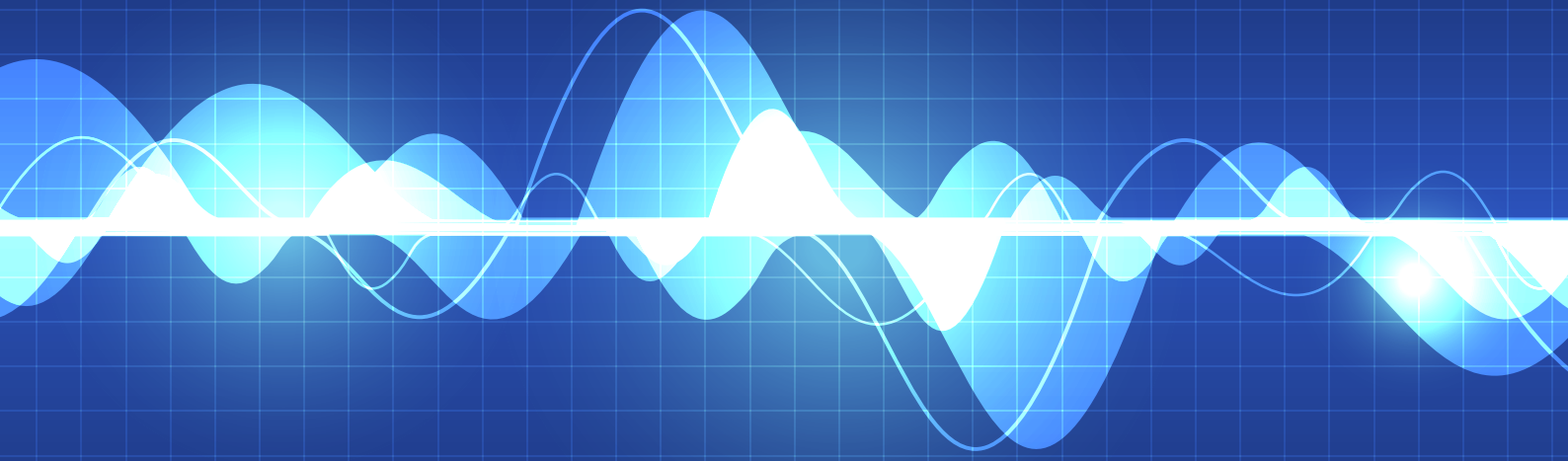
221-227 & 289-317 Luddenham Road, Orchard Hills

Noise Impact Assessment

Prepared for HBB Property
September 2021



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221-227 & 289-317 Luddenham Road, Orchard Hills

Noise Impact Assessment

Report Number

J200388 RP#1

Client

HBB Property

Date

10 September 2021

Version

Final

Prepared by	**Approved by**
	
James Small	**Najah Ishac**
Associate	Director
10 September 2021	10 September 2021

Executive Summary

This report has been commissioned by HBB Property to address potential noise impacts associated with the proposed Alspec Industrial Business Park to be located at 221-227 & 289-317 Luddenham Road, Orchard Hills NSW. The proposal will include the subdivision of the existing allotments to twenty-four individual warehouse lots with associated office space, hardstands and loading docks.

The scope of this assessment is to undertake a high-level assessment of likely noise generated by an indicative site masterplan to support the planning proposal. We note that the indicative masterplan used for the basis of the assessment is not final and is subject to change prior to any future State Significant Development (SSD) application and development applications.

The purpose of this assessment is to determine whether the operation of the development is capable of achieving compliance with Environmental Protection Authority (EPA) guidelines, to inform the future masterplan design and to provide a framework for assessing noise from each allotment as part of the future masterplan.

Noise from the operation of the indicative masterplan has been assessed against the EPA 2017, Noise Policy for Industry (NPfI). The NPfI provides a framework for addressing noise from multiple allotments within an industrial subdivision such that the cumulative impacts do not exceed recommended limits.

Also, the potential for road traffic noise generation on Luddenham Road has been assessed using the guidance provided in the NSW Department of Environment Climate Change and Water (DECCW) 2011, Road Noise Policy (RNP).

