APPENDIX J –
NOISE AND VIBRATION IMPACT ASSESSMENT

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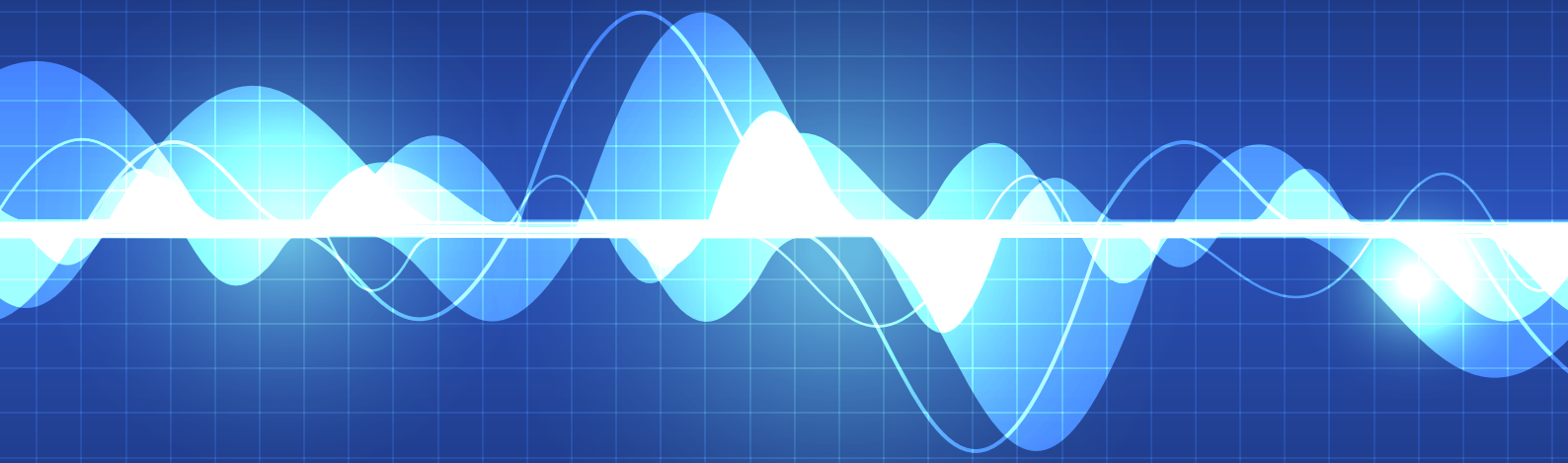
Luddenham Advanced Resource Recovery Centre

Noise and vibration impact assessment

Prepared for Coombes Property Group/KLF Holdings Pty Ltd
July 2020



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Luddenham Advanced Resource Recovery Centre

Noise and vibration impact assessment

Report Number

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Client

Coombes Property Group/KLF Holdings Pty Ltd

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Final

Prepared by	**Approved by**
	
Carl Fokkema Associate 17 July 2020	**Najah Ishac** Director 17 July 2020

Executive Summary

ES1 Project overview

Coombes Property Group (CPG) in partnership with KLF Holdings Pty Ltd (KLF) propose to develop an advanced resource recovery centre (ARRC) on the site to the north of the existing quarry void.

CPG and KLF have commenced the application process (Modification 5, also referred to as MOD 5) to modify the consent of their existing quarry located immediately to the south of the proposed ARRC site to allow quarry operations to recommence, with the intention of completing quarry operations by 31 December 2024 as currently approved.

The key components of the ARRC project are as follows:

- construction and operation of an advanced construction and demolition resource recovery centre;
- accepting and processing up to 600,000 tonnes per annum (tpa) of waste for recycling;
- despatch of up to approximately 540,000 tpa of recycled product;
- despatch of approximately 60,000–120,000 tpa of unrecyclable material either to an offsite licensed waste facility or to the adjacent quarry void (the later will be subject to separate approval);
- if required, upgrade the access road from the subject property to Adams Road;
- use of the access road from subject property to Adams Road; and
- the ARRC will operate up to 24 hours a day, 7 days per week.

The ARRC will accept general solid waste comprising building and demolition waste as well as selected commercial and industrial waste. No special, liquid, hazardous, restricted solid water, putrescible solid waste, or odorous waste will be accepted at the ARRC.

The vast majority of materials accepted will be recovered, the remaining minor amount (10–20%) of unrecyclable materials will be disposed of at an offsite licensed landfill or to the quarry void on the site as part of rehabilitating the void.

ES2 Assessment

This assessment has been prepared to consider the noise and vibration impacts of the ARRC on existing noise-sensitive assessment locations in the area in terms of site operations and related traffic impacts associated with the use of the Adams Road site access by ARRC vehicles and to review cumulative noise associated with MOD5 quarry operations during the day. The assessment considers the potential changes to the area as the development of the Western Sydney Aerotropolis and noise exposure as outlined in the Western Sydney Airport EIS, Assessment of Ground-Based Operational Noise, prepared by Wilkinson Murray (September 2015).

ES3 Operations

Prior to the rezoning of the land, it is predicted that the PNTLs at assessment locations will be met during the operation of the ARRC alone with the following exceptions:

- Day: R3 (+16 dB) and R6 (+9 dB);
- Evening: R2 (+4 dB), R3 (+16 dB) and R6 (+10 dB); and
- Night: R2 (+9 dB), R3 (+21 dB), R4 (+4 dB), R5 (+3 dB) and R6 (+14 dB).

Prior to the rezoning of the land, it is predicted that the ARRC noise levels will satisfy the day amenity level (53 dBA) at most assessment locations, with the exception being R3 (currently unoccupied).

Under the definitions of Section 4.2 of NPfI (see Table 3.5) the predicted noise exceedances of intrusiveness noise level would be considered **moderate** at R1 to R6.

For the operation of the combined ARRC and quarry (Table 5.2), it is predicted that the day PNTLs at assessment locations will be exceeded at:

- R3 (+17 dB);
- R4 (+5 dB);
- R5 (+4 dB); and
- R6 (+13 dB).

The results indicate that there will be a marginal to moderate increases in cumulative levels for assessment locations R4 and R5, whilst significant, as defined in Section 4.2 of the NPfI (see Table 3.5), increases are predicted for R3 and R6.

The modelling predicts that the applicable amenity noise levels will be satisfied at the active recreation (AR1) and commercial (C1) components of the Hubertus Club for both ARRC and cumulative ARRC and MOD5 quarry operations.

Therefore, additional noise mitigation measures, such as restricting operational hours, noise mitigation measures or negotiated agreements, will be required if ARRC operations commence prior to the area being rezoned. If construction of the ARRC is completed (anticipated to be late 2021) prior to rezoning of the area (anticipated to occur in 2020), the ARRC will only be operated during daytime hours until the completion of quarry operations in December 2024.

After to the rezoning of the land, it is predicted that the ARRC noise levels will satisfy the applicable industrial amenity criterion ($L_{Aeq,15min}$ 68 dB), for isolated residences in industrial zoned land, at all assessment locations (Table 5.1). Therefore, it is generally predicted that the criterion will be met at all future developments on these properties. However, this will be in part dependent on the configuration of the developments.

Road traffic noise levels are predicted to satisfy RNP assessment requirements on the Adams Road north of the ARRC site and on Elizabeth Drive. There is the potential for road traffic noise levels to exceed RNP assessment criteria on Adams Road south of the ARRC site and management measures or restrictions on project-related traffic movements may be required.

ES4 Construction

Construction noise levels from the project are predicted to exceed noise management levels (NMLs) at the closest assessment locations, with exceedances greater than 10 dB above NML at R3 and R6. Accordingly, residents will be notified prior to works commencing. Noise monitoring during construction will be considered to determine if actual construction noise levels are above NMLs. Subject to the measured level of exceedance, availability of feasible and reasonable noise mitigation and management measures will be determined. This is discussed further in Section 7.

The potential for vibration impacts on residents and vibration sensitive structures near construction has been assessed. The nearest residence to construction activity is assessment location R3 which is approximately 40 m away from closest construction activities. This assessment location is outside of the safe working distances of likely plant, required to maintain acceptable human response and structural vibration levels. Vibration impacts from construction at residential assessment locations are therefore highly unlikely.

With the effective management and incorporation of mitigation and management measures listed in Section 6.2, construction noise and vibration emissions from the project can be managed to minimise impacts.

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1 Introduction

1.1 Overview

CFT No 13 Pty Ltd, a member of Coombes Property Group (CPG), has recently acquired the property at 275 Adams Road, Luddenham NSW (Lot 3 in DP 623799, 'the site') within the Liverpool City Council municipality. The site is host to an existing shale/clay quarry.

CPG owns, develops, and manages a national portfolio of office, retail, entertainment, land, and other assets. The company's business model is to retain long-term ownership and control of all its assets. CPG has the following staged vision to the long-term development of the site:

- Stage 1 Quarry Reactivation: **Solving a problem**. CPG intends to responsibly avoid the sterilisation of the remaining natural resource by completing the extraction of shale which is important to the local construction industry as raw material used by brick manufacturers in Western Sydney. Following the completion of approved extraction activities, the void will be prepared for rehabilitation.

- Stage 2 Advanced Resource Recovery Centre and Quarry Rehabilitation: **A smart way to fill the void**: CPG in partnership with KLF Holdings Pty Ltd (KLF) and in collaboration between the circular economy industry and the material science research sector, intends to establish a technology-led approach to resource recovery, management, and reuse of Western Sydney's construction waste, and repurposing those materials that cannot be recovered for use to rehabilitate the void. This will provide a sustainable and economically viable method of rehabilitating the void for development.

- Stage 3 High Value Employment Generating Development: **Transform the land to deliver high value agribusiness jobs**. CPG intends to develop the rehabilitated site into a sustainable and high-tech agribusiness hub supporting food production, processing, freight transport, warehousing, and distribution, whilst continuing to invest in the resource recovery research and development (R&D) initiatives. This will deliver the vision of a technology-led agribusiness precinct as part of the Aerotropolis that balances its valuable assets including proximity to the future Western Sydney Airport (WSA) and Outer Sydney Orbital.

This report relates to a new development application relating to the delivery of Stage 2 above.

KLF is an Australian-owned and operated waste management company that operates two strategically located resource recovery and recycling facilities in Sydney; one at Camellia and another at Asquith. KLF has 20 years' experience in the waste recycling and resource recovery industry. KLF facilities are licensed by the NSW Environment Protection Authority (EPA) and have full International Organisation for Standardisation (ISO) accreditation.

1.2 The site

There is an existing clay and shale quarry on the subject property approved under Development Consent DA-315-7-2003, as modified. The quarry is currently inactive. CPG and KLF (the 'applicants') have commenced the application process to modify the quarry's consent to allow quarry operations to recommence, with the primary intention of changing the approved access to the subject property to allow quarry operations (Modification 5, also referred to as MOD 5). The Modification 5 application does not seek to extend quarry operations beyond December 2024.

It is proposed to develop an advanced resource recovery centre (ARRC) within the same lot to the north of the existing quarry void. The ARRC site is shown in Figure 1.1.

The project is integral in achieving the intended future commercial/industrial land use for the subject property as the project provides a commercially viable means to infill the quarry void (subject to separate development consent). This will support the Western Sydney Airport and ongoing development of the Western Sydney Aerotropolis.

A new State significant development (SSD) consent under Division 4.1 of the *Environmental Planning and Assessment Act 1979* (EP&A Act) is required to establish the ARRC. On 24 April 2020, the Department of Planning, Industry and Environment (DPIE) issued Secretary's Environmental Assessment Requirements (SEARs) for the environmental impact statement (EIS) for the project. The SSD consent application number is SSD-10446.

This report has been prepared by EMM Consulting Pty Ltd (EMM) on behalf of the applicants.

1.3 Project overview

The key components of the ARRC project are as follows:

- construction and operation of an advanced construction and demolition resource recovery centre;
- accepting and processing up to 600,000 tonnes per annum (tpa) of waste for recycling;
- despatch of up to approximately 540,000 tpa of recycled product;
- despatch of approximately 60,000–120,000 tpa of unrecyclable material either to an offsite licensed waste facility or to the adjacent quarry void (the later will be subject to separate approval);
- if required, upgrade the access road from the subject property to Adams Road;
- use of the access road from subject property to Adams Road; and
- the ARRC will operate up to 24 hours a day, 7 days per week.

The ARRC will accept general solid waste comprising building and demolition waste as well as selected commercial and industrial waste. No special, liquid, hazardous, restricted solid water, putrescible solid waste, or odorous waste will be accepted at the ARRC.

It is anticipated that ARRC construction will commence in mid-2021 and ARRC operations will commence in 2022. As discussed in Section 6.1, if construction of the ARRC is completed (anticipated to be late 2021) prior to rezoning of the area (anticipated to occur in 2020), the ARRC will only be operated during daytime hours until completion of quarry operations in December 2024.

The vast majority of materials accepted will be recovered, the remaining minor amount (10–20%) of unrecyclable materials will be disposed of at an offsite licensed landfill or to the quarry void on the site as part of rehabilitating the void.

The proposed project layout is shown in Figure 1.1.

1.4 Purpose of this report

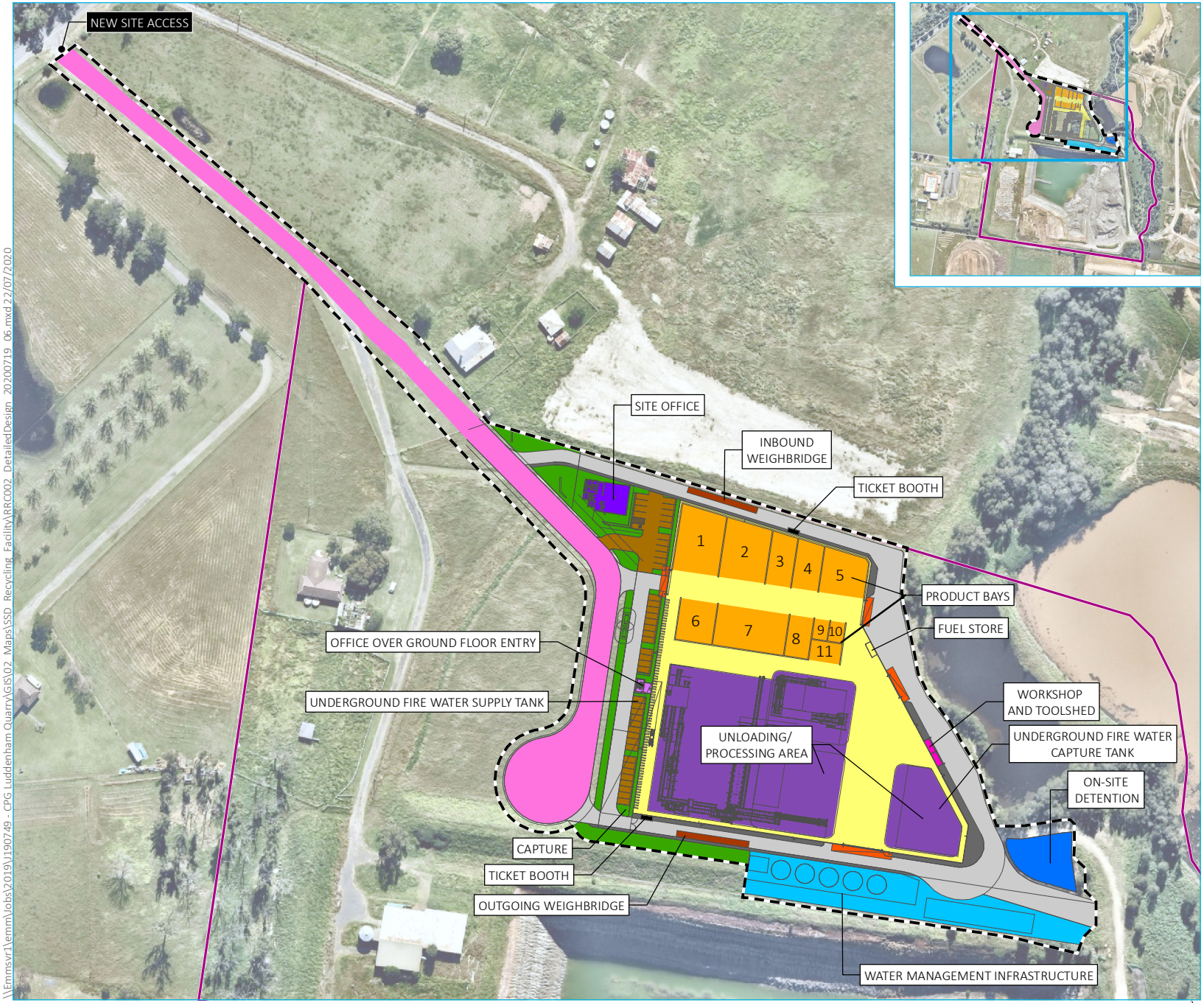
This report has been prepared to assess the noise and vibration impacts of the ARRC proposal on existing noise-sensitive assessment locations in the area in terms of modified site operations and related traffic impacts associated with the use of the Adams Road site access by quarry vehicles. This assessment considers the potential changes to the area as the development of the Western Sydney Aerotropolis and noise exposure as outlined in the Western Sydney Airport EIS, Assessment of Ground-Based Operational Noise, prepared by Wilkinson Murray (September 2015).

1.5 Planning Secretary's Environmental Assessment Requirements (SEARs)

The SEARs for the ARRC development was issued on 24 April 2020. SEARs requirements related to the noise and vibration aspect of the project are outlined and addressed in Table 1.1.

Table 1.1 SEARs noise and vibration requirements

SEARs requirements	Report section
A quantitative assessment of potential construction, operational and transport noise and vibration impacts in accordance with relevant NSW Environment Protection Authority guidelines. This is to include the identification of existing and potential future sensitive receivers, including Western Sydney Airport and consideration of approved and/or proposed developments in the vicinity	Section 5
Details and justification of the proposed noise mitigation and monitoring measures	Section 6
Specified times of operation for all phases of the development and for all noise producing activities	Section 4
Cumulative impacts of other developments	Section 5.1



KEY

- Subject property
- ARRC site
- Indicative detailed layout

Proposed element

- Awning
- Carpark
- Hardstand
- ARRC access road
- Kerb/pedestrian area
- Landscaping
- Office over ground floor
- On-site detention
- ARRC warehouse
- Product bay
- Site office
- Ticketbooth
- Tool shed, workshop
- Unloading/processing
- Water management infrastructure, including treatment plant and storage
- Weighbridge

Product bays

1. Concrete/ rubble masonry
2. Clean timber
3. Rigid plastics
4. Paper/cardboard/film
5. Stumps/asphalt/metal
6. Heavy residual
7. Fines screened
8. Soil audit
9. Ferrous
10. Non-ferrous
11. Non-recyclables

Source: EMM (2020); DFSI (2017); GA (2011); Nearmap (2020); Reid Campbell (2020)

0 50 100 m

GDA 1994 MGA Zone 56

N

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Project overview

Luddenham Advanced Resource Recovery Centre
Noise & Vibration Impact Assessment
Figure 1.1

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2 Existing acoustic environment

2.1 Noise and vibration assessment locations

The nearest representative noise sensitive locations to the ARRC have been identified for the purpose of assessing potential noise and vibration impacts. These locations were selected to represent the range and extent of noise impacts from the ARRC. Details are provided in Table 2.1 and their locations are shown in Figure 2.1. They are referred to in this report as assessment locations.

Table 2.1 Noise assessment locations

ID	Address	Classification (currently)	Easting	Northing
R1	21612177 Elizabeth Drive, Luddenham	Residential	288775	6250213
R2	21112141 Elizabeth Drive, Luddenham	Residential	289113	6250041
R3	285 Adams Road, Luddenham (currently unoccupied)[1]	Residential	288931	6249685
R4	5 Anton Road, Luddenham	Residential	288390	6249272
R5	185 Adams Road, Luddenham	Residential	288317	6249178
R6	225 Adams Road, Luddenham	Residential	288751	6249563
R7	161 Adams Road, Luddenham	Residential	287971	6249090
R8	25102550 Elizabeth Drive, Luddenham	Residential	288373	6250229
AR1	Hubertus Club outdoor firing range	Active recreation	288643	6249324
C1	Hubertus Club restaurant including outdoor facilities	Commercial	288680	6249400

1. It is understood that the landowner intends to redevelop the property for non-residential uses but impacts at this residence have been assessed in full in this report.

2.2 Background noise survey

To establish the existing ambient noise environment of the area, unattended noise surveys and operator-attended aural observations were conducted at monitoring locations as guided by the procedures described in Australian Standard AS 1055-1997 - *Acoustics - Description and Measurement of Environmental Noise*.

Noise monitoring was conducted at three locations considered to be representative of the range of noise levels likely to be experienced by residential assessment locations in the vicinity of the site. The logger locations were selected after inspection of the site and its surrounds, giving due consideration to other noise sources which may influence the readings (eg domestic air-conditioners), the proximity of assessment locations to the site, security issues for the noise monitoring device and gaining permission for access from the residents or landowners.

The monitoring locations selected are presented in Table 2.2 and shown in Figure 2.1.

Table 2.2 Noise monitoring locations

Dates	ID	Address	Instrumentation
25 February	NM1	2111 Elizabeth Street, Luddenham	ARL NGARA (S/N 878123)
to	NM2	275 Adams Road, Luddenham	ARL NGARA (S/N 878113)
5 March 2020	NM3	225 Adams Road, Luddenham	ARL NGARA (S/N 878124)

The noise loggers were programmed to record statistical noise level indices continuously in 15-minute intervals, including the L_{Amax}, L_{A1}, L_{A10}, L_{A50}, L_{A90}, L_{A99}, L_{Amin} and the L_{Aeq}. Calibration of all instrumentation was checked prior to and following monitoring. All equipment carried appropriate and current National Association of Testing Authorities (NATA) (or manufacturer) calibration certificates.

A summary of existing background and ambient noise levels is given in Table 2.3. Results are provided for each day in Appendix A.

Table 2.3 Summary of existing background and ambient noise

Monitoring location	Period[1]	Rating background level (RBL), dBA	Measured $L_{Aeq, period}$ noise level[2], dBA
NM1 – 2111 Elizabeth Street, Luddenham	Day	46	60
	Evening	40	55
	Night	39	55
NM2 – 275 Adams Road, Luddenham	Day	39	50
	Evening	38	54
	Night	35	45
NM3 – 225 Adams Road, Luddenham	Day	37	49
	Evening	38	45
	Night	33	43

1. Day: 7 am to 6 pm Monday to Saturday; 8 am to 6 pm Sundays and public holidays; Evening: 6 pm to 10 pm; Night: 10 pm to 7 am, Sunday to Friday and 10 pm to 8 am Saturday and public holidays.
2. The energy averaged noise level over the measurement period and representative of general ambient noise.

KEY

- Subject property
- ARRC site
- Cadastral boundary
- Noise measurement location

Assessment location

- Active recreation
- Commercial
- Residential

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Source: EMM (2020); DFSI (2017); GA (2011); Nearmap (2020)

0 100 200 m

GDA 1994 MGA Zone 56

N

Noise monitoring and assessment locations

Luddenham Advanced Resource Recovery Centre
Noise & Vibration Impact Assessment
Figure 2.1

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2.3 Future acoustic environment - Western Sydney Airport

The Western Sydney Airport (WSA) will significantly alter the acoustic environment in the vicinity of the WSA site and surrounding areas. As part of the Environmental Impact Statement (EIS) for WSA, Chapter 11, Airport construction and ground operations noise, prepared by The Australian Government, Department of Infrastructure and Regional Development (September 2016) considered ground running and taxiing of aircraft and impacts on surrounding areas. WSA is projected to open and commence operations in 2026.

Volume 4 of the EIS, Appendix E2, Airport ground-based noise and vibration Western Sydney Airport EIS, Assessment of Ground-Based Operational Noise prepared by Wilkinson Murray dated September 2015 (WM Report No. 14168-1 Version F) provided further detail into the assessment of ground running activities.

The EIS adopted the following criteria for the assessment of WSA ground based operational noise potentially impacting residences:

- engine ground running $L_{Aeq,15min}$ 45 dB; and
- taxiing of aircraft $L_{Aeq,15min}$ 40 dB.

Noise levels from ground running and taxiing noise were predicted for worst case meteorological conditions for the year 2030 representing Stage 1 of WSA with a single runway to the north-west. A review of the predicted noise levels (WM report Table 3-4) confirm that ground running has the potential to impact up to 7,258 residences above the criterion of 45 dBA and taxiing to impact up to 3,117 residences above a criterion of 40 dBA.

Additionally, the noise contours for 2030 taxing activities (WM report Figure 3-3) confirm that residences and other land uses within 1,500 m of the Luddenham quarry operations would be exposed to noise levels from WSA activities of $L_{Aeq,15min}$ 50–60 dB. Considering the proposed continuous 24/7 operation of WSA, airport operations would also increase ambient background noise levels.

2.4 Proposed State Environmental Planning Policy (Western Sydney Aerotropolis)

A review of the Western Sydney Aerotropolis Planning Package, including the *Western Sydney Aerotropolis Discussion Paper on the Proposed State Environmental Planning Policy Draft - for public comment* (Western Sydney Planning Partnership (WSPP) 2019) and Draft State Environmental Planning Policy (Western Sydney Aerotropolis (Aerotropolis SEPP) mapping (WSPP 2019a) confirms the subject site and adjacent areas including residential properties and the Hubertus Club adjacent to the west are proposed to be accommodated under a zoning of Agribusiness. Agribusiness is to "allow for limited residential development that is ancillary to Agricultural and Agribusiness operations outside of the ANEC/ANEF 20 and above contours". However, a review of the proposed Aerotropolis SEPP Australian Noise Concept Contour (ANEC)/Australian Noise Exposure Forecast Contour (ANEF) mapping confirms that all existing residences in the vicinity of the quarry site are located within the 20 ANEC/ANEF for the proposed WSA. The proposed Agribusiness land use table goes further to state that an objective is to: " Ensure there are no sensitive land uses (such as residential, aged care, early education and childcare, educational establishments and hospitals amongst other uses) located within the ANEC 20 and above contours."

It is noted that CPG/KLF lodged a submission in response to the Western Sydney Aerotropolis Planning Package requesting that the proposed zoning of the site be revised from Agribusiness to Enterprise due to the unique characteristics of the site as an existing quarry. The Enterprise zone shares the same objective of ensuring no sensitive land uses (such as residential uses) are located within the ANEC/ANEF 20 and above contours.

Changing land use in the vicinity of the proposed ARRC needs to be considered in developing appropriate noise assessment criteria. It is anticipated that the existing residential properties in closest proximity to the site (R3 to R6) are unlikely to remain in the medium term (3–5 years) and transition to future land aligned with the new zoning under the Aerotropolis SEPP. Further, R3 is currently unoccupied and it is understood that the landowner intends to redevelop the property for non-residential uses.

2.5 Meteorology

The *Noise Policy for Industry* (NPfI) (EPA 2017) requires assessment of noise under standard and noise enhancing weather conditions. The NPfI defines these as follows:

- **Standard meteorological conditions:** defined by stability categories A through to D with wind speeds up to 0.5 metres per second (m/s) at 10 m above ground level (AGL) for day, evening and night periods.

- **Noise-enhancing meteorological condition:** defined by stability categories A through to D with light winds (up to 3 m/s at 10 m AGL) for the day and evening periods; and stability categories A through to D with light winds (up to 3 m/s at 10 m AGL) and/or stability category F with winds up to 2 m/s at 10 m AGL.

The NPfI specifies the following two options to consider meteorological effects:

1. Adopt the noise-enhancing meteorological conditions for all assessment periods for noise impact assessment purposes without an assessment of how often these conditions occur – a conservative approach that considers source-to-receiver wind vectors for all assessment locations and F class temperature inversions with wind speeds up to 2 m/s at night; or

2. Determine the significance of noise-enhancing conditions. This involves assessing the significance of temperature inversions (F and G class stability categories) for the night-time period and the significance of light winds up to and including 3 m/s for all assessment periods during stability categories other than E, F or G. Significance is based on a threshold of occurrence of 30% determined in accordance with the provisions in this policy. Where noise-enhancing meteorological conditions occur for less than 30% of the time, standard meteorological conditions may be adopted for the assessment.

2.5.1 Winds

The NPfI recommends consideration of wind effects if they are “significant”. The NPfI defines “significant” as the presence of source-to-receiver wind speed (measured at 10 m above ground level) of 3 m/s or less, occurring for 30% of the time in any assessment period and season.

This is further clarified by defining source-to-receiver wind direction as being the directional component of wind. The NPfI states that where wind is identified to be a significant feature of the area then assessment of noise impacts should consider the highest wind speed below 3 m/s, which is considered to prevail for at least 30% of the time.

A thorough review of the vector components of hourly wind data was undertaken for data extracted from the Australian Bureau of Meteorology’s (BoM) automatic weather station (AWS) at Badgerys Creek for the year 2017 following advice from EMM Air Quality assessment with outputs presented in Table 2.4. Analysis identified that wind was a feature of the area under some seasons and periods, in accordance with the NPfI procedures, and hence wind was incorporated into the noise modelling for evening and night operations.

Table 2.4 **Percentage occurrence of wind speeds between 0.5 to 3 m/s (vector at 22.5° intervals), Badgerys Creek from January 2017 to January 2018**

Direction	Day				Evening				Night			
	Winter	Autumn	Spring	Summer	Winter	Autumn	Spring	Summer	Winter	Autumn	Spring	Summer
N	18.4%	13.4%	17.3%	14.8%	17.3%	9.0%	6.7%	11.1%	14.9%	10.3%	9.3%	12.5%
NNE	17.7%	15.4%	21.1%	17.6%	14.5%	14.1%	14.3%	17.4%	11.1%	10.8%	13.3%	13.5%
NE	13.1%	15.8%	22.4%	18.1%	9.9%	19.0%	23.1%	22.4%	6.7%	11.4%	15.9%	13.3%
ENE	7.8%	15.7%	18.9%	15.5%	7.3%	24.9%	33.1%	26.1%	4.3%	12.3%	21.5%	12.7%
E	6.0%	15.5%	14.0%	11.8%	7.7%	28.8%	**39.6%**	28.3%	3.3%	13.6%	23.7%	14.1%
ESE	5.7%	15.2%	11.3%	10.0%	8.7%	28.3%	**38.5%**	29.0%	3.1%	14.0%	22.2%	17.7%
SE	6.4%	15.3%	8.8%	9.2%	12.0%	28.4%	**33.2%**	27.9%	5.0%	14.7%	22.0%	21.4%
SSE	7.8%	14.4%	7.0%	8.2%	16.0%	26.8%	24.7%	24.2%	8.2%	15.9%	20.3%	25.2%
S	11.8%	14.5%	6.5%	7.5%	20.9%	24.7%	16.3%	19.7%	18.2%	22.0%	20.9%	30.1%
SSW	17.7%	17.0%	6.0%	7.0%	27.0%	25.7%	10.9%	13.8%	**33.4%**	**30.8%**	24.5%	32.3%
SW	20.9%	17.2%	5.4%	5.8%	28.3%	23.1%	7.8%	8.5%	**40.4%**	**33.4%**	25.6%	28.6%
WSW	20.8%	14.7%	4.9%	4.5%	27.4%	17.4%	7.4%	5.6%	**41.0%**	**30.0%**	22.3%	22.5%
W	17.2%	10.9%	3.9%	3.4%	24.7%	12.5%	6.9%	3.1%	**34.4%**	21.6%	16.5%	14.3%
WNW	12.2%	6.7%	3.3%	2.9%	20.4%	6.9%	5.9%	2.1%	23.2%	11.9%	10.4%	7.5%
NW	13.0%	6.0%	5.1%	4.3%	20.5%	4.5%	5.4%	3.5%	18.7%	8.0%	7.0%	7.6%
NNW	16.9%	9.5%	10.9%	9.2%	19.8%	6.0%	4.3%	6.4%	17.3%	9.4%	6.4%	10.6%

Note: Based on data calculated (using CALMET) for the site for Calendar Year 2017.

2.5.2 Temperature inversions

Temperature inversions (ie where atmospheric temperature increases with altitude) typically occur during the night-time period in the winter months and can also increase site noise levels at surrounding assessment locations. As per the NPfI, temperature inversions are to be assessed when they are found to occur for 30% of the time (about two nights per week) or greater during the winter months. It is noted that for the purpose of determining presence of temperature inversion conditions, the NPfI defines 'night-time' to be the period from 6 pm to 7 am and hence encompasses evening and night noise assessment period.

Drainage flow winds (ie localised cold air travelling in a direction of decreasing altitude) can occur during temperature inversion conditions. The increase of noise levels caused by a drainage flow wind needs consideration if a development (ie noise source) is at a higher altitude to surrounding assessment locations, and where there is no intervening topography. The site is lower than surrounding assessment locations accordingly drainage flow winds are not relevant.

Table 2.5 provides a summary of the Pasquill atmospheric stability categories (or a measure of temperature gradients) for evening and night. The analysis is based on data extracted from the BoM AWS at Badgerys Creek for the year 2017.

Noise enhancement due to temperature inversions occurs when the atmosphere is relatively stable which corresponds with atmospheric stability class category F and G.

Table 2.5 Percentage occurrence of Pasquill stability categories

Pasquill stability category	Percentage occurrence (night[1] period)				
	Annual	Summer	Autumn	Winter	Spring
A	0.0%	0.0%	0.0%	0.0%	0.0%
B	0.0%	0.0%	0.0%	0.0%	0.0%
C	0.0%	0.0%	0.0%	0.0%	0.0%
D	71.5%	69.1%	75.7%	66.2%	74.9%
E	8.6%	7.9%	8.7%	11.8%	5.7%
F	14.5%	16.0%	11.7%	17.1%	13.4%
G	5.4%	6.9%	3.9%	4.9%	6.0%
F + G	20.0%	22.9%	15.6%	22.0%	19.4%

1. NPfI defined 'night' for assessment of temperature inversion conditions as sunset to sunrise - that is 6.00 pm to 7.00 am.

The results indicate that 'F' and 'G' class temperature inversions are not a feature of the area as they do not occur for more than 30% of the time during the winter and therefore do not require assessment. Albeit prediction of noise in accordance with ISO9613-2 includes noise enhancement conditions.

3 Assessment criteria

3.1 Operational noise

Operational noise associated with the ARRC will principally be from mobile plant and equipment, including road trucks. However, the proposal involves the construction of a large warehouse building to contain the receipt, processing and dispatch of all materials. Additional ancillary plant associated with the facility would include generator, water pump/s, water treatment plant and roof ventilation fans.

Noise from development in NSW is regulated by the local council, Department of Planning Industry and Environment (DPIE) and/or the Environment Protection Authority (EPA), and sites generally have a licence and/or development consent conditions stipulating noise limits. These limits are typically derived from project specific trigger or operational noise levels predicted at assessment locations. They are based on EPA guidelines (eg NPfI) or noise levels that can be achieved by a specific site following the application of all reasonable and feasible noise mitigation.

The objectives of noise trigger levels established in accordance with the NPfI are to protect the community from excessive intrusive noise and preserve amenity for specific land uses. It should be noted that the audibility of a noise source does not necessarily equate to disturbance at an assessment location.

To ensure these objectives are met, the EPA provides project specific noise trigger levels, namely intrusiveness and amenity.

The direct application of the NPfI and consideration of the existing residential assessment locations is based on current zoning and land use. There will be a transitional phase as the surrounding land is proposed to be rezoned under the proposed Aerotropolis SEPP. Subject to final gazetting of the Aerotropolis SEPP, future development of the land surrounding the site will need to consider the ANEC/ANEF contours to ensure there is no development in noise sensitive land uses within the ANEC/ANEF 20 and above contours. The site and assessment locations R1 to R7 are within this contour.

The acoustic environment within the area surrounding the site will change significantly following the completion and commencement of operations at WSA, forecast for 2026.

3.1.1 Intrusiveness noise levels

The NPfI intrusiveness noise triggers require that $L_{Aeq,15min}$ noise levels (energy average noise level over a 15-minute period) from the site do not exceed the rated background level (RBL) by more than 5 dB during the relevant operational periods. The intrusiveness noise levels are only applicable at residential assessment locations.

The NPfI (Table 2.2 notes) states:

> For isolated residences within an industrial zone, the industrial amenity level is usually applied.

Residences surrounding the site will be rezoned under the Aerotropolis SEPP and be rezoned Agribusiness. A review of permitted uses within this land use zone include earthworks, freight and transport facility, electricity generating works, intensive agriculture, light industry, rural industry, service station, warehouse or distribution centre and other similar uses. These land uses are consistent with uses adopted for industrial development as defined in the NPfI. Consistent with the application of the NPfI, results in the project amenity level of 65 dBA $L_{Aeq,period}$ have been applied to existing isolated residential properties within the rezoned area.

If CPG/KLF are successful in their request to have the proposed zoning of the site revised to Enterprise, a review of permitted uses within the Enterprise zone include a range of industrial and commercial uses consistent with uses adopted for industrial development as defined in the NPfI. As per a future Agribusiness zoning, consistency with the application of the NPfI, results in the amenity criterion of 65 dB(A) $L_{eq,period}$ have been applied to existing isolated residential properties within the area if rezoned Enterprise.

Table 3.1 presents the intrusiveness noise levels determined for the site based on the adopted RBLs. Where assessment locations have been grouped together in the following tables, it is expected that the ambient noise environment at these assessment locations is similar.

Table 3.1 Project intrusiveness noise levels

Residential assessment location[1]	Assessment period[2]	Adopted RBL, dBA	Project intrusiveness noise level (RBL + 5 dB), $L_{Aeq,15min}$, dB
R1, R2 & R8	Day	46	51
	Evening	40	45
	Night	39	44
R3[3]	Day	39	44
	Evening	38	43
	Night	35	40
R4 – R7	Day	37	42
	Evening	37[3]	42
	Night	33	38

1. Residential assessment locations only.
2. Day: 7 am to 6 pm Monday to Saturday; 8 am to 6 pm Sundays and public holidays; Evening: 6 pm to 10 pm; 6 am to 7 am Monday to Saturday, 6 am to 8 am Sundays and public holidays; Night: remaining periods.
3. Currently unoccupied.

3.1.2 Amenity noise levels

The assessment of amenity is based on noise levels specific to the land use. The noise levels relate only to industrial noise and exclude road or rail traffic noise. Where the measured existing industrial noise approaches recommended amenity noise levels, it needs to be demonstrated that noise levels from new developments will not contribute to existing industrial noise such that amenity noise levels are exceeded.

To ensure that industrial noise levels (existing plus new) remain within the recommended amenity noise levels for an area, the project amenity noise level for a new industrial development is the recommended amenity noise level (outlined in Table 2.2 of the NPfI) minus 5 dB. It is noted that this approach is based on a receiver being impacted by multiple industrial sites (or noise sources).

Residential areas potentially affected by ARRC operational noise are located to the east, south and west of the site. The project amenity noise level for the identified assessment locations are presented in Table 3.2 based on a suburban noise amenity area. The NPfI defines suburban as an area with local traffic of characteristically intermittent traffic flows or with some limited commerce or industry. These areas typically have evening noise levels defined by natural elements and human activity.

Table 3.2 Project amenity noise levels

Assessment location	Time period[1]	Indicative area	Project amenity noise level[2] dB, $L_{Aeq,period}$
R1 to R8	Day	Suburban	50 (55-5)
	Evening		40 (45-5)
	Night		35 (40-5)
AR1	When in use	Active recreation	50 (55-5)
CP1	When in use	Commercial	60 (65-5)
Agribusiness/Enterprise	When in use	Industrial	65 (70-5)

Source: NPfI (EPA 2017)

1. Day: 7 am to 6 pm Monday to Saturday; 8 am to 6 pm Sundays and public holidays; Evening: 6 pm to 10 pm; Night: 10 pm to 7 am Monday to Saturday; 10 pm to 8 am Sundays and public holidays.
2. Project amenity noise level is Amenity noise level (Table 2.2 of NPfI) -5 dB in accordance with NPfI Section 2.4.2.

Subject to the gazetting of the Aerotropolis SEPP, the land surrounding the site is to be zoned Agribusiness with the land use adjacent being of commercial or industrial activities and result in amenity noise goals being applied of 60 dBA and 65 dBA for commercial and industrial respectively.

3.1.3 Project noise trigger level

The project noise trigger level (PNTL) is the lower of the calculated intrusiveness or amenity noise levels. Taking account of the measured background noise levels, project intrusive noise levels and project amenity levels for residential assessment locations, a summary of the PNTLs for the assessment of noise from ARRC operations is presented in Table 3.3 based on current zoning and land use.

Table 3.3 Project noise trigger levels

Assessment location	Assessment period[1]	Intrusiveness noise level, $L_{Aeq,15min}$, dB	Amenity noise level[2], $L_{Aeq,15min}$, dB	PNTL[3], $L_{Aeq,15min}$, dB
R1, R2 & R8	Day	51	53	51
	Evening	45	43	43
	Night	44	38	38
R3	Day	44	53	44
	Evening	43	43	43
	Night	40	38	38
R4–R7	Day	42	53	42
	Evening	42	43	42
	Night	38	38	38
AR1	When in use	n/a	53	53
CP1	When in use	n/a	63	63
Agribusiness/Enterprise	When in use	n/a	63–68	63–68

1. Day: 7 am to 6 pm Monday to Saturday; 8 am to 6 pm Sundays and public holidays; Evening: 6 pm to 10 pm; 6 am to 7 am Monday to Saturday, 6 am to 8 am Sundays and public holidays; Night: remaining periods.
2. Project amenity LAeq,15min noise level is the recommended amenity noise level $L_{Aeq,period}$ +3 dB as per the NPfI.
3. PNTL is the lower of the calculated intrusiveness or amenity noise levels.

Following gazetting of the Aerotropolis SEPP, the project noise trigger levels surrounding the site would be based on the NPfI amenity criteria for commercial and industrial land use with levels of 60 dBA and 65 dBA respectively including isolated residential assessment locations (Section 3.1.1).

3.2 Sleep disturbance

The NPfI suggests that a detailed maximum noise level event assessment should be undertaken where operation or construction night-time noise levels at a residential location exceed:

- $L_{Aeq,15\ minute}$ 40 dB or the prevailing RBL plus 5 dB (whichever is the greater); and/or
- L_{Amax} 52 dB or the prevailing RBL plus 15 dB (whichever is the greater).

Guidance regarding potential for sleep disturbance is also provided in the RNP. The RNP calls upon numerous studies that have been conducted into the effect of maximum noise levels on sleep. The RNP acknowledges that, at the current (2011) level of understanding, it is not possible to establish absolute noise level criteria that would correlate to an acceptable level of sleep disturbance. However, the RNP provides the following conclusions from the research on sleep disturbance:

- maximum internal noise levels (L_{Amax}) below 50 to 55 dB are unlikely to awaken people from sleep; and
- one or two noise events per night, with maximum internal noise levels (L_{Amax}) of 65 to 70 dB, are not likely to affect health and wellbeing significantly.

It is commonly accepted by acoustic practitioners and regulatory bodies (ie EPA) that a facade including a partially open window will reduce external noise levels by 10 dB. Therefore, external noise levels in the order of 60 to 65 dB calculated at the facade of a residence is unlikely to awaken people according to the RNP.

If noise levels over the screening criteria are identified, then additional analysis would consider factors such as:

- how often the events would occur;
- the time the events would occur;
- whether there are times of day when there is a clear change in the noise environment (such as during early morning shoulder periods); and
- current scientific literature available regarding the impact of maximum noise level events at night.

Table 3.4 provides the noise level event screening criteria for the residential assessment locations.

Table 3.4 Sleep disturbance screening criteria at residences

Assessment location	Adopted night RBL, dB	Night-time maximum noise level event screening criteria, dB	
		$L_{Aeq,15\ minute}$	L_{Amax}
R1, R2 & R8	39	44	54
R3	35	40	52
R4 – R7	33	40	52

Following the rezoning of the surrounding land under Aerotropolis SEPP, the above sleep disturbance criteria would no longer apply.

3.3 Mitigating noise

Where noise levels above the PNTLs are predicted, all feasible and reasonable mitigation are to be considered for the project to reduce noise levels towards the PNTLs, before any residual impacts are determined and addressed.

The significance of the residual noise impacts is generally based around the human perception to changes in noise levels as explained in the glossary of the acoustic terms. For example, a change in noise level of 1 to 2 dB is typically indiscernible to the human ear. The characterisation of a residual noise impact of 0 to 2 dB above the PNTL is therefore considered negligible. The NPfI characterisation of residual noise impact is outlined further in Table 3.5.

Table 3.5 Significance of residual noise impacts

If the predicted noise level minus the project noise trigger level is:	And the total cumulative industrial noise level is:	Then the significance of the residual noise level is:
≤2 dB	Not applicable	Negligible
≥3 but ≤5 dB	Less than recommended amenity noise level or Greater than recommended amenity noise level, but the increase in total cumulative industrial noise level resulting from development is ≤1 dB	Marginal
≥ 3 but ≤5 dB	Greater than recommended amenity noise level and the increase in total cumulative industrial noise level resulting from the development is >1 dB	Moderate
>5 dB	Less than or equal to recommended amenity noise level	Moderate
>5 dB	Greater than recommended amenity noise level	Significant

Source: NPfI (NSW Government, 2017)

3.4 Historical quarry operations

The quarry site to the south of the proposed ARRC previously operated for more than ten years prior to the former operator ceasing operations. As part of a review of the background to the site, EMM reviewed the site Noise Management Plan (NMP), Clay/Shale Quarry, Adams Road, Luddenham prepared by Golder Associates dated March 2009 (Report No. 087623124 001 Rev 1) as required under DA no. 315-7-2003. The NMP outlined the schedule of plant and equipment and site activities, sensitive noise receptors and noise criteria (daytime 41 dB $L_{Aeq,15minute}$).

It is noted that the closest assessment location for the MOD5 quarry application currently submitted is R3 or 285 Adams Road, Luddenham, which was excluded from the Plan as a sensitive noise receptor due to an agreement in place with the previous quarry operator. However, R6 225 Adams Road, Luddenham was considered.

3.5 Transitional project noise trigger levels

For this site, the application of the NPfI for existing industrial premises is appropriate for the assessment of noise from the continued operation of the ARRC following re-zoning. Also relevant is the transitional nature of intended land use in the vicinity of the WSA (Section 2.4) and change in acoustic environment based on predicted noise level exposure outlined in Section 2.3 for WSA ground running and taxiing operations.

Considering the predicted noise exposure from previous quarry operations (Section 3.4) and transitional nature of the area in the context of the development of the WSA and broader Aerotropolis, the application of an amenity criteria for limited day operations may be considered appropriate and would result in a PNTL of 53 dBA.

Notwithstanding, the assessment has considered the existing situation with residential properties and land use with intrusive and amenity criteria, and the anticipated future surrounding land uses within the ANEC/ANEF 20 proposed WSA contour.

3.6 Construction noise

The *Interim Construction Noise Guideline* (ICNG) (DECC 2009) has been jointly developed by NSW Government agencies, including the NSW Environment Protection Authority (EPA) and Department of Planning (DoP) (now DPIE). The objectives of the guideline relevant to the planning process are to promote a clear understanding of ways to identify and minimise noise from construction and to identify 'feasible' and 'reasonable' work practices. The guideline recommends standard construction hours where noise from construction activities is audible at residential premises (ie assessment locations), as follows:

- Monday to Friday 7 am to 6 pm;
- Saturday 8 am to 1 pm; and
- no construction work is to take place on Sundays or public holidays.

The ICNG acknowledges that works outside standard hours may be necessary, however, justification should be provided to the relevant authorities.

The ICNG provides two methodologies to assess construction noise emissions. The first is a quantitative approach, which is suited to major construction projects with typical durations of more than three weeks. This method requires noise emission predictions from construction activities at the nearest assessment locations and assessment against ICNG recommended noise levels.

The second is a qualitative approach, which is a simplified assessment process that relies more on noise management strategies. This method is suited to short-term infrastructure and maintenance projects of less than three weeks.

This assessment has adopted a quantitative approach. The qualitative aspects of the assessment include identification of assessment locations, description of works involved including predicted noise levels and proposed management measures that include a complaint's handling procedure.

3.6.1 Construction noise management levels - residents

Table 3.6 provides ICNG noise management levels (NML) which apply to residential assessment locations.

Table 3.6 ICNG construction noise management levels for residences

Time of day	NML $L_{Aeq,15min}$	Application
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 $L_{eq(15\text{-}min)}$ is greater than the noise-affected level, the proponent should apply all feasible and reasonable work practices to meet the noise affected level. • The proponent should also inform all potentially impacted residents of the nature of works to be carried out, the expected noise levels and duration, as well as contact details.
	Highly noise affected 75 dBA	The highly noise-affected level represents the point above which there may be strong community reaction to noise. • 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.

Source: ICNG (EPA, 2009).

3.6.2 Construction noise management levels – other noise sensitive land uses

Table 3.7 summarises the ICNG recommendations and provides NML for other land uses.

Table 3.7 ICNG noise levels at other land uses

Land use	Management level, $L_{Aeq,15\ minute}$
Industrial premises	External noise level 75 dB (when in use)
Offices, retail outlets	External noise level 70 dB (when in use)
Hotels[1]	External noise level 65 dB (7 am to 10 pm) 60 dB (10 pm to 7 am)
Classrooms at schools and other educational institutions	Internal noise level 45 dB (when in use)
Hospital wards and operating theatres	Internal noise level 45 dB (when in use)
Places of worship	Internal noise level 45 dB (when in use)
Active recreation areas	External noise level 65 dB (when in use)
Passive recreation areas	External noise level 60 dB (when in use)

Source: ICNG (DECC 2009).

1. NML based on AS2017 recommend maximum internal noise level and the premise that windows and doors for such development would typically remain closed, providing 20 dB of outdoor to indoor construction noise level reduction.

3.6.3 Project specific construction noise management levels

The project construction NMLs for recommended standard and out of hour periods are presented in Table 3.8 for all assessment locations. However, it is acknowledged that limited construction is associated with the MOD5 application and would be limited to daytime hours only.

Table 3.8 Construction noise management levels – all assessment locations

Assessment location	Period	Adopted RBL[1]	NML $L_{Aeq,15min}$, dB
R1, R2 & R8	Day (standard ICNG hours)	46	56
	Day (OOH)	46	51
R3[2]	Day (standard ICNG hours)	39	49
	Day (OOH)	38	43
R4–R7	Day (standard ICNG hours)	37	47
	Day (OOH)	37	42
AR1	When in use	n/a	65
CP1	When in use	n/a	70

1. The RBLs adopted from Table 2.3.
2. Currently unoccupied.

3.7 Construction vibration

3.7.1 Human perception of vibration

Humans can detect vibration levels which are well below those causing any risk of damage to a building or its contents.

The actual perception of motion or vibration may not in itself be disturbing or annoying. An individual's response to that perception, and whether the vibration is "normal" or "abnormal", depends very strongly on previous experience and expectations, and on other connotations associated with the perceived source of the vibration. For example, the vibration that a person responds to as "normal" in a car, bus or train is considerably higher than what is perceived as "normal" in a shop, office or dwelling.

Human tactile perception of random motion, as distinct from human comfort considerations, was investigated by Diekmann and subsequently updated in German Standard DIN 4150 Part 2 1999. On this basis, the resulting degrees of perception for humans are suggested by the vibration level categories given in Table 3.9.

Table 3.9 suggests that people will just be able to feel floor vibration at levels of approximately 0.15 millimetres per second (mm/s) and that the motion becomes "noticeable" at a level of approximately 1 mm/s.

Table 3.9 Peak vibration levels and human perception of motion

Approximate vibration level	Degree of perception
0.10 mm/s	Not felt
0.15 mm/s	Threshold of perception
0.35 mm/s	Barely noticeable
1 mm/s	Noticeable
2.2 mm/s	Easily noticeable
6 mm/s	Strongly noticeable
14 mm/s	Very strongly noticeable

Note: These approximate vibration levels (in floors of building) are for vibration having a frequency content in the range of 8 Hertz (Hz) to 80 Hz.

3.7.2 Assessing vibration - a technical guideline

Environmental Noise Management – Assessing Vibration: a technical guideline (DEC 2006) (the guideline) is based on BS 6472 – 2008, Evaluation of human exposure to vibration in buildings (1–80 Hz).

The guideline presents preferred and maximum vibration values for the use in assessing human responses to vibration and provides recommendations for measurement and evaluation techniques. At vibration values below the preferred values, there is a low probability of adverse comment or disturbance to building occupants. Where all feasible and reasonable mitigation measures have been applied and vibration values are still beyond the maximum value, it is recommended that the operator negotiate directly with the affected community.

The guideline defines three vibration types and provides direction for assessing and evaluating the applicable criteria. Table 2.1 of the guideline provides examples of the three vibration types and has been reproduced in Table 3.10.

Table 3.10 Examples of types of vibration

Continuous vibration	Impulsive vibration	Intermittent vibration
Machinery, steady road traffic, continuous construction activity (such as tunnel boring machinery).	Infrequent: Activities that create up to 3 distinct vibration events in an assessment period, e.g. occasional dropping of heavy equipment, occasional loading and unloading. Blasting is assessed using ANZEC (1990).	Trains, intermittent nearby construction activity, passing heavy vehicles, forging machines, impact pile driving, jack hammers. Where the number of vibration events in an assessment period is three or fewer these would be assessed against impulsive vibration criteria.

Continuous vibration associated with compaction of road base for new site access road is most relevant to the construction of the quarry.

Intermittent vibration (as defined in Section 2.1 of the guideline) is assessed using the vibration dose concept which relates to vibration magnitude and exposure time. Intermittent vibration is representative of heavy vehicle pass-bys and construction activities such as impact hammering, rolling or general excavation work.

Section 2.4 of the guideline provides acceptable values for intermittent vibration in terms of vibration dose values (VDV) which requires the measurement of the overall weighted rms (root mean square) acceleration levels over the frequency range 1 Hz to 80 Hz.

To calculate VDV the following formula is used (refer to Section 2.4.1 of the guideline):

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

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.

The acceptable VDV for intermittent vibration are reproduced in Table 3.11.

Table 3.11 Acceptable vibration dose values for intermittent vibration

Location	Daytime		Night-time	
	Preferred value, $m/s^{1.75}$	Maximum value, $m/s^{1.75}$	Preferred value, $m/s^{1.75}$	Maximum value, $m/s^{1.75}$
Critical areas	0.10	0.20	0.10	0.20
Residences	0.20	0.40	0.13	0.26
Offices, schools, educational institutions and places of worship	0.40	0.80	0.40	0.80
Workshops	0.80	1.60	0.80	1.60

1. Daytime is 7 am to 10 pm and night-time is 10 pm to 7 am.
2. These criteria are indicative only, and there may be a need to assess intermittent values against continuous or impulsive criteria for critical areas.

There is a low probability of adverse comment or disturbance to building occupants at vibration values below the preferred values. Adverse comment or complaints may be expected if vibration values approach the maximum values. The guideline recommends that activities should be designed to meet the preferred values where an area is not already exposed to vibration.

3.7.3 Structural vibration

i Australian Standard AS 2187.2 – 2006

In terms of the most recent relevant vibration damage criteria, Australian Standard AS 2187.2 - 2006 *Explosives - Storage and Use - Use of Explosives* recommends that the frequency dependent guideline values and assessment methods given in BS 7385 Part 2-1993 *Evaluation and measurement for vibration in buildings Part 2* be used as they are "applicable to Australian conditions".

The standard sets guide values for building vibration based on the lowest vibration levels above which damage has been credibly demonstrated. These levels are judged to give a minimum risk of vibration induced damage, where minimal risk for a named effect is usually taken as a 95% probability of no effect.

Sources of vibration that are considered in the standard include demolition, blasting (carried out during mineral extraction or construction excavation), piling, ground treatments (eg compaction), construction equipment, tunnelling, road and rail traffic and industrial machinery.

The recommended limits (guide values) for transient vibration to manage minimal risk of cosmetic damage to residential and industrial buildings are presented numerically in Table 3.12 and graphically in Figure 3.1.

Table 3.12 Transient vibration guide values - minimal risk of cosmetic damage

Line[1]	Type of Building	Peak component particle velocity in frequency range of predominant pulse	
		4 Hz to 15 Hz	15 Hz and above
1	Reinforced or framed structures Industrial and heavy commercial buildings	50 mm/s	50 mm/s
2	Unreinforced or light framed structures Residential or light commercial type buildings	15 mm/s at 4 Hz increasing to 20 mm/s at 15 Hz	20 mm/s at 15 Hz increasing to 50 mm/s at 40 Hz and above

Notes: Refers to the "Line" in Figure 3.1

The standard notes that the guide values in Table 3.12 relate predominantly to transient vibration which does not give rise to resonant responses in structures and low-rise buildings.

Where the dynamic loading caused by continuous vibration is such as to give rise to dynamic magnification due to resonance, especially at the lower frequencies where lower guide values apply, then the guide values in Table 3.12 may need to be reduced by up to 50%.

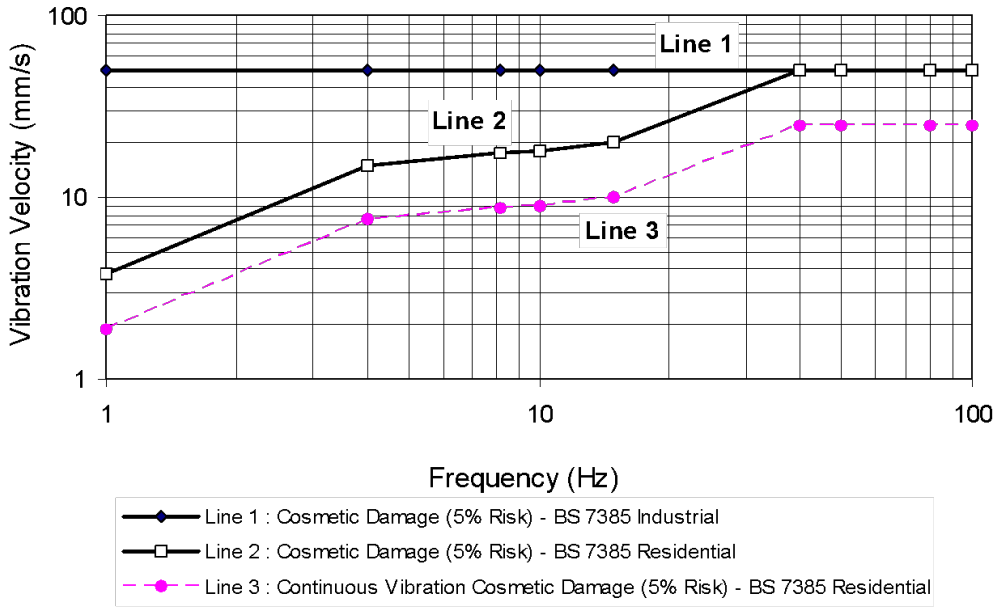


Figure 3.1 Graph of transient vibration guide values for cosmetic damage

In the lower frequency region where strains associated with a given vibration velocity magnitude are higher, the guide values for building types corresponding to Line 2 are reduced. Below a frequency of 4 Hz where a high displacement is associated with the relatively low peak component particle velocity value, a maximum displacement of 0.6 mm (zero to peak) is recommended. This displacement is equivalent to a vibration velocity of 3.7 mm/s at 1 Hz (as shown in Figure 3.1).

Fatigue considerations are also addressed in the standard and it is concluded that unless calculation indicates that the magnitude and number of load reversals is significant (in respect of the fatigue life of building materials) then the guide values in Table 3.12 should not be reduced for fatigue considerations.

In order to assess the likelihood of cosmetic damage due to vibration, AS2187 specifies that vibration measurements should be undertaken at the base of the building and the highest of the orthogonal vibration components (transverse, longitudinal and vertical directions) should be compared with the criteria curves presented in Table 3.12.

It is noteworthy that in addition to the guide values nominated in Table 3.12 the standard states that:

> Some data suggests that the probability of damage tends towards zero at 12.5 mm/s peak component particle velocity. This is not inconsistent with an extensive review of the case history information available in the UK.

3.7.4 Road traffic noise

Construction and operational traffic require assessment for potential noise impacts. The principle guidance to assess the impact of the road traffic noise on assessment locations is in the *NSW Road Noise Policy* (RNP) (EPA 2011) Table 3.13 presents the road noise assessment criteria for residential land uses (ie assessment locations), reproduced from Table 3 of the RNP for road categories relevant to construction and use of the ARRC. Elizabeth Drive is an arterial road, whilst under the definitions of the NSW RNP, Adams Road with be a sub-arterial road.

Table 3.13 Road traffic noise assessment criteria for residential land uses

Road category	Type of project/development	Assessment criteria – dBA	
		Day (7 am to 10 pm)	Night (10 pm to 7 am)
Freeway/arterial/sub-arterial roads	Existing residences affected by additional traffic on existing freeway/arterial/sub-arterial roads generated by land use developments.	$L_{eq,15hr}$ 60 (external)	$L_{eq,9hr}$ 55 (external)
Local roads	Existing residences affected by additional traffic on existing local roads generated by land use developments.	$L_{eq,1hr}$ 55 (external)	$L_{eq,1hr}$ 50 (external)

Additionally, the RNP states that where existing road traffic noise criteria are already exceeded, any additional increase in total traffic noise level should be limited to an increase of up to 2 dB.

In addition to meeting the assessment criteria in Table 3.13 any significant increase in total traffic noise at the relevant residential assessment locations must be considered. Residential assessment locations experiencing increases in total traffic noise levels above those presented in Table 3.14 should be considered for mitigation.

Table 3.14 Road traffic relative increase criteria for residential land uses

Road category	Type of project/development	Total traffic noise level increase – dBA	
		Day (7 am to 10 pm)	Night (10 pm to 7 am)
Freeway/arterial/sub-arterial roads and transit ways	New road corridor/redevelopment of existing road/land use development with the potential to generate additional traffic on existing road.	Existing traffic $L_{eq(15\text{-}hr)}$+12 dB (external)	Existing traffic $L_{eq(9\text{-}hr)}$+ 12 dB (external)

Appendix B of the RNP, states that noise levels shall be rounded to the nearest integer, whilst difference between two noise levels are to be rounded to a single decimal place.

4 Noise assessment approach

4.1 Overview

This section presents the methods and base parameters used to model operational and construction noise and vibration emissions from the operation of the ARRC and MOD5 quarry operations.

Operational and construction noise levels were predicted using DGMR Software proprietary modelling software, iNoise. The model allows prediction under the ISO9613-2 "*Acoustics – Attenuation of Sound during Propagation Outdoors – general method"* algorithm. This algorithm is accepted by the EPA. Features which affect the predicted noise level that are considered in the noise modelling include:

- equipment sound power levels and locations;
- screening from structures;
- receiver locations;
- ground topography;
- noise attenuation due to geometric spreading;
- ground absorption; and
- atmospheric absorption.

The model was populated with 3-D topography of the project and surrounding area, extending out past nearest assessment locations. Plant and equipment representing the range of proposed operation and construction scenarios was modelled at locations representing the worst case noise levels throughout the operation and construction.

4.2 Operational noise

4.2.1 Design drawings

The acoustic assessment of the ARRC has been based on proposed project layout (Figure 1.1) and location of plant and equipment (Appendix B) includes the following operational assumptions:

- road trucks on site access road and traversing site around and through building as outlined in Appendix B comprising:
  - Day: 20 trips (in/out) or 10 trucks per 15 minutes;
  - Evening: 12 trips (in/out) or 6 trucks per 15 minutes;
  - Night: 10 trips (in/out) or 5 trucks per 15 minutes;
- All receipt, processing and dispatch of recycling materials conducted within a warehouse building on the central northern portion of the site. Building structure comprising of:
  - 2.5 m lower portion of walls comprising 250–300 mm precast or insitu concrete; and

- upper walls and roof comprising minimum 0.6 mm BMT metal cladding and minimum 150 mm medium duty thermofoil faced blanket Eight roof ventilators / fans with a sound power level of L_{Aeq} 78 dB each;

- water treatment plant, pump room and diesel generator located to the south and south-east of the processing building.

4.2.2 Plant and equipment

Plant and equipment and associated sound power levels considered for the ARRC are presented in Table 4.1. The list is based on information provided by the proposed site operator (KLF Holdings) and assumptions for similar resource recovery centres.

The sound power levels assigned to each item have been sourced from an EMM measurement database of similar equipment, Department of Environment, Food and Rural Affairs (DEFRA) 2005, *Update of Noise Database for Prediction of Noise on Construction and Open Sites*, manufacturer data and other equivalent facilities.

Table 4.1 Operational noise sources

Noise source	No. of items	Sound power level per item (L_{Aeq}) dBA	Total sound power level (L_{Aeq}) dBA
Road Trucks	3–10	103	113
Trommel Screen[1]	1	109	109
Shredder[1]	1	108	108
Excavator (14 t)[1]	2	105	108
Excavator (PC300 or equivalent – 30 t)[1]	1	108	108
Front End Loader (CAT972 or equivalent)[1]	2	105	108
Mobile Crusher + Loader[1]	1	116	116
Water treatment plant	1	94	94
Pump room	1	82	82
Generator	1	94	94
Roof fans / ventilators	8	78	97
Total			**119**

1. Equipment located within building

4.2.3 Night-time maximum noise level events and sleep disturbance

The ARRC will operate 24 hours per day/7 days per week, hence assessment of intermittent noise and potential for sleep disturbance at residential assessment locations during the night-time hours (10 pm to 7 am) is required by the NPfI, although this criteria will not apply following rezoning of the area. For assessment of sleep disturbance, a sound power level of 115 dBA L_{Amax} was considered for airbrake release of site trucks. The area on the site with the greatest potential for this activity to occur is the weighbridge on the northern and southern sides of the building and within warehouse building as shown on Figure 1.1.

4.2.4 Noise predictions

i Single point predictions

Noise levels were predicted to assessment locations identified in Table 2.1 using the noise sources outlined in Table 4.1. The overall $L_{Aeq,15min}$ noise contribution was modelled for direct assessment against NPfI PNTLs.

ii Noise contours

Further to the above approach and acknowledging other residential areas to the north, east, south and west of the site, noise contours have been generated for activities to determine the potential extent of noise exposure.

4.2.5 Noise enhancing meteorology

Noise modelling was conducted using DGMR Software proprietary modelling software, iNoise. The model utilised international standard ISO 9613-2:1996 'Acoustics – Attenuation of sound during propagation outdoors'. As per Section 1 of the standard:

> The method predicts the equivalent continuous A-weighted sound pressure level (as described in parts 1 to 3 of ISO 1996) under meteorological conditions favourable to propagation from sources of known sound emission.
>
> These conditions are for downwind propagation, as specified in 5.4.3.3 of ISO 1996-2:1987 or, equivalently, propagation under a well-developed moderate ground-based temperature inversion, such as commonly occurs at night.

A summary of modelling conditions for which noise predictions have been provided are shown in Table 4.2. In addition to standard ISO noise enhancing conditions, the assessment has also considered an adverse source to receiver wind of up to 3 m/s in accordance with the findings of the wind analysis summarised in Table 2.4. This was achieved using the CONCAWE algorithm within the same model.

Table 4.2 Conditions adopted in the model

Assessment condition	Period	Temperature	Wind speed (m/s)	Relative humidity	Stability class
ISO9613	Day	20°C	2[1]	60%	n/a
ISO9613 / CONCAWE	Evening	10°C	3	90%	n/a
ISO9613 / CONCAWE	Night	10°C	3	90%	n/a

1. Downwind conditions in accordance with ISO9613 algorithm – Section 5 and 8.

4.3 Construction noise

4.3.1 Times

Construction activities associated with the ARRC works would be daytime hours only and restricted to bulk earthworks, provision of hardstand and associated roadways for building, and building structure erection. Anticipated total duration of the works is approximately 68 weeks.

4.3.2 Equipment sound power levels

i Continuous

Equipment sound power levels have been taken from the *Update of Noise Database for Prediction of Noise on Construction and Open Sites* (DEFRA 2005), where available. Otherwise data was sourced from an EMM database of similar equipment which is based on measurements at other construction sites.

Acoustically significant fixed and mobile equipment items were considered in the model for the site with 100% utilisation based on information provided by KLF Holdings to assumptions to represent a range of activities likely to undertaken during the construction works. A summary of the construction phases, duration, number of plant and cumulative sound power levels (Lw) are presented in Table 4.3. The model considered the cumulative plant and equipment sound power level as an area source across the site providing a potential worst-case scenario for each phase of construction.

Table 4.3 Construction stages and equipment sound power levels

Equipment/Activity	Number of items (per 15 minutes)	SWL per item, LAeq	Total SWL, LAeq	Cumulative SWL per phase, LAeq
Stage 1: Bulk earthworks (duration = 8 weeks)				
Rigid tipper	1	103	103	115
Bobcat	2	95	98	
Roller	1	109	109	
Excavator	1	107	107	
Scraper 631	1	112	112	
Semi trailer	1	103	115	
Stage 2: Concrete hardstand, lower walls, bunkers and roadway (duration = 30 weeks)				
Concrete agitator	3	108	113	118
Concrete pump	3	109	114	
Crane	1	112	112	
Semi-trailer	1	103	103	
Flatbed Hiab truck	1	103	103	
Stage 3: Building structure and erection (duration = 30 weeks)				
Hand tools	3	108	113	116
Trucks	2	103	106	
Crane	1	112	112	
Elevated work platform	1	103	103	

ii Night-time maximum noise level events and sleep disturbance

Construction activities are not proposed during the ICNG night-time hours of 10 pm to 7 am. Therefore, intermittent noise and assessment of the sleep disturbance at residential assessment locations has not been considered further for construction activities.

4.3.3 Noise predictions

To assess a potential worst-case construction scenario, the assessment has considered the identified plant and equipment in Table 4.3 and operating continuously over a 15 minute period. Construction noise levels were predicted to the assessment locations listed in Table 2.1 and identified in Figure 2.1.

4.4 Construction vibration

Safe working distances for typical items of vibration intensive plant are listed in Table 4.4. The safe working distances are quoted for both "Cosmetic Damage" (refer British Standard BS 7385) and "Human Comfort" (refer British Standard BS 6472-1).

Table 4.4 Recommended safe working distances for vibration intensive plant

Plant Item	Rating/Description	Safe working distance	
		Cosmetic damage (BS 7385)	Human comfort (BS 6472)
Vibratory Rollers	<50 kN (typically 12 tonnes)	5 m	15 to 20 m
	<100 kN (typically 24 tonnes)	6 m	20 m
	<200 kN (typically 46 tonnes)	12 m	40 m

Source: From Transport Infrastructure Development Corporation Construction's Construction Noise Strategy (Rail Projects), November 2007 – based on residential building.

Safe work distances relate to continuous vibration. For most construction activity, vibration emissions are intermittent in nature. The safe working distances are therefore conservative.

The safe working distances presented in Table 4.4 are indicative and will vary depending on the item of plant and local geotechnical conditions. They apply to cosmetic damage of typical buildings under typical geotechnical conditions.

The safe working distances have been used to assess the potential for construction vibration impacts based on proposed activities.

4.5 Road traffic noise

4.5.1 Overview

Access for vehicles associated with the operation of the ARRC will be from Adams Road and Elizabeth Drive. Project related traffic has the potential to impact on residential properties on these road segments. The assessment has considered existing traffic volumes and projected vehicle movements associated with the operational activities. The assessment assumed scenarios of all ARRC traffic travelling on northern section of Adams Road and an even distribution of ARRC traffic on Adams Road north and south of the ARRC site with ARRC operating at full production.

Traffic movements from construction would be only on the northern section of Adams Road and significantly lower than operational movements, accordingly assessment was not considered necessary if modelling demonstrated that higher operational traffic volumes satisfied RNP criteria. Note that vehicles on the proposed access road are treated as part of onsite noise in accordance with the NPfI.

4.5.2 Existing traffic volumes

Existing average daily traffic movements for Adams Road and Elizabeth Drive were established from classified tube counts conducted in November 2019 and March 2020. Future traffic growth on the road network was confirmed based on data contained in Traffic Impact Assessment (EMM 2020) for operational years of 2024 and 2029 and summarised in Table 4.5.

Table 4.5 Average existing daily traffic volumes

Road segment	Day 7 am to 10 pm				Night 10 pm to 7 am			
	LV[1]	HV[2]	Total	HV%	LV	HV	Total	HV%
Adams Road (2020)	1625	129	1753	7	272	19	291	7
Adams Road (2024)	4885	387	5272	7	1221	97	1318	7
Adams Road (2029)	5545	439	5984	7	1386	110	1496	7
Elizabeth Drive (2020)	7135	1571	8706	18	1361	271	1632	17
Elizabeth Drive (2024)	5545	439	5984	7	1386	110	1496	7
Elizabeth Drive (2029)	7571	1667	9238	18	1893	417	2310	18

1. LV light vehicles
2. HV heavy vehicles

4.5.3 Projected traffic volumes

A summary of the project site generated traffic from both the proposed ARRC and quarry operations are presented in for 2024 and 2029 operational years and represent peak site generation. The proponent has indicated that up to 50% of ARRC truck trips may travel south on Adams Road. Quarry operation is expected to cease by 2024.

Table 4.6 Projected traffic volumes

Year of operation	Day 7 am to 10 pm			Night 10 pm to 7 am		
	LV[1]	HV[2]	Total	LV	HV	Total
2024[3]	76	1092	1168	22	248	270
2029	58	992	1050	22	248	270

1. LV light vehicles
2. HV heavy vehicles
3. Incorporates ARRC + Quarry during day time for operational year 2024

4.5.4 Methodology

The US EPA Federal Highways (FHWA) method was considered in the assessment of road traffic noise due to low traffic flows (<200 vehicles per hour) as the calculation procedure is more sensitive to low traffic volumes compared to other methods.

Road traffic noise levels from the project have been assessed by calculating existing and existing plus project traffic, including potential for 50% of truck trips south on Adams Road at representative residential assessment locations using FHWA methods. The following assumptions have been adopted:

- a vehicle sign posted speed for Elizabeth Drive of 80 km/h;
- a vehicle sign posted speed limit on Adams Road of 70 km/h;
- no buildings or other intervening objects that will act like a noise barrier between the road and the noise assessment point are proposed; and
- a facade reflection has been added to predicted noise levels in accordance with the RNP.

5 Impact assessment

5.1 Operational noise

5.1.1 Single point predictions

In accordance with the procedures outlined in Section 1, predicted single point operational noise levels are provided in Table 5.1 for day, evening and night operations of the ARRC. The daytime noise levels from the combined ARRC and quarry are also provided. The levels presented for each assessment location represents the energy-average noise level over a 15 minute period and assumes all plant and activities operating concurrently in accordance with scenarios outlined in Section 4.2 under noise enhancing conditions including 3 m/s winds (evening and night). The predictions have also considered cumulative noise associated with concurrent ARRC and MOD5 quarry operations during day hours up to 2024 (ie when quarry operations will cease).

Table 5.1 Predicted operational noise levels – ISO9613 and 3 m/s wind (evening/night)

Assessment location	Classification	Period	PNTL[1], dB$L_{Aeq,15min}$ (current zoning)	Industrial amenity criterion[2], dB $L_{Aeq,15min}$ (future zoning)	Predicted ARRC and [ARRC + quarry] noise level, dB $L_{Aeq,15min}$
R1	Residential	Day	51	68	41 [44]
		Evening	43		40-43
		Night	38		**40-43**
R2	Residential	Day	51		45 [47]
		Evening	43		**45-47**
		Night	38		**45-47**
R3[4]	Residential	Day	44		**60 [61]**
		Evening	43		**59**
		Night	38		**59**
R4	Residential	Day	42		40 **[47]**
		Evening	42		**40-42**
		Night	38		**39-42**
R5	Residential	Day	42		38 **[46]**
		Evening	42		38-41
		Night	38		38-**41**
R6	Residential	Day	42		**51 [55]**
		Evening	42		**50-52**
		Night	38		**50-52**
R7	Residential	Day	42		35 [42]
		Evening	42		35-38
		Night	38		35-38
R8	Residential	Day	51		37 [42]
		Evening	43		37-39

Table 5.1 Predicted operational noise levels – ISO9613 and 3 m/s wind (evening/night)

Assessment location	Classification	Period	PNTL[1], dBL$_{Aeq,15min}$ (current zoning)	Industrial amenity criterion[2], dB L$_{Aeq,15min}$ (future zoning)	Predicted ARRC and [ARRC + quarry] noise level, dB L$_{Aeq,15min}$
		Night	38		36-**39**
AR1	Active recreation	When is use	53	68	43-48 [50]
C1	Commercial	When is use	63		45-48 [52]

1. Criteria applicable prior to rezoning.
2. Criteria applicable following rezoning.
3. Exceedances of the PTNL prior to rezoning are shown in **bold**.
4. Currently unoccupied.

Calculated levels from cumulative MOD5 quarry + ARRC operations are in brackets [] for day-time operations up to 2024

i Prior to rezoning

The noise exceedances, prior to rezoning, due to operation of the ARRC are summarised for day, evening and night periods in Table 5.2.

It is proposed to reactivate the quarry and continue day-time only quarry operations to the end of 2024 (EMM 2020a). The noise exceedances, prior to rezoning, due to the day-time operation of the ARRC and the quarry are also summarised in Table 5.2.

Table 5.2 Combined ARRC and quarry noise level exceedances prior to rezoning – ISO9613

Assessment location	Predicted noise exceedance, dB				
	ARRC (day)	ARRC (evening)	ARRC (night)	Quarry MOD5 (day)	ARRC + quarry (day)
R1	-	-	+5	-	-
R2	-	+4	+9	-	-
R3[1]	+16	+16	+21	+9	+17
R4	-	-	+4	+4	+5
R5	-	-	+3	+3	+4
R6	+9	+10	+14	+10	+13
R7	-	-	-	-	-
R8	-	-	+1	-	-
AR1	-	-	-	-	-
C1	-	-	-	-	-

1. Currently unoccupied.

For the operation of the ARRC alone, it is predicted that the PNTLs at assessment locations will be exceeded at:

- Day: R3 (+16 dB) (unoccupied) and R6 (+9 dB);
- Evening: R2 (+4 dB), R3 (+16 dB) and R6 (+10 dB); and

- Night: R2 (+9 dB), R3 (+21 dB), R4 (+4 dB), R5 (+3 dB) and R6 (+14 dB).

Prior to the rezoning of the land, it is predicted that the ARRC noise levels will satisfy the day amenity level (53 dBA) at most assessment locations, with the exception being R3 (currently unoccupied).

Under the definitions of Section 4.2 of NPfI (see Table 3.5) the predicted noise exceedances of the PNTLs (intrusiveness noise level) are define as **moderate** at R1 to R6, given that the recommended amenity noise level is satisfied.

Noise exceedances were predicted for a number of residential assessment locations during the day under standard ISO9613 noise enhancing conditions for MOD5 quarry operations (EMM 2020).

For the operation of the combined ARRC and quarry (Table 5.2), it is predicted that the PNTLs at assessment locations will be exceeded at:

- R3 (+17 dB) (unoccupied);
- R4 (+5 dB);
- R5 (+4 dB); and
- R6 (+13 dB).

The results indicate that there will be a marginal to moderate increases in cumulative levels for assessment locations R4 and R5, whilst significant, as defined in Section 4.2 of the NPfI (see Table 3.5), increases are predicted for R3 and R6.

The modelling predicts that the applicable amenity noise levels will be satisfied at the active recreation (AR1) and commercial (C1) components of the Hubertus Club for both ARRC and cumulative ARRC and MOD5 quarry operations.

These predictions assume that all quarry equipment is operating and that all ARRC components (including deliveries, processing and dispatch) are operating simultaneously at a rate that would allow 600,000 tpa of waste to be delivered, processed and the products/unrecyclable residues dispatched, and that airport construction activities are also occurring. With ARRC operations expected to start in 2022, it is unlikely that the ARRC will reach full capacity prior to the completion of quarrying activities at the end of 2024. Therefore, the predictions above represent a worst-case scenario.

Additional noise mitigation measures, such as restricting operational hours, noise mitigation measures or negotiated agreements, will be required if ARRC operations commence prior to the area being rezoned (see Section 6.1).

ii After rezoning

After to the rezoning of the land, it is predicted that the ARRC noise levels will satisfy the applicable industrial amenity criterion ($L_{Aeq,15min}$ 68 dB) at all assessment locations (Table 5.1).

This recognises the envisaged future commercial/industrial use of the agribusiness zone. Over time, particularly after the start of airport operations (Section 2.3), the acoustic environment will be significantly altered with ambient background and L_{Aeq} noise levels significantly increased. Notwithstanding, the applicants will consult with the affected residents regarding potential noise mitigation measures (see Section 6.1).

It is noted, that while the applicable noise criteria at the residences will increase with the rezoning of the land, the value of the land will also increase substantially.

As the amenity criterion ($L_{Aeq,15min}$ 68 dB) is predicted to be met at all assessment locations on surrounding properties, it is generally predicted that the criterion will be met at all future development on these properties. However, this will be in part dependent on the configuration of the developments.

5.1.2 Intermittent noise events (sleep disturbance)

i Prior to rezoning

Modelling of intermittent L_{Amax} noise events at night considered a typical worst-case event for air brake release and a source sound power level of 115 dBA. Potential for these events were considered at the north and south weighbridges and predicted to the identified residential assessment locations. The results of the predictions under ISO9613 conditions and 3 m/s wind are presented in Table 5.3.

Table 5.3 Predicted intermittent noise levels – ISO9613 and 3 m/s wind

Assessment location	Classification	Period	Screening level prior to rezoning, dB	Predicted intermittent noise level, dB L_{Amax}
R1	Residential	Night	52	45–48
R2	Residential	Night	52	49–52
R3	Residential	Night	52	**65**
R4	Residential	Night	52	44–47
R5	Residential	Night	52	42–45
R6	Residential	Night	52	**55–57**
R7	Residential	Night	52	39–42
R8	Residential	Night	52	42–45

Results of modelling confirm compliance with the sleep disturbance screening level of 52 dBA for most residential assessment locations with the exception of R3 and R6 prior to rezoning.

Residences R3 and R6 may be offered at-receiver noise mitigation under VLAMP procedures and negotiated agreements associated with MOD5 quarry operations (EMM 2020). The incorporation of at receiver mitigation or the application of negotiated agreements would address any potential impacts associated with sleep disturbance impacts if operations start prior to rezoning.

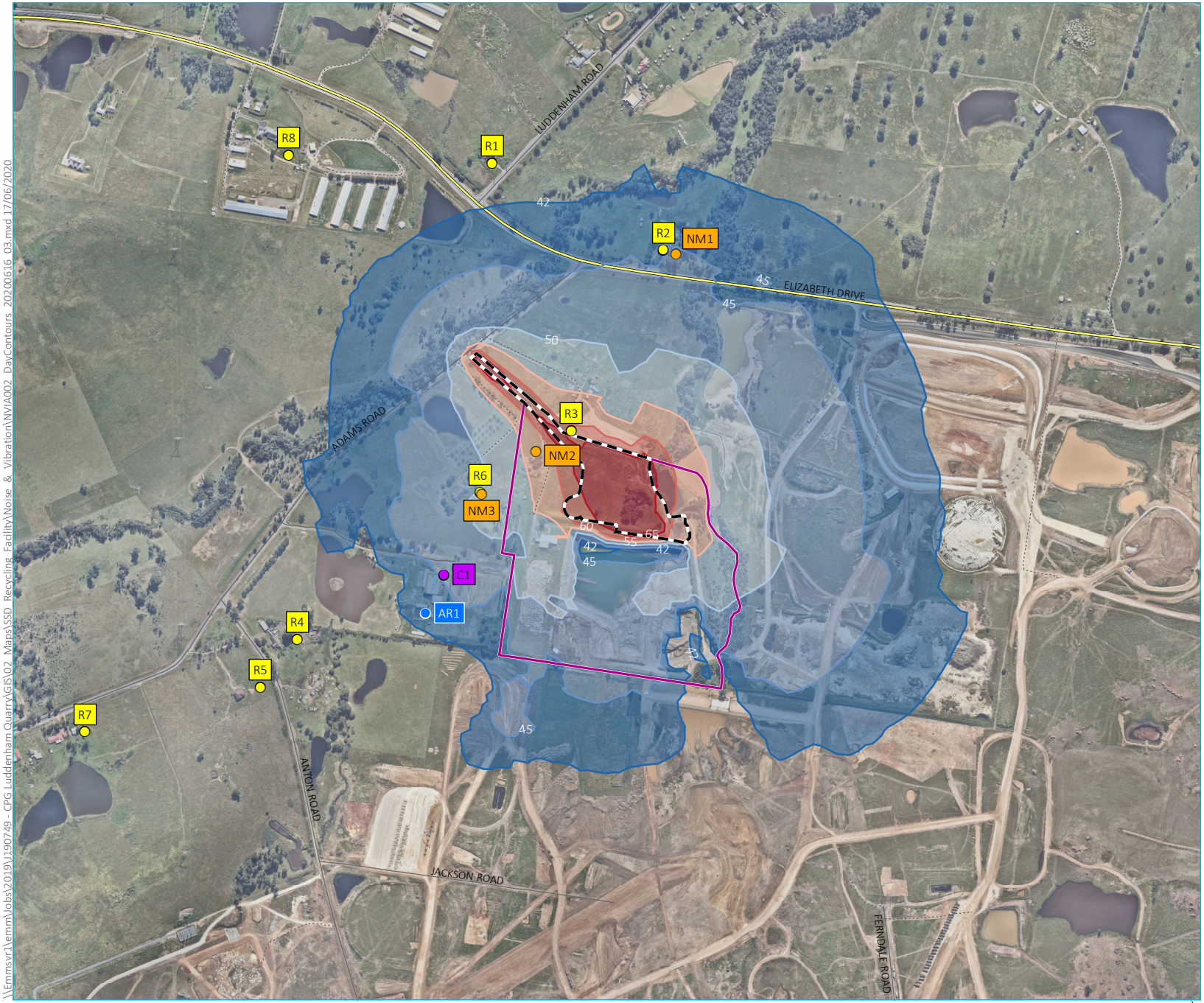
Additional noise mitigation measures will be required if operations commence prior to the area being rezoned (see Section 6.1).

ii After rezoning

The sleep disturbance screening levels will not apply after the area is rezoned. Notwithstanding, the applicants will consult with the affected residents regarding potential noise mitigation measures (see Section 6.1).

5.1.3 Contours

Predicted $L_{Aeq,15min}$ operational noise contours representing day operations under ISO9613 noise enhancing conditions are provided in Figure 5.1, Figure 5.2 and Figure 5.3. The contours depict the extent of noise exposure surrounding the site including the identified reference assessment locations.



KEY

- Subject property
- ARRC site
- Major road
- Minor road
- Vehicular track
- Noise measurement location

Assessment location

- Active recreation
- Commercial
- Residential

Day noise contour levels - calm conditions

- 42 - 45 dB(A)
- 45 - 50 dB(A)
- 50 - 55 dB(A)
- 55 - 60 dB(A)
- 60 - 65 dB(A)
- 65+ dB(A)

\\Emmsvr1\emm\Jobs\2019\I190749 - CPG Luddenham Quarry\GIS\02 Maps\SSD Recycling Facility\Noise & Vibration\NVIA002 DayContours 20200616 03.mxd 17/06/2020

Source: EMM (2020); DFSI (2017); GA (2011); Nearmap (2020)

0 200 400 m

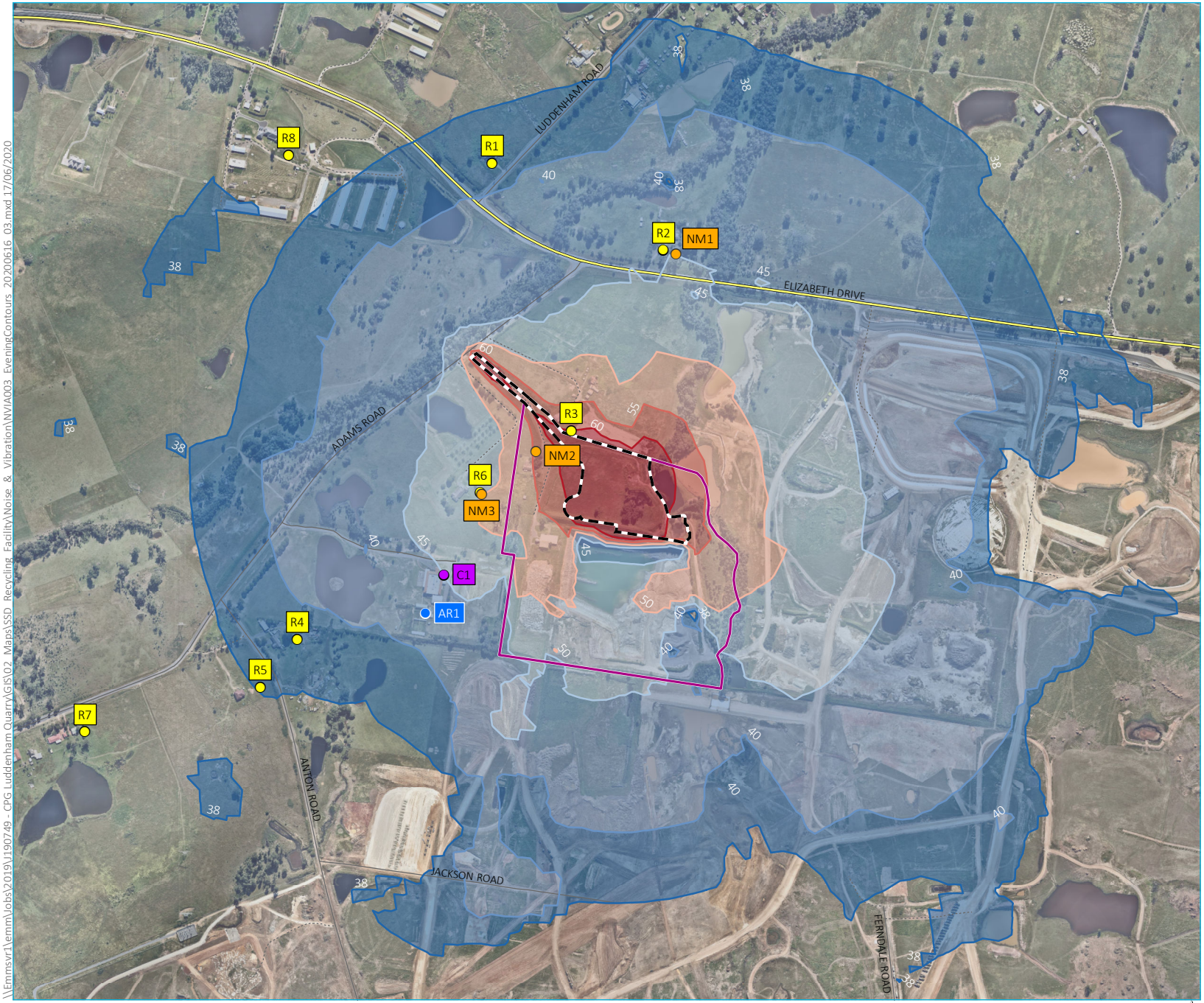
GDA 1994 MGA Zone 56

N

Operational noise contours - day, calm conditions

Luddenham Advanced Resource Recovery Centre
Noise & Vibration Impact Assessment
Figure 5.1

EMM creating opportunities



KEY

- Subject property
- ARRC site
- Major road
- Minor road
- Vehicular track
- Noise measurement location

Assessment location

- Active recreation
- Commercial
- Residential

Evening noise contour levels - calm conditions

- 38 - 40 dB(A)
- 40 - 42 dB(A)
- 42 - 50 dB(A)
- 50 - 55 dB(A)
- 55 - 60 dB(A)
- 60+ dB(A)

Source: EMM (2020); DFSI (2017); GA (2011); Nearmap (2020)

0 200 400 m

GDA 1994 MGA Zone 56

N

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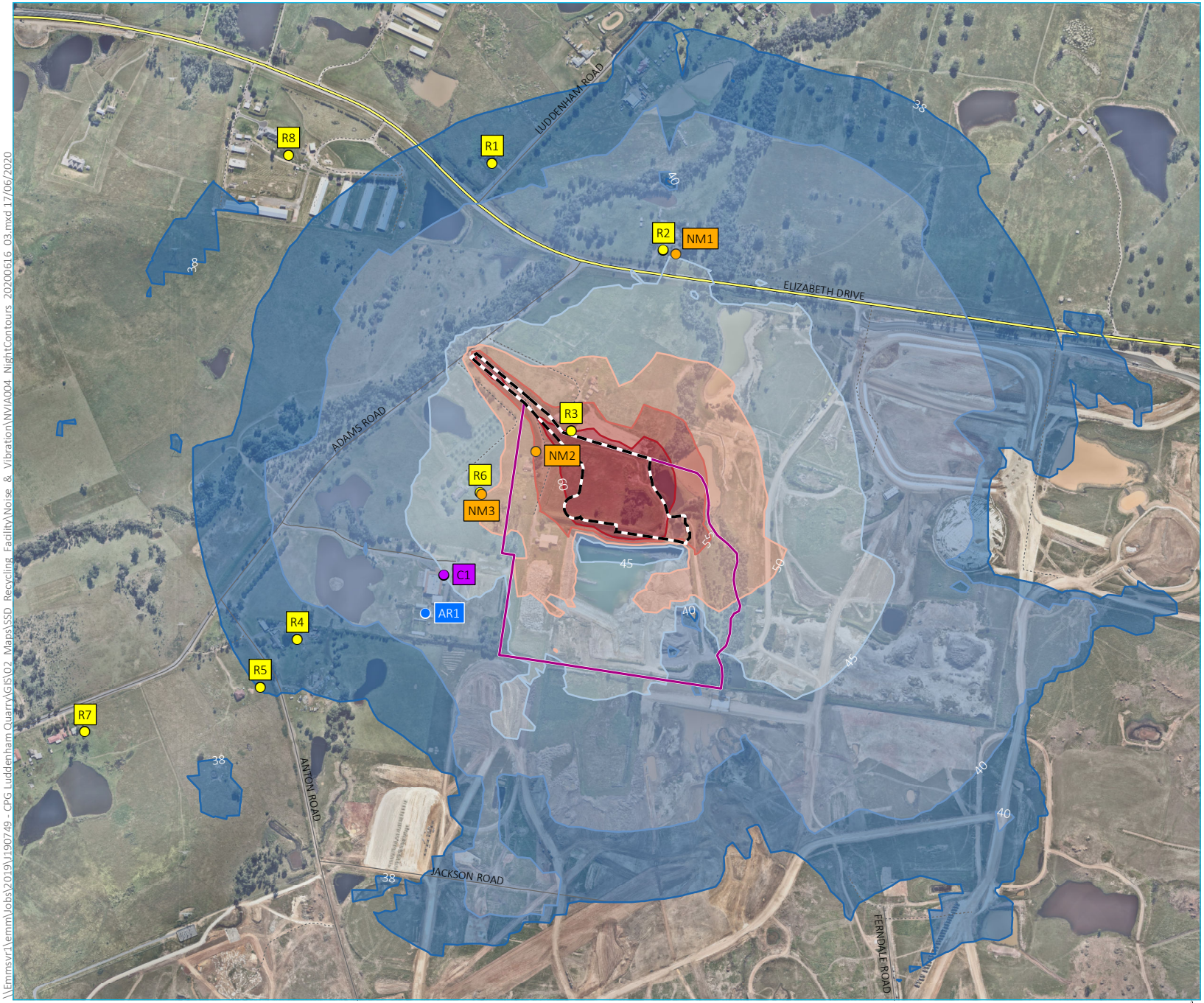
Operational noise contours - evening, calm conditions

Luddenham Advanced Resource Recovery Centre
Noise & Vibration Impact Assessment
Figure 5.2

EMM
creating opportunities



KEY

- Subject property
- ARRC site
- Major road
- Minor road
- Vehicular track
- Noise measurement location

Assessment location

- Active recreation
- Commercial
- Residential

Night noise contour levels - calm conditions

- 38 - 40 dB(A)
- 40 - 42 dB(A)
- 42 - 50 dB(A)
- 50 - 55 dB(A)
- 55 - 60 dB(A)
- 60+ dB(A)

Source: EMM (2020); DFSI (2017); GA (2011); Nearmap (2020)

0 200 400 m

GDA 1994 MGA Zone 56

N

\\Emmsvr1\emm\Jobs\2019\J190749 - CPG Luddenham Quarry\GIS\02 Maps\SSD Recycling Facility\Noise & Vibration\NVIA004 NightContours 20200616 03.mxd 17/06/2020

Operational noise contours - night, calm conditions

Luddenham Advanced Resource Recovery Centre
Noise & Vibration Impact Assessment
Figure 5.3

EMM creating opportunities

5.2 Construction noise

5.2.1 Single point predictions

In accordance with procedures outlined in Section 4.3.3, prediction of construction noise levels are provided in Table 5.4 for standard day periods under ISO9613 conditions. The level presented for each assessment location represents the energy-average noise level over a 15-minute period and assumes all plant operating concurrently. The predicted exceedance of the ICNG noise affected NML at each assessment location is also provided. Modelling has considered Stage 2 works (Table 4.3) that comprise the highest total sound power level of construction works, hence potential for greatest noise impact.

The proponent will manage construction noise levels where exceedances of NMLs have been identified. The construction noise management methods will be detailed in a construction noise management plan.

The ICNG recommends the following where NMLs are predicted to be exceeded:

- application of feasible and reasonable work practices to minimise noise;
- inform potentially impacted residents of the nature of the works to be carried out, expected noise levels and duration and relevant contact details; and
- negotiation with the community where noise from work outside standard hours is predicted to exceed the relevant NML by more than 5 dB.

Table 5.4 Predicted construction noise levels - Stage 1 – road works

Assessment location	Classification	Period[1,2]	Noise affected NML, dB	Highly noise affected NML, dB	Predicted construction noise level, dB $L_{Aeq,15min}$	Level above NML[3]
R1	Residential	Standard	56	75	44	-
R2	Residential	Standard	56	75	50	-
R3	Residential	Standard	49	75	68	+19
R4	Residential	Standard	47	75	44	-
R5	Residential	Standard	47	75	42	-
R6	Residential	Standard	47	75	56	+9
R7	Residential	Standard	47	75	38	-
R8	Residential	Standard	56	75	41	-
AR1	Active recreation	Any period	65	n/a	48	-
C1	Commercial	Any period	70	n/a	50	-

1. Standard hours (7 am to 6 pm Monday to Friday, 8 am to 1 pm Saturday and no work on Sunday or public holidays.
2. Level above NML for Standard hours only

It is predicted that the NML will be exceeded at the closest residential assessment locations (R3 and R6 inclusive). Noise levels do not exceed the highly noise affected NML at any residence. Residents will be notified prior to works commencing. Noise monitoring during the initial stages of construction will be undertaken to determine if actual construction noise levels are above NMLs. If NMLs are exceeded, the proponent will:

- identify feasible and reasonable mitigation measures that reduce construction noise levels to at or below NMLs where practical; and

- maintain construction during ICNG standard hours only.

As described in Section 6.2, the above will be determined depending on the measured level of exceedance and the availability of feasible and reasonable noise mitigation and management measures. It is noted that the predicted noise exceedances for construction activities are generally consistent (within 2 dB at R3) or less (R6) than predicted operational noise exceedances for ARRC and ARRC + Quarry operations during the daytime period at R3 and R6.

5.3 Construction vibration

In relation to human comfort response, the safe working distances in Table 4.4 relate to continuous vibration and apply to residential assessment locations. For most construction activities, vibration emissions are intermittent in nature and for this reason, higher vibration levels, occurring over shorter periods are allowed, as discussed in BS 6472-1.

The nearest residence (R3) is located approximately 40 metres to the closest proposed construction activities. This assessment location is beyond the safe working distances for human response (Table 4.4). Vibration impacts from construction at residential assessment locations are therefore highly unlikely.

The safe working distances for cosmetic damage should be monitored throughout the construction process. Based on the safe working distances guide in Table 4.4, if construction is within 25 m of sensitive structures, then work practices should be reviewed so that the safe working distance in Table 4.4 are followed.

If safe working distances need to be encroached, real time vibration monitoring with audible and visual alarms should be installed at vibration sensitive structures so actual vibration levels can be monitored and managed appropriately in real-time.

5.4 Road traffic noise

In accordance with the RNP, Adams Road is classified as a sub-arterial road and Elizabeth Drive is classified as an arterial road. Based on projected future traffic volumes (Section 4.5.2) and site traffic generation (Section 4.5.3), a summary of the calculated existing and future road traffic noise levels are presented for day and night in Table 5.5 and Table 5.6 respectively. This assessment assumed scenarios of all ARRC traffic travelling on northern section of Adams Road and an even distribution of ARRC traffic on Adams Road north and south of the ARRC site with ARRC operating at full production.

Table 5.5 Road traffic noise calculations – day (7 am to 10 pm)

Road segment	Approximate distance of residential façade from nearest carriageway	Existing movements[1]	Existing plus project movements	RNP Criteria[2,3] L_{Aeq}	Noise level increase due to the Project, $L_{Aeq,15hr}$
		Calculated level, $L_{Aeq,15hr}$	Predicted level, $L_{Aeq,15hr}$		
Operation - 2024					
Adams Road (north)	205 m	46.5	51.4	60	5.0
Adams Road (south)[4]	35 m	63.7	66.8	60	3.2
Elizabeth Drive[5]	45 m	65.4	66.6	60	1.2
Operation - 2029					
Adams Road (north)	205 m	47.0	51.4	60	4.3
Adams Road (south)[4]	35 m	64.2	66.9	60	2.7
Elizabeth Drive[5]	45 m	65.8	66.8	60	1.0

1. Projected future traffic volumes 2024 and 2029 (TIA, EMM 2020)
2. Adams Road is a sub-arterial road and is assessed as LAeq,9hr 55 dBA
3. Elizabeth Drive is an arterial road and assessed as LAeq,9hr 55 dBA
4. Assessment of road traffic noise for Adams Road (south) considered 50% of ARRC traffic travelling south
5. Noise measurements at 2111 Elizabeth Drive were reviewed in conjunction with the classified traffic counts and FHWA predictions and confirmed levels within 1 dB

Predicted noise levels for Adams Road (north) confirm relative increases of 4.3–5.0 dB, however the levels are significantly below the baseline day goal of $L_{Aeq,15hr}$ 60 dBA and satisfies the RNP requirements. Existing daytime traffic noise levels on Elizabeth Drive exceed the baseline RNP criteria of $L_{Aeq,15hr}$ 60 dBA. Assessment of day traffic predictions confirm compliance with the <2 dB allowance criterion for Elizabeth Drive.

Predicted road traffic noise levels for Adams Road (south) for the even distribution of ARRC traffic has confirmed that the RNP day and relative increase criteria area exceeded. In order to reduce road traffic noise level increases to <2 dB, project-related truck trips on Adams Road would need to be restricted to not more than 285 truck trips and 330 trips for the day period for the operational years of 2024 and 2029 to meet the road noise criteria. Alternatively, another mitigation measure, such as at-receiver treatments for impacted residential buildings, could be considered.

Table 5.6 Road traffic noise calculations, Night (10 pm to 7 am)

Road segment	Approximate distance of residential façade from nearest carriageway	Existing movements[1]	Existing plus project movements	RNP Criteria[2,3] L_{Aeq}	Noise level increase due to the Project, $L_{Aeq,9hr}$
		Calculated level, $L_{Aeq,9hr}$	Predicted level, $L_{Aeq,9hr}$		
Operation - 2024					
Adams Road (north)	205 m	42.7	47.4	55	4.7
Adams Road (south)[4]	35 m	59.9	62.8	55	3.0
Elizabeth Drive[5]	45 m	66.1	67.2	55	1.1
Operation - 2029					
Adams Road (north)	205 m	43.2	47.6	55	4.3
Adams Road (south)[4]	35 m	60.4	63.1	55	2.7
Elizabeth Drive[5]	45 m	66.4	67.4	55	1.0

1. Projected future traffic volumes 2024 and 2029 (TIA, EMM 2020)
2. Adams Road is a sub-arterial road and is assessed as LAeq,9hr 55 dBA
3. Elizabeth Drive is an arterial road and assessed as LAeq,9hr 55 dBA
4. Assessment of road traffic noise for Adams Road (south) considered 50% of ARRC traffic travelling south
5. Noise measurements at 2111 Elizabeth Drive were reviewed in conjunction with the classified traffic counts and FHWA predictions and confirmed levels within 1 dB

Predicted noise levels for Adams Road (north) confirm relative increases of 4.3–4.7 dB, however the level is significantly below the baseline night goal of $L_{Aeq,9hr}$ 55 dBA and satisfies the RNP requirements. Existing night-time traffic noise levels on Elizabeth Drive exceed the baseline RNP criteria of $L_{Aeq,9hr}$ 55 dBA. Assessment of night traffic predictions confirm compliance with the <2 dB allowance criterion for Elizabeth Drive.

Predicted road traffic noise levels for Adams Road (south) for even distribution of ARRC traffic has confirmed that the RNP night and relative increase criteria area exceeded. In order to reduce road traffic noise level increases to <2 dB, project-related truck trips on Adams Road would need to be restricted to not more than 72 truck trips and 81 trips per night for the operational years of 2024 and 2029 to meet the road noise criteria. Alternatively, another mitigation measure, such as at-receiver treatments for impacted residential buildings, could be considered.

This assessment has necessarily made a number a traffic assumptions. The actual traffic noise impacts will be dependent on the rate of background traffic growth, the rate at which the AARC reaches full production and the project-related traffic distribution.

6 Noise mitigation and management

6.1 Operation

6.1.1 Onsite noise

The operation of the ARRC is expected to commence following the rezoning of the land under the Aerotropolis SEPP this is expected to occur in 2020. It is anticipated that ARRC construction will commence in mid-2021 and ARRC operations will commence in 2022. If the application to modify the quarry's consent (MOD5, see Section 1.2) is approved, quarry operations will recommence as soon as possible and will be complete by December 2024. Airport operations are scheduled to start in 2026.

With the transition of land to industrial or commercial land use under either the Agribusiness or Enterprise zone, application of the industrial amenity criteria in accordance with the procedures of the NPfI (NPfI Table 2.2) for isolated residences in industrial zoned land would result in noise compliance with the relevant amenity noise goal of $L_{Aeq,period}$ 65 dB / $L_{Aeq,15min}$ 68 dB. Notwithstanding, the applicants will consult with the affected residents regarding potential noise mitigation measures.

Additional noise mitigation measures to reduce noise impacts, to comply with PTNLs as closely as reasonably and feasibly possible, will be required if operations commence prior to the area being rezoned (see Section 5.1).

If construction of the ARRC is completed (anticipated to be late 2021) prior to rezoning of the area (anticipated to occur in 2020), the ARRC will only be operated during daytime hours until the completion of quarry operations in December 2024.

With the restriction in ARRC operations to daytime only, noise exceedances are restricted to assessment locations R3 (unoccupied) and R6. In this case, additional further noise mitigation measures will also be required to reduce noise impacts at R3 and R6. These measures may include the following:

- including of acoustic walls in the site design;
- automatic doors on the warehouse;
- acoustic treatments to residences; and
- negotiated agreements with residents.

6.1.2 Traffic noise

Based on current traffic growth projections on Adams Road, traffic noise increase criteria are predicted to be exceeded on the Adams Road south of the ARRC site, assuming that there is an even distribution of ARRC traffic on Adams Road north and south of the ARRC site and that the ARRC is operating at full production.

Potential measures that could be implemented are:

- Restrict project-related truck trips on Adams Road south of the ARRC site as follows:
  - Daytime (7am to 10 pm): 225 truck trips (in 2024) and 330 truck trips (in 2029); and
  - Night (10 pm to 7am): 72 truck trips (in 2024) and 81 truck trips (in 2029).
- At-receiver treatments for impacted residential buildings.

These would need to be adjusted based on to the actual non-project related traffic using Adams Road in these years.

6.2 Construction

6.2.1 General

The EPA's NSW ICNG requires that construction noise levels are assessed against NMLs.

Construction is expected to commence in mid-2021. Construction noise levels above NMLs have been predicted for residential assessment locations prior to rezoning (expected to occur in 2020). It is not uncommon for construction projects to exceed NMLs. For this reason, they are not considered as noise criteria, but as a trigger for all feasible and reasonable noise mitigation and management to be considered, once exceeded.

There is limited opportunity due to proximity of residential assessment locations, site location and local topography to provide significant noise mitigation. Management measures that could be implemented on site are provided in the following sections. It is noted that the predicted noise exceedances for construction activities are generally consistent (within 2 dB at R3) or less than predicted operational noise exceedances (R6) for ARRC and ARRC + Quarry operations during daytime period at R3 and R6.

6.2.2 Work practices

Feasible and reasonable mitigation measures to reduce construction noise levels will be reviewed and implemented subject to imposed Conditions of Approval and the status of rezoning.

Work practice methods may include:

- regular reinforcement (such as at toolbox talks) of the need to minimise noise and vibration;
- avoiding the use of portable radios, public address systems or other methods of site communication that may unnecessarily impact upon nearby residents;
- develop routes for the delivery of materials and parking of vehicles to minimise noise;
- where possible, avoid the use of equipment that generates impulsive noise; and
- notify residents prior to the commencement of intensive works.

6.2.3 Plant and equipment

Additional measures for plant and equipment may include:

- where possible, choose quieter plant and equipment based on the optimal power and size to most efficiently perform the required tasks;
- operate plant and equipment in the quietest and most efficient manner; and
- regularly inspect and maintain plant and equipment to minimise noise and vibration level increases, to ensure that all noise and vibration reduction devices are operating effectively.

6.2.4 Quantifying noise reductions

Approximate noise reductions provided by some of these measures are provided in Table 6.1.

Table 6.1 Relative effectiveness of various forms of noise control

Noise control	Nominal noise reduction possible, in total A-weighted sound pressure level, dB
Increase source to receiver distance[1]	approximately 6 dB for each doubling of distance
Reduce equipment operating times or turn off idling machinery[2]	approximately 3 dB per halving of operating time
Operating training on quiet operation[2]	Up to 3 to 5 dB
Screening (eg noise barrier)[1]	normally 5 dB to 10 dB, maximum 15 dB
Enclosure (eg shed/building)[1]	normally 15 dB to 25 dB, maximum 50 dB
Silencing (eg exhaust mufflers) [1]	normally 5 dB to 10 dB, maximum 20 dB

1. Sourced from AS2436-2010
2. Based on EMM's measurement experience at construction and mining sites

7 Conclusion

This assessment has been prepared to consider the noise and vibration impacts of the ARRC on existing noise-sensitive assessment locations in the area in terms of site operations and related traffic impacts associated with the use of the Adams Road site access by ARRC vehicles and to review cumulative noise associated with MOD5 quarry operations during the day. The assessment considers the potential changes to the area as the development of the Western Sydney Aerotropolis and noise exposure as outlined in the Western Sydney Airport EIS, Assessment of Ground-Based Operational Noise, prepared by Wilkinson Murray (September 2015).

7.1 Operations

Prior to the rezoning of the land, it is predicted that the PNTLs at assessment locations will be met during the operation of the ARRC alone with the following exceptions:

- Day: R3 (+16 dB) and R6 (+9 dB);
- Evening: R2 (+4 dB), R3 (+16 dB) and R6 (+10 dB); and
- Night: R2 (+9 dB), R3 (+21 dB), R4 (+4 dB), R5 (+3 dB) and R6 (+14 dB).

Prior to the rezoning of the land, it is predicted that the ARRC noise levels will satisfy the day amenity level (53 dBA) at most assessment locations, with the exception being R3 (currently unoccupied).

Under the definitions of Section 4.2 of NPfI (see Table 3.5) the predicted noise exceedances of intrusiveness noise level would be considered **moderate** at R1 to R6.

If the ARRC commences operations prior to the area being rezoned, operation of the combined ARRC and quarry, it is predicted that the day PNTLs at assessment locations will be exceeded at:

- R3 (+17 dB);
- R4 (+5 dB);
- R5 (+4 dB); and
- R6 (+13 dB).

The results indicate that there will be a marginal to moderate increases in cumulative levels for assessment locations R4 and R5, whilst significant, as defined in Section 4.2 of the NPfI (see Table 3.5), increases are predicted for R3 and R6.

The modelling predicts that the applicable amenity noise levels will be satisfied at the active recreation (AR1) and commercial (C1) components of the Hubertus Club for both ARRC and cumulative ARRC and MOD5 quarry operations.

Therefore, additional noise mitigation measures, such as restricting operational hours, noise mitigation measures or negotiated agreements, will be required if ARRC operations commence prior to the area being rezoned. If construction of the ARRC is completed (anticipated to be late 2021) prior to rezoning of the area (anticipated to occur in 2020), the ARRC will only be operated during daytime hours until the completion of quarry operations in December 2024.

After to the rezoning of the land, it is predicted that the ARRC noise levels will satisfy the applicable industrial amenity criterion ($L_{Aeq,15min}$ 68 dB), for isolated residences in industrial zoned land, at all assessment locations (Table 5.1). Therefore, it is generally predicted that the criterion will be met at all future developments on these properties. However, this will be in part dependent on the configuration of the developments.

Road traffic noise levels are predicted to satisfy RNP assessment requirements on the Adams Road north of the ARRC site and on Elizabeth Drive. There is the potential for road traffic noise levels to exceed RNP assessment criteria on Adams Road south of the ARRC site and management measures or restrictions on project-related traffic movements may be required.

7.2 Construction

Construction noise levels from the project are predicted to exceed noise management levels (NMLs) at the closest assessment locations, with exceedances greater than 10 dB above NML at R3 and R6 closest to the site. Accordingly, residents will be notified prior to works commencing. Noise monitoring during construction will be considered to determine if actual construction noise levels are above NMLs. Subject to the measured level of exceedance, availability of feasible and reasonable noise mitigation and management measures will be determined. This is discussed further in Section 4.3. Predicted noise exceedances for construction activities are generally consistent (within 2 dB at R3) or less than predicted operational noise exceedances (R6) for ARRC and ARRC + Quarry operations during daytime period at R3 and R6.

The potential for vibration impacts on residents and vibration sensitive structures near construction has been assessed. The nearest residence to construction activity is assessment location R3 which is approximately 40 m away from closest construction activities. This assessment location is outside of the safe working distances of likely plant, required to maintain acceptable human response and structural vibration levels. Vibration impacts from construction at residential assessment locations are therefore highly unlikely.

With the effective management and incorporation of mitigation and management measures listed in Section 6.2, construction noise and vibration emissions from the project can be managed to minimise impacts.

References

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Wilkinson Murray 2015, Western Sydney Airport Environmental Impact Statement, Volume 4, Appendix E2, *Airport Ground-based Noise and Vibration - Western Sydney Airport EIS, Assessment of Ground-Based Operational Noise*, (Report No. 14168-1 Version F).

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WSPP 2019a *Draft State Environmental Planning Policy (Western Sydney Aerotropolis) mapping*

Abbreviations

Abbreviation	Term
ARL	Acoustic Research Laboratories
AGL	above ground level
ANZEC	Australian and New Zealand Environment Council
ABL	Assessment background level
BoM	Bureau of Meteorology
CSSI	critical State significant infrastructure
CEMP	Construction Environmental Management Plan
DECC	Department of Environment and Climate Change
DEC	Department of Environment and Conservation
DEFRA	Department of Environment, Food and Rural Affairs (United Kingdom)
D&B	drill and blast
DP&E	Department of Planning and Environment
EPA	Environmental Protection Authority
EIS	environmental impact statement
EMM	EMM Consulting Pty Limited
Future Gen	Future Generation Joint Venture
FHWA	US EPA Federal Highways
GWh	gigawatt hours
HV	heavy vehicle
ICNG	Interim Construction Noise Guideline
LGAs	local government areas
LV	light vehicle
MAT	Main Access Tunnel
MW	megawatts
NATA	National Association of Testing Authorities
NPfI	Noise Policy for Industry
NML	noise management level
NVIA	Noise and vibration impact assessment
OOH	out of hours
PHES	Pumped Hydro-Electric Storage
PPV	peak particle velocity
POEO Act	Protection of the Environment Operations Act 1997 (NSW)
PNTL	project noise trigger level
RBL	rating background level
RNP	Road Noise Policy
RMS	root mean square
SHL	Snowy Hydro Limited
SEARs	Secretary's environmental assessment requirements
SSI	State significant infrastructure
VDV	vibration dose value

Glossary

Technical terms typically utilised in a noise assessment report are explained in Table 7.1.

Table 7.1 Glossary of acoustic terms and abbreviations

Abbreviation or term	Definition
ABL	The assessment background level (ABL) is defined in the INP as a single figure background level for each assessment period (day, evening and night). It is the tenth percentile of the measured L_{A90} statistical noise levels.
Amenity noise level	The amenity noise levels relate to the overall level of industrial noise subject to land zoning or use
A-weighting	There are several different weightings utilised for describing noise, the most common being the 'A-weighting'. This attempts to closely approximate the frequency response of the human ear.
Day period	Monday–Saturday: 7.00 am to 6.00 pm, on Sundays and public holidays: 8.00 am to 6.00 pm.
dB	Noise is measured in units called decibels (dB).
DPIE	NSW Department of Planning, Industry and Environment
EA	Environmental assessment
EMM	EMM Consulting Pty Limited
EP&A Act	NSW *Environmental and Planning Assessment Act 1979* (NSW)
EPA	NSW Environment Protection Authority (formerly the Department of Environment, Climate Change and Water).
Evening period	Monday–Saturday: 6.00 pm to 10.00 pm, on Sundays and public holidays
ICNG	Interim Construction Noise Guideline
Intrusive noise level	The intrusive noise level refers to noise that intrudes above the background level by more than 5 dB.
L_{A1}	The A-weighted noise level exceeded for 1% of the time.
L_{A10}	The A-weighted noise level which is exceeded 10% of the time. It is roughly equivalent to the average of maximum noise level.
L_{A90}	The A-weighted noise level that is exceeded 90% of the time. Commonly referred to as the background noise level.
L_{Aeq}	The A-weighted energy average noise level. This is the equivalent continuous sound pressure level over a given period. The $L_{Aeq(15\text{-}minute)}$ descriptor refers to an L_{Aeq} noise level measured over a 15 minute period.
L_{Amax}	The maximum A-weighted sound pressure level received during a measurement interval.
Night period	Monday–Saturday: 10.00 pm to 7.00 am, on Sundays and public holidays: 10.00 pm to 8.00 am.
NMP	Noise management plan
PNTL	The project noise trigger levels (PNTLs) are targets for a particular industrial noise source or industry. The PNTLs are the lower of either the project intrusive noise level or project amenity noise level.
POEO Act	NSW *Protection of the Environment Operations Act 1997* (NSW)
RBL	The rating background level (RBL) is an overall single value background level representing each assessment period over the whole monitoring period. The RBL is used to determine the intrusiveness criteria for noise assessment purposes and is the median of the average background levels.
RNP	Road Noise Policy

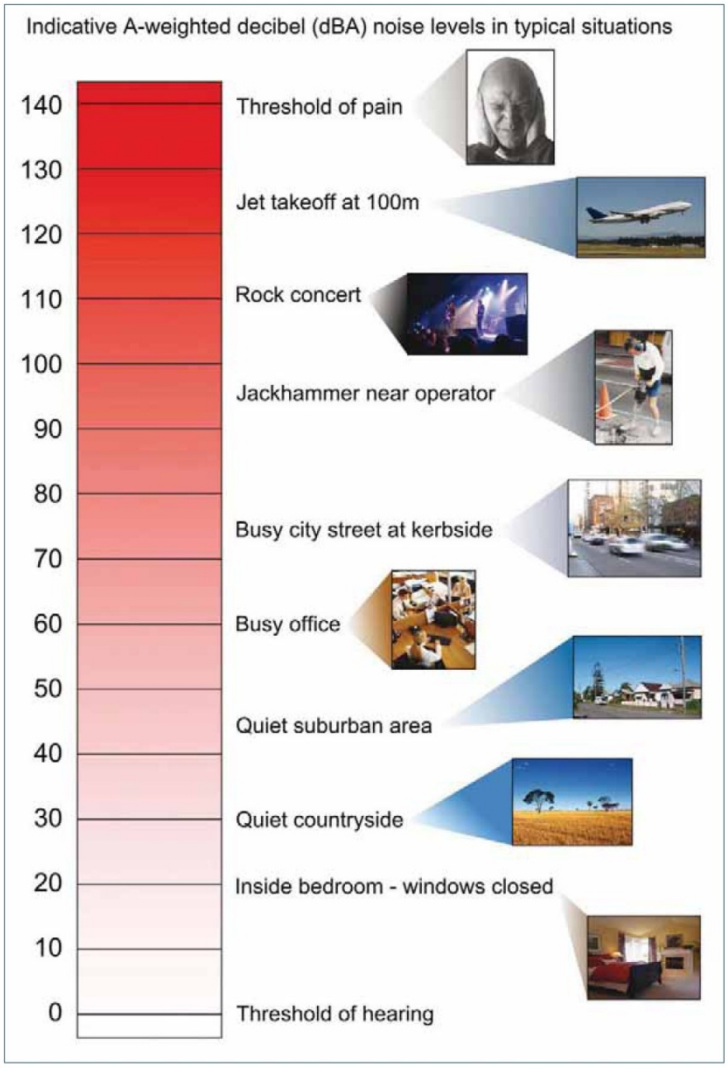
Table 7.1 Glossary of acoustic terms and abbreviations

Abbreviation or term	Definition
Sound power level (L_w)	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.
Temperature inversion	A meteorological condition where the atmospheric temperature increases with altitude.

It is useful to have an appreciation of decibels (dB), the unit of noise measurement. Table 7.2 gives an indication as to what an average person perceives about changes in noise levels. Examples of common noise levels are provided in Figure 7.1.

Table 7.2 Perceived change in noise

Change in sound level (dB)	Perceived change in noise
3	just perceptible
5	noticeable difference
10	twice (or half) as loud
15	large change
20	four times (or quarter) as loud



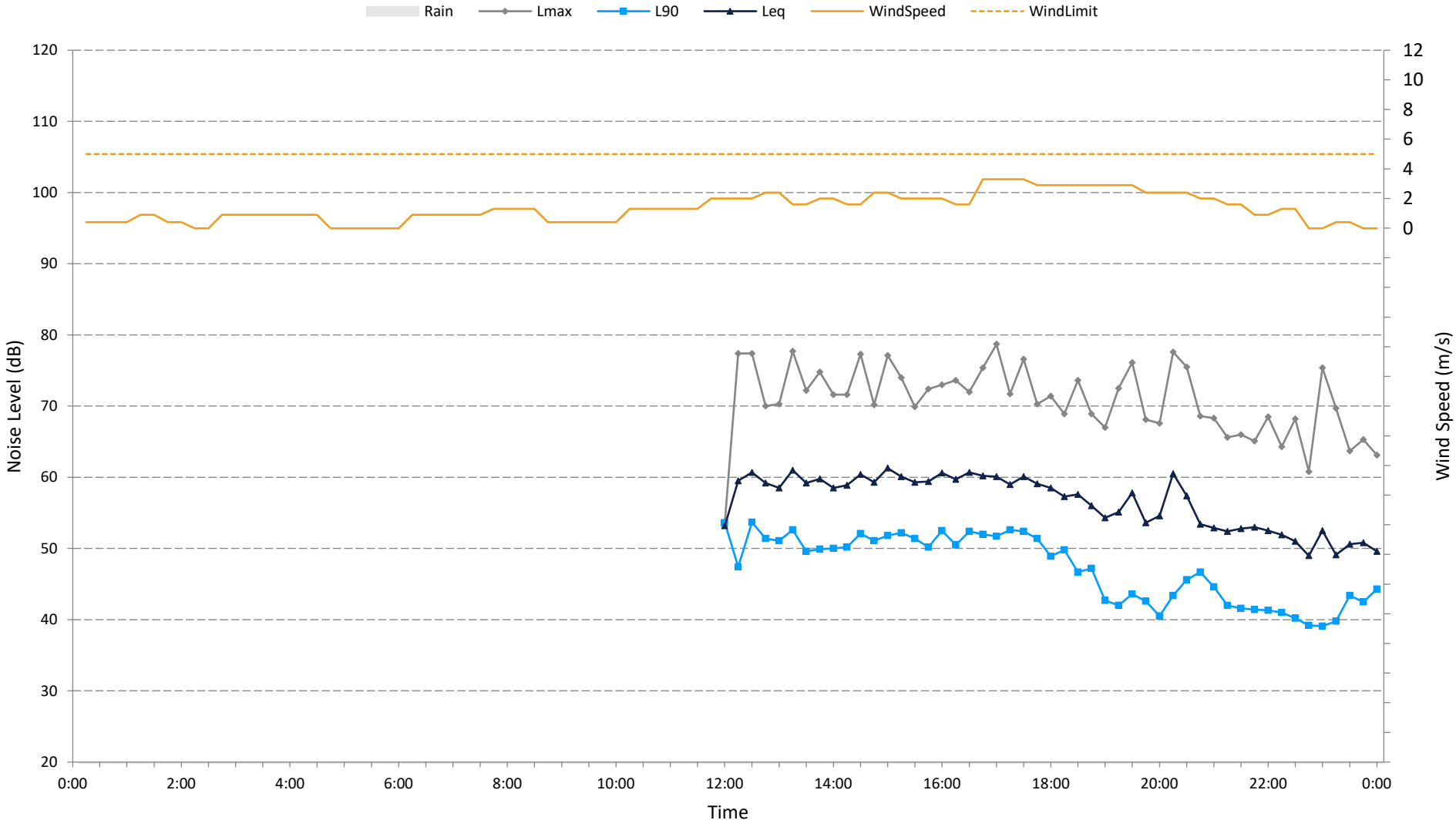
Source: Road Noise Policy (Department of Environment, Climate Change and Water 2011)

Figure 7.1 Common noise levels

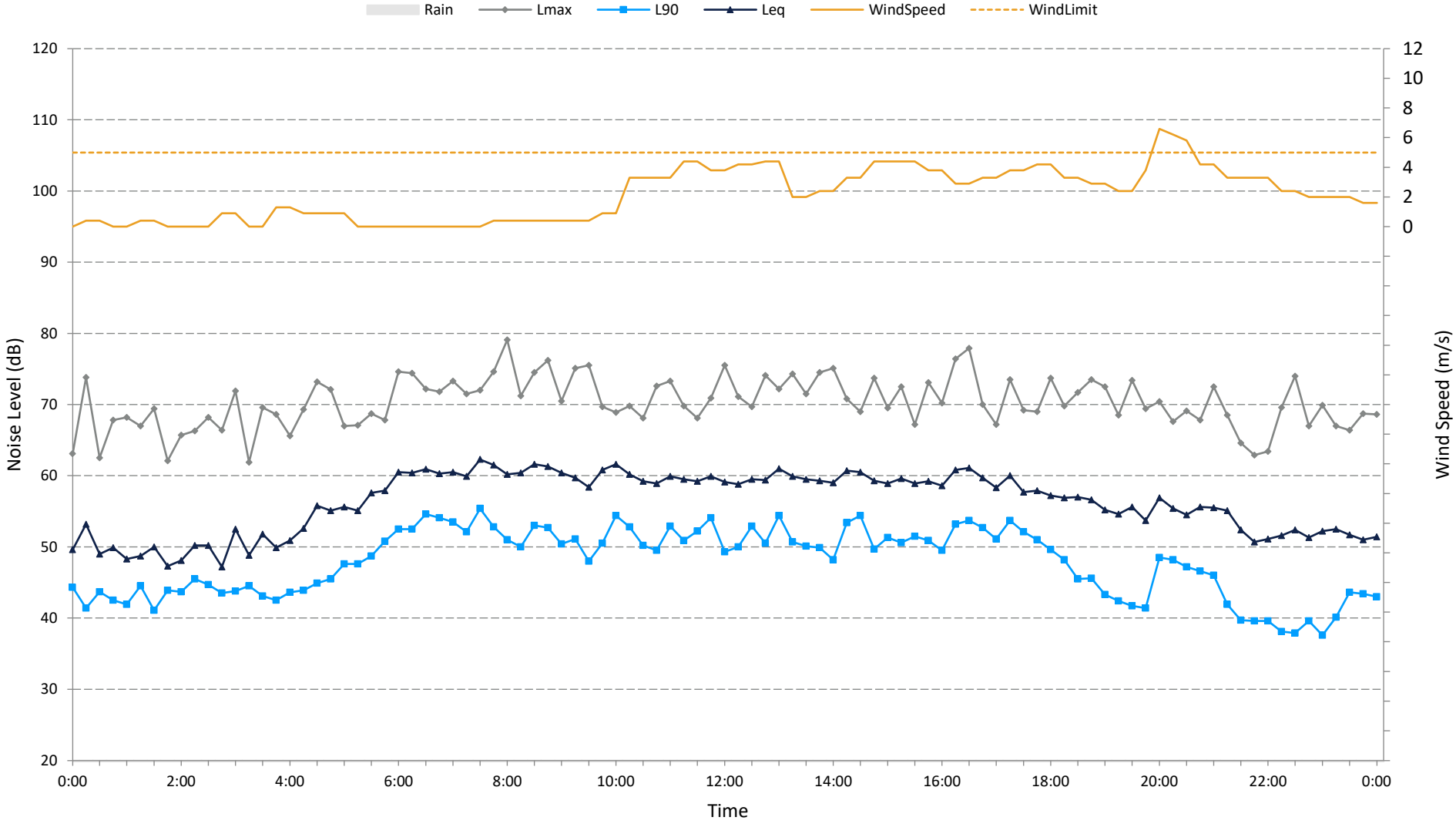
Appendix A

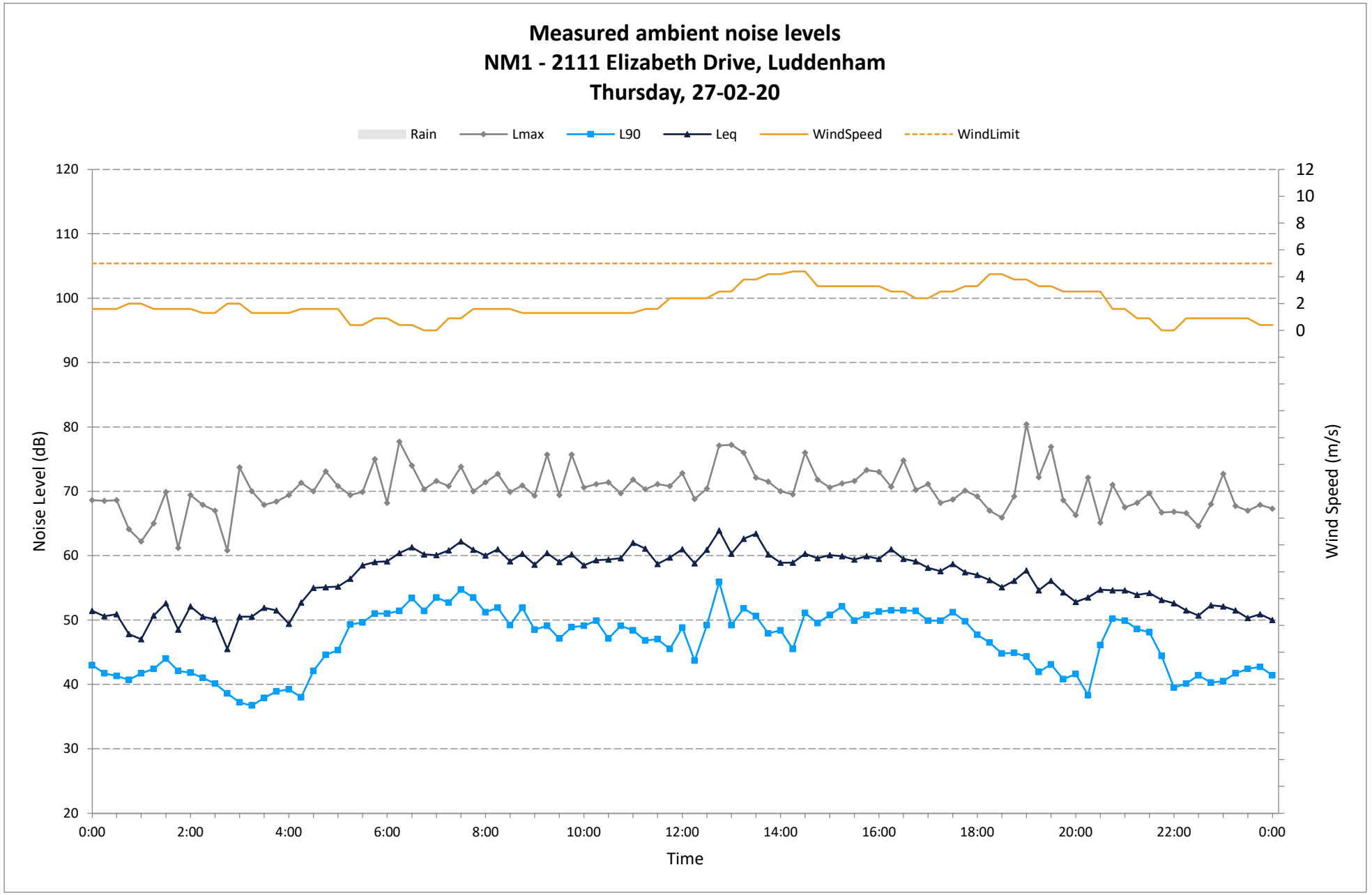
Ambient noise monitoring results

Measured ambient noise levels
NM1 - 2111 Elizabeth Drive, Luddenham
Tuesday, 25-02-20

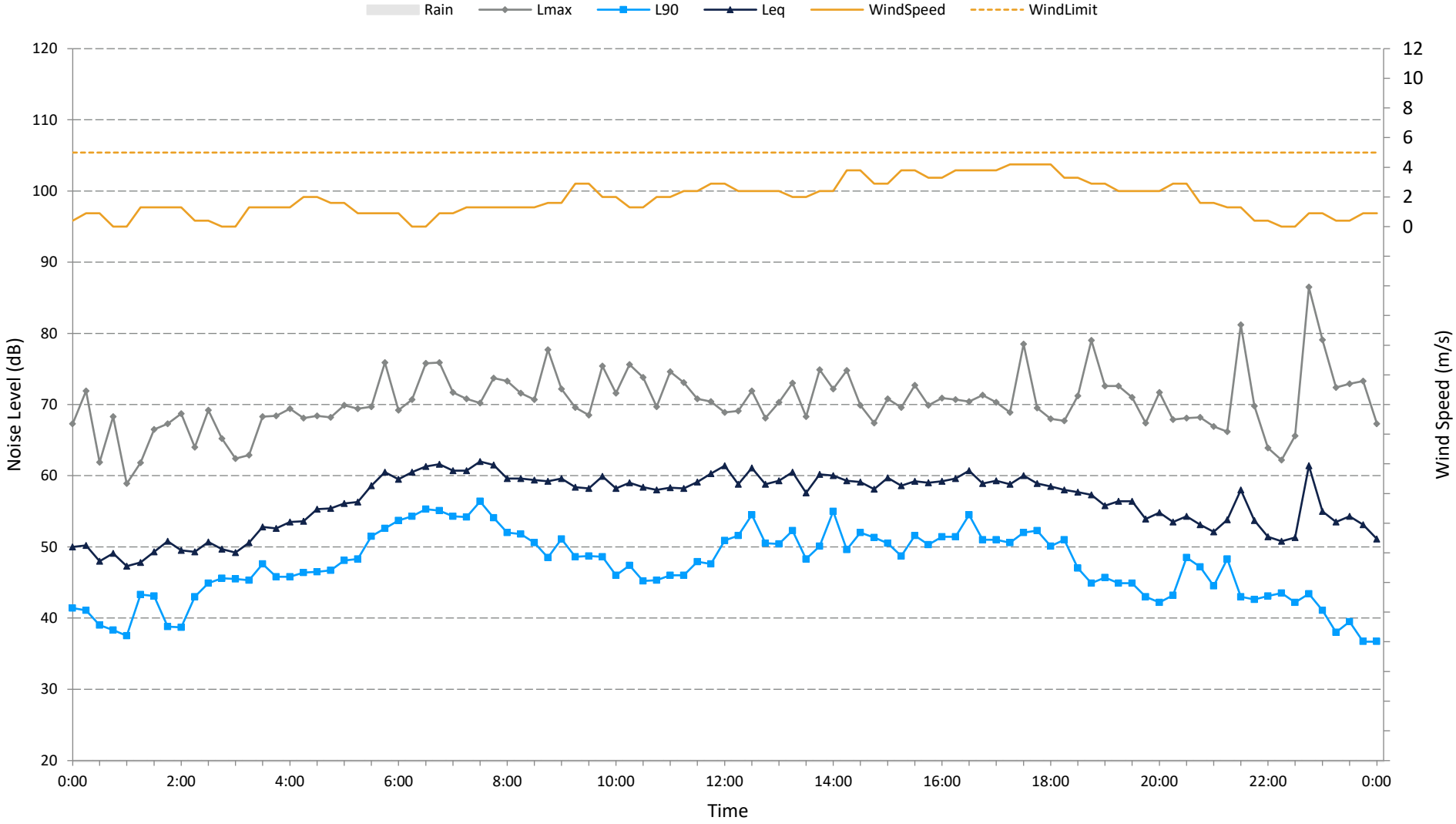


Measured ambient noise levels
NM1 - 2111 Elizabeth Drive, Luddenham
Wednesday, 26-02-20

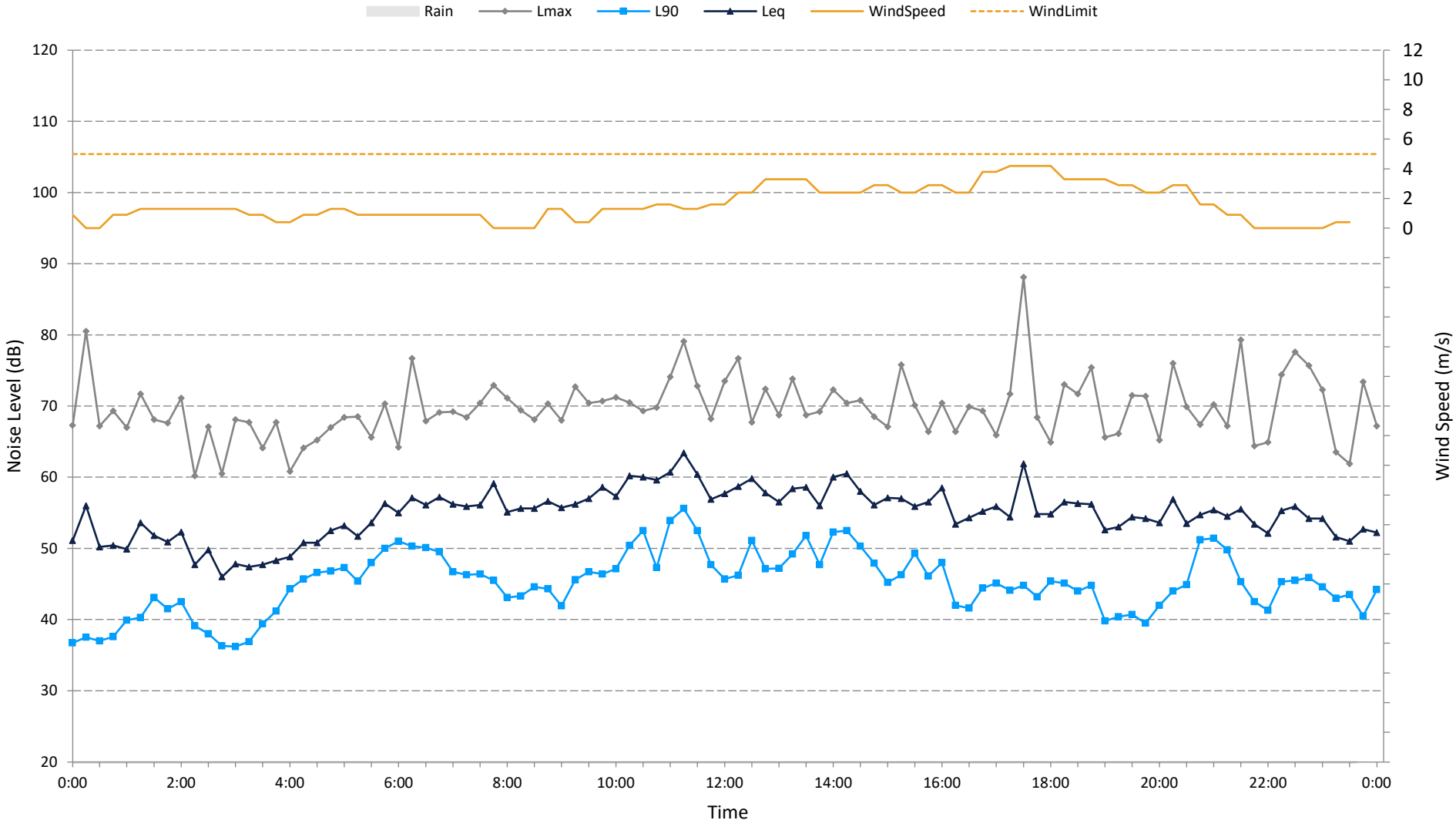



Measured ambient noise levels
NM1 - 2111 Elizabeth Drive, Luddenham
Thursday, 27-02-20
Rain
Lmax
L90
Leq
WindSpeed
WindLimit
Noise Level (dB)
Wind Speed (m/s)
Time
120
110
100
90
80
70
60
50
40
30
20
12
10
8
6
4
2
0
0:00
2:00
4:00
6:00
8:00
10:00
12:00
14:00
16:00
18:00
20:00
22:00
0:00

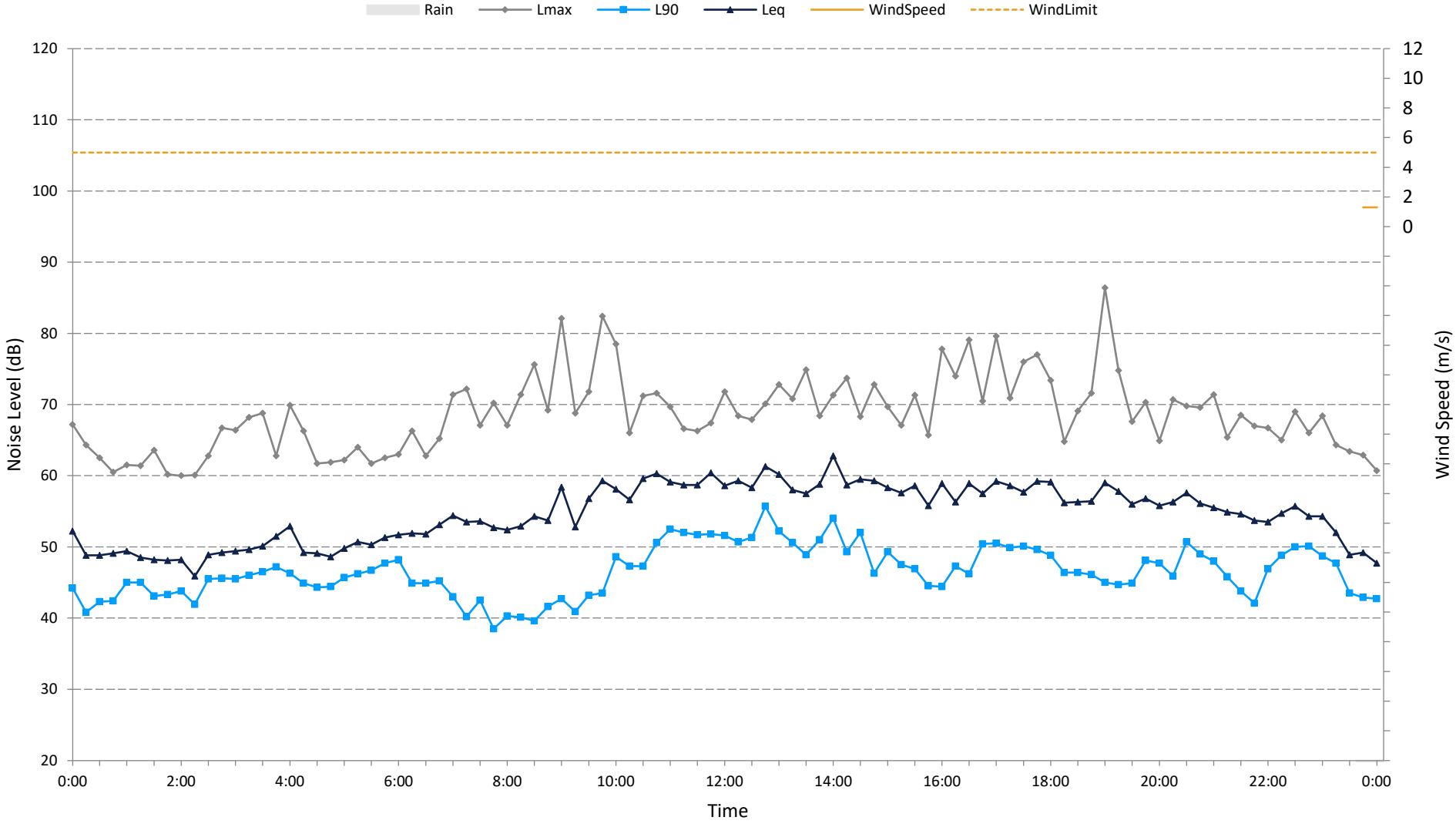
Measured ambient noise levels
NM1 - 2111 Elizabeth Drive, Luddenham
Friday, 28-02-20



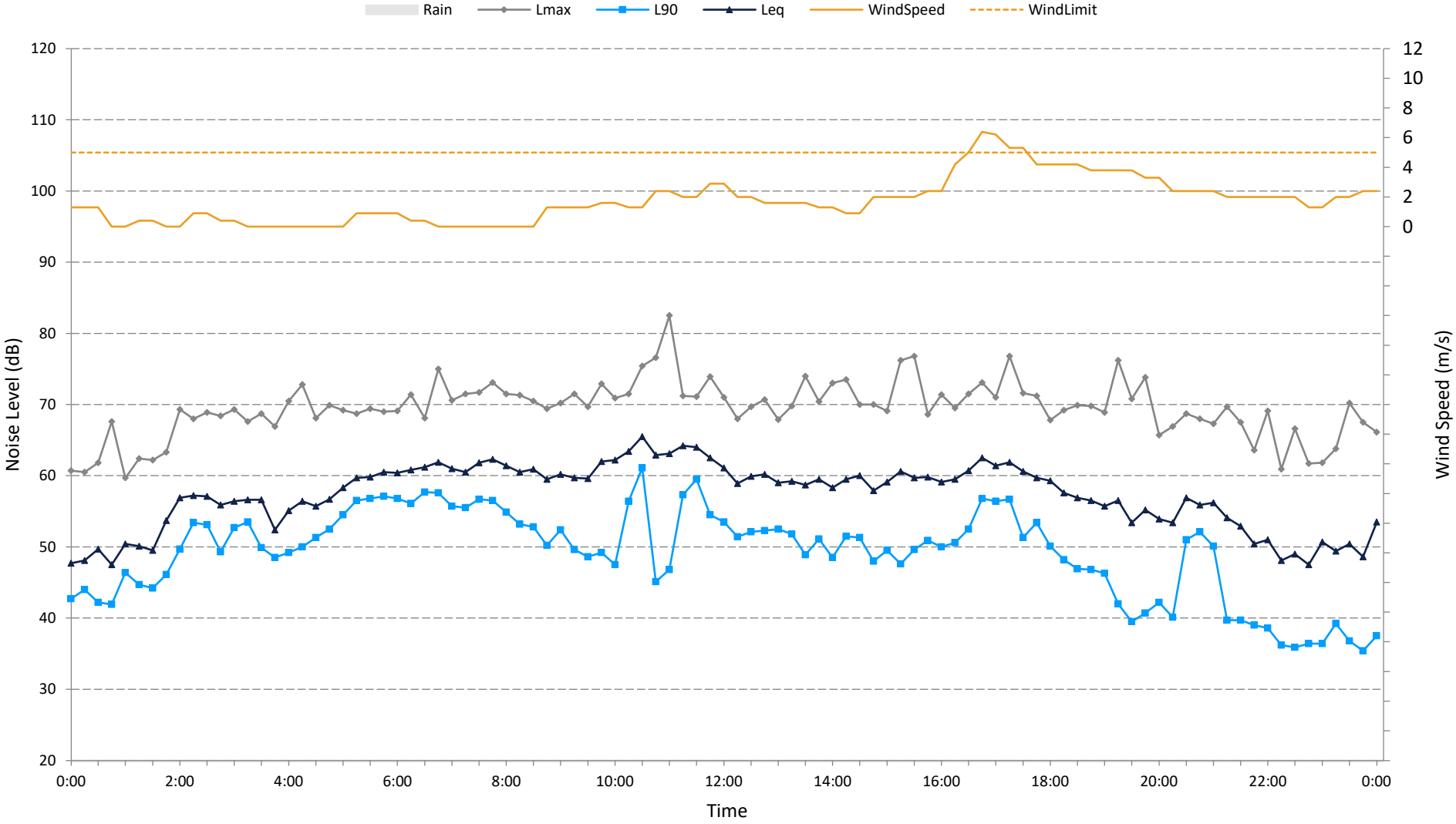
Measured ambient noise levels
NM1 - 2111 Elizabeth Drive, Luddenham
Saturday, 29-02-20



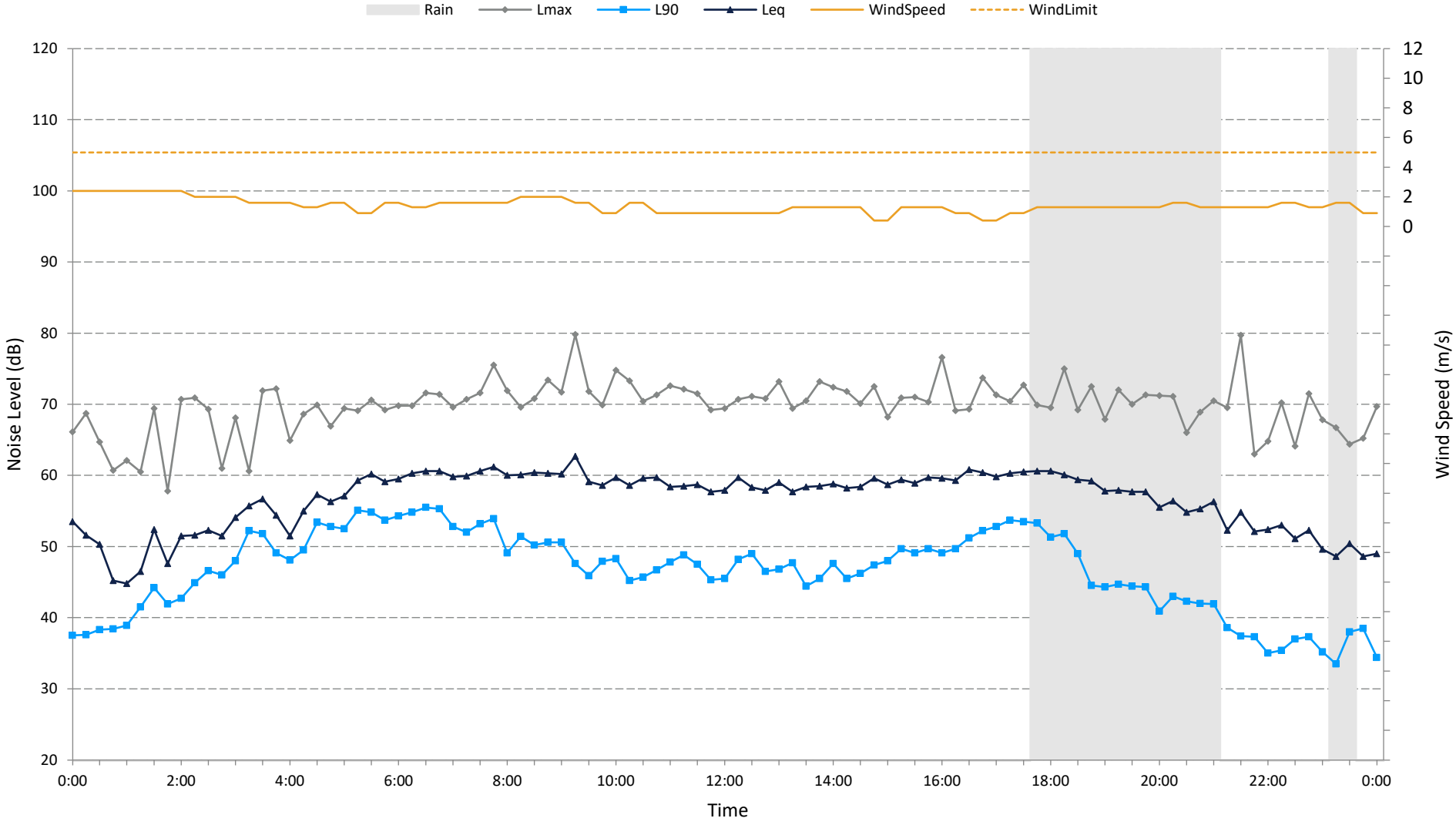
Measured ambient noise levels
NM1 - 2111 Elizabeth Drive, Luddenham
Sunday, 01-03-20

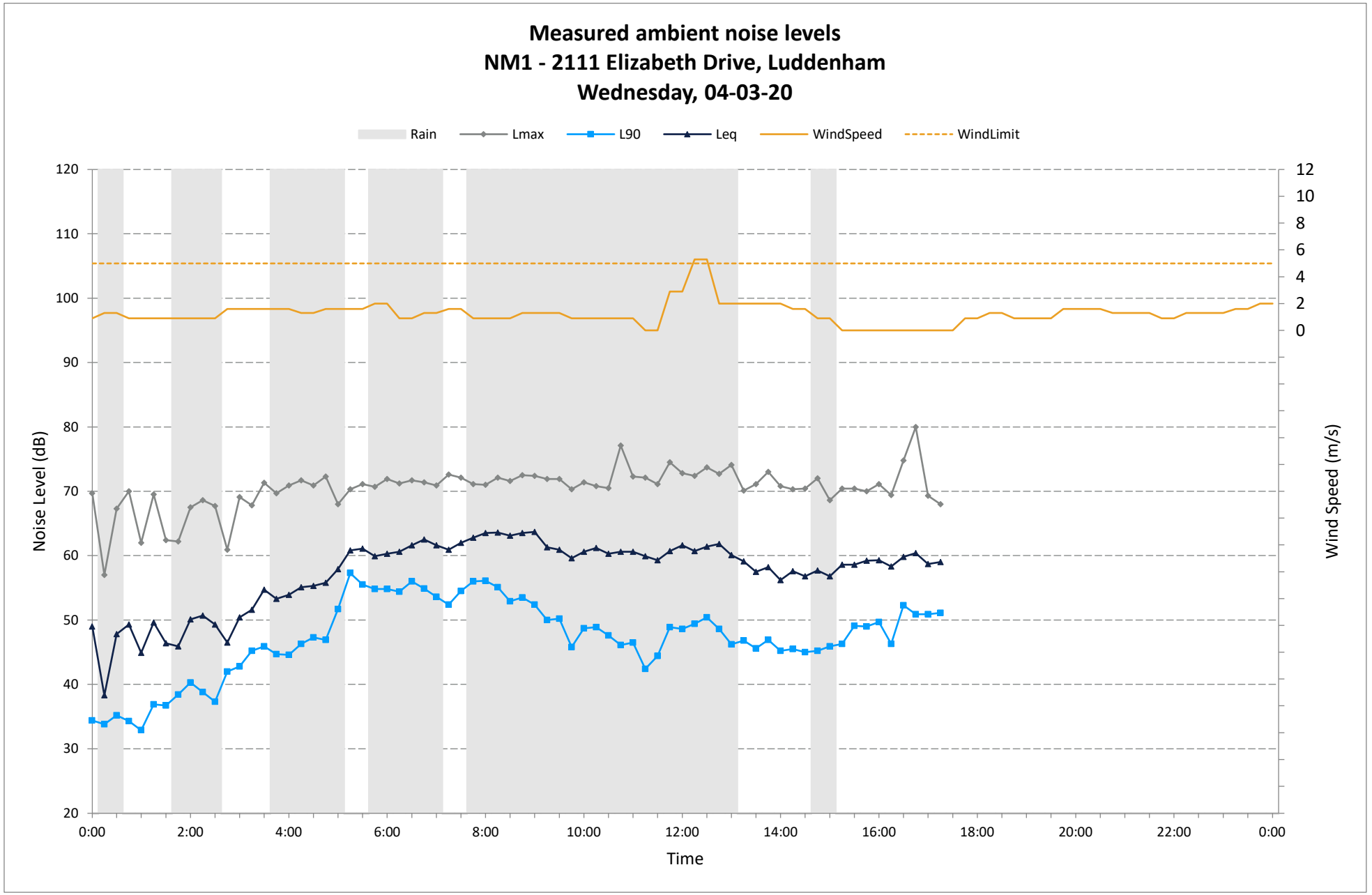


Measured ambient noise levels
NM1 - 2111 Elizabeth Drive, Luddenham
Monday, 02-03-20



Measured ambient noise levels
NM1 - 2111 Elizabeth Drive, Luddenham
Tuesday, 03-03-20




Measured ambient noise levels
NM1 - 2111 Elizabeth Drive, Luddenham
Wednesday, 04-03-20
Rain
Lmax
L90
Leq
WindSpeed
WindLimit
Noise Level (dB)
Wind Speed (m/s)
Time
120
110
100
90
80
70
60
50
40
30
20
12
10
8
6
4
2
0
0:00
2:00
4:00
6:00
8:00
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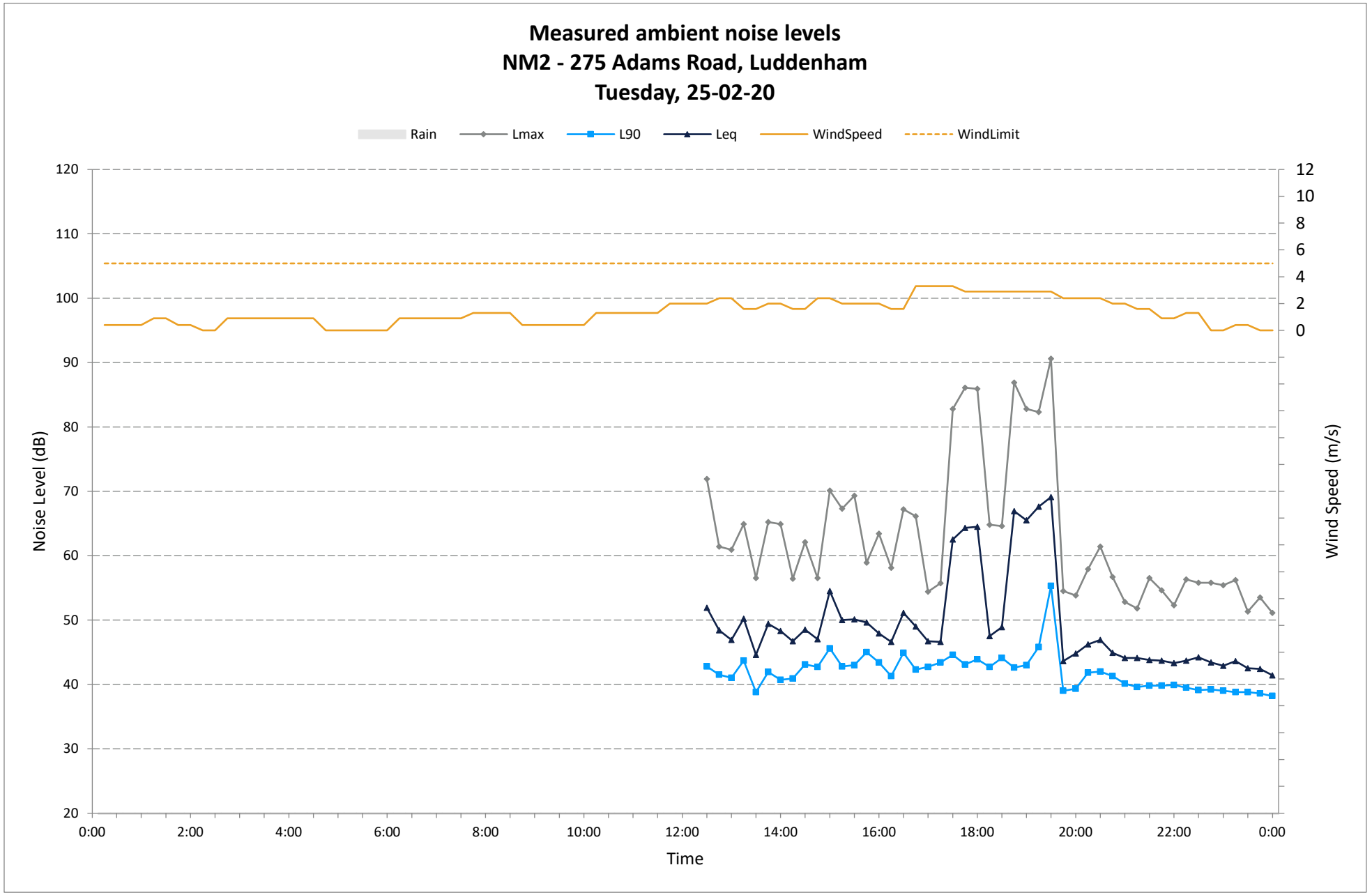
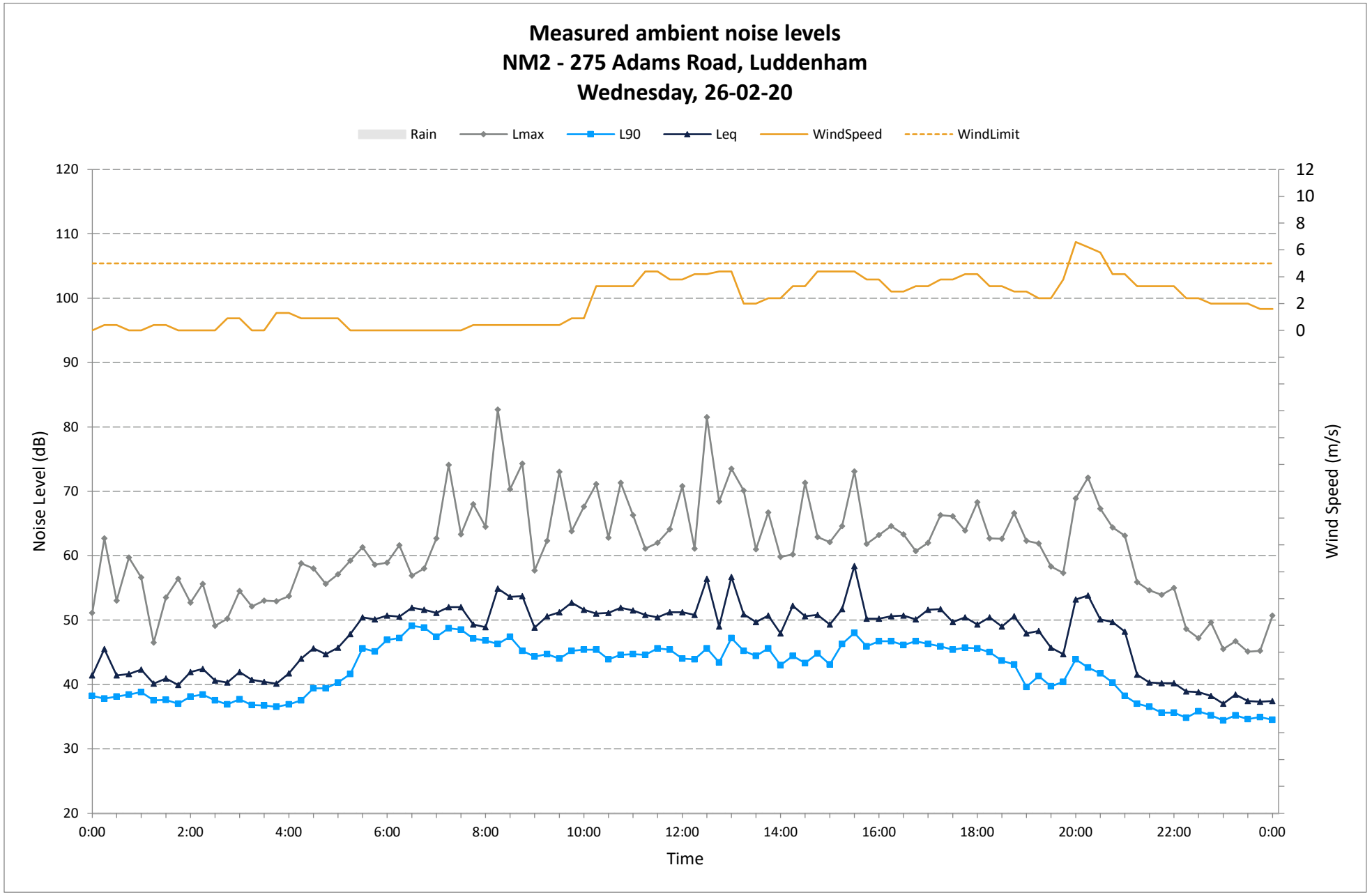
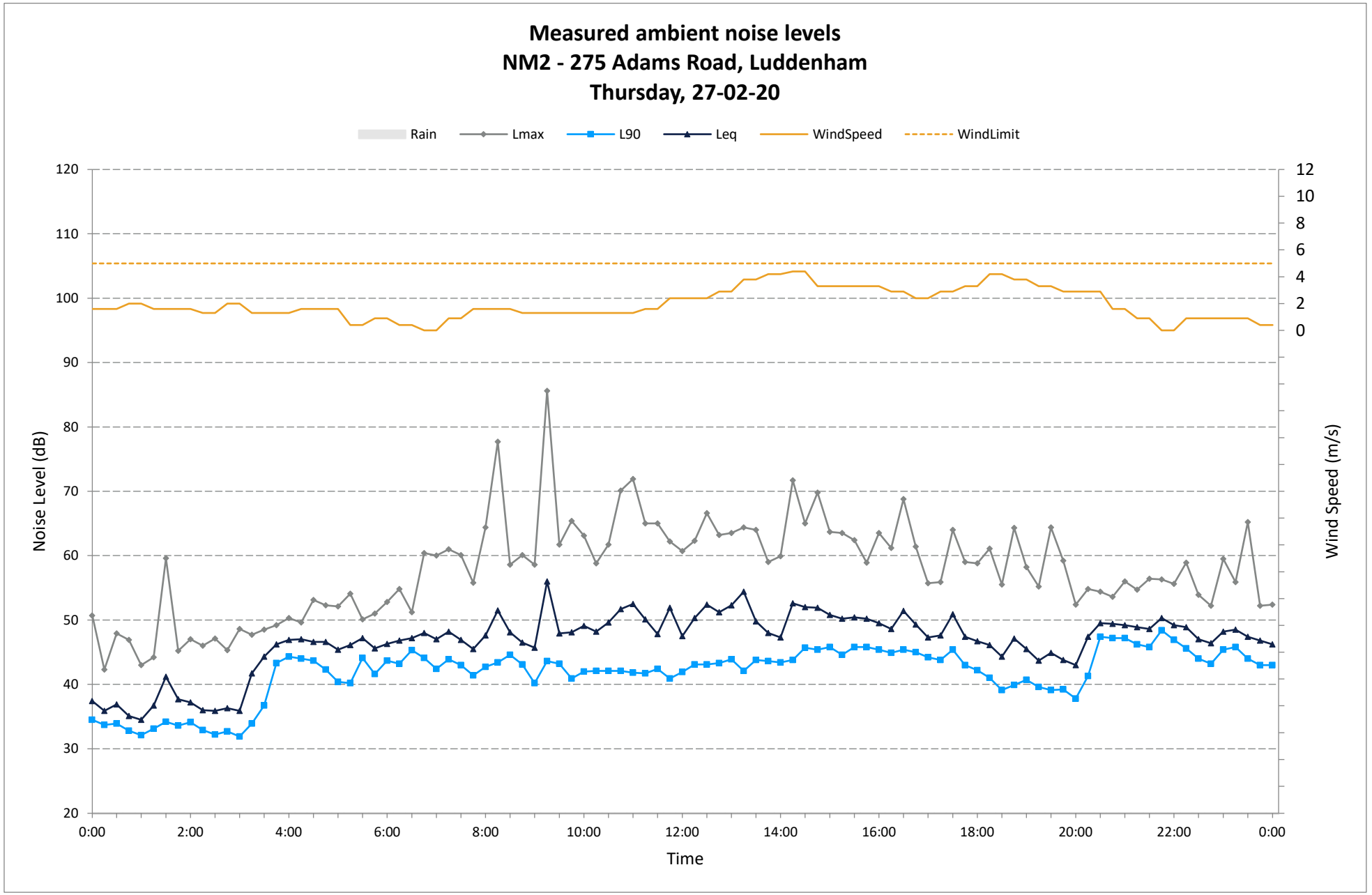
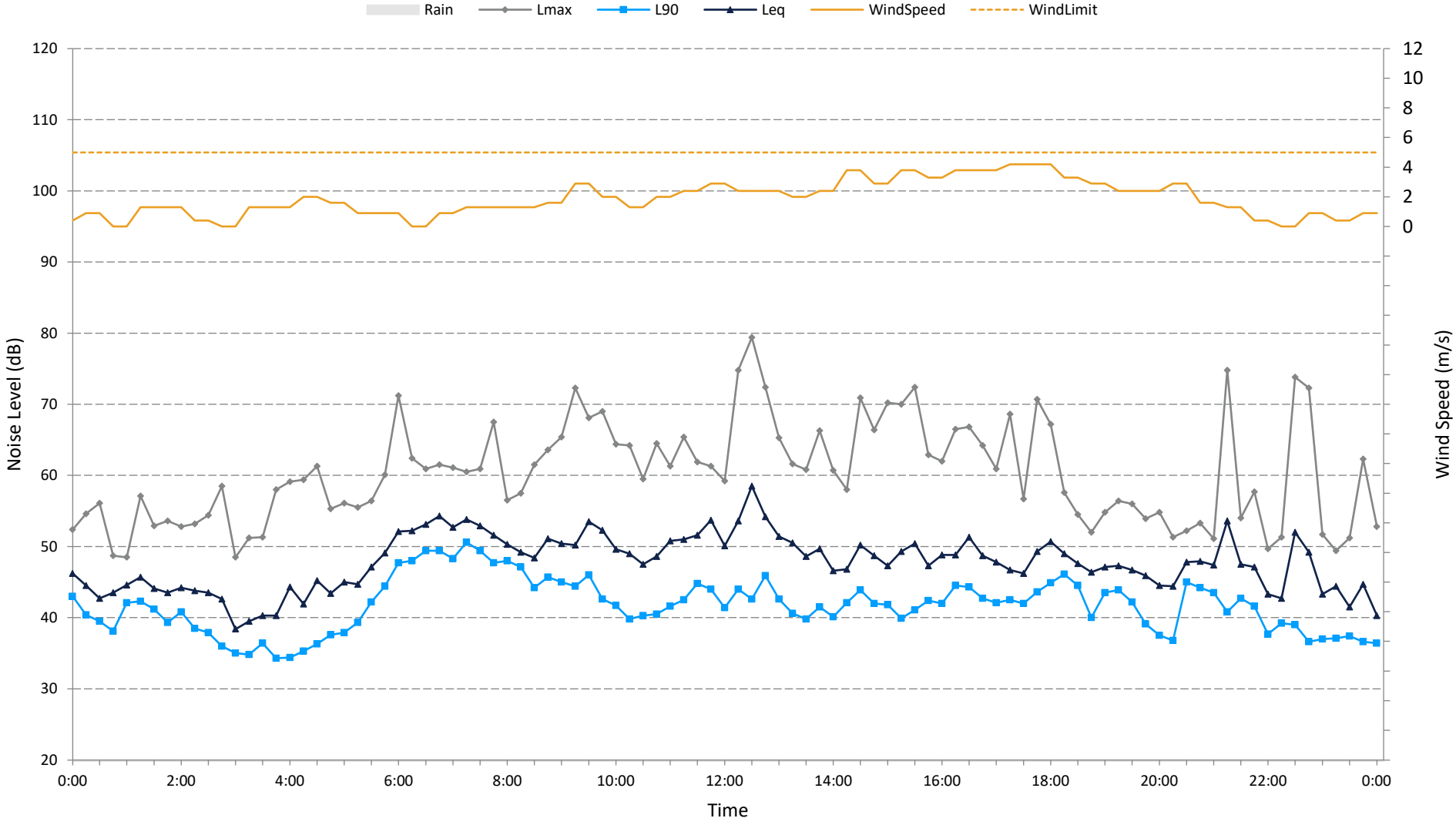
12:00
14:00
16:00
18:00
20:00
22:00
0:00

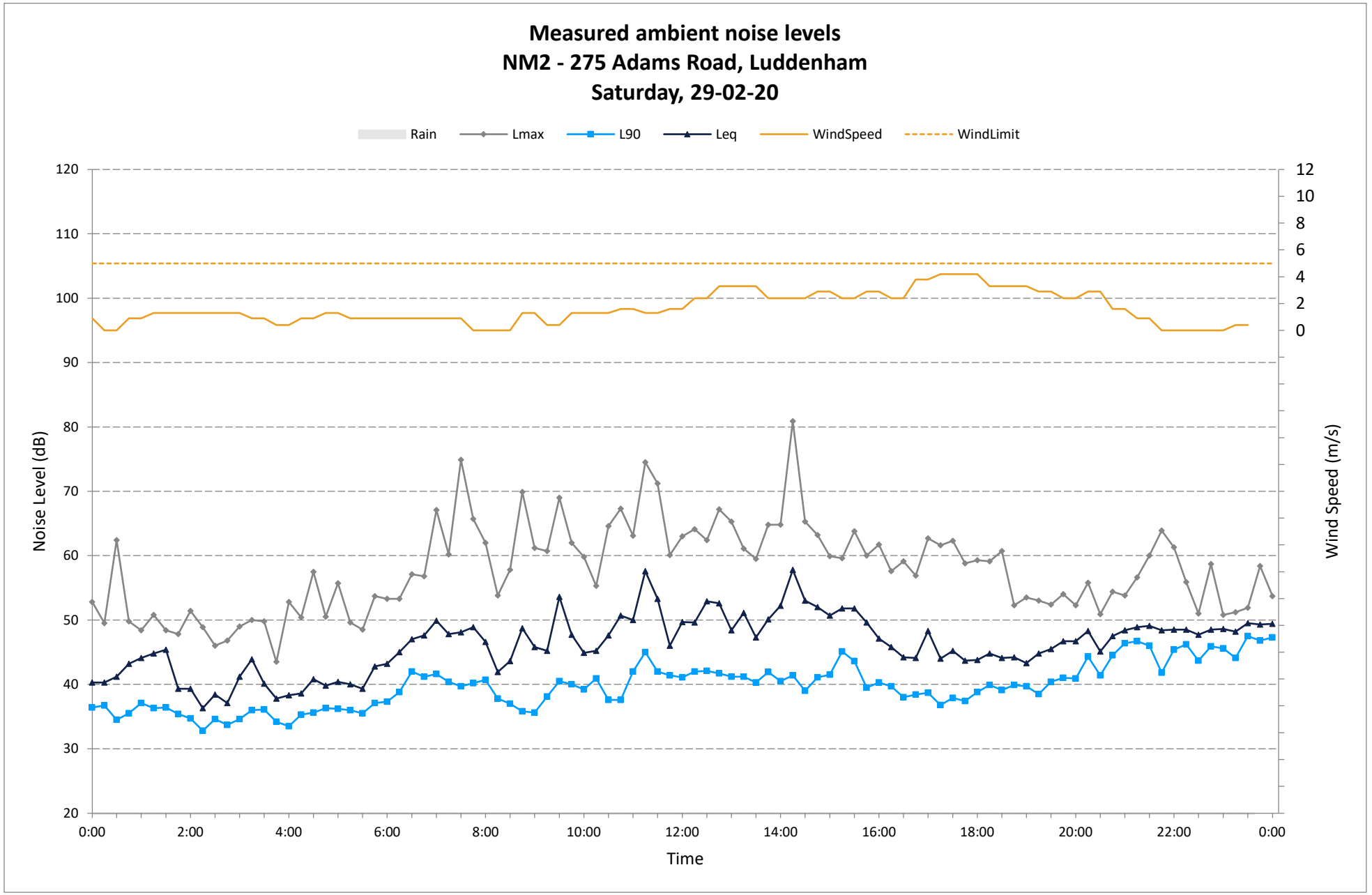

Measured ambient noise levels
NM2 - 275 Adams Road, Luddenham
Tuesday, 25-02-20
Rain
Lmax
L90
Leq
WindSpeed
WindLimit
Noise Level (dB)
Wind Speed (m/s)
Time
120
110
100
90
80
70
60
50
40
30
20
12
10
8
6
4
2
0
0:00
2:00
4:00
6:00
8:00
10:00
12:00
14:00
16:00
18:00
20:00
22:00
0:00


Measured ambient noise levels
NM2 - 275 Adams Road, Luddenham
Wednesday, 26-02-20
Rain
Lmax
L90
Leq
WindSpeed
WindLimit
Noise Level (dB)
Wind Speed (m/s)
Time
120
110
100
90
80
70
60
50
40
30
20
12
10
8
6
4
2
0
0:00
2:00
4:00
6:00
8:00
10:00
12:00
14:00
16:00
18:00
20:00
22:00
0:00


Measured ambient noise levels
NM2 - 275 Adams Road, Luddenham
Thursday, 27-02-20
Rain
Lmax
L90
Leq
WindSpeed
WindLimit
Noise Level (dB)
Wind Speed (m/s)
Time
120
110
100
90
80
70
60
50
40
30
20
12
10
8
6
4
2
0
0:00
2:00
4:00
6:00
8:00
10:00
12:00
14:00
16:00
18:00
20:00
22:00
0:00

Measured ambient noise levels
NM2 - 275 Adams Road, Luddenham
Friday, 28-02-20




Measured ambient noise levels
NM2 - 275 Adams Road, Luddenham
Saturday, 29-02-20
Rain
Lmax
L90
Leq
WindSpeed
WindLimit
Noise Level (dB)
Wind Speed (m/s)
Time
120
110
100
90
80
70
60
50
40
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20
12
10
8
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0:00
2:00
4:00
6:00
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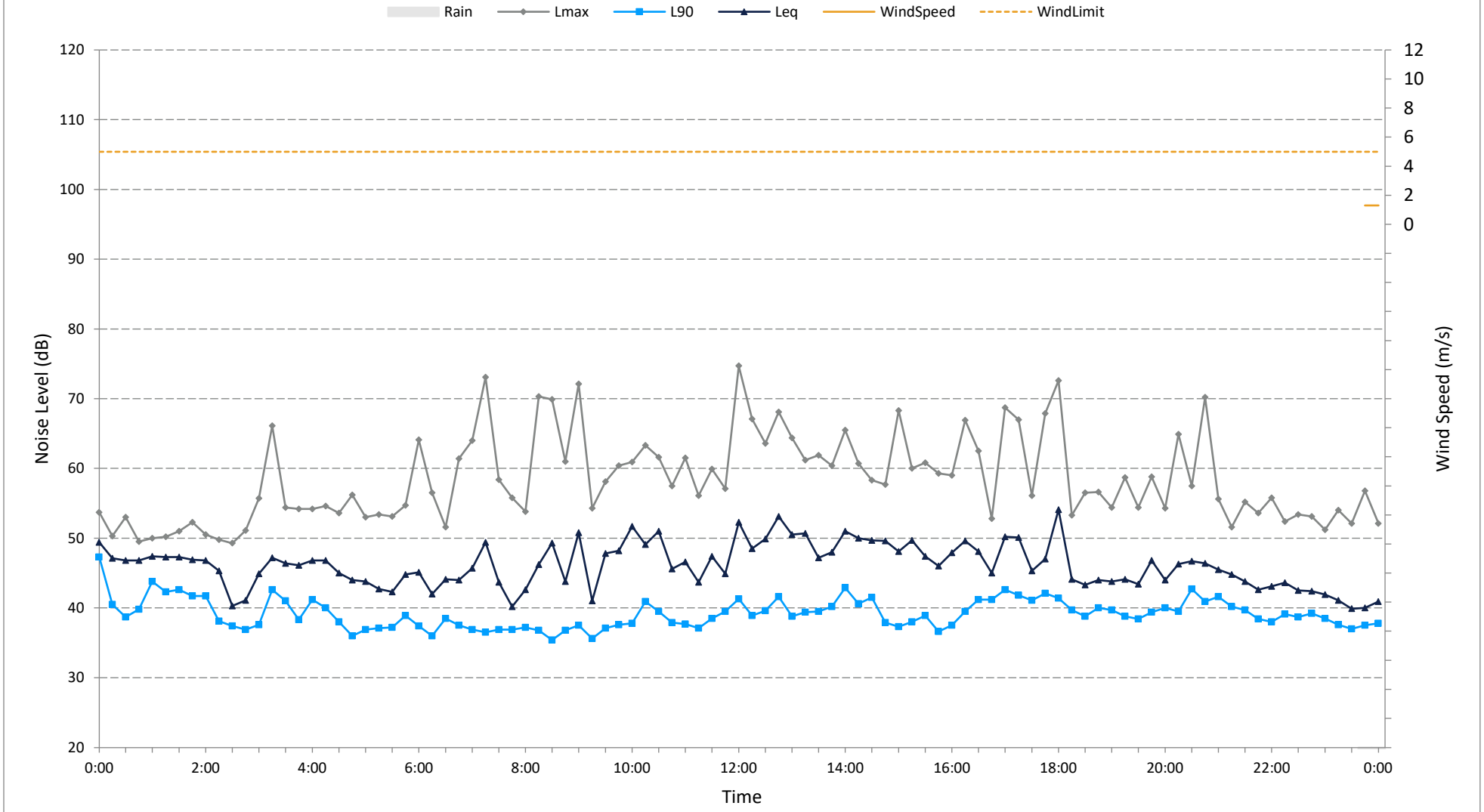
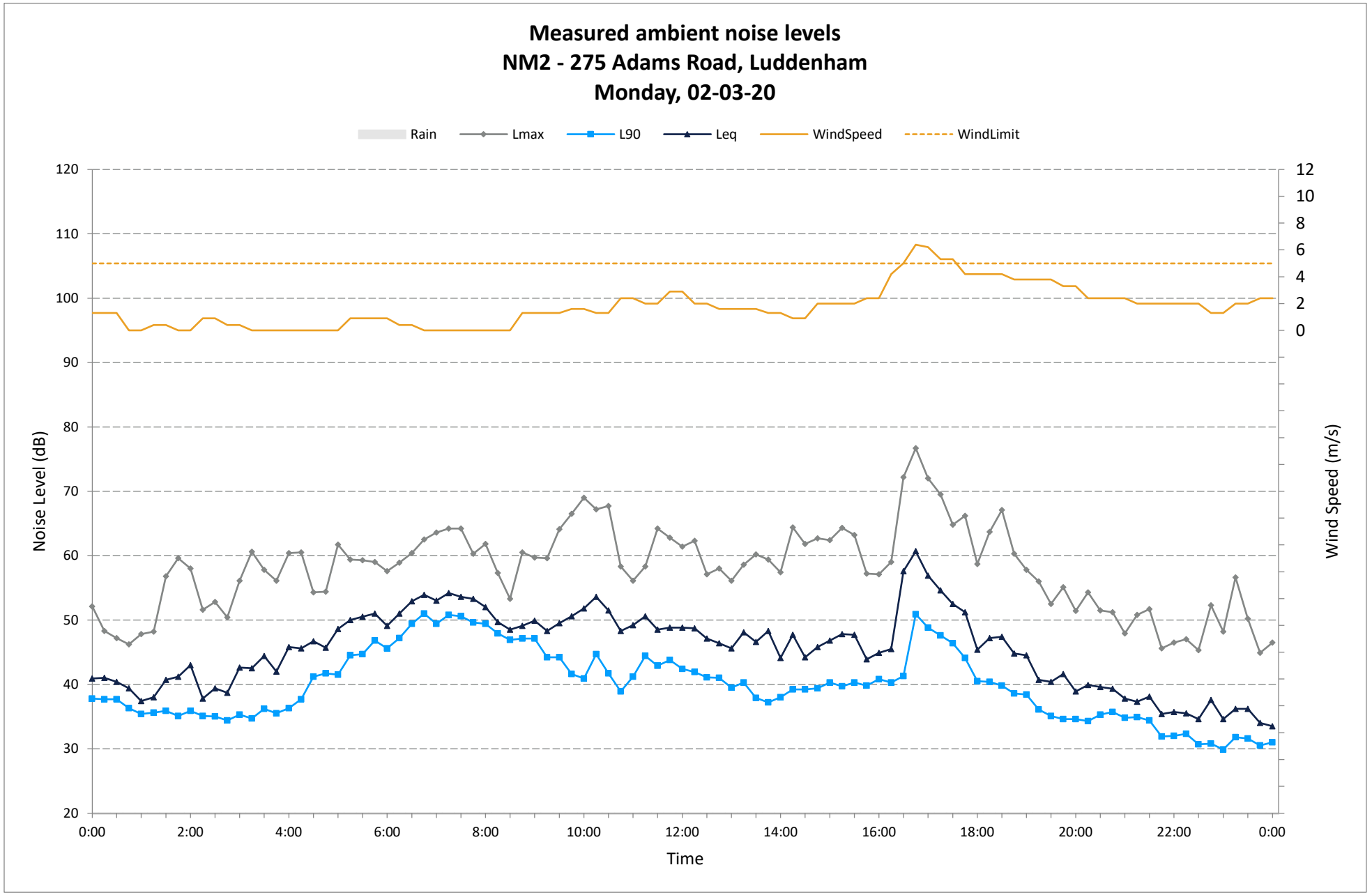
10:00
12:00
14:00
16:00
18:00
20:00
22:00
0:00

Measured ambient noise levels
NM2 - 275 Adams Road, Luddenham
Sunday, 01-03-20




Measured ambient noise levels
NM2 - 275 Adams Road, Luddenham
Monday, 02-03-20
Rain
Lmax
L90
Leq
WindSpeed
WindLimit
Noise Level (dB)
Wind Speed (m/s)
Time
120
110
100
90
80
70
60
50
40
30
20
12
10
8
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2
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0:00
2:00
4:00
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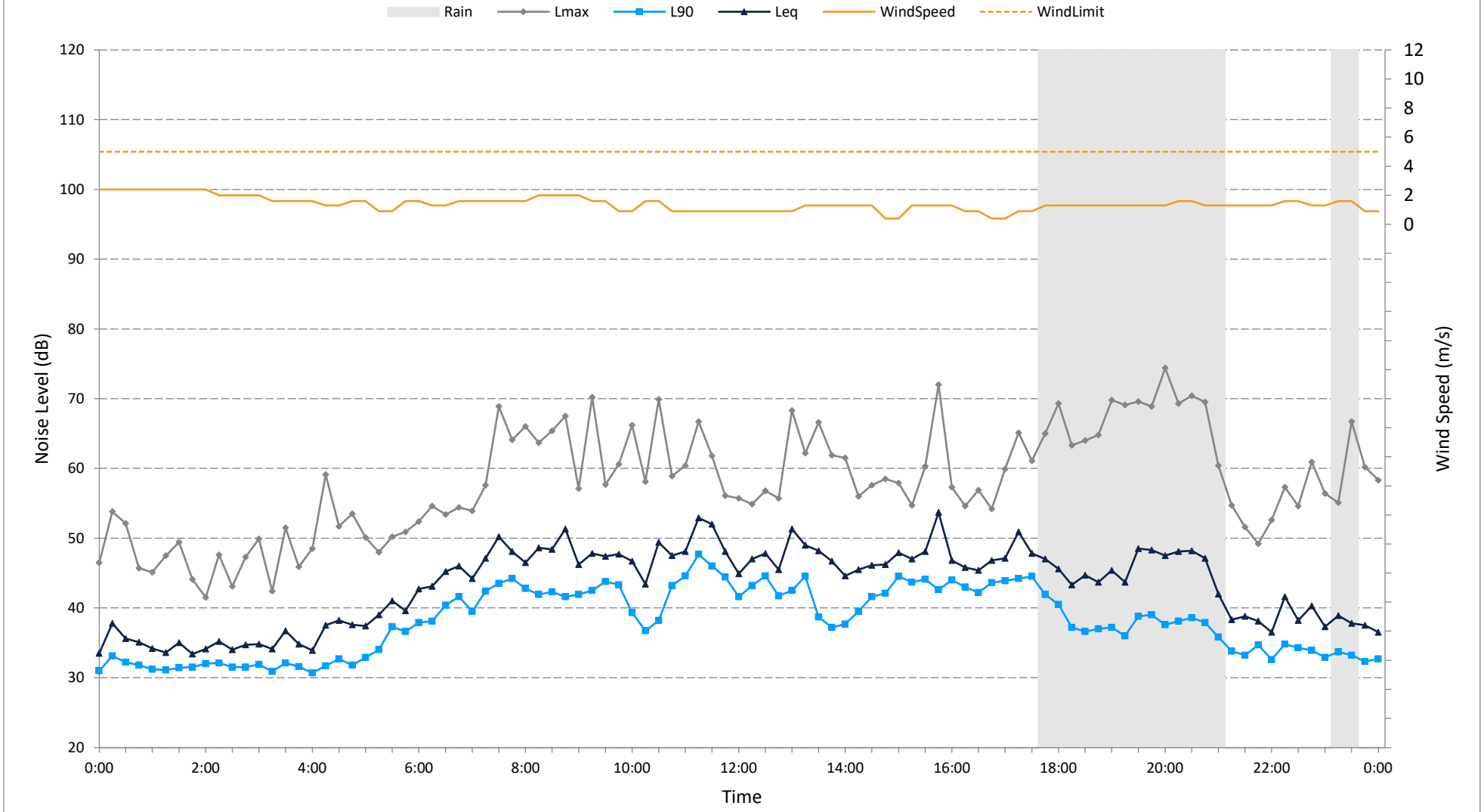
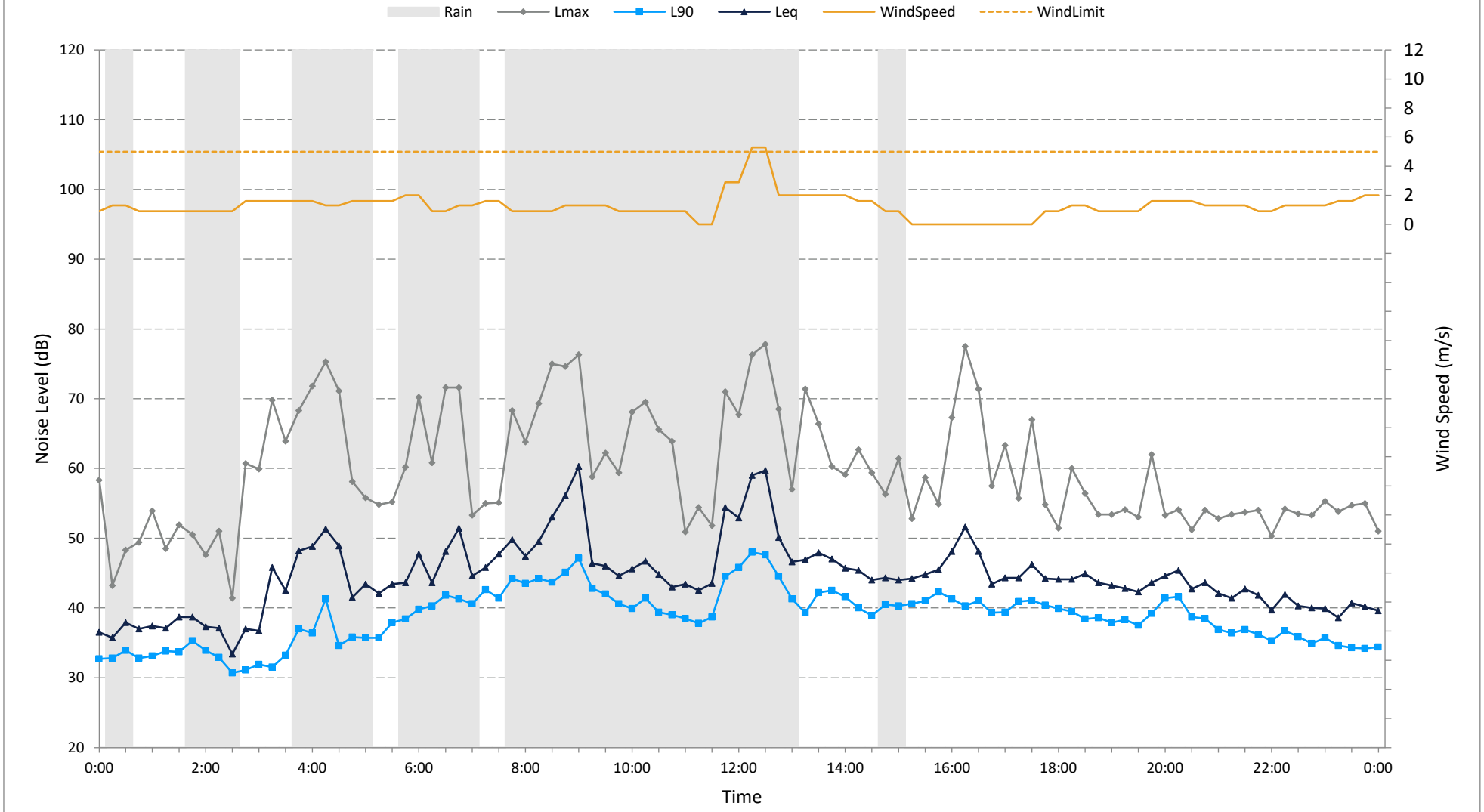
22:00
0:00

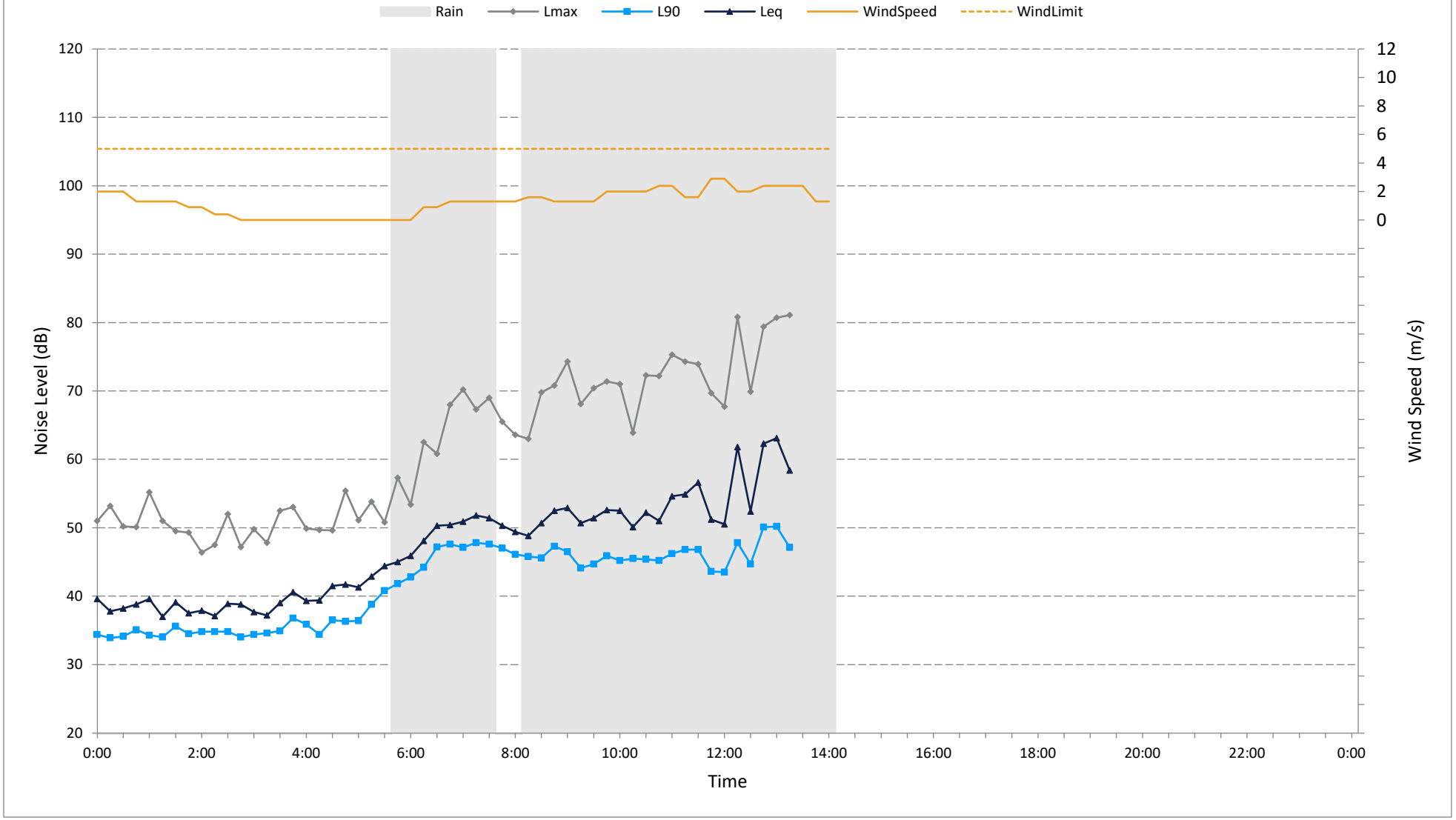
Measured ambient noise levels
NM2 - 275 Adams Road, Luddenham
Tuesday, 03-03-20



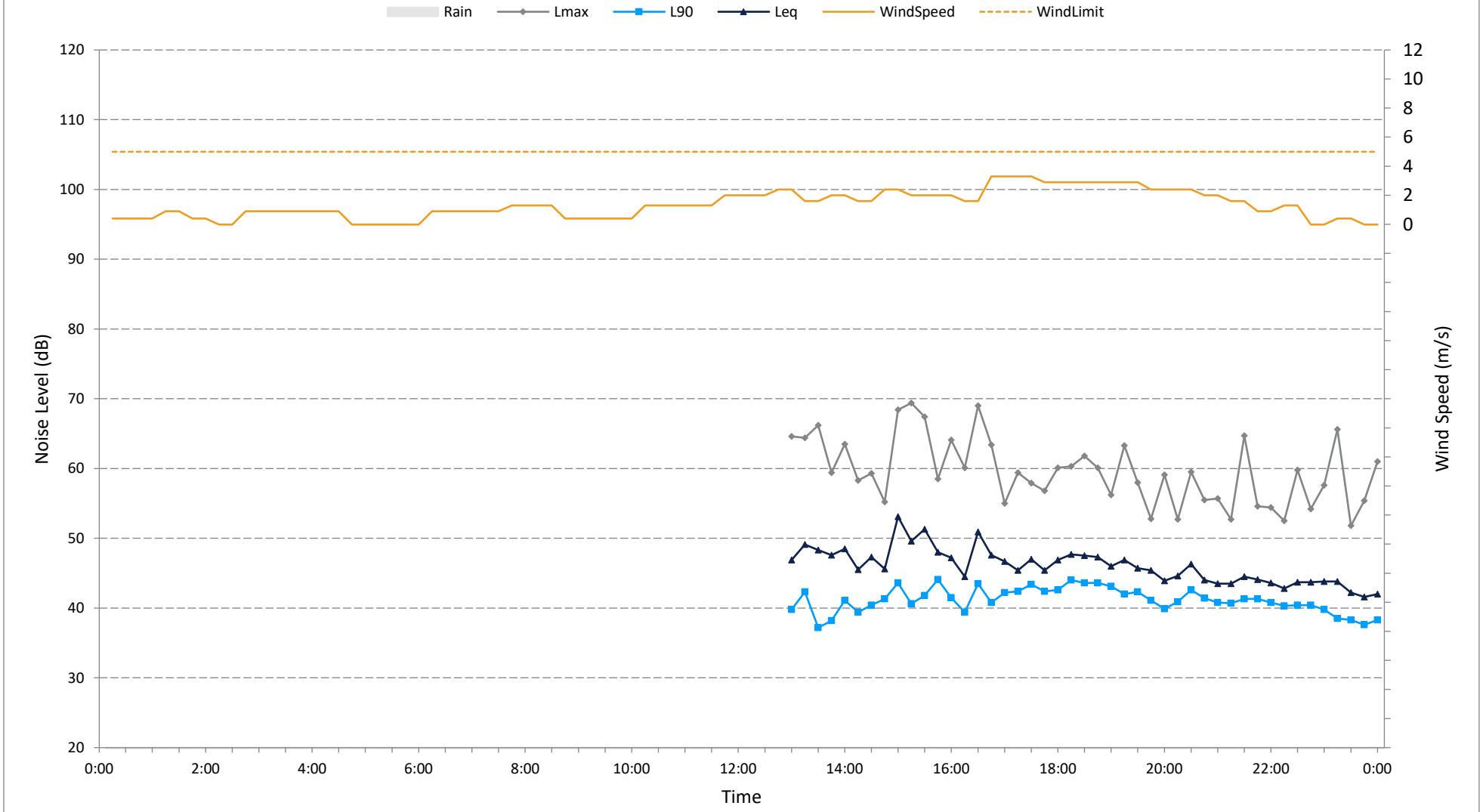
Measured ambient noise levels
NM2 - 275 Adams Road, Luddenham
Wednesday, 04-03-20

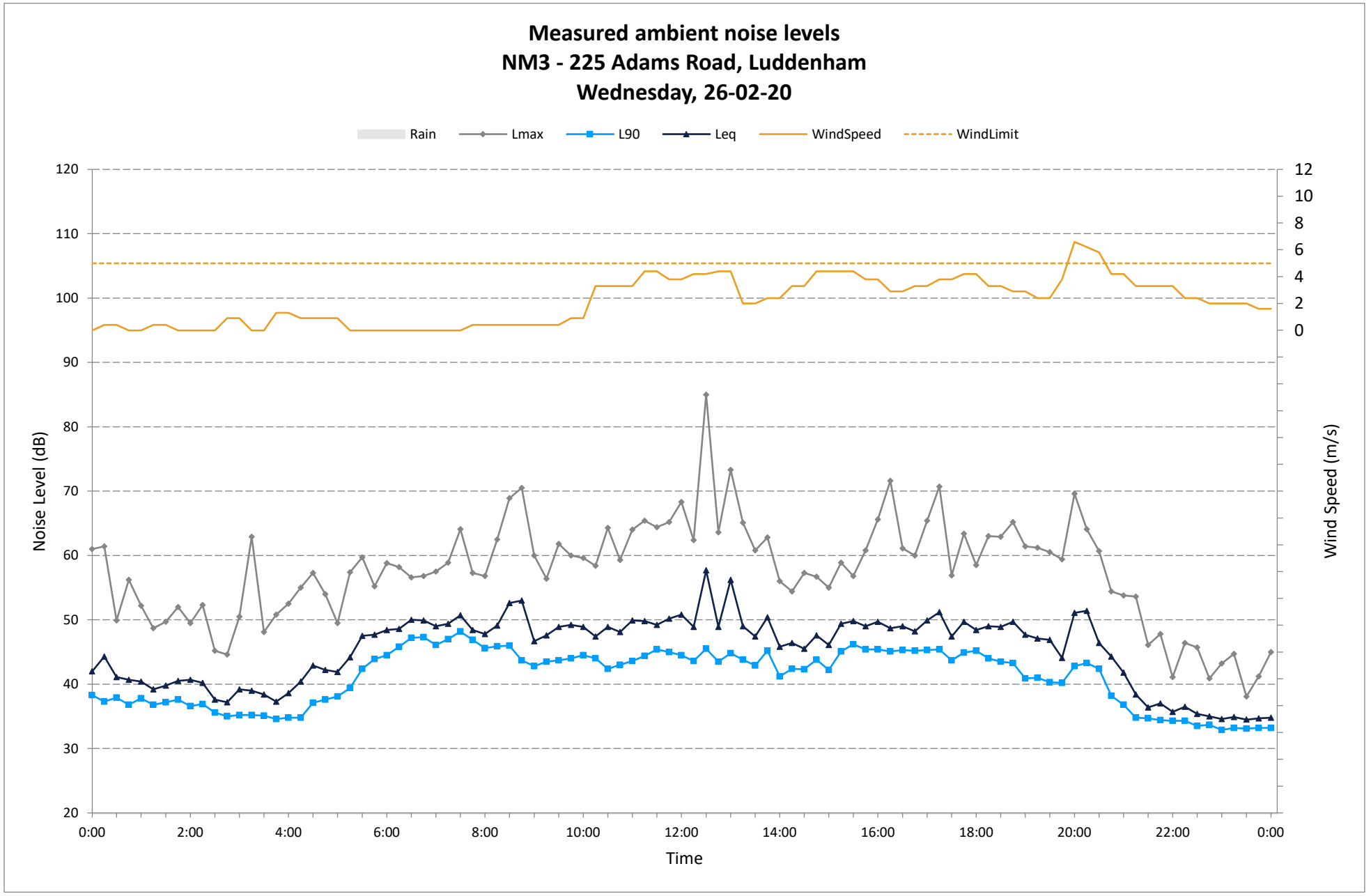


Measured ambient noise levels
NM2 - 275 Adams Road, Luddenham
Thursday, 05-03-20



Measured ambient noise levels
NM3 - 225 Adams Road, Luddenham
Tuesday, 25-02-20




Measured ambient noise levels
NM3 - 225 Adams Road, Luddenham
Wednesday, 26-02-20
Rain
Lmax
L90
Leq
WindSpeed
WindLimit
Noise Level (dB)
Wind Speed (m/s)
Time
120
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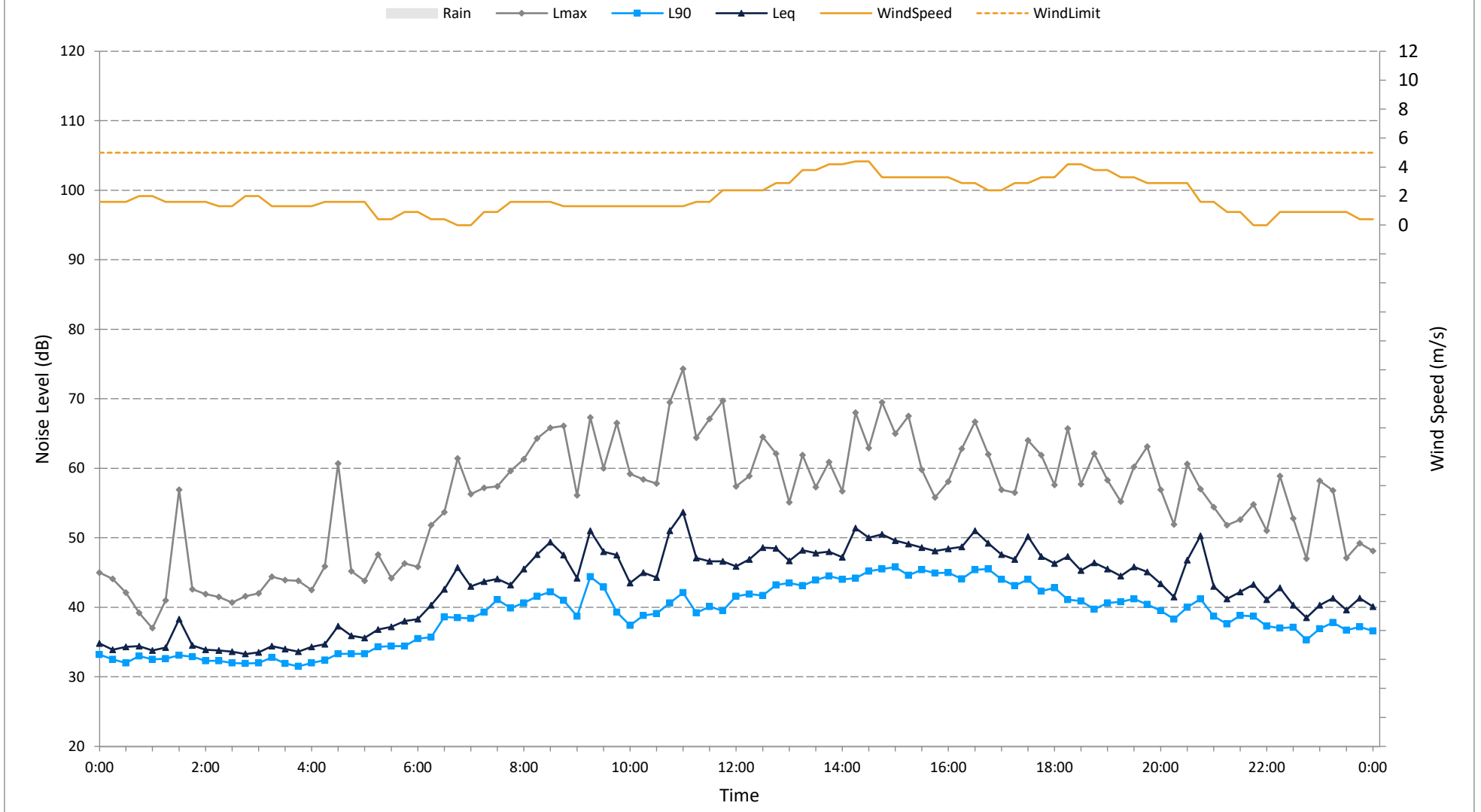
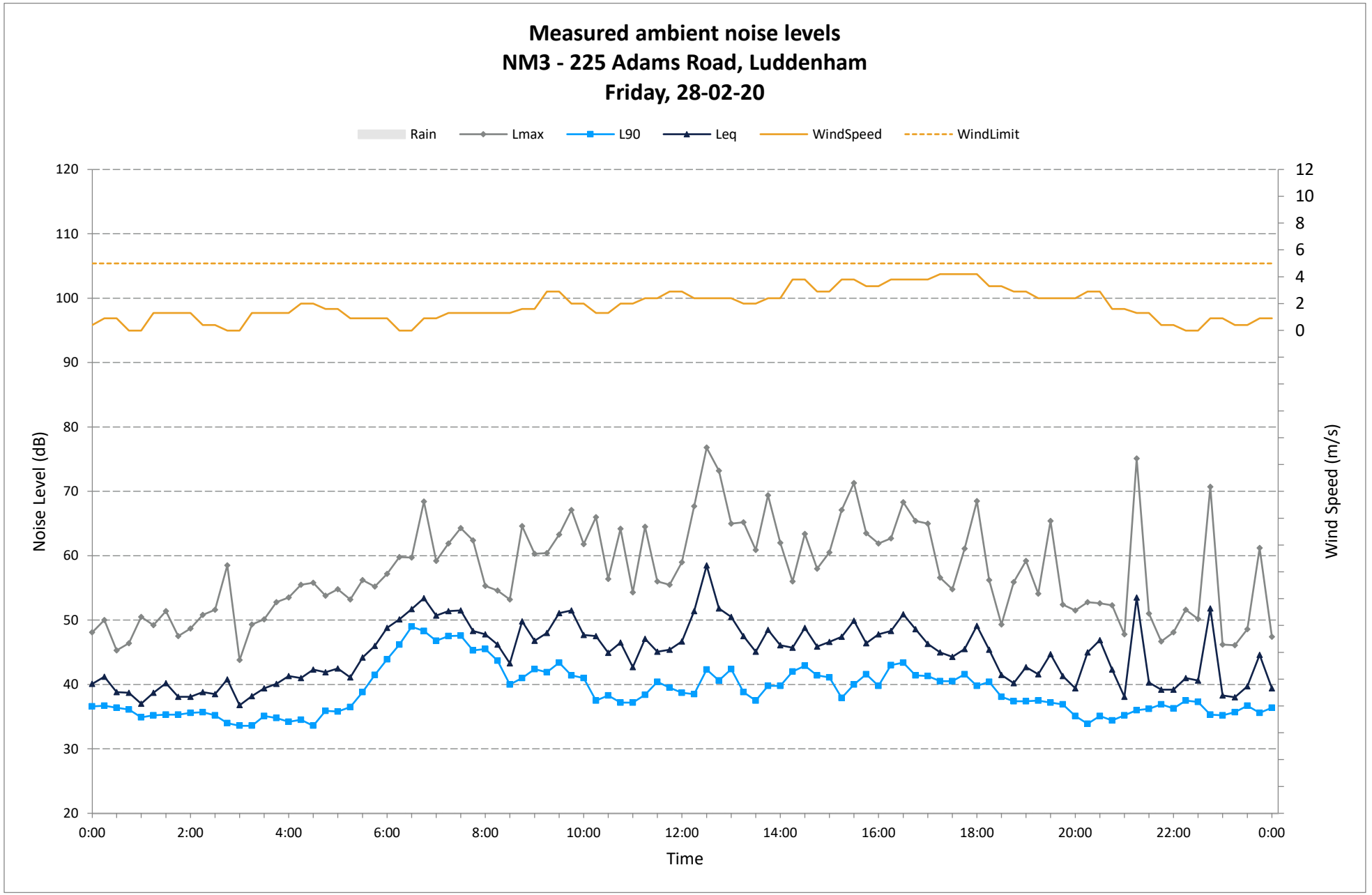
Measured ambient noise levels
NM3 - 225 Adams Road, Luddenham
Thursday, 27-02-20




Measured ambient noise levels
NM3 - 225 Adams Road, Luddenham
Friday, 28-02-20
Rain
Lmax
L90
Leq
WindSpeed
WindLimit
Noise Level (dB)
Wind Speed (m/s)
Time
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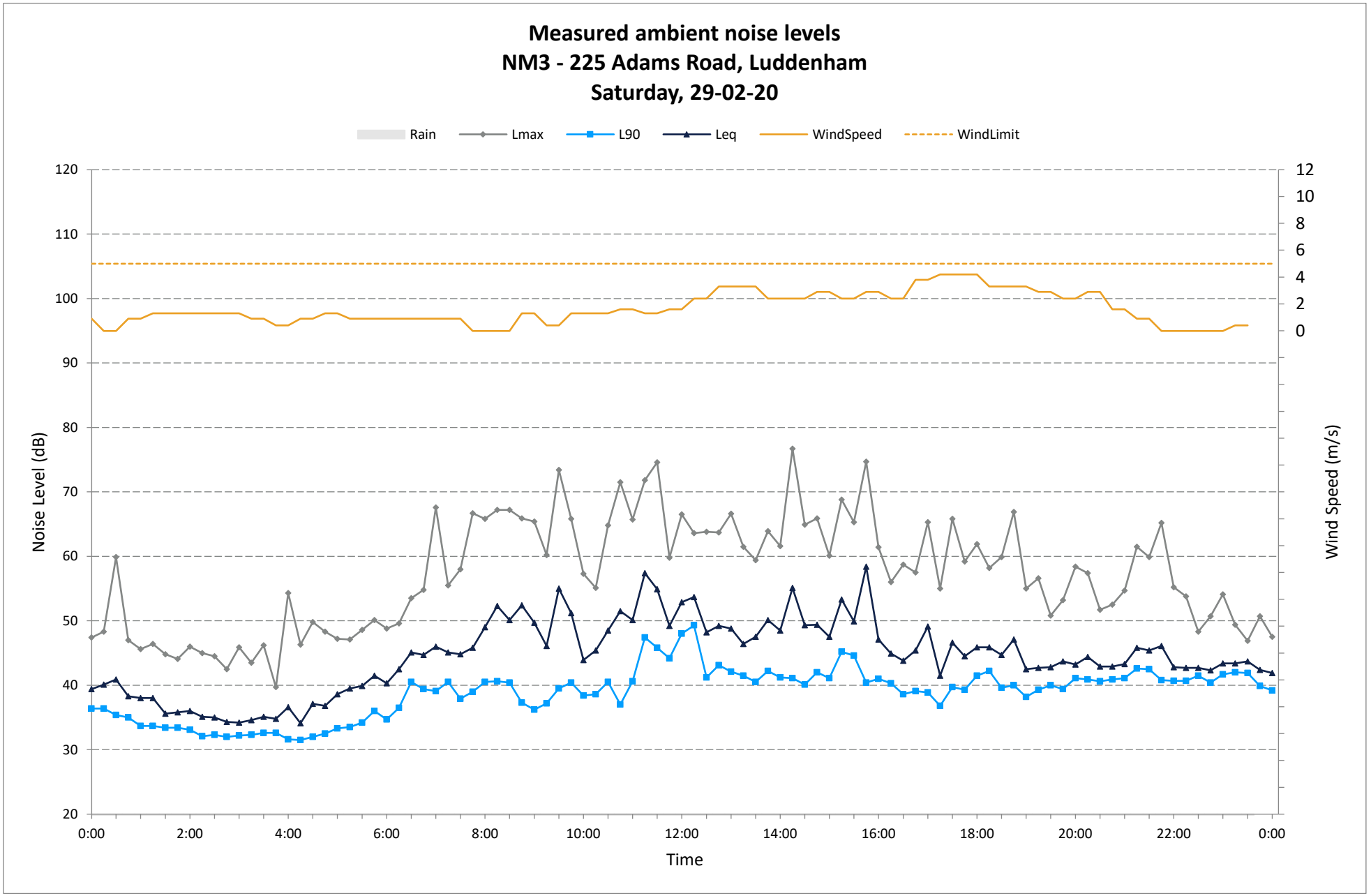
Measured ambient noise levels
NM3 - 225 Adams Road, Luddenham
Saturday, 29-02-20
Rain
Lmax
L90
Leq
WindSpeed
WindLimit
Noise Level (dB)
Wind Speed (m/s)
Time
120
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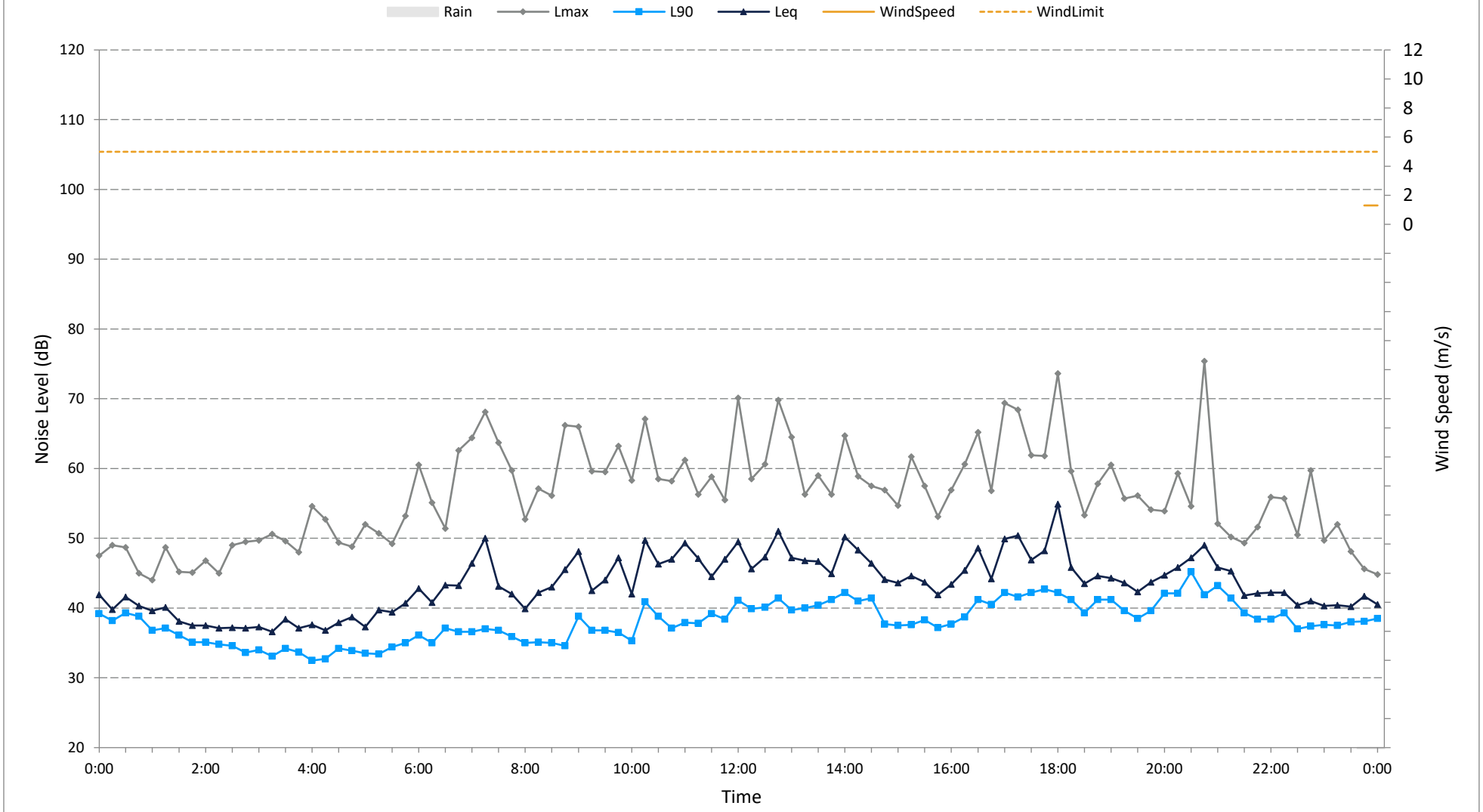
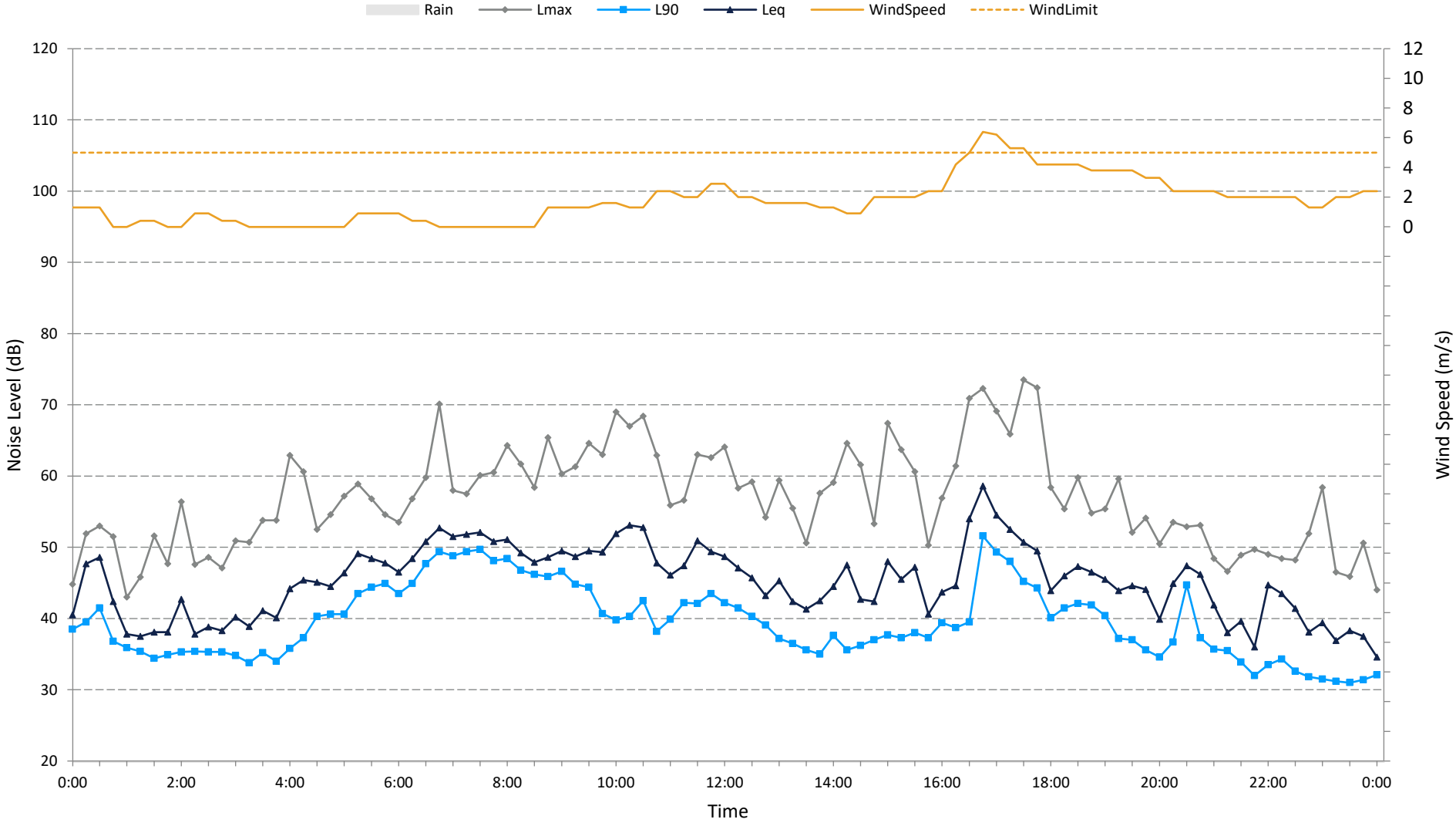
22:00
0:00

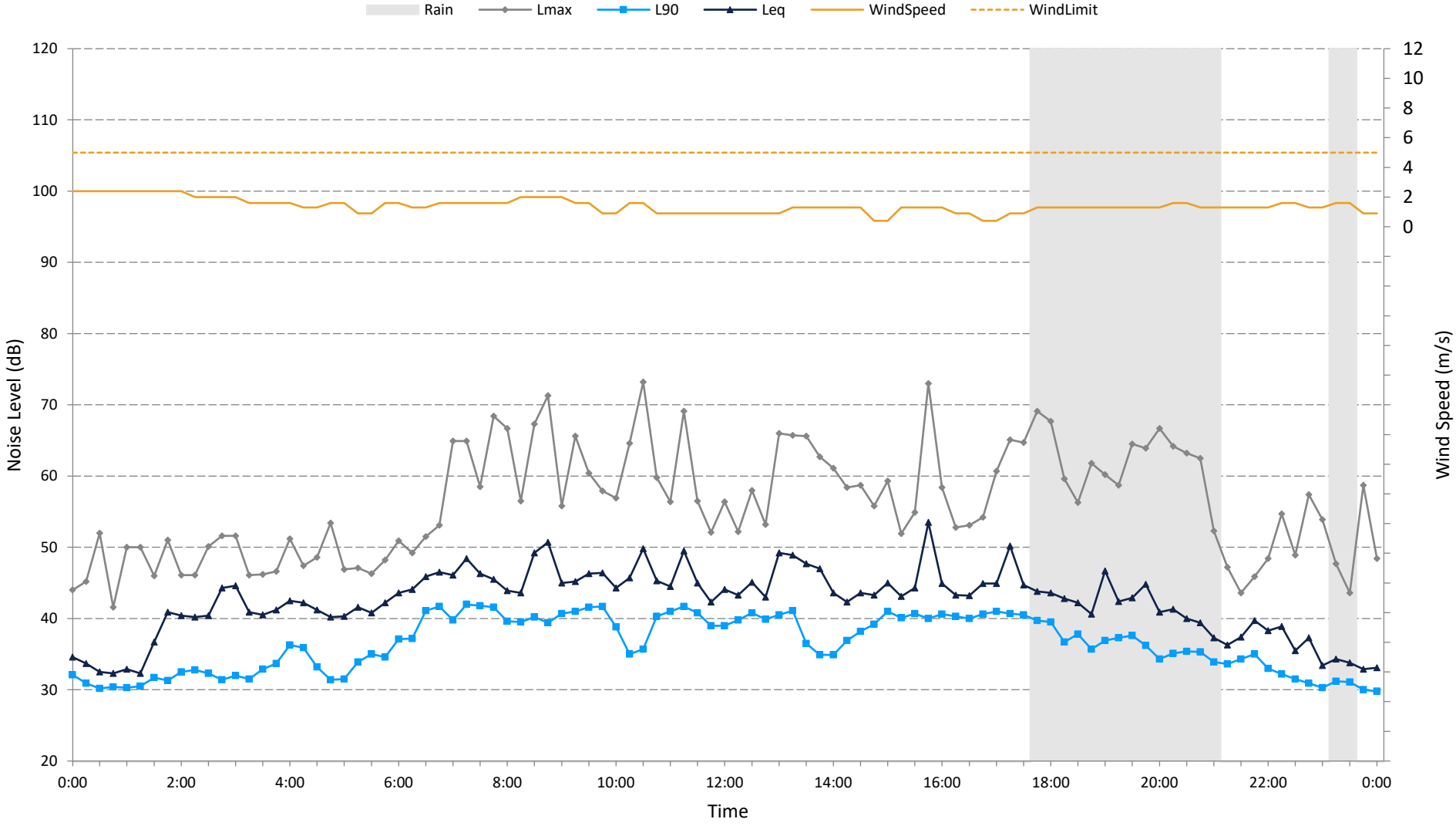
Measured ambient noise levels
NM3 - 225 Adams Road, Luddenham
Sunday, 01-03-20

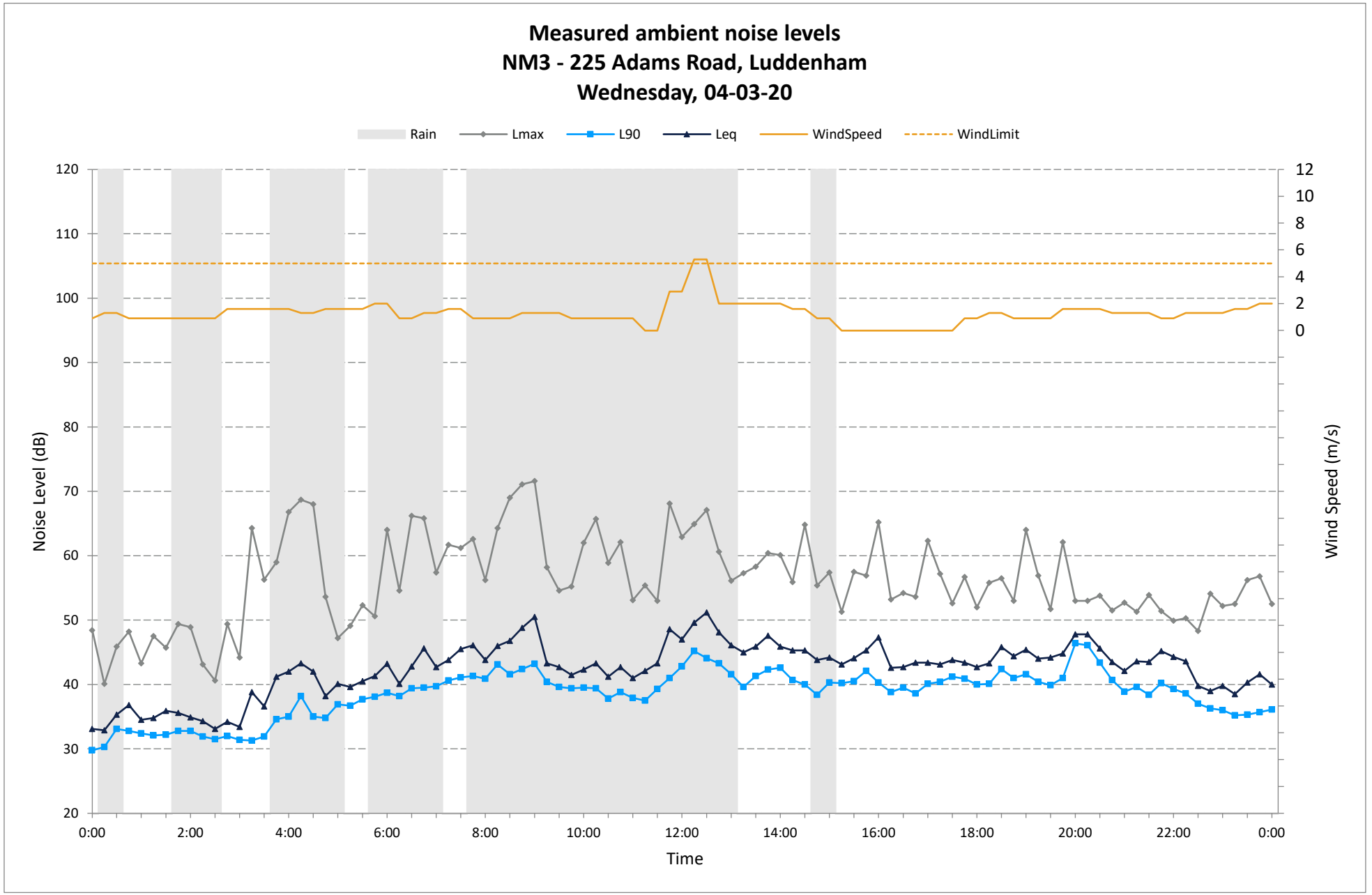


Measured ambient noise levels
NM3 - 225 Adams Road, Luddenham
Monday, 02-03-20



Measured ambient noise levels
NM3 - 225 Adams Road, Luddenham
Tuesday, 03-03-20




Measured ambient noise levels
NM3 - 225 Adams Road, Luddenham
Wednesday, 04-03-20
Rain
Lmax
L90
Leq
WindSpeed
WindLimit
Noise Level (dB)
Wind Speed (m/s)
Time
120
110
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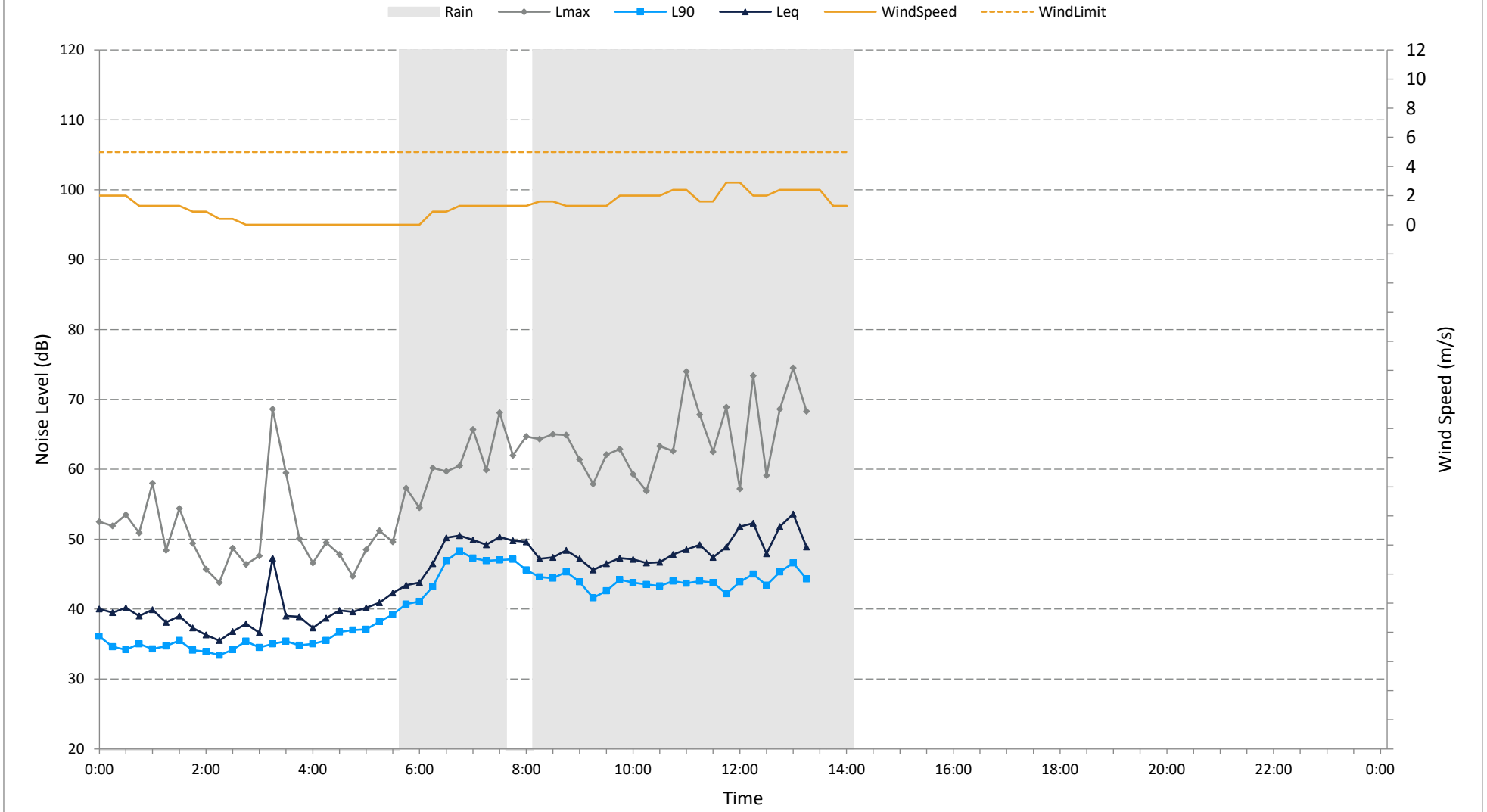
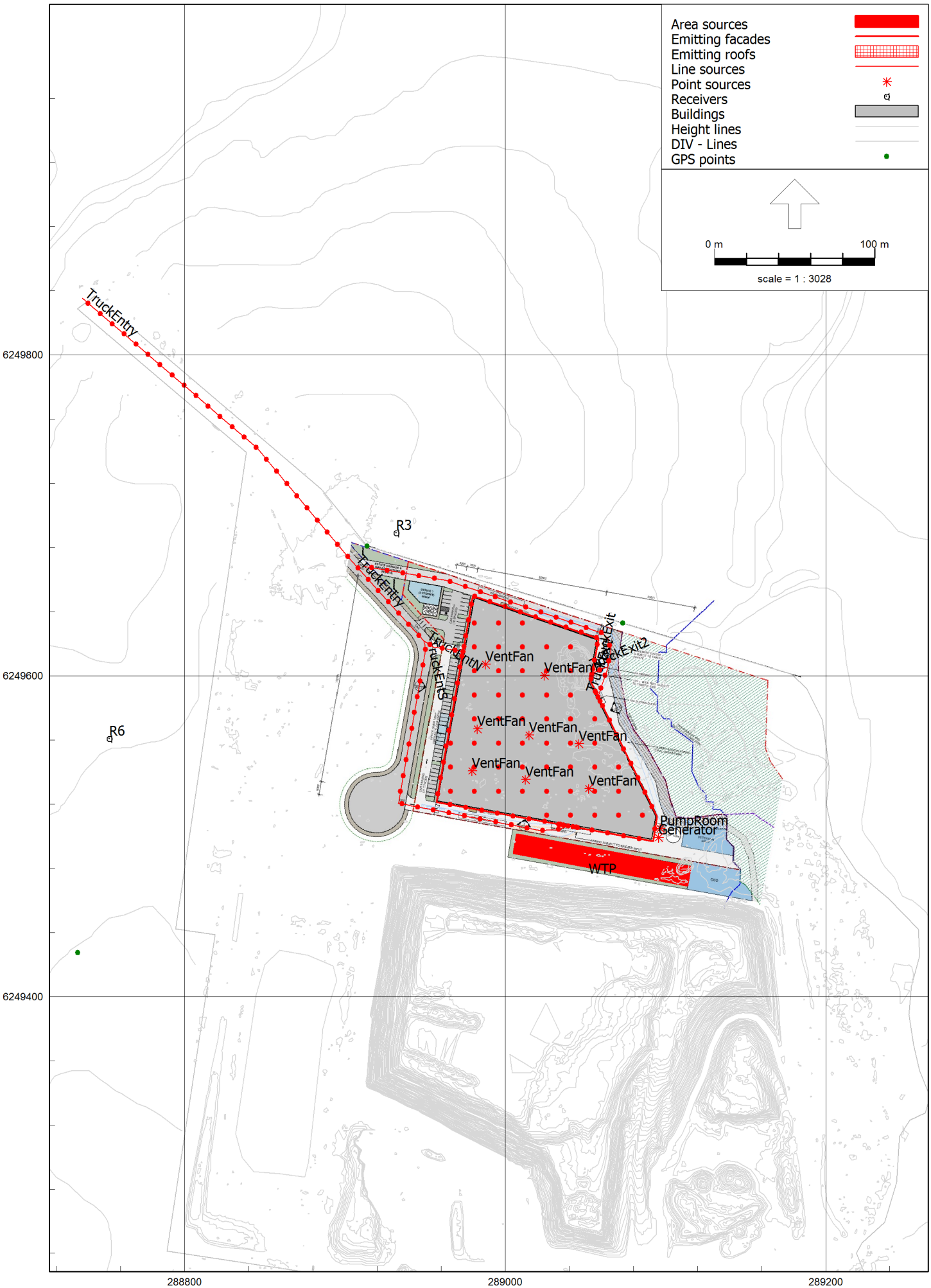
Measured ambient noise levels
NM3 - 225 Adams Road, Luddenham
Thursday, 05-03-20



Appendix B

Noise modelling - source locations


Area sources
Emitting facades
Emitting roofs
Line sources
Point sources
Receivers
Buildings
Height lines
DIV - Lines
GPS points
0 m
100 m
scale = 1 : 3028
TruckEntry
TruckEntry
TruckEntry
TruckExit
TruckExit2
R3
R6
VentFan
VentFan
VentFan
VentFan
VentFan
VentFan
VentFan
VentFan
PumpRoom
Generator
WTP
6249800
6249600
6249400
288800
289000
289200