur within area
Cabomba caroliniana Cabomba, Fanwort, Carolina Watershield, Fish Grass, Washington Grass, Watershield, Carolina Fanwort, Common Cabomba [5171]		Species or species habitat likely to occur within area
Chrysanthemoides monilifera Bitou Bush, Boneseed [18983]		Species or species habitat likely to occur within area
Chrysanthemoides monilifera subsp. rotundata Bitou Bush [16332]		Species or species habitat likely to occur within area
Eichhornia crassipes Water Hyacinth, Water Orchid, Nile Lily [13466]		Species or species habitat likely to occur within area
Genista sp. X Genista monspessulana Broom [67538]		Species or species habitat may occur within area
Lantana camara Lantana, Common Lantana, Kamara Lantana, Large-leaf Lantana, Pink Flowered Lantana, Red Flowered Lantana, Red-Flowered Sage, White Sage, Wild Sage [10892]		Species or species habitat likely to occur within area
Opuntia spp. Prickly Pears [82753]		Species or species habitat likely to occur within area
Pinus radiata Radiata Pine Monterey Pine, Insignis Pine, Wilding Pine [20780]		Species or species habitat may occur within area
Rubus fruticosus aggregate Blackberry, European Blackberry [68406]		Species or species habitat likely to occur within area
Sagittaria platyphylla Delta Arrowhead, Arrowhead, Slender Arrowhead [68483]		Species or species habitat likely to occur within area
Salvinia molesta Salvinia, Giant Salvinia, Aquarium Watermoss, Kariba Weed [13665]		Species or species habitat likely to occur within area
Senecio madagascariensis Fireweed, Madagascar Ragwort, Madagascar		Species or species

Name	Status	Type of Presence
Groundsel [2624]		habitat likely to occur within area

Caveat

The information presented in this report has been provided by a range of data sources as acknowledged at the end of the report.

This report is designed to assist in identifying the locations of places which may be relevant in determining obligations under the Environment Protection and Biodiversity Conservation Act 1999. It holds mapped locations of World and National Heritage properties, Wetlands of International and National Importance, Commonwealth and State/Territory reserves, listed threatened, migratory and marine species and listed threatened ecological communities. Mapping of Commonwealth land is not complete at this stage. Maps have been collated from a range of sources at various resolutions.

Not all species listed under the EPBC Act have been mapped (see below) and therefore a report is a general guide only. Where available data supports mapping, the type of presence that can be determined from the data is indicated in general terms. People using this information in making a referral may need to consider the qualifications below and may need to seek and consider other information sources.

For threatened ecological communities where the distribution is well known, maps are derived from recovery plans, State vegetation maps, remote sensing imagery and other sources. Where threatened ecological community distributions are less well known, existing vegetation maps and point location data are used to produce indicative distribution maps.

Threatened, migratory and marine species distributions have been derived through a variety of methods. Where distributions are well known and if time permits, maps are derived using either thematic spatial data (i.e. vegetation, soils, geology, elevation, aspect, terrain, etc) together with point locations and described habitat; or environmental modelling (MAXENT or BIOCLIM habitat modelling) using point locations and environmental data layers.

Where very little information is available for species or large number of maps are required in a short time-frame, maps are derived either from 0.04 or 0.02 decimal degree cells; by an automated process using polygon capture techniques (static two kilometre grid cells, alpha-hull and convex hull); or captured manually or by using topographic features (national park boundaries, islands, etc). In the early stages of the distribution mapping process (1999-early 2000s) distributions were defined by degree blocks, 100K or 250K map sheets to rapidly create distribution maps. More reliable distribution mapping methods are used to update these distributions as time permits.

Only selected species covered by the following provisions of the EPBC Act have been mapped:

- migratory and
- marine

The following species and ecological communities have not been mapped and do not appear in reports produced from this database:

- threatened species listed as extinct or considered as vagrants
- some species and ecological communities that have only recently been listed
- some terrestrial species that overfly the Commonwealth marine area
- migratory species that are very widespread, vagrant, or only occur in small numbers

The following groups have been mapped, but may not cover the complete distribution of the species:

- non-threatened seabirds which have only been mapped for recorded breeding sites
- seals which have only been mapped for breeding sites near the Australian continent

Such breeding sites may be important for the protection of the Commonwealth Marine environment.

Coordinates

-31.43601 152.81544

Acknowledgements

This database has been compiled from a range of data sources. The department acknowledges the following custodians who have contributed valuable data and advice:

-Office of Environment and Heritage, New South Wales
-Department of Environment and Primary Industries, Victoria
-Department of Primary Industries, Parks, Water and Environment, Tasmania
-Department of Environment, Water and Natural Resources, South Australia
-Department of Land and Resource Management, Northern Territory
-Department of Environmental and Heritage Protection, Queensland
-Department of Parks and Wildlife, Western Australia
-Environment and Planning Directorate, ACT
-Birdlife Australia
-Australian Bird and Bat Banding Scheme
-Australian National Wildlife Collection
-Natural history museums of Australia
-Museum Victoria
-Australian Museum
-South Australian Museum
-Queensland Museum
-Online Zoological Collections of Australian Museums
-Queensland Herbarium
-National Herbarium of NSW
-Royal Botanic Gardens and National Herbarium of Victoria
-Tasmanian Herbarium
-State Herbarium of South Australia
-Northern Territory Herbarium
-Western Australian Herbarium
-Australian National Herbarium, Canberra
-University of New England
-Ocean Biogeographic Information System
-Australian Government, Department of Defence
Forestry Corporation, NSW
-Geoscience Australia
-CSIRO
-Australian Tropical Herbarium, Cairns
-eBird Australia
-Australian Government – Australian Antarctic Data Centre
-Museum and Art Gallery of the Northern Territory
-Australian Government National Environmental Science Program
-Australian Institute of Marine Science
-Reef Life Survey Australia
-American Museum of Natural History
-Queen Victoria Museum and Art Gallery, Inveresk, Tasmania
-Tasmanian Museum and Art Gallery, Hobart, Tasmania
-Other groups and individuals

The Department is extremely grateful to the many organisations and individuals who provided expert advice and information on numerous draft distributions.

Please feel free to provide feedback via the Contact Us page.

© Commonwealth of Australia
Department of the Environment
GPO Box 787
Canberra ACT 2601 Australia
+61 2 6274 1111

ASIA PACIFIC OFFICES

BRISBANE
Level 2, 15 Astor Terrace
Spring Hill QLD 4000
Australia
T: +61 7 3858 4800
F: +61 7 3858 4801

CANBERRA
GPO 410
Canberra ACT 2600
Australia
T: +61 2 6287 0800
F: +61 2 9427 8200

DARWIN
5 Foelsche Street
Darwin NT 0800
Australia
T: +61 8 8998 0100
F: +61 2 9427 8200

MACKAY
21 River Street
Mackay QLD 4740
Australia
T: +61 7 3181 3300

MELBOURNE
Suite 2, 2 Domville Avenue
Hawthorn VIC 3122
Australia
T: +61 3 9249 9400
F: +61 3 9249 9499

NEWCASTLE
10 Kings Road
New Lambton NSW 2305
Australia
T: +61 2 4037 3200
F: +61 2 4037 3201

PERTH
589 Hay Street
Jolimont WA 6014
Australia
T: +61 8 9422 5900
F: +61 8 9422 5901

ROCKHAMPTON
rockhampton@slrconsulting.com
M: +61 407 810 417

SYDNEY
2 Lincoln Street
Lane Cove NSW 2066
Australia
T: +61 2 9427 8100
F: +61 2 9427 8200

TAMWORTH
PO Box 11034
Tamworth NSW 2340
Australia
M: +61 408 474 248
F: +61 2 9427 8200

TOWNSVILLE
Level 1, 514 Sturt Street
Townsville QLD 4810
Australia
T: +61 7 4722 8000
F: +61 7 4722 8001

AUCKLAND
68 Beach Road
Auckland 1010
New Zealand
T: +64 27 441 7849

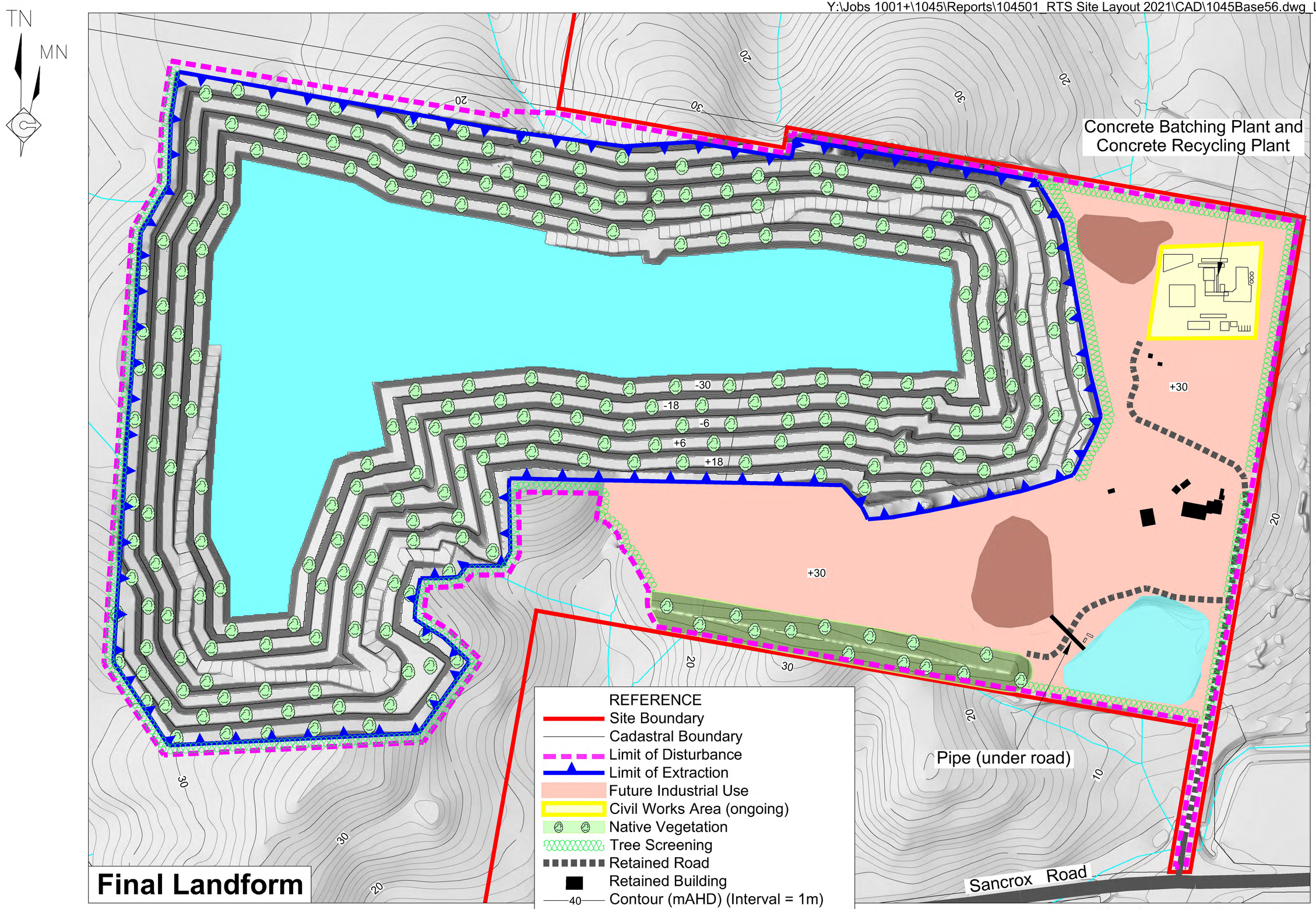
NELSON
5 Duncan Street
Port Nelson 7010
New Zealand
T: +64 274 898 628

NEW PLYMOUTH
Level 2, 10 Devon Street East
New Plymouth 4310
New Zealand
T: +64 0800 757 695

Appendix I

Quarry Extraction Plans – Final Landform

Y:\Jobs 1001+\1045\Reports\104501_RTS Site Layout 2021\CAD\1045Base56.dwg_Layout1-14.05.2021-5:08 PM



Note: Some boundaries are coincident & are offset for clarity

Figure 3
INDICATIVE FINAL LANDFORM

Appendix J

Summary of Public Submissions

Sancrox Quarry Expansion

Summary of Issues Raised in Submissions

Issue Name	Summary of issues	No.	%
Noise (Transport/ Road)	Sleeping at night with our windows open is already hard with the sound of trucks screaming up the highway. We are already experiencing extra noise and traffic on Sancrox Road with the new industrial area being built, Sancrox Road has a large number of pot holes and two low level bridges which barely handle the current traffic let alone more trucks. Truck activity broadly will increase and along with it noise, thus there is 796 truck activities adding to the overall sound scape in the local area and along the highway, 24 hours a day.	7	3%

Issue Name	Summary of issues	No.	%
Hours of Operation	Operation hours - are stated as 24 hours a day, 7 days a week. Due to noise generated I believe 24 hour operations at this site, close to rural residential areas, is inappropriate. Local residents can expect their sleep will be disrupted from noise from the quarry 24/7. Sleep deprivation can adversely impact health. No 24/7 operation Land/Home owners entitled to "peace & quiet" (back to reasonable work hours) I am concerned about the proposed operation of quarry activities to operate on a 24/7 basis. I am also worried possible sleep deprivation it will cause local residents. The works were expanded and ran 24 hours a day it would definitely disturb my family and business. I am also extremely concerned about the increased blasting and crushing, and proposed 24/7 operation of the rock crushing plant, and the associated level of noise pollution, ground vibration and air quality from the operation. This degradation of quality of life will be caused by the proposed 24 hr. a day operation (light pollution at night as well as dust and machinery noise). Daytime operation excluding Sundays is the maximum that should be allowed in a community precinct. The processes carried out do not have to run at night and can be easily shutdown/restarted. I am totally against any further operating hours or days for this current operation. A quarry operating 24/7 will negatively impact on our peaceful lifestyle There will be no respite from constant noisy plant and equipment. Despite noise mitigation measures, the rural ambience is already reduced and any extra noise generation, especially at night, will only make it worse. The noise impact of a 24 hour, 7 days a week operation is particularly concerning. There will be no respite from constant noisy plant and equipment. The extra blasting and 24 hour working in the quarry is totally unexceptionable for the local residents who have built in this area. 24 hour operation should be absolutely rejected, these processes do not need to run throughout the night. There is no need for a 24/7 operation. The current demand for building materials for this area is more than adequately catered for by current suppliers operating in normal hours. The plant and equipment required can readily be shut down and restarted; there is no continuous type of process that requires a 24/7 operation. I strongly object to its proposed operating hours of 24/7. As a nearby resident, I feel that if this quarry is approved as advertised, my peaceful lifestyle will be significantly impacted by this quarry operating around the clock seven days a week particularly with increased noise, dust, truck movements and blasting. Facility operating 24hrs per day is not an appropriate development to be located right in the middle of the fastest growing residential area in one of the fastest growing regional LGA's in NSW. The noise impact of a 24 hour, 7 days a week operation is particularly concerning. There will be no respite from constant noisy plant and equipment. Daytime operation excluding Sundays is the maximum that should be allowed in a community precinct. The processes carried out do not have to run at night and can be easily shutdown/restarted. We could not accept nor be expected to accept current noise levels 24 hours a day. This would be an impost on our home and the application does not adequately substantiate how our house might be affected by night-time noise with the proposed development.	190	71%

Issue Name	Summary of issues	No.	%
Noise (Operational)	The noise and ground shaking. Major concern of noise pollution hours of operation and devalue of properties in surrounding areas The noise from blasting and crushing of rocks will be unbearable. Noise, smell, dust and the increase in traffic will be highly criticised in light of the devastation around Port Macquarie that has been all across the media. I am also worried about the noise ... will cause local residents. We can currently hear the quarry works: trucks reversing, crushing, loading...and if the works were expanded and ran 24 hours a day it would definitely disturb my family and business. This noise pollution ...would also lower our property value I am also extremely concerned about the increased blasting and crushing, and proposed 24/7 operation of the rock crushing plant, and the associated level of noise pollution, ground vibration and air quality from the operation. It is not possible to make an assessment or form a judgement on the impacts of this issue on receivers. The documentation has not established appropriate buffers for noise, vibration, dust and flyrock are available within the quarry land. There would be some noise and vibration that would impact me and other residents of Sancrox. Despite noise mitigation measures, the rural ambience is already reduced and any extra noise generation, especially at night, will only make it worse. I currently hear the operation during daylight hours, so for this to operate on a 24 hour 7 days a week basis would be totally intolerable. generate substantial noise pollution and vibration with the potential to create annoyance and disrupt sleep/rest patterns for the nearby residents, especially given the proposed 2417 scale of operations. Noise and vibration pollution that will worsen with a 24/7 operation as proposed How can you expect a quarry less than 1 km away operating 24/7 not to result in considerable noise pollution? concerns about the noise issues for locals as this area becomes more of a suburban populated area We object to the noise pollution due to blasting. noise and dust and health impacts from same are unacceptable for this residential location. Despite noise mitigation measures, the rural ambience is already reduced and any extra noise generation, especially at night, will only make it worse. The extra blasting and 24 hour working in the quarry is totally unexceptionable for the local residents who have built in this area. Potential significant local noise pollution from proposed 24/7 operations. a. As stated in the report, this is a rural area. The area has a quiet disposition, with some impact of the highway. The highway is sporadic (NOT constant), and thus having another sporadic or even constant noise emission is of great significance. This cumulative effect cannot be misunderstood. This will become a 24/7 noise source with the only requirement that Hansen laughably 'procure quietest machinery', but as long as it still fulfils the machine function. This is a ridiculous and insulting mitigation strategy and only speaks to the lack of accountability to the residents should noise levels be breached. Residents do not have complex or expensive monitoring equipment to be able to test and monitor noise emissions. Equipment should be supplied to residents and reports made public with strict penalties to exceeding acceptable levels. Comment that cumulative noise levels are 'beyond control of Hanson' is not true. If Hansen is contributing to the cumulative noise, then they are totally in control of the overall output. This should be corrected and refactored in control strategies prior to any further consideration. According to the submission noise levels are going to exceed acceptable levels for properties South of the mine. This alone is enough to reject the proposal. Report only indicated maximum background noise. It is possible that the noises were made from bird calls. It should be reported as to the cause of the peaks of the noises recorded. There is a significant difference between rural animal noises and mining activity, thus all noise cannot be treated equally. It is entirely inadequate for the mitigation strategy to for the impact of noise pollution to 'reduce by feasible and reasonable measures'. This is another example of unenforceable control measures plaguing this report and submission. Residents need a much greater objective understanding of the measures and fallbacks for this project prior to any further consideration. Noise impacts only considered the 'average person' and has not taken into account the noise (and light) impact on local animals, including nesting, breeding,	197	74%

Issue Name	Summary of issues	No.	%
	hunting. Adoption of sleep disturbance levels is high and over exaggerated given rural nature of the area. This should be refactored and reassessed. We find that identified sleep disturbance levels south of the site for 12 months an incredible admission. This is a very long time and is totally unacceptable. Controls and mitigations such as 'Good practice construction necessary', such that 'ICNG focuses on minimising noise impacts rather than achieving numeric noise levels' is inadequate. Findings 'noise emissions would exceed the PSNL during all modelled conditions' excluding the additional cumulative road noise from trucks at 792 movements a day should mean rejection of the proposal. Admission and context that 'noise from construction sites is inevitable' provides an automatic 'out' for any noise pollution at any time with no recourse. The background noise that has been generated already by the upgrading of the highway to a motorway is there 24/7 and can be heard kilometres away due to the terrain and tree clearing associated with the upgrade. At a recent Christmas get together of local people, the unanimous opinion was that the ambient noise from the highway had substantially increased. The Sancrox Quarry operation will exponentially add more to the already increased background noise. I acknowledge that noise monitoring has been done as part of the EIS and may be within "perceived" tolerances but when this noise is there all day, all night and every night, it will become intolerable My peaceful lifestyle will be significantly impacted by this quarry operating around the clock seven days a week particularly with increased noise The Sancrox area has already had a substantial increase in noise (24/7), due to the upgrading of the highway to a motorway. Despite noise mitigation measures, the rural ambience is already reduced and any extra noise generation, especially at night, will only make it worse The exhibited noise modelling provided does not provide noise level contour diagrams ad it is not clear how noise will be received by neighbouring properties. We do not accept 24 crushing plant noise 24 hours a day. With the scale of the excavation proposed and timeframe of the development we would have expected a noise/screen bund along the entire boundary with our property and all neighbouring properties. Given the scale of the proposed development and the nature of the crushing and processing equipment, it is submitted that a bund wall be placed along the Eastern boundary adjacent to Expressway Spares property in order to deal with noise issues. we submit that a bund along the Eastern boundary could also be utilised as a visual screen. Exhibited noise modelling provided does not provide noise level contour diagrams and it is not clear how noise will be received by neighbouring properties.		

Issue Name	Summary of issues	No.	%
Vibration (Operational)	The noise and ground shaking. We can feel explosions literally shake the earth and our house through the day and if the works were expanded and ran 24 hours a day it would definitely disturb my family and business. Vibrations would also lower our property value. I am also extremely concerned about the increased blasting and crushing, and proposed 24/7 operation of the rock crushing plant, and the associated level of noise pollution, ground vibration and air quality from the operation. There would be some noise and vibration that would impact me and other residents of Sancrox. Noise pollution and vibration with the potential to create annoyance and disrupt sleep/rest patterns for the nearby residents, especially given the proposed 24/7 scale of operations. Noise and vibration pollution that will worsen with a 24/7 operation as proposed The only vibration aspects sufficiently addressed are those related to blasting, as this is a statutory requirement. No mention is made within the EIS in respect of clearing, ripping and any other operations. No risk assessment is sighted within the EIS to address other potential matters. The EIS has no consideration in respect of real / potential changes in zoning and is also devoid of such exposure modelling	16	6%
Vibration (Blast)	No blasting or vibration Increased blasting that can be heard 2kms away in the Sancrox community We object to the risk to buildings from blasting vibrations, once again this is a rural lifestyle area that does not need blasting of the earth. Noise and vibration can easily travel that distance when blasting in the quarry … not conducive to a healthy environment. My peaceful lifestyle will be significantly impacted by this quarry operating around the clock seven days a week particularly with increased blasting.	18	7%
Blast (safety)	Twice daily blasting will impact traffic on Sancrox Rd and may impact the Pacific Highway, every blast. How this will be managed is uncertain but there is a code of conduct for blast guarding which has been developed by the Australian Explosives Industry and Safety Group which Hanson should consider adopting. The current freedom of movement of local residents may be impacted twice daily, from blasting. There is no mention of fly rock control and management of post blast gases that in sufficient concentrations are harmful. It is stated that a contractor will carry out the blasting with no explosives kept on site. However the EIS does not cover off on how the management of ammonium nitrate, emulsion, detonators and other matters are carried out so as to prevent a catastrophic explosion that could impact upon and beyond the PSA. There is no information in respect of controls, response plans etc. in the case of an incident. It is almost incomprehensible that this has not been satisfactorily addressed due to the potential for high loss of life and destruction. There is no apparent Principal Hazard Analysis (PHA) / Principle Risk Assessment (PRA) study within the framework of a recognised high to extreme risk activity. No comfort can be given the proponent's culture and record of poor performance.	11	4%

Issue Name	Summary of issues	No.	%
Blast (flyrock)	Blasting from the current operations are already impacting on the local businesses of Cassegrain Winery and Expressway spares, as debris is regularly raining down on their respective rooves, (as reported by them). We also understand that Flyrock may occur during blasting; we do not accept this risk. Rock-fly can be a danger and risk to nearby people, businesses and properties. There is no flyrock assessment within the EIS. There is comment that blasting will comply with AS2187-2006 however there is no detail as to how that will occur. The proposal does not provide any flyrock buffers and these must be contained within quarry property. The SKM/Terrock report calculated a 90m buffer for flyrock and any proposed blasting should be at least 90 metres from the Southern boundary of our property and the proposal should be modified accordingly. Our property has experienced flyrock in the past. Neighbour reported that fly rock fell onto Cassegrain Winery on regular basis from blasting at the existing operations. Reference to EXPLO Conference presentation notes every blast should be guarded for a distance, in every direction on a radius of 800m and to a standard such as Code of Good Blast Guarding Practice issues by AEISG. No detailed fly rock assessment. No flyrock buffers. All buffers for flyrock be contained within the Hanson property, noted within SKM/Terrock report states any blasting be at least 90m from property boundary.	18	7%
Water use (mitigation)	Water use - The EIS states that dust will be mitigated mainly through the use of water. We are experiencing water restrictions at this time, and the excessive use of scarce water to suppress dust in dry periods is inappropriate. The report states that the quarry will have a groundwater inflow are between 40,000 and 60,000 litres per day which equates to 15 - 22 megalitres per annum. There are no mitigation measures proposed within the EIS for the loss of this volume of water from the groundwater aquifer.	4	1%
Surface water impacts	The natural water on the site, currently supporting native flora and fauna, will be diverted to industrial use and North and west alluvial flood plains of the Hastings River and Haydons Creek will be impacted. Pollution (air and waterway disruption to the natural landscape (surface and groundwater) Increasing industrial use of water is inappropriate in a period of drought and climate change The proposed development will also affect the local water system. In a time of drought it is unacceptable that the local watercourse that currently supports native flora and fauna will be diverted to industrial use. PMHC councillors have also noted possible risk to local water security if pollution from the project were to enter the water supply that has been carefully planned over decades. The development will divert a native flora and fauna watercourse to industrial use The proposed land-clearing will also contribute to climate change and to the reduction of local rainfall. It will also involve diversion of natural water flows for industrial use. There is no consideration of the impact of the loss of water from the environment that will occur due to the expansion of the quarry; The removal of water from the upper reach of the Fernbank Creek catchment and how that affects the longer-term viability of the creek. In brief there is no mitigation for the loss of this surface water from the environment provided for in the EIS and the documentation has not established that there will not be impacts on the environment from changes in hydrology extending beyond the quarry landholding. Existing sales floor area that stores crushed rock at the quarry has been artificially filled over a number of years. It is now some 5m above existing ground levels and results in large volumes of stormwater runoff into our property during prevailing weather/rain that goes for days and weeks after said event.	161	60%

Issue Name	Summary of issues	No.	%
Groundwater Impacts	A mining project of this size is not appropriate for the location. In the many years since the quarry was first commenced, the growth in residential population of Port Macquarie has been significant, to the point where the quarry in its current operations is surrounded by newly-developing residential property and tourism-related businesses. A small increase in the size of the current quarry should not cause too many problems, but this proposal is to triple the size of the existing quarry and increase its operation to 24hrs per day with all the accompanying adverse impacts on local residential amenity. There are issues with water supply and the potential impact on groundwater that are not adequately addressed by the EIS. There are massive environmental problems that the EIS does not adequately address - including the proposed destruction of up to 60Ha of core kola habitat in a significant regional wildlife corridor. Our local koala population and its habitat has been decimated since the recent bushfires, and more loss of habitat will have disastrous long-term impacts on the local koala population. A large mine with concrete batching plant and bitumen manufacturing facility operating 24hrs per day is not an appropriate development to be located right in the middle of the fastest growing residential area in one of the fastest growing regional LGA's in NSW. There is no consideration of the impact of the loss of water from the environment that will occur due to the expansion of the quarry; The proposed quarry expansion has the potential to have a significant impact on the groundwater in the locality. The information provided with the application does not consider the impact of this on the environment; Groundwater modelling figure 8.4 indicates significant drawdown on our property (up to 40m) and especially in areas that are to be dedicated to Council as E2 habitat. How will the groundwater drawdown affect our residence, dam and orchard. How is the order of groundwater drawdown justified on neighbouring properties. How is it being offset? There is a 'base case' but there is no comparative modelling between the "Base Case" and the predevelopment and post development scenarios. The documentation has not established that there will not be impacts on the environment from changes in groundwater levels extending beyond the quarry landholding and in particular for Fernbank Creek. The groundwater drawdown maps show an impact on our property and a drawdown of some 4 metres of so. Given the distance we are away from the quarry we would have expected no impact to groundwater on our property.	19	7%

Issue Name	Summary of issues	No.	%
Air Quality (Dust, PM10)	The dust from the plant is more than enough now. It will probably not be advisable for local residents to drink their tank water because of the dust impact. The efficiency of solar panels for hot water heating and electricity will diminish significantly over time because of a build-up of dust. Costs of home maintenance will increase with more frequent painting, cleaning of roof and down pipes and windows, all from a build-up of dust. There may be a higher concentration of dust particles within the air within the region for the next 10 to 30 years. Noise, smell, dust and the increase in traffic will be highly criticised in light of the devastation around Port Macquarie that has been all across the media. I am also worried about the dust... will cause local residents. I am also extremely concerned about the increased blasting and crushing, and proposed 24/7 operation of the rock crushing plant, and the associated level of noise pollution, ground vibration and air quality from the operation. Dust both from the quarry and vehicles transporting the mined materials. Pollution (air and waterway) Serious concerns regarding air quality (dust and odour) 24/7 operations will affect air quality of Sancrox. The fine dust that will be released into the air may not be seen but can still reach our airways, potentially resulting in cancer or chronic illness that may not present for decades. Noise and dust and health impacts from same are unacceptable for this residential location Regularly, when westerly winds blow across the quarry, dust clouds have formed which has a significant impact on visibility on the Pacific Highway. Dust and particles that will be carried on the wind are not conducive to a healthy environment. The dust and particles will create more breathing difficulties for people suffering with breathing issues, asthma and bronchitis. There will extra dust and dirt from the 24 hour works. My peaceful lifestyle will be significantly impacted by this quarry operating around the clock seven days a week particularly with increased dust. The receptor areas as indicated in the EIS are not well founded and only notional. It appears some likely critical receptor areas have been excluded from the EIS. With prevailing wind and wind speeds the plumes of dust and fumes are more than likely to extend beyond the identified receptors and pass permissible limits well beyond those identified in the EIS. The EIS makes no mention of effective real time 24/7 monitoring at multiple locations and required action in respect of exceedances. There appears to be no modelling of air quality for the current and proposed quarry and its equipment. We submit that any crushing plant be made to be fully contained in order to mitigate dust. Tank water will likely be adversely affected by dust. Home maintenance will be increased as a result of quarry dust.	44	16%

Issue Name	Summary of issues	No.	%
Air Quality (emissions)	Emissions - Excessive fossil fuel emissions, including a high level of carcinogenic diesel emissions, and bitumen fumes I also have concerns about the pollution and what this may do to the air quality. Noise, smell, dust and the increase in traffic will be highly criticised in light of the devastation around Port Macquarie that has been all across the media. Increased emissions from a quarry mining the environment and the activities directly related to that, has to pollute on a large scale more than it did previously. Carbon emissions associated with this proposal place an unacceptable risk to our communities safety The unacceptably high level of CO2 emissions over the project lifecycle To what extent does this proposal require the purchase of certified carbon offsets to mitigate high-level carbon emissions? It is propose to construct and operate an Asphalt Plant. These plants are known sources of hazardous air pollutants (HAP's) that are semi volatile, volatile and metal. Some consist of known Class One carcinogens (cancer causing agents) and other agents deleterious to health. The EIS does not appear to set up a real time monitoring regime to ensure that emissions including fugitive emissions plumes are detected and alarmed for automatic plant shutdown to prevent plumes affecting the residents in the area. With the prevailing winds residents in the areas are downwind are potentially exposed.	16	6%
Transport (Traffic/noise)	I am a neighbouring property and there are a lot of truck movements as it is. Noise, smell, dust and the increase in traffic will be highly criticised in light of the devastation around Port Macquarie that has been all across the media. Increased volume of traffic with accompanying noise and fumes on Rawdon Island Rd (Sancrox Road). Expansion will further exacerbate the increased traffic of heavy vehicles and their associated noise congestion on residential street networks. A significant increase of approximately 158 additional heavy vehicle trips per day on Sancrox Road. This represents a dramatic increase and consequentially a higher level of risk to motorists in the local area. In particular during night-time hours with reduced visibility. The EIS does not take into account graduated and total traffic increases due to the present and ongoing increase in respect of the growing industrial area at Sancrox both east and west of the Pacific Highway. This is a major omission. No consideration has been given to feed in from Sancrox Road in respect of proposed, planned or on-the-radar changes in zoning and population density. The study looks at the past not the future. This would most likely include school buses in the mix of increased traffic. This is a major omission.	9	3%
Transport (increased truck movements)	Increased risk to native animals from the increased truck volume. We are in a koala transit area. We have many other native animals near the roadway. We object to the Quarry and proposed increased traffic, both heavy and light vehicles as it poses a safety risk to us our family and our friends. I also worry about the increased truck traffic using the site and potential for more fatal accidents in the area There is a significant 24 hour a day increase in movement of trucks to almost 800 per day. This will have an incredible impact on the safety of Sancrox Road, and also push more local traffic to other local roads to avoid this heavy vehicle bottleneck. Data obtained for this report is inaccurate or old, given accident along Bushland Drive in 2019 was not in place. Not only will this have a safety impact as there is an increased population in Sancrox (which was NOT modelled properly), but it will have a cumulative noise impact in the entire area. My peaceful lifestyle will be significantly impacted by this quarry operating around the clock seven days a week particularly with increased truck movements	13	5%
Community Impacts (Health)	Community would likely suffer from increased anxiety around the perceived health effects on their families. Is the mental health and well-being of residents who pay a premium for a quiet lifestyle less important because there are fewer of us? Noise and dust and health impacts from same are unacceptable for this residential location It will probably not be advisable for local residents to drink their tank water because of the dust impact There may be a higher concentration of dust particles within the air within the region for the next 10 â€“ 30 years.	5	2%

Issue Name	Summary of issues	No.	%
Community Impacts (Social and economic)	The community need for good quality quarry material must be in balance with the social and economic costs of its extraction. A "new" quarry at Sancrox will deliver Hanson all the upside, and PMHC and existing and future communities all the downside. An approval for a "new" quarry also gives Hanson a significantly enhanced competitive position. Concerns of devaluation of surrounding homes & land This noise pollution and vibrations would also lower our property value. My concern is that we will lose clients as a direct result and make our business no longer sustainable which would leave eight employees out of work. Sancrox and the noise, dust, vibrations & truck traffic throughout the area will be detrimental to all the new houses in this residential area. This expansion will also affect quality of life for current residents and future residents who have purchased land in the new Riverside Park estate contribute to a loss of identity and by extension a perceived depreciation of land value, thus causing further anguish to residents. Should the expansion of quarry be approved, there is no foreseeable way this development would proceed based on all the concerns aforementioned. This would be at great loss to the economic growth of port Macquarie with regards to significant job creation and stimulation of the local construction industry, as well as the wider progression of the district's property market. The efficiency of solar panels for hot water heating and electricity will diminish significantly over time because of a build-up of dust. Costs of home maintenance will increase with more frequent painting, cleaning of roof and down pipes and windows, all from a build-up of dust. The report's conclusion and discussion was based off the premise that "does not involve significant change to land uses at this location". This is incorrect as the operations at the site would include an additional concrete batching and asphalt plant. Further operations of the site from business hours to 24 hours 7 days a week constitutes a significant change in usage. What follows is an incorrect assessment and inaccurate submission. That the "efficient and cost effective delivery" is of social benefit. Rather this statement is misleading and false, as this is a business benefit to Hansen. This should be removed from consideration as to the social benefits of the proposal. Rock mining, asphalt and concrete crushing is and can be done at other sites, it is an additional service not a sole service in this area. It must be noted that impact of this project is 'likely to be positive' provided that the localised 'negative social impacts are mitigated and monitored', whilst there is only broad non-specific statements as to how these significant negative effects will actually be mitigated. Objective measurements must be undertaken, objective reporting and consequences for breaches must also be part of any project review for all parties. References such as 'beyond control of Hansen', 'feasible and practical efforts' only demonstrate the inadequate means to which residents will be able to hold Hanson to account if/when they breach their requirements. The economic advantages to the community, cited in the application are invalid and should be ignored. The "job creation" that is touted for this site will be at the expense of current jobs in other local businesses that will be forced to close or reduce operation by this development. There will be NO net gain in employment, it will in fact, lead to a reduction in jobs Loss of the PM koala population will have detrimental flow-on economic effects – koalas are worth around $50 million to the local economy annually (PMHC Draft Koala Recovery Strategy 2017). The EIS information is highly predictive is supposition only and is tied to the opinion of a consultancy service paid by Hanson. The EIS states that their supply is required for the Pacific Highway upgrade. This has been completed from Sydney to Coffs Harbour and locations beyond. This is a false claim. Within the EIS other quarries in the area have been identified that can satisfactorily maintain supply. It is nonsense within the EIS to suggest cartage would be required from Newcastle from another Hanson quarry. There is no community advantage by increasing output from this quarry and alternatively and more importantly, there will be no community disadvantage if this mine ceases operation. The "job creation" that is touted for this site will be at the expense of current jobs in other local businesses that will be forced to close or reduce operation by this development. There will be NO net gain in employment, it will in fact, lead to a reduction in jobs. The growth in residential population of Port Macquarie has been significant, to the point where the quarry in its current operations is surrounded by newly-developing residential property and tourism-related businesses. There are no developer contributions proposed in the application. There is limited to no discussion or consideration of the Council's Urban Growth Management Strategy or the future urban investigation area of Fernbank Creek and Sancrox. The proposed expansion creates 10 jobs which is good, however, the impact of the proposed expansion is not commensurate with the jobs created. There is no justification that the capital investment required for this development is such that it requires an approval of 30 years to amortise the investment. There are no developer contributions suggested in any of the exhibited documentation.	32	12%

Issue Name	Summary of issues	No.	%
Community Impacts (Environmental)	There is a natural water course and koala habitat running directly through my property through my neighbours and down to Sancrox road. Port Macquarie, which is undergoing significant residential development that will be directly affected by the increased environmental impact of this quarry expansion. Negative impacts on our collective human rights ... the right to pass land and resources down through the generations and the right to a healthy environment are not being met. the expansion of this quarry would be in direct violation with community interests (Sancrox and Surrounding Areas) in recent light of the Climate Change Emergency. I moved to this area to enjoy the tranquillity of the natural environment while still being close to town. undergoing significant residential development that will be directly affected by the increased environmental impact of this quarry expansion. Clearance for commercial & developers purposes benefit only those developers & businesses not the greater community. We object to the clearing of land, both as to the visual view of landscape scarring as well as native animal habitat. My surrounding residential development will be directly affected by the increased environmental impact of the proposed quarry expansion Eucalypt trees were removed for the development of the soon to be released Industrial Site, they also removed the buffer between the Sancrox Quarry and the Pacific Highway Our community greatly values its koala population and does not want to see them offset away from the Port-Macquarie Hastings region. The removal of Spotted Gum (winter flowering), Grey Ironbark (winter, spring and summer flowering), Blackbutt (spring - summer flowering) and Pink Bloodwood (summer - autumn flowering) species from the local area will result in the loss of crucial winter and autumn flowering species. The loss of native forest vegetation, adversely impacts unique local biodiversity The right of quiet enjoyment of local properties will be destroyed by this development. There are real actual and potential negative social impacts associated with the proposed project inclusive of but not limited to increased traffic and heavy vehicle movements, increased noise and vibration, impacts to air and water quality and clearing of bushland, which have not been appropriately mitigated to prevent impacts to the sense of place and amenity of the surrounding area The right of quiet enjoyment of local properties will be destroyed by this development. The quarry was originally only intended for a life until approximately 2005, when the estimated winnings were forecast to be exhausted. The Port Macquarie region is expanding rapidly. This development is in the Sancrox area, approximately 6km west of Port Macquarie, which is undergoing significant residential development that will be directly affected by the increased environmental impact of this quarry expansion. The Port Macquarie region is expanding rapidly. This development is in the Sancrox area, approximately 6km west of Port Macquarie, which is undergoing significant residential development that will be directly affected by the increased environmental impact of this quarry expansion. Limited discussion of closure and management of void.	154	58%

Issue Name	Summary of issues	No.	%
Amenity	significant loss of amenity for residents will reduce amenity and house value for neighbouring properties We moved to Port Macquarie as part of our retirement plans. This area was chosen because of its proximity to our nearby hinterlands and quick access up and down the coast to accommodate our love of travelling. No consideration has been given to feed in from Sancrox Road in respect of proposed, planned or on the radar changes in zoning and population density. The study looks at the past not the future. This would most likely This expansion project is smack bang in the middle of our future growth area. With prevailing winds being very variable in this area and with potential growth areas surrounding this quarry the expansion will totally ruin the amenity of the precinct. This proposal is to triple the size of the existing quarry and increase its operation to 24hrs per day with all the accompanying adverse impacts on local residential amenity. Visual assessment is poorly done, and the photographs and visibility model provided in the EIS documentation are not a true reflecting of the existing quarry operation.	16	6%

Issue Name	Summary of issues	No.	%
Quality of EIS	Page 39 of the EIS shows the bitumen plant being coal fired. Page 40 of the EIS says the bitumen plant is gas fired, therefore how can this information be relied upon. insufficient field work conducted in 2015, four years ago. Current, independent and comprehensive field surveys are required to validate the report. The EIS states that no evidence for the threatened plant species likely to occur on the site was recorded during field surveys undertaken as part of the BAR. However SLR ... concluded that until a positive identification can be made, it is recommended that the Dendrobium specimen recorded should be treated as the threatened species D. melaleucaphilum, which is listed as endangered in NSW under the (former) Threatened Species Conservation Act. The Biodiversity Report has not considered the cumulative impact of vegetation clearance within a regional context and the continued fragmentation of remaining vegetation across the landscape. the Biodiversity Assessment Report is woefully inadequate, based as it is on inadequate field work conducted 4 years ago. Annex C and the BAR are flawed, formulated on inadequate field surveys and limited data which is now four years old. The EIS and BAR lack currency, objectivity and rigor. Annex C, 'Biodiversity Assessment Report', is based on field work four years old, prior to the NSW State of Emergency from bush fires. The subject land requires current assessment as surviving animals forced to relocate may have moved onto these 43 hectares of native bushland. The EIS is seriously flawed and fails to properly assess or describe the likely impacts across a whole range of environmental, social and economic factors, at local, state and federal levels. There has been a very poor consultative process, not least the Community Consultation Committee failure to fulfill its role I believe that the Hanson Environmental Impact Statement (ERM Ref. 0418291) currently on exhibition does not properly address the issues arising from its proximity to a significant residential development. The Biodiversity Assessment Report downplays the importance of corridors in the area to be cleared. At the very least, field surveys should be redone, given that it is 4 years since they were completed and much has changed since that time. As well, as the habitat burnt since then, several species have been added to the threatened species list in NSW. The noise modelling provided does not show any noise level contour diagrams as they affect residential receivers, either with or without mitigation. No noise level contours for both daytime and night-time noise levels as they affect residential receivers. The bund walls shown on the plans, south of the quarry processing area and to the west of the quarry excavation, appear to ignore the underlying topography. While length, width and height of the walls are provided, no datum is shown to enable the RL of the top of each wall to be determined. The single line drawing of the quarry processing area does not show any internal roads or RL's to determine the height of this are and that of potential nose generators, to allow any independent assessment of the effectiveness of the walls as a mitigation measure. There is no flyrock assessment within the REF. The only reference to blasting is that "Blasting practices at the quarry are to be undertaken in accordance with AS 2187.2". The proposed quarry does not provide any flyrock buffers. There is ample evidence on the adjoining properties of flyrock from the quarry lying on the surface of the ground. There is no modelling of air quality for the current and proposed quarries or the mitigated scenario. The photographs and visibility model provided in the EIS are not a true reflection on the visibility of the quarry operation. In some cases they are not current, in other cases that have been taken from relatively close low elevation position. No RLs have been provided for the quarry operational areas and the proposed noise and visual screen bund walls. There is no details on how the proposed quarry is to be rehabilitation... virtually no mitigation strategies in place to address the environmental impacts and no rehabilitation plan. The EIS is in part notional, therefore not fully factual and as above without responsibility for implications. The EIS is at best speculative. Insufficient field work was conducted in 2015, four years ago. A major flaw of the EIS is that it fails to record koalas at six locations and the presence of habitat critical to the endangered Swift Parrot. (Refs: Office of Environment and Heritage Records, 2008 -2013.Ref. DA Annex C	163	61%

Issue Name	Summary of issues	No.	%
	Inadequacy and lack of integrity of the Environmental Impact Statement The EIS fails to identify and properly examine the impacts of the proposal both within and external to the site or provide any meaningful mitigation for those impacts. No Quarry Rehabilitation Plan has been provided as part of the EIS to allow for any estimate of the volume or overburden required for this purpose. On this basis, the overburden will add a further 260,000 tonnes per annum to the above 1,473,333 tonnes per annum of production, assuming a 30-year life. The EIS document makes use of the Biodiversity Conservation (Savings and Transitional) Regulation 2017, using the definition of a "pending or interim planning application". It is difficult to see how this EIS meets the requirements of Clause 27 (1) (b) and Clause 27 (2) of the Regulation with the last re-issued SEARs dated 18 September 2017 and the SSD Application lodged on 10 July 2019. The Biodiversity Assessment Report (BDAR) does not meet the requirements of Part 6.15 (1) in terms of the date of the report being 17 June 2019. Application of Part 6.15 will require the re-application of the Biodiversity Calculator (and depending on the output of re-application of the Biodiversity Calculator) re-submission and potentially re-exhibition of the BDAR. The Biodiversity Values field studies were completed in 2015, while the Biodiversity Credits Report is dated 4 July 2017. The current EIS proposal also varies from the concept used in the Credits Report. The EIS and associated biodiversity report makes limited references to previous ecological assessments completed as part of various urban growth and development proposals in the immediate area and including this site. The report assessments outcomes differ significantly from those carried out previously. The 2011 Biolink report prepared for Port Macquarie-Hastings Council (PMHC) as part of the Greater Sancrox Structure Plan, identified the majority of the area proposed for the quarry expansion as being part of a Sub-regional Corridor (Fig 10). (Refer Attachment 2). In terms of ecological values, the area proposed for quarry expansion was mapped as either "irreplaceable" or be "value managed". The Connectivity Links provided with the EIS (Appendix E), have not been placed over aerial photographs to allow the proposal to be assessed, in the context of the overall area. Table 5.7 in the EIS proposes mitigation measures including "Design and implement a planting plan for corridor of native vegetation east and west of proposed quarry pit, to maintain north south corridor link of trees, as per sub-regional corridor in the Biolink Greater Sancrox Structure Plan (PMHC 2015)". The ecological report within the EIS has not identified any of the Hollow Bearing Trees within the quarry footprint previously identified in the Biolink report. (Refer Attachment 3). The quarry excavation contours and infrastructure areas proposed, do not relate to the surrounding topography and therefore it is not possible to determine the actual extent of clearing proposed. Both the existing and proposed vegetation in the offset area will be compromised by the changes to both the surface water and groundwater regimes created by the quarry development. The biodiversity report does not discuss the impact on flora, fauna and riparian water quality from the changes in hydrology and groundwater created by the impact of the quarry on surface water and ground water flows. The ecological report with the EIS acknowledges that the site is "potential koala habitat" in accordance with SEPP 44 and that 805 records exist of koala in the search area but does not reference the approved KPoMs adjoining the southern and northern boundaries of the proposed quarry expansion. There is a large existing large farm dam within the proposed quarry footprint which is not mentioned in the ecological report. There does not appear to be any ecological assessment of this aquatic habitat in respect of two threatened species, the Green and Golden Bell Frog and the Green-thighed Frog known to occur locally. Threatened Species Likelihood of Occurrence outcomes, based upon the OEH Wildlife Atlas search, do not appear to be relevant for a number of species, e.g. koala, powerful owl, masked owl, all of which have been identified on adjoining areas in the Biolink Report for the Greater Sancrox Structure Plan. The application does not provide sufficient information to allow for an assessment of the acoustic impacts due to the expansion of the quarry; There is a lack of detail about how the quarry will be rehabilitated or for what use the massive hole in the ground will be utilised. We own Lot 1 DP 1144490, in various diagrams/drawings, indicates that the proposed development of the quarry carries over the boundary and onto our land. Our understanding is that the Biodiversity Assessment Report (BAR) included in this EIS does not meet the requirements of Part 6.15(1) in terms of the date of the report, being 17 June 2019. The EIS document makes use of the Biodiversity Conservation (Savings and Transitional) Regulation		

Issue Name	Summary of issues	No.	%
	2017, using the definition of a “pending or interim planning application”. It is difficult to see how this EIS meets the requirements of Clause 27 (1) (b) and Clause 27 (2) of the Regulation with the re-issued SEARs date 18 September 2017 and the SSD Application lodged on 10 July 2019. The Biodiversity Values field studies were completed in 2015, while the Biodiversity Credits Report is dated 4 July 2017. The current EIS proposal also varies from the concept used in the Credits Report. The Biodiversity Strategy adopted by Port Macquarie Hastings Council (PMHC) must govern decision−making rather than information from the Sancrox Quarry Expansion Project proponent, which includes a biodiversity assessment report that is not current, relies on insufficient fieldwork and fails to acknowledge historical records of koalas on the subject land.		

Issue Name	Summary of issues	No.	%
Conflict of land use in Community	Would not make it a nice place to live. Allowing this to go ahead would ruin the properties around it. I object to the expansion of the Sancrox Quarry as it will strongly impact on my home and the environment around me including the wildlife. With the beautiful tranquil community that has been built in the Thrumster and Sovereign Hills area, the last thing that is needed is an expansion of a quarry creating dust, noise and potential health impacts. In light of recent events in the area with fires, we don't need more forestry demolished, more wildlife habitat destroyed and negatively impacting the environment. Being so close to a housing area, surely the noise and pollution would not be good for the community, let alone the nearby schools, child care centres and future generations. None of these (surrounding) industries are going to see an advantage to having an expanded quarry, which uses explosives, operating 24 hours a day, seven days per week in such close proximity. The significant increase in heavy vehicles will also not support these employers. The development of adjacent land for rural residential use was made prior to the operation of the quarry. It was made on the premise that the quarry would cease operation ~2005. The agreements made at the mines' inception, to cease operation, are testament to the fact that the surrounding rural residential development was forecast and approved to expand. The expansion of the quarry does not appear consistent with Council's Urban Growth Management Strategy which envisages future urban expansion in this locality. After many years of planning and expenditure, approval was granted for the area to be subject of industrial development creating more employment than the proposed project, taking pressure off the Port Macquarie area meaning that social and economic ramifications going beyond the immediate vicinity. There is a 15-year supply of residential land in PMHC LGA is a myth - it's only 7 years and most likely less with impact of 2017 Biodiversity Legislation consideration.	25	9%

Issue Name	Summary of issues	No.	%
Justification of project (need for expansion/increase in volume)	Port Macquarie is the fastest growth area in NSW and all future development is to the west, it has less residential Lots than it has quarry rock There are already other concrete and asphalt plants in the region that have the capacity to service the demand. The supply of all rock aggregates (both current and future), produced at this site can be sourced from alternative quarries in the local area. These alternate quarries are better environmentally suited to this operation and do not impact the environment to the extent that this new development will. The proposed extra operations of finished product supply, (concrete and asphalt), is currently satisfied by other local businesses. No data on historic production from the quarry has been provided. This temporary approval of increased production under the current approval ceased on 14 March 2019. None of the above changes in production approvals are discussed in the EIS which suggests the current extraction licence continues to allow 455,000 tonnes per annum production as part of the context for the current application for an increase to 750,000 tonnes per annum. No quantifiable justification for the increase to 750,000 tonnes per annum has been provided. There is no data on the demand for quarry resources across the region or projections of demand into the future. The proposed quarry void is estimated to generate 52 million tonnes of material, which, even allowing for 15% for overburden, over the proposed 30 years, will generate 1,473,333 tonnes of quarry material per annum. (Refer Attachments 1a & 1b). This is nearly double the proposed 750,000 tonnes per annum sought in the current application, or alternatively, at 750,000 tonnes per annum, the proposed quarry extent will provide a life almost double that requested. The EIS does not provide any information to demonstrate that a quarry of this scale is required to meet the current and projected demands for quarry materials within the region. The lack of justification for the 400% increase in annual production also then relates to the proposed extension of operating of the quarry hours to 24 hours per day and 7 days per week. Without verifiable justification for the significant increase in the proposed annual output, the extension of operating hours can also not be supported. The scale of the proposed expansion appears to be excessive. No justification is provided for an increase in production of 400% to that allowed under the current quarry licence; The justification to increase the demand and output of Sancrox Quarry by 4 times to go to 750,000 tonnes per annum is not clear. If demand and output is not there, then the scale of the proposal and the need to go to a 24hr operation is not there. We have no objection to the quarry continuing at the same level of operation that it is now during normal business hours. The proposed scale of the expanded quarry operating 24/7 is neither justified nor appropriate for this location. Why are Hanson allowed to make a claim that there is no quarry within 200km when there are up to six quarries well inside that radius. The justification in increase the demand and the output of Sancrox Quarry by 4 times to go to 750,000 tpa is not clear.	29	11%

Issue Name	Summary of issues	No.	%
Justification of project (resource available)	Quarry operation within the PMHC area are quite competitive. I do not understand the need for extra crushing materials, as the Pacific Hwy has already been upgraded 100km in each direction of this plant, so the extra material extracted is clearly not for this use, nor am I aware of any project nearby that would require that quantity of materials so its location does not seem a viable one. The Pacific Highway upgrade has been completed for well over 100km in either direction from Sancrox making the carting of product for the highway unviable. The EIS does not provide any examination or assessment of the existing quarry resources available within the region. The scale of the Project is vast. The quarry footprint to be increased by 182%. Its extraction limit to be increased by 65%. No longer just a mine - offers additional concreate batching, recycling and asphalt production services. A mining project of this size is not appropriate for the location. Hanson themselves have a future quarry site on Milligans Road at Wauchope which is not mentioned, let alone the remaining four existing and operating hard rock quarries in the region. The EIS is presented as if the Sancrox quarry is the only local supply of hard rock material. The geology of the site is known to be volatile in places and highly weathered. No details have been provided on the drilling exploration program to prove up the resource, in terms of the various classes material the quarry is projected to produce or the volume of overburden or unsuitable material. Within the documentation on exhibition, there is no assessment of resources within the Port Macquarie Hastings region and no data on historic production rates from the quarry has been provided. Quarries in the region are owned by Hanson, Hytec, Boral, Holcim, PBM and others and it is difficult to see an expansion of this scale justified on any commercial basis. The current approved rate of extraction is for 185,000 tonnes per annum and any change to this rate should be in the context of overall supply within the region. Applicant has not reported the conduct of a drill program to evidence 30 year quarry life at extraction rate 750,000tpa. Equates to 22.5M tonnes of resource.	22	8%

Issue Name	Summary of issues	No.	%
Biodiversity (Habitat loss, hallow-bearing trees and Biodiversity Corridor)	A subregional biological linkage corridor runs right through the centre of the proposed new pit location. Hanson has not made appropriate recognition of the biological community corridor nor identified how to manage its removal and create alternatives. This expansion will have a HUGE NEGATIVE impact on our local environment ... and a subregional biological linkage corridor. The clearing of the land to expand the quarry will have a significant negative impact on our local flora and fauna that we are already seeing suffer due to drought and fires. ...the tree clearing have a large negative impact on moisture levels and air quality I am extremely concerned about the clearing of 40 hectares of native bush land and the effect it will have on our native wildlife due to habitat loss. Recent bushfires make this native bushland valuable to ... fauna & flora. Flora clearance and endangered or vulnerable wildlife, both under enormous pressure caused by urban expansion as well as industrial expansion. There is an Endangered biological corridor (identified in 2015) which runs right through the middle of the new quarry pit Undeveloped bush land we have remaining in the area need to be maintained for native species that we have put under so much stress. We cannot afford to lose another 40 hectares for this expansion. Conserve as much native forest as possible We cannot support the removal of more trees in our region This project has significant biodiversity impacts on a number of native flora and fauna populations. The proposed development will irreversibly impact the biodiversity existing on the mid-north coast, which has already been severely depleted by recent bush fires in the region. Clearing of 43.1 ha of native forest vegetation...loss of hollow-bearing trees…removal of foraging habitat for locally occurring native fauna No mention of the provision of nest boxes as part of the proposed offset strategy. Loss of crucial winter and autumn flowering species (feed species) It is absurd to suggest that the loss of vegetation in the project area will not result in habitat fragmentation or the loss of connectivity between the proposed offset area and the remaining vegetation south of the project area. The Biodiversity Report has not considered the cumulative impact of vegetation clearance within a regional context and the continued fragmentation of remaining vegetation across the landscape The further destruction to native habitats, essential to the survival of our native animals would see results such as fauna drop into the endangered species area Our biodiversity cannot cope with further clearing of habitat. This development will place even more stress on these (koalas) and other animals, whose status is tenable at best. Particularly the issues of which food trees flower seasonally to our massively compromised wild life which rely on these few remnants of native flowers trees This depletion of forested land has had a serious impact on a wide range of native animals, with Koala being the most noticeable. A major flaw of the EIS is that it fails to record the presence of habitat critical to the endangered Swift Parrot. Unacceptable biodiversity loss from cutting down native forest The clearing also destroys an identified critical link needed to maintain vegetation connectivity for animal movement. It is absurd to suggest that the loss of vegetation in the project area will not result in habitat fragmentation or the loss of connectivity between the proposed offset area and the remaining vegetation south of the project area. The removal of the vegetation in the project area will effectively isolate fauna that remain in the proposed offset area and the disconnection the offset area will greatly reduce its ecological viability. It takes approximately 75-100 years for a eucalypt to form a hollow. The majority of hollow bearing trees recorded in the Biodiversity Assessment Report occur in the Spotted Gum - Grey Ironbark open forest - this association does not occur in the proposed offset area. Furthermore, no hollow-bearing trees were recorded in the proposed offset area and there is no mention of the provision of nest boxes as part of the proposed offset strategy. Clearing of trees, hollowed trees and vegetation is pushing koalas, snakes, lizards, flying foxes and many other species towards extinction with habitat destruction, we will leave our children with nothing. Project area falls directly within a sub-regional biodiversity corridor. It is absurd to suggest that the loss of vegetation in the project area will not result in habitat fragmentation or the loss of connectivity between the proposed offset area and the remaining vegetation south of the project area. The figures in Appendix E of the Biodiversity Assessment are incomplete - widths are missing, and they seem to suggest that Connecting Link 2 will persist despite the clearance of all vegetation and the presence of machinery. The removal of the vegetation in the project area will effectively isolate fauna that remain in the proposed offset area and the disconnection the offset area will greatly reduce its ecological viability.	208	78%

Issue Name	Summary of issues	No.	%
Biodiversity Impacts (Koala habitat)	The noise and dust pollution will affect all the residents and animals that chose to call this area our home. The Koala population has been decimated in this area due to the recent bushfires so they can't afford to lose any more habitat. A core koala habitat of high use level exists in the centre of the proposed new quarry, and a very large portion is medium use koala habitat. Given the devastating bushfires currently threatening this already endangered species, now more than ever we need to protect their habitat. Previous studies revealed 5 hollow bearing trees for koala habitat in the proposed pit area. The EIS prepared by Hanson says there is 1. With the devastation of the koala and other wildlife populations due to the fires and their habitat there will be much interest from local and worldwide media on this site. This expansion will have a HUGE NEGATIVE impact on ... our already devastated Koala population, Recent bushfires make this native bushland valuable to koalas ... the new pit will wipe out a 'high and medium use' koala habitat The Greater Sancrox Area Structure Plan ... identifies the land to be cleared as medium to high activity koala habitat...Draft Coastal Koala Plan of Management 2018 (CKPOM) produced by PMHC identifies the area as core koala habitat. he clearing also destroys an identified 'critical link and vegetation connectivity in the immediate, and the Greater Sancrox Structure Plan, eliminating traverses by animals south-north through the centre of the Development Site I know my concerns over our Koala population are shared amongst many. This project will destroy 40ha of prime habitat for koalas. 40 hectares of koala habitat to be destroyed for a quarry mining is unbelievable and unacceptable. 40ha of prime koala habitat that hasn't been affected by the recent bushfires that is going to be cleared The proposed removal of trees is within an area that has been identified* as a medium high koala activity corridor which would be extremely detrimental to the preservation of this already threatened species , this land has potential to become critical koala breeding habitat and therefore be essential for the continuation of the local population. native food sources and vegetation have been extremely impacted, which makes the existing vegetation encompassed in the suggested development area extremely important for the rehabilitation of the iconic species. he proposed quarry expansion of 40 hectares into native bushland further depleting koala corridors The extraordinary fund raising success of the Koala Hospital highlights the international attention currently being focused on this region and koalas in particular. This is certainly not the time to be considering an application that requires habitat removal. A major flaw of the EIS is that it fails to record koalas at six locations and the presence of habitat critical to the endangered Swift Parrot. proposal will involve clearing valuable koala habitat this is particularly disgraceful considering the bushfire crisis and threat to this endangered species as a result of nearby bushfire Injured and now homeless koalas may migrate to, or have to be moved onto, the proposed development site. It is unbelievable that proponent wishes to clear a viable patch of intact koala habitat when so much habitat in the region has been recently lost to fire. The Greater Sancrox Structure Plan (Port Macquarie Hastings Council, 2014), identifies a portion of the land to be cleared as medium to high activity koala habitat. The Urban Growth Management Strategy 2017-2036(PMHC 2017) classifies the area as a 'medium biodiversity asset/constraint' and identifies that the site could provide a 'major conceptual habitat link'. The Draft Coastal Koala Plan of Management 2018 (CKPOM) produced by PMHC identifies the area as core koala habitat. With what has already taken place in the area, which cannot be reversed, Hanson Constructions proposal to destroy a further 29.63 ha of koala habitat is disturbing. With recent bushfires decimating large areas of Koala habitat it is imperative that any remaining areas are saved from development. Genetic diversity: the importance of different genomes for koalas is widely understood for disease resistance. Removal of koala habitat, and its impact on local populations already decimated by the November 2019 bushfires, results in a failure to protect genomes in areas of high development pressure. With the recent bushfires, the land which is to be cleared is a crucial wildlife habitat for koalas that have been decimated along with other animals and their habitat in the surrounding area within 10 - 20km and further afield. The development will likely remove medium to high activity/core koala habitat Given the extent of bush loss recently with fires and extreme koala population pressure, bush such as this should be retained for potential resettlement. Given the significant concern at all levels to the destruction of Koala habitat and the decline of yet another species, it's not logical to proceed any further with destruction of this habitat	215	81%

Issue Name	Summary of issues	No.	%
Biodiversity Impact (EEC	An Endangered Ecological Community (EEC) of Flax leaved paperbark, prickly-leaved tea tree is located in the area of the new pit. Significant swamp oak and mixed eucalypt open forest areas will have to be destroyed. It will also have a direct impact on our endangered ecological community of paperbark ... Destroy significant swamp oak and eucalypt open forest areas which include several ecologically sensitive hollow bearing trees. Clearing 43.1 hectares of native forest vegetation, 0.55 ha of which is identified as the threatened ecological community Subtropical coastal floodplain forest (NR117) with serious and irreversible environmental impact. Stripping of 0.55 ha of the Subtropical coastal floodplain forest Threatened Ecological Community; In this habitat is Eucalyptus teriticornis, Forest Red Gum, an important feed and forage tree for the Critically Endangered Swift Parrot. The project includes “clearing 43.1 hectares of native forest vegetation, 0.55 ha of which is identified as the threatened ecological community Subtropical coastal floodplain forest (NR117)” with serious and irreversible environmental impact. (Ref: DA, Annex C)	169	63%

Issue Name	Summary of issues	No.	%
Use of offsets	Proposed "Ecosystem credits" system of payment by the developer to offset destruction of threatened species does not compensate for the serious and irreversible impact on the natural environment. The proposed offset site is a mere 49 hectares - not even a 2:1 offset, proposed offset doesn't include two vegetation associations (Tallowwood - Small-fruited Grey Gum dry grassy open forest) Offsets cannot replace the biodiversity values of existing trees. The proposed offset site is a mere 49 hectares. The lack of adequate “equivalence” in the proposed offset area A 2:1 offset ratio is not observed Of the vegetation associations identified in the project area, two are not included in the proposed offset area and a third is inadequately represent – tallowwood/small-fruited grey gum/dry grassy open forest No hollow-bearing trees are recorded in the proposed offset area, but are present in the development area An offset area of land will NOT provide the critically important ecosystem services that are needed in this time: the land must be in proximity to the burnt sites. A payment to a Biodiversity fund will NOT reseed and repopulate our lands. Grossly inadequate and unsuitable biodiversity offsets are suggested, particularly relating to koala habitat. Offset plantings are not acceptable as compensation for koala habitat clearing. "Like for like" offset i.e. mature trees of the same vegetation species composition, capable of sustaining live adult koalas today, must be achieved before the project is approved. Koalas are already at risk of functional extinction (PMHC Draft Koala Recovery Strategy 2017). Offsetting does not increase populations. The offset will be secured either through purchasing and retirement of 2,449 ecosystem credits from the credit market (with some ecosystem credits to be generated by potential offset lands within the study area) or payment of an equivalent monetary value into the recently established Biodiversity Conservation Fund. Offsetting at a State level via payment into a fund has several issues: - Genetic diversity: the importance of different genomes for koalas is widely understood for disease resistance. Removal of koala habitat, and therefore likely destruction of local populations, results in a failure to protect genomes in areas of high development pressure. - Resistance to Climate Change: research has predicted that koalas on the coastal floodplain will be much more resistant to climate change than koalas in other areas (e.g. western NSW). The viability of coastal populations is much higher than western populations. - Community Value: Our community greatly value their koalas and do not want to see them offset away from the Port-Macquarie Hastings region. The offset is not largely “like for like”, as only one vegetation community in the offset site is also represented in the proposed quarry site. And the 49 hectares that constitute the proposed offset for the quarry expansion, as shown in the Biodiversity Assessment Report, has a very large area of cleared habitat, with seemingly no plan to replant it. Even if it is replanted, it will not provide food resources for the two critically endangered birds for decades. And there is always the option for the developer to simply pay into the Biodiversity Conservation Fund, which may not protect local biodiversity at all. Proposed “Ecosystem credits” system of payment by the developer to offset destruction of threatened species does not compensate for the serious and irreversible impact on the natural environment.	164	61%

Issue Name	Summary of issues	No.	%
Climate Change/Greenhouse gas emissions/CO2 emissions	This deforestation and forest degradation will contribute to global greenhouse gas emissions and fewer trees in a region can contribute to drought by reducing the amount of local rainfall. The project "over its entire life cycle is estimated to release approximately 48.4 million tonnes of CO2-e into the atmosphere" 2.5 million tonnes less than Sweden's total emissions in 2017(1). This project should not be given permission to proceed due to a failure to locally commit in the EIS to a plan for the reduction of GHG's in keeping with the Heidelberg statement and a failure to clearly indicate a fully detailed and costed offset plan inclusive of location and monitored results within the EIS that are factually beneficial in respect of all considerations.	151	57%
Management of mitigation measures	Evidence is that the culture at the Sancrox Quarry is not capable of managing mitigation measures for existing operational conditions. There is no indication that Hanson proposes significantly different behaviours to support the management of mitigation measures in the proposed new quarry. Hanson has not adhered to approval conditions for operations at the existing Sancrox quarry why expect a different outcome with a substantially more difficult to operate quarry? no bund is proposed to be built to protect any development to the south (i.e. on Le Clos Sancrox). Will any proposed bund be sufficient anyway to mitigate the noise and dust? quarry's ability to mitigate any detrimental impacts on the environment, especially given their incidence of non compliance and subsequent fine by the EPA in 2016 The Proponent - Hanson Construction Materials Pty Ltd was fined $15,000 in 2016 for breaching the conditions of its Environment Protection Licence at the Sancrox Quarry. It is unacceptable that the NSW Government is even considering a proposal from a company with an existing record of environmental breaches at the site in question. Hanson has not been able to comply with the screens of trees conditional requirements for the existing quarry. How therefore will they cope with the requirements of significantly higher standard mitigation measures given the dimension of the proposed larger new pit? With the scale of excavation proposed and timeframe of the development we would have expected a noise/screen bund along the entire boundary without property and all neighbouring properties.	19	7%

Issue Name	Summary of issues	No.	%
Hanson track record/current operations	The company operating this site has a poor track record of environmental compliance and were fined $15,000 by the Environmental Protection Authority in 2016 for breaches of their water management operational obligations. Finally, I understand that Hanson Construction Materials Pty Ltd were fined $15,000 in 2016 for breaching the conditions of its Environment Protection Licence at the Sancrox Quarry. While the fine at worst is simply “business” cost (were the “gains” from this breach ever monetized?). It highlights a flagrant disregard for environmental considerations by this business, and an inherent/proven “untrustworthiness” of this business being given approval for further development in this sensitive area It is unacceptable that the NSW Government is even considering a proposal from a company with an existing record of environmental breaches at the site in question. The company has a poor record of groundwater management and was fined in 2016 for breaches (ref: EPA 24.03.2016). There is a low level of trust that the company would honour ‘make good’. The proponent has recently incurred a substantial fine by the EPA for breaches of their environmental compliance obligations. This quarry has a history of not meeting it's obligations in relation to it's impact upon adjoining properties. None of the boundaries have been provided with safety fencing. The current EMP requires the revegetation around the boundaries, which has no happened. The development consent included a condition requiring a Quarry Rehabilitation Plan to be submitted within 6 months of the Consent being issued. There is no evidence that any of this plan, if it exists, has ever been implemented. A poly pipe siphon hose has been placed from one of the quarry water storage dams across an adjoining owner's property to the south without any form of consent. The quarry was fined in 2015 by the EPA for failing to carry out water sampling required within it's EPL. (examples of past environmental NSW EPA fines (as well as examples from news articles re BHQ) Given the record of the proponent I submit that the Heidelberg Group inclusive of Hanson does not prequalify for a social licence or formal governmental approval to proceed with the Sancrox Quarry Expansion Project. Quarry has not met existing consent conditions with respect to establishing and maintaining a vegetated screen along its Northern and Eastern boundaries. Non of the existing quarry boundaries have any safety fencing. The stormwater issue that has been raised by us over a long period of time has been ignored in this application. The 'exporting' of flyrock risk onto neighbouring properties in the past appears to have been continued with this application. One of the license conditions is that there should be maintained a screen of trees immediately to the east of the existing quarry. There is no such screen. This is not an onerous requirement but Hanson has chosen not to comply with the screen of trees conditional requirement for the existing quarry.	159	60%
Heritage	The proposed works impact Aboriginal heritage sites, including a Scar Tree and ceremonial site of high cultural significance.	11	4%

Issue Name	Summary of issues	No.	%
Visual	Hanson has not been able to comply with the screens of trees conditional requirements for the existing quarry. How therefore will they cope with the requirements of significantly higher standard mitigation measures given the dimension of the proposed larger new pit? The trees around the quarry have already be bulldozed so now the quarry is fully exposed from the highway (you could not see it before) so already we have lost Koala habitat. The visual assessment is poorly done and the photographs and visibility model provided in the EIS documentation are not a true reflection of the existing quarry operation. No assessment on how the quarry and the new plant will look when already approved development proceeds to the North, East and South of the quarry. A decent and permanent visual screen should be provided along the whole Northern boundary of the quarry so that as our development (already approved) proceeds and the quarry operations are appropriately screened within its own property boundaries. The visual assessment and visibility model contained in the EIS are not a true reflection of the visibility of the quarry operation. A detailed visual assessment needs to be completed to show how the new equipment (particularly the concrete batching plant which looks to be some 20m high?) and the proposed expanded quarry operations are to be appropriately screened from neighbouring properties and from public roads. Any screens ought to be provided for within the quarry property and the suggested noise bund noted earlier could also provide such a visual screen.	14	5%

Issue Name	Summary of issues	No.	%
Engagement Process	All residents should be notified of this in writing not by flyer in mail. The project has been kept quiet from the local community and councils. This development proposal has so far attempted to fly under the radar for local residents. Proper consultation and acknowledgment of the impacts of the development is required and we call for the rejection of the proposal in its current form. Objective actions and penalties also need to be considered as it is significantly lacking in this submission There is already poor record by the company in community consultation. Residents only found out about this by another residents letterbox drop. Hansen was not proactive or open about the plans. Submission time frames have been quick and does not allow residents proper scrutiny or response to the 1500+ page report. A proper consultation process should begin and submission time frames restarted. If this is the beginning of the process, Hansen have already demonstrated their contempt for the local residents and there is concern that they will only continue with this degree of engagement during the construction and into the future mine site. The requirements of the advertised Public Exhibition period for SSD 7293 were seriously breached. The advertised exhibition of documents in the local region, Port Macquarie, did not occur. The documents (DA/EIS and Annexures) were NOT available from Port Macquarie Hastings Council (PMHC) office for half of the advertised exhibition period. The Community Consultative Committee (CCC) does not appear to have fulfilled its legal role and this should be investigated. The CCC, led by independent chairperson, Lisa Andrews, had one meeting on 6.7.2018. The CCC minutes from that meeting state that the CCC will, “act as a conduit to the community”, and, “schedule their next meeting to occur in the exhibition period” (DA p 527). The Community Consultative Committee (CCC) does not appear to have fulfilled its legal role and this should be investigated. The CCC, led by independent chairperson, Lisa Andrews, had one meeting on 6.7.2018. The CCC minutes from that meeting state that the CCC will, “act as a conduit to the community”, and, “schedule their next meeting to occur in the exhibition period” (DA p 527). Most stakeholders in the Primary Study Area (PSA) have been denied or severely constrained by a failure of the proponent to properly advise of and execute a consultation process that is open, transparent and professional. This is inclusive of the notification and deployment of details and information to the greater Primary Study Area (PSA) community. It appears no information or invitation to take part in the consultative process was issued or delivered to the balance of the PSA / Sancrox area that has the potential to be significantly impacted by this project. This has resulted a high percentage of the landowners and residents of Sancrox being denied the opportunity to present their views and cases within the framework of an honest, effective and meaningful consultation process. Until 3 weeks ago when a neighbour alerted us of the quarry expansion plans I had no idea of the proposal and had ZERO correspondence or consultation regarding this from the Hanson Group or anyone else. It is my belief that if any one of the stakeholders being neighbours or otherwise should have been notified regarding this project it should have been us…. who live next door. The consultation process regarding this expansion process has been as non-transparent as anything I’ve ever seen. As mentioned above, as a direct neighbour of this site…we have not been notified as part of any consultation at all. We have been disappointed by the lack of direct and detailed engagement by Hanson with us regarding all of the neighbourly issues raised in the submission. We were aware of the intention to expand the quarry but many of our neighbours were not. We do not believe the consultation process was appropriate given the scale of development proposed. If there is a revised proposal, then this should be taken through a proper consultation process.	11	4%
high speed rail corridor	No mention is made of the high-speed rail corridor which goes right through the middle of the deepest part of the quarry. This will require the high-speed corridor to be moved onto the adjoining land owned by Jeff Freeman. No mention is made of the fact that the corridor for the proposed East Coast High Speed Rail line runs right through the middle of the new quarry pit.	13	5%
Impact on Billabong Koala Sanctuary	No mention is made of the impact upon the Billabong Wildlife Park and Koala Sanctuary less than 1 km from the pit.	8	3%

Issue Name	Summary of issues	No.	%
Surrounding land sterilization	Hanson claim in their submission that Port Macquarie has a 15 year supply of Residential land. It is worth noting that the Council has acknowledged that the new Biodiversity Legislation introduced in 2016 has meant that the estimated 15 year supply of Residential land as stated in the UGMS and referred to in the Hanson letter, may be grossly overestimated. It is believed by the local Land Development experts, including LDA, that the amount of Residential land remaining in Port Macquarie is only approx. 5-7 years. This figure is to be confirmed by a study currently being conducted in conjunction with the PMHC. Possibly the impacted areas cannot be contained within the Hanson owned land simply via management of mitigation measures. The new Sancrox quarry project will fragment and alienate land and result in conflict with adjoining land uses. I see that voluntary acquisitions can be made for their properties so I take from that the fact that the expansion of this quarry could make those properties unliveable.	9	3%
Alternative site (Herons Creek, Bago) / alternative material usage	Hanson describe the resources found in their existing quarry and potential new quarry is in short supply. What they fail to disclose is the true number of quarries located in the local area with the similar material. Hanson claim they don't own other resources in the area, but in fact they own Lot 2 DP 814356 at Milligans Road, Bago were there are ample Reserves closer than the 200km claimed in their submissions. This quarry also contains high quality rhyolite daicite. Hanson claim that transport costs will be excessive because of 200km haulage distance. More accurately the supply from Bago is only 20km from Sancrox, so this would be negligible. Hanson states that there are no supplies of similar rock in the area or a quarry within 200km. That is patently untrue and in fact Hanson owns land within 20km which contain adequate high quality rock which is adjacent to a recently approved new quarry. There are also many other competitor's quarries in the close vicinity We have Bago Quarry to the south west and Hytec Quarry at Bonny Hills on the coast to the south. This project is simply not needed for this area Rather than quarry road base materials, a better option is to utilise plastic bags, recycled glass and printer toner in the construction of new roads. Following China's ban on foreign waste imports in 2018, Australia now has a glut of recyclables of which only a small fraction is repurposed. Through crushing glass back into sand, it is possible repurpose not only glass bottles and jars, but also plate glass, drinking ware, crockery and Pyrex into road base. As well as ensuring more glass can be recycled, transforming glass back into sand reduces the need to mine virgin material for road base and asphalt, decreasing road resealing costs and limiting truck movements on the road. Making road base and fill material from recycled products, rather than mining virgin materials, uses considerably less energy and water, and creates less air pollution. The claim that lack of alternative sources or outlets justifies the expansion, is not supported: e.g. Hanson operates Ready Mix Concrete at_14 Blackbutt Road, Port Macquarie. Hanson is only one part of the global Heidelberg Cement Group, the largest supplier of aggregates and third largest supplier of cement in the world. Proponent owns lands adjacent to Bago State forest which contains high and consistent quality hard rock in large quantities.	41	15%

Issue Name	Summary of issues	No.	%
New Quarry/not expansion	The proposed expansion is to be located on a new Lot and DP and all plant is to be moved, and therefore it would be best described as a new quarry, especially given that the existing quarry was to be closed last century. Hanson states that this application is for an extension of the existing quarry. In reality it is for a NEW quarry on adjacent land owned by Hanson. The operation of this quarry from establishment was located on Lot 353 DP 754434 prior to licensing regulation. A condition of the continuing operation of the quarry was that the operation would cease in approx. 2005 and the pit be converted to a water storage dam at cessation. The quarrying operation at this site has continued past the agreed closure date and it is obvious by the application that the resource on Lot 353 is now, or soon to be, exhausted. Commencement of mining on another separate parcel of land that has not previously been approved must surely constitute a new and distinct development. Any new development should be subject to the appropriate approval process with the checks and balances that would apply to any new development. This new development should not be touted merely as an expansion to an operation (that should have been closed years ago) These are additional operations and are not part of the current operation and are not a state significant development. They should be treated as a new development and sited on appropriately zoned industrial land. The proposed 'quarry expansion' is more than that! It also includes two new additional operations, concrete batching and asphalt production which should be required to undergo individual Development Applications under Local Government planning instruments. There are already other concrete and asphalt plants in the region that have the capacity to service the demand.	150	56%

Issue Name	Summary of issues	No.	%
Current (Le Clos) and Future (Le Clos Verdun, Le Clos Sancrox) rural residential impacts/house value	The quarry is not ideally situated. In every direction over the range of 300m - 1,300m, there is both current and potential residential development and this new proposal is not consistent with the needs for this local government area. No mention is made of the currently being constructed 142 Lot Rural Residential sub-division to the west of the site (Le Clos Verdun), the eastern boundary of which is only 600m from the western edge of the new quarry. No mention is made of the existing houses located on Le Clos Sancrox, the nearest of which is less than 1km from the edge of the proposed new quarry and the proposal currently being considered by PMHC to rezone the whole Le Clos Sancrox as residential, the closest parts of which will be approximately 300m from the southern edge of the proposed new quarry. No mention is made of any bund to the south of the last stage of the new quarry which is essential to protect anything on Le Clos Sancrox. Furthermore, will any bund be effective anyway? Hanson states that the new quarry will not impact on any local existing and future land uses. This is a gross mistruth. Currently there are many houses situated within 300m to 1000m of the edge of the new quarry pit. A change in traffic volume will lessen my enjoyment of my property, and cause a deterioration of my property's value. Close proximity of Riverpark Sancrox to the Sancrox quarry and its proposed expansion would cause adverse effects to the amenity of residents and the surrounding community Will reduce amenity and house value for neighbouring properties This area has been earmarked by Port Macquarie-Hastings Council as a future residential development opportunity. The significant increase in heavy vehicle movements can only have a negative impact on road safety along this narrow road. Currently there are many houses situated within 300m to 1000m of the edge of the new quarry pit. In addition, no mention is made of the142 Lot Riverpark Sancrox Estate, the eastern edge of which is only 600m from the edge of the proposed new quarry pit. No mention either is made of the proposed new residential sub-division proposed on Le Clos Sancrox, the edge of which will be only 300m away, nor of the need for expansion of residential development being proposed by the Port Macquarie Hastings Council in the Port Macquarie to Wauchope corridor of which Le Clos Sancrox is the first part Coordination with Council's Urban Growth Management Strategy and mitigating impact on future growth is an important aspect and one that this application fails to address in detail. My land is part of an estate of some 51 lots of approx. 2ha each. All lot owners have combined to make an application to the Port Macquarie Hasting Council, at their request, to rezone the land from Rural to Residential. Existing rural residential development at Le Clos Verdun will be adversely impacts by this proposed development from a noise and dust viewpoint.	35	13%

Issue Name	Summary of issues	No.	%
Lack of Consultation	there are many other people in this area that would be negatively impacted by the proposed expansion … and I am not sure if they have been consulted or are aware of the Quarry's desire to expand. how does a project such as this reach this level of approval, without proper community/rate payer consultation? completely inadequate community consultation I am only aware of this proposal through one of my neighbours informing me of the planned expansion...I am yet to meet a local resident that has been contacted. There has been insufficient consultation on this development. In fact, the documents required for exhibition during SSD 7293 were not available from Port Macquarie Hastings Council for the first two weeks of the initial four week exhibition period, and the wider community was not aware of the meetings, actions or intentions of Community Consultative Committee responsible for this project. the process of this development approval is not acceptable and the fact that State Government, not Local Council, assess this Development Application is very inappropriate and concerning. On 20.11.19 Councillors of PMHC unanimously agreed on their own URGENT Submissions to the State Government highlighting very serious issues including: lack of transparent consultation with the broader community; The CCC met only once at the beginning of the process, there has been no consultation during the preparation of the EIS and the CCC has now met again following the exhibition of the EIS. Expressway Spares preference is that a more direct engagement take place so that the neighbourly issues be addressed in a more detailed manner.	16	6%
Impacts on roads/ degradation of roads	Increased 24/7 heavy vehicle movements on the light duty local roads will compromise road safety and accelerate pavement failure. Rawdon Island Rd. The road is in poor shape now and increased volume of heavy vehicles will cause its further deterioration. The design of the road is not appropriate for increased vehicle volume. Both Sancrox and Rawdon Island Road are very unsuitable roads to cater for trucks and heavy traffic flow, especially truck and dog vehicles, these roads are designed for light rural traffic. It is already too dangerous a road to walk, ride a bike or a horse safely, the roads (Sancrox and Rawdon Island Road) are too narrow. Despite the construction of Winery Road we consistently see heavy vehicles from the quarry using Fernbank Creek Rd as the preferred and shorter route in Port Macquarie. This road is a popular route for the local cycling community and residents from Wauchope and Sancrox and it is only a matter of time before we have a serious accident on this narrow, twisting road. Sancrox Road there is no mention of road pavement destruction / wear and tear and the cost/recompense to ratepayers as not all traffic is on the Pacific Highway. One major issue is that of existing (never mind increasing) 'truck and dog' type traffic. We refer to the to heighten traffic and safety risk posed by quarry "Truck and Dog" type traffic to our family and friends and visitors in motor vehicles, bicycles, jogging or on horseback being met on Sancrox Road, Frogs Road round-a-bout, at the Le Clos Sancrox and Sancrox Road intersection, at the Sancrox and Rawdon Island Roads intersection, along Sancrox, Rawdon Island and Fernbank Creek roads. We have already had a family member have a serious motor vehicle accident with a Quarry truck on Sancrox Road.	142	53%
Support		3	1%

Issue Name	Summary of issues	No.	%
Aboriginal impacts	Quarry expansion of 40 hectares … negative impacts on the rights of indigenous peoples to land and resources held collectively Impact on Aboriginal heritage sites, including a Scar Tree and ceremonial site of high cultural significance There will also be an impact on Aboriginal heritage sites, including a Scar Tree and ceremonial site of 'high cultural significance' Identified Aboriginal heritage sites will be adversely impacted, including a Scar Tree and ceremonial site of “high cultural significance”	142	53%
anticipation of closure of Sancrox	The quarry was originally only intended for a life until approximately 2005, when the estimated winnings were forecast to be exhausted.	8	3%
RU1 land zoning	There are approved substantial subdivisions (some 142 allotments) on adjacent land that this development will negatively affect. The objectives of the RU1 zoning state: “To minimise conflict between land uses within this zone and land uses within adjoining zones.” A large and noisy mining operation on nearby land will only generate conflict and is directly in contradiction of the objectives of the zoning. The 2011 Port Macquarie Hastings Local Environmental Plan zoning prohibits the proposed activities. The area includes an RU1 zone (RU1 - Primary Production) under which the quarry industry should not operate, and Environment Protection Zones E2 (E2 Environmental Conservation zone) and E3 (E3 Environmental Management zone). The ‘State Significant Development’ status given this application for quantitative extraction of raw materials from the quarry, should not vary the terms of local zoning. Application No. SSD-7293 by Hanson Construction Materials Pty Ltd for Sancrox Quarry Expansion Project is clearly not in keeping with the Port Macquarie Hastings Council Urban Growth Management Strategy so as to minimise conflict. Refer LEP 2011 and Sancrox Structure Plan 2014 – 2035. Port Macquarie Hastings Council is currently moving to reconsider zoning of the Sancrox area for other than rural residential e.g. Le Clos with a likely leaning to residential as seen at the Sovereign Hills area. Therefore, any current studies embodied in the EIS should be rendered invalid. The SSD designation, apparently applied because of the size of the proposal, is inappropriate and should not be used to vary the terms of RUI zoning to allow the project. The zoning of the subject land should not be changed because it accurately reflects the rural quality of its location, history and future. The quarry has outlived its approval which should not be renewed or extended. The surrounding area is now on a rural residential trajectory accommodating native plant communities and native animals.	7	3%