Given the early stages of development planning, commentary has been provided with regard to achieving the objectives of the NSW Department of Environment and Climate Change (DECC) 2009, Interim Construction Noise Guideline (ICNG). No specific assessment of construction noise has been undertaken at this stage given the many unknowns as would be expected at this stage.

The outcomes from the assessment of noise from the indicative masterplan indicates the following:

- Noise associated with the operation of warehouses can be mitigated with the implementation of architectural acoustic treatments which would be formulated as part of each individual lot development application such that the treatment is consistent with the operational use.

- On-site vehicle noise (eg loading dock hardstand operations, carparks, etc.) will comply with the amenity noise targets of the NPfI which would be the more applicable criterion to be adopted for the assessment of cumulative noise impact from an industrial precinct.

  Exceedances of the NPfI intrusiveness noise targets is likely at the nearest assessment locations without appropriate controls that would need to be designed once specific details are known for each individual use.

  Notwithstanding the above, noise from on-site movements can be minimised using a combination of:

  - landscaping treatments such as acoustic barriers;
  - management controls; and
  - consideration of building orientation as part of the future masterplan.

- Additional road traffic noise along Luddenham Road is expected to comply with road traffic noise targets. It is further noted that increased road traffic noise would be realised over a number of years and should be considered in the planned growth of the area (ie major transport infrastructure, industrial, retail, commercial and high density residential).

This report includes discussion on the incorporation of lands to the east of the site, between the project and Luddenham Road. These allotments have been included in the structure plan for rezoning to industrial use (IN2). This IN2 area and the subject site have been considered in the context of existing and future surrounding land uses.

A detailed assessment of the lots within the IN2 zone have not been undertaken at this stage given their current residential use which have been addressed for noise impacts associated with the previous structure plan for the site.

High level discussion has been provided as to the potential impacts of the proposed rezoning to industrial use with regard to:

- operational noise associated with warehousing and manufacturing uses; and
- increased road traffic noise generation on Luddenham Road due to the incorporation of additional industrial allotments.

In-principle recommendations have been provided with regard to the future master plan of these allotments with consideration to built form and operation such that acoustic requirements for the project may be met.

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1 Introduction

EMM Consulting Pty Limited has been engaged to assess potential noise impacts from the possible operations of the proposed Alspec Industrial Business Park to be located at 221-227 & 289-317 Luddenham Road, Orchard Hills NSW ('the Site').

This assessment has been prepared to review likely noise impacts from the operation of the Site to support the planning application. An indicative masterplan for the site has been used to substantiate likely noise from industrial use on the site. The outcomes from this assessment may be used to identify:

- likely level of noise generated by the development and compliance with Environmental Protection Authority (EPA) guidelines and standards; and
- in-principle acoustic measures, management controls and site planning which may be employed as part of the future masterplan design to mitigate noise from the site as practically possible.

The objective of this study is to:

- formulate suitable noise emission criteria to assess noise emissions from the use of the Site, including:
  - from operational noise sources such as on-site vehicle movements, noise generated from inside warehouses (ie manufacturing) and mechanical plant operation;
  - potential increases in road traffic noise along Luddenham Road due to site generated traffic; and
  - the construction of the development;
- identify key noise sources as part of the project with the potential to impact surrounding noise sensitive receivers;
- identify key assessment locations which may be impacted by the use of the Site;
- model likely noise levels from the operation of the development at key assessment locations;
- discuss suitable mitigation measures to achieve noise emission criteria or minimise noise from the site as practically possible given the context of the Site within a developing industrial and commercial area; and
- provide a framework to address noise from the Site as part of future applications.

Commentary has also been provided regarding potential construction noise impacts on surrounding land uses. Given the early stages of the application process, this commentary is provided in principle.

Discussion has been included regarding the incorporation of additional lands to the east of the site, between the project and Luddenham Road. These allotments have been included in the structure plan for rezoning to industrial use (IN2). A detailed masterplan has not been prepared for these allotments at this stage and therefore only in-principle advice has been included with regard to:

- operational noise associated with warehousing and manufacturing uses; and
- increased road traffic noise generation on Luddenham Road due to the incorporation of additional industrial allotments.

1.1 Referenced guidelines and policies

This assessment has been prepared following the appropriate guidelines, policies and industry requirements, as follows:

- NSW Department of Environment and Climate Change (DECC) 2009, Interim Construction Noise Guideline (ICNG);
- NSW Environment Protection Authority (EPA) 2017, NSW Noise Policy for Industry (NPfI);
- NSW Department of Environment Climate Change and Water (DECCW) 2011, Road Noise Policy (RNP) and associated application notes; and
- Department of Environment and Conservation (DEC) NSW 2006, Assessing Vibration: a technical guideline.

1.2 Glossary of acoustic terms

A number of technical terms are required for the discussion of acoustics. These are explained in Table 1.1.

Table 1.1 Glossary of acoustic terms

Term	Description
dB	Noise is measured in units called decibels (dB).
A-weighting	There are several scales for describing noise, the most common being the 'A-weighted' scale. This attempts to closely approximate the frequency response of the human ear.
L_{A1}	The A-weighted noise level exceeded for 1% of a measurement period.
L_{A10}	The A-weighted noise level which is exceeded 10% of the time. It is approximately equivalent to the average of maximum noise levels.
L_{A90}	Commonly referred to as the background noise, this is the A-weighted level exceeded 90% of the time.
L_{Aeq}	The A-weighted energy average noise from a source and is the equivalent continuous sound pressure level over a given period. The $L_{Aeq,15min}$ descriptor refers to an L_{Aeq} noise level measured over a 15-minute period.
L_{Amax}	The maximum root mean squared A-weighted sound pressure level received at the microphone during a measuring interval.
RBL	The Rating Background Level (RBL) is an overall single value background level representing each assessment period over the whole monitoring period.
Sound power level	This is a measure of the total power radiated by a source. The sound power of a source is a fundamental property of the source and is independent of the surrounding environment.

It is useful to have an appreciation of decibel, the unit of noise measurement. Table 1.2 gives an indication as to what an average person perceives about changes in noise levels.

Table 1.2 Perceived change in noise

Change in sound pressure level (dB)	Perceived change in noise
up to 2	typically indiscernible
3	just perceptible
5	noticeable difference

Table 1.2 Perceived change in noise

Change in sound pressure level (dB)	Perceived change in noise
10	twice (or half) as loud
15	large change
20	four times (or quarter) as loud

Examples of common noise levels are provided in Figure 1.1.

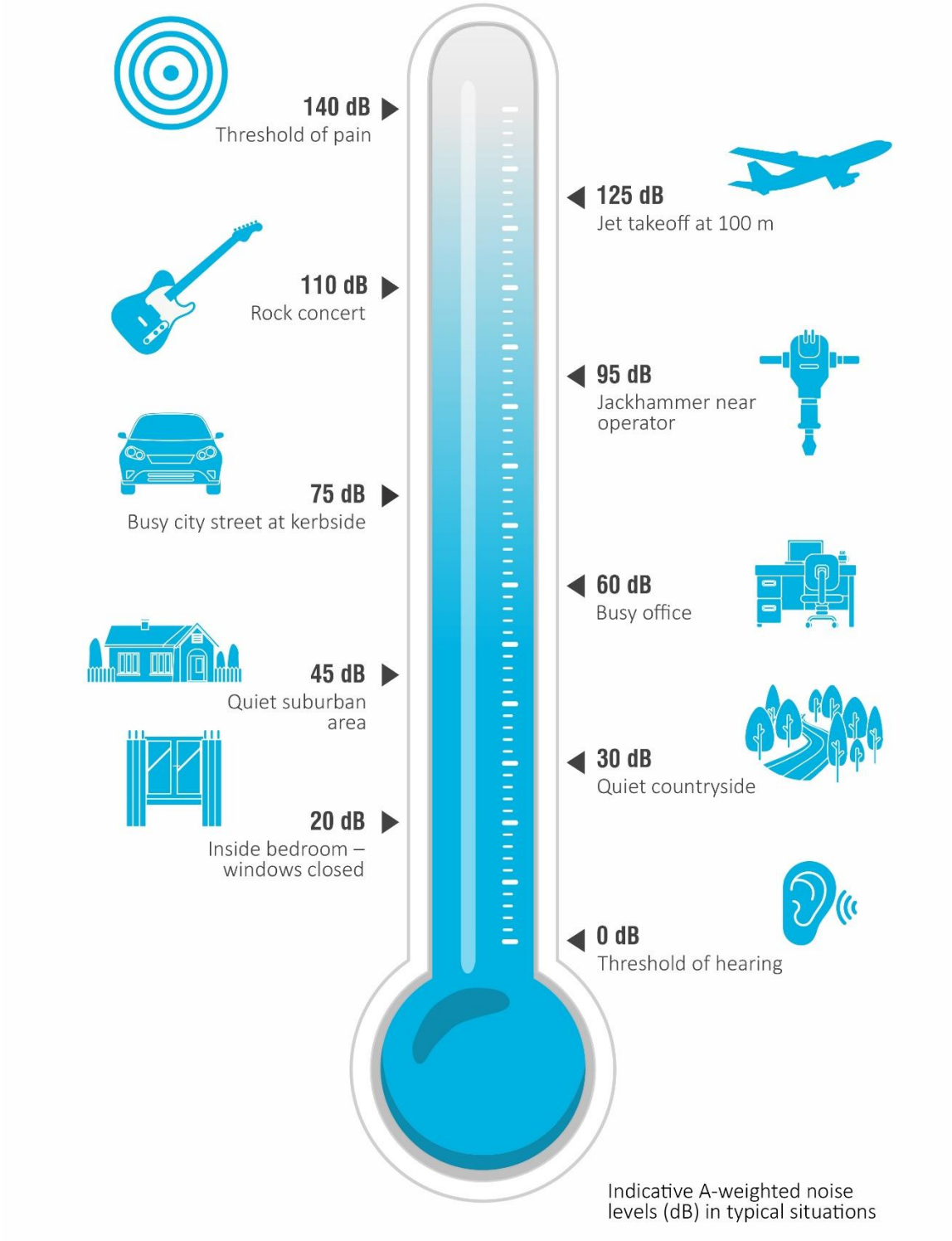


Figure 1.1 **Common noise levels**

2 Project and site description

2.1 Site location and background

The Site is located at 221-227 & 289-317 Luddenham Road, Orchard Hills and is legally described as Lot 1 in DP 1099147 & Lot 242 in DP 1088991.

The total site area is approximately 125.3 hectares with road frontages to Luddenham Road. The proposed site and adjacent allotments are located within the Penrith City Council local government area (LGA). The zoning for the site is RU2 Rural Landscape.

2.2 Existing uses

The Site is generally surrounded by the following land uses:

- To the north of the site:
  - Patons Lane Resource Recovery Centre (RCC) to the northwest; and
  - TransGrid along the northern boundary of the site with rural residential beyond.
- To the east of the site:
  - active recreation (Bosna Croatian Club);
  - residential development directly adjoining the eastern boundary; and
  - residential land use on the eastern side of Luddenham Road.

  The active recreation and residential uses directly adjoining the eastern boundary has been included for rezoning to industrial use (IN2). The residential dwellings currently inhabiting this area have been assessed under the current RU2 zoning. The gradual change to IN2 will therefore serve to improve the outcomes of this assessment.
- To the south of the site:
  - rural residential land use along the southern boundary of the site;
  - Sydney Water supply pipeline easement; and
  - St Mary's / Kennett's Airfield.
- Department of Defence owned environmental conservation zoned land to the west of the site.

2.3 Proposal

The planning proposal includes a rezoning of the existing rural zoning to include an industrial precinct which will be developed over three stages. The development is to incorporate:

- industrial warehousing facilities with associated offices;

- hardstands and loading docks;
- internal roadways; and
- environmental zoning and electrical easements.

A fourth stage may incorporate industrial uses on the land between the development and Luddenham Road which has been included in the structure plan for rezoning to IN2.

2.4 Future regional development

Whilst the Site is currently located in an area encompassing generally rural properties, the region has been marked for significant future industrial, commercial and infrastructure development. A sample of such developments or areas marked for significant redevelopment include:

- Western Sydney Employment Area Precinct and Aerotropolis;
- Mamre Road Precinct – an 850 hectare industrial precinct approximately 1 km to the southeast of the Site;
- Sydney Science Park – a $5 billion mixed-use smart city that will create an internationally recognised epicentre for research, development, commercialisation and innovation in the heart of Western Sydney. The development will incorporate commercial, education, residential and retail uses;
- Western Sydney Freight Line– a new freight rail corridor adjoining the southern and western boundary of the site;
- North South Rail Line – a new freight and passenger rail corridor adjoining the western boundary of the site; and
- Outer Sydney Orbital – new transport corridor incorporating a motorway and freight line, which will adjoin the western boundary of the site.

The development of these areas is not insignificant and would ultimately result in increases in the ambient noise level, particularly for assessment locations adjacent the Site.

2.5 Assessment locations

Off site assessment locations that could potentially experience noise from the development have been separated into three noise catchment areas (NCAs) which have been derived based on likely consistent or representative noise environments and are discussed as follows:

- NCA1 represents residential assessment locations on the eastern side of Luddenham Road. The dwelling façades facing the development also faces Luddenham Road and as such is susceptible to noise from road traffic noise;
- NCA2 represents residential assessment locations on the western side of Luddenham Road. These properties back onto the site. The rear façade of each dwelling is screened from Luddenham Road and is generally screened from road traffic noise. As such, lower background noise levels are expected which is consistent with noise monitoring conducted at the site. It is noted that these residential properties have been included in the structure plan for the precinct for rezoning to IN2.; and
- NCA3 represents remote assessment locations which are removed from Luddenham Road.

Noise sensitive uses which have been addressed in this report include the assessment locations provided in Table 2.1 and are shown in Figure 3.1.

Table 2.1 Assessment locations

Noise catchment area (NCA)	Assessment location ID	Address	MGA 56 Coordinate		Land use
			Easting	Northing	
NCA1	R1	182 Luddenham Road, Orchard Hills	292707	6255864	Residential
NCA1	R2	202 Luddenham Road, Orchard Hills	292718	6255742	Residential
NCA1	R3	212 Luddenham Road, Orchard Hills	292729	6255685	Residential
NCA1	R4	216 Luddenham Road, Orchard Hills	292737	6255636	Residential
NCA1	R5	222 Luddenham Road, Orchard Hills	292745	6255592	Residential
NCA1	R6	226 Luddenham Road, Orchard Hills	292752	6255550	Residential
NCA1	R7	230 Luddenham Road, Orchard Hills	292760	6255500	Residential
NCA1	R8	236 Luddenham Road, Orchard Hills	292768	6255452	Residential
NCA1	R9	240 Luddenham Road, Orchard Hills	292782	6255398	Residential
NCA1	R10	246 Luddenham Road, Orchard Hills	292786	6255352	Residential
NCA1	R11	250 Luddenham Road, Orchard Hills	292797	6255301	Residential
NCA1	R12	256 Luddenham Road, Orchard Hills	292804	6255252	Residential
NCA1	R13	262 Luddenham Road, Orchard Hills	292802	6255208	Residential
NCA1	R14	268 Luddenham Road, Orchard Hills	292750	6255017	Residential
NCA1	R21	320 Luddenham Road, Orchard Hills	292641	6254644	Residential
NCA2	R15	229 Luddenham Road, Orchard Hills	292458	6255431	Active recreation
NCA2	R16	233 Luddenham Road, Orchard Hills	292603	6255351	Residential
NCA2	R17	251 Luddenham Road, Orchard Hills	292575	6255258	Residential
NCA2	R18	275 Luddenham Road, Orchard Hills	292561	6255025	Residential
NCA2	R19	287 Luddenham Road Orchard Hills	292552	6254987	Residential
NCA2	R20	319 Luddenham Road, Orchard Hills	292377	6254700	Residential
NCA2	R22	339 Luddenham Road, Orchard Hills	292428	6254440	Residential
NCA3	R23	405 Luddenham Road, Orchard Hills	291959	6254260	Residential
NCA3	R24	327 Luddenham Road, Orchard Hills	291497	6254625	Residential

2.6 Key issues

The key acoustic considerations for the development include the following:

- the Site is in a rural environment which currently exhibits low background noise levels. The assessment of noise associated with large scale development of this nature within an environment absent of significant noise sources can be impractical without considering the potential for future development of the region which may increase the ambient environment; and

- the development is expected to generate significant road traffic along Luddenham Road in context with existing volumes. Potential noise impacts associated with this increase need to be addressed with consideration to the lifetime of the development masterplan and the increase of road traffic noise due to other development in the region.

3 Existing environment

Noise monitoring was conducted to establish the existing prevailing noise environment at the proposed development site. Four unattended noise loggers were deployed on the site at locations representative of the acoustic environment at the nearest assessment locations close to Luddenham Road and at locations representative of receivers further removed from Luddenham Road.

3.1 Measurement equipment and locations

Noise monitoring was carried out using three Acoustic Research Labs (ARL) NGARA environmental noise loggers and one Svantek 979 environmental noise logger. The details of each noise monitoring location is provided in Table 3.1 and illustrated on Figure 3.1.

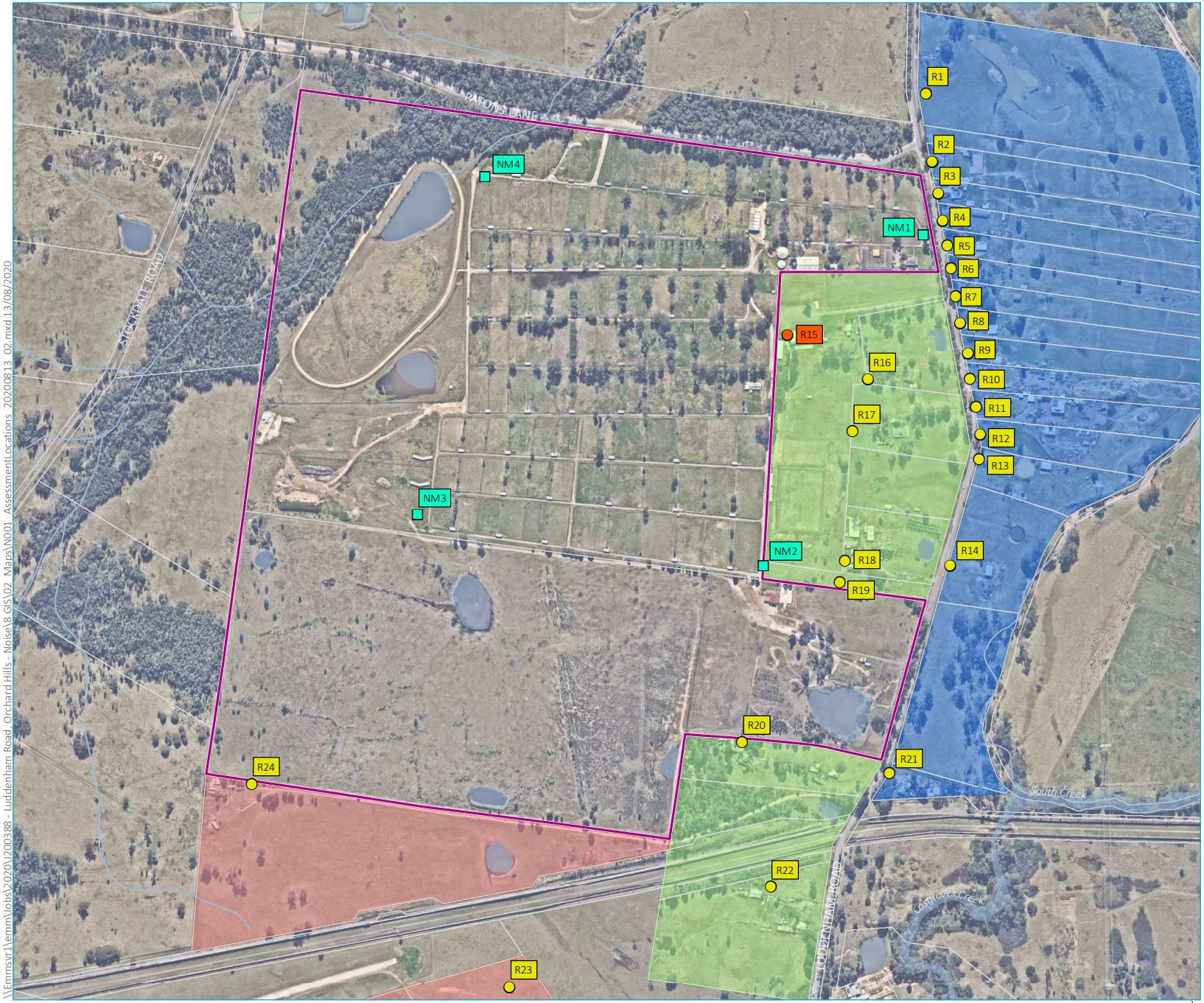
Table 3.1 Monitoring locations

Monitor ID	Equipment type and serial number	Period of measurement	Monitor location		
			Address	Easting (MGA)	Northing (MGA)
NM1	Svantek 979, 21095	24 July to 4 August	221-227 Luddenham Road, Orchard Hills	292703	6255625
NM2	ARL NGARA, 878125	1 July to 13 July	221-227 Luddenham Road, Orchard Hills	292376	6254999
NM3	ARL NGARA, 878123	1 July to 13 July	221-227 Luddenham Road, Orchard Hills	291825	6255085
NM4	ARL NGARA, 878138	1 July to 13 July	221-227 Luddenham Road, Orchard Hills	291902	6255708

Loggers were programmed to record statistical noise level indices continuously in 15 minute intervals in accordance with the requirements of the NPfI, 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 measurements. All equipment carried appropriate and current NATA (or manufacturer) calibration certificates.

3.2 Weather affected noise data

Weather data for the survey period was obtained from the BOM weather station at Badgerys Creek (ID 067108). The wind speed and the rainfall data were used to exclude noise data during periods of any rainfall and/or wind speed in excess of 5 metres per second (m/s) (approximately 9 knots) at the microphone height in accordance with NPfI methods.



KEY

- Site boundary
- Watercourse/drainage line
- Waterbody
- Cadastral boundary
- Noise monitoring location

Assessment location

- Active recreation
- Residential

Noise catchment areas

- NCA1
- NCA2
- NCA3

INSET KEY

- Main road
- NPWS reserve
- State forest

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

0 250 500 m

GDA 1994 MGA Zone 56

N

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Noise monitoring and assessment locations

Alspec Industrial Business Park
Noise and vibration impact assessment
Figure 2.1

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3.3 Measured noise levels

A summary of the existing background and ambient noise levels is provided in Table 3.2. Daily results and charts from the noise logger are provided in Appendix A.

Table 3.2 Summary of unattended ambient noise monitoring (1 July to 4 August 2020)

Noise monitoring location	Time period[1]	Existing noise levels	
		$L_{Aeq(period)}$, dB	Rating background level (RBL), dB
NM1	Day	58	40
	Evening	56	39
	Night	54	34
NM2	Day	53	34
	Evening	43	36
	Night	41	30
NM3	Day	48	30
	Evening	41	34
	Night	39	30
NM4	Day	51	29
	Evening	41	36
	Night	40	33

Note 1. The daytime is 7 am to 6 pm; evening 6 pm to 10 pm; night-time 10 pm to 7 am. On Sundays and Public Holidays, the daytime is 8 am to 6 pm; evening 6 pm to 10 pm; night-time 10 pm to 8 am.

Noise levels recorded at NM2, NM3 and NM4 indicate that the evening RBL is consistently higher than the day RBL. Monitoring was conducted during the colder winter months which would typically negate insect noise which more commonly contributes to higher evening noise levels. Noise monitoring locations were also far removed from each other and thus removed from a possible singular extraneous noise source which may impact the monitoring. As such it can only be concluded that this is characteristic of the area.

The acoustic environment in some locations can have rating background noise levels (RBLs) which would result in noise criteria that are impractical for the reasonable assessment of noise from a site. Section 2.3 of the NPfI provides guidance where the recorded RBL is below the minimum assumed background noise level and is reproduced in Table 3.3. Where the recorded RBL is below the minimum assumed background noise level, the minimum assumed background noise level is adopted for assessment purposes in accordance with the NPfI.

Table 3.3 Minimum assumed RBLs

Time of day	Minimum assumed rating background noise level, dBA
Day	35
Evening	30
Night	30

4 Assessment criteria

4.1 Operational noise

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

The objectives of noise trigger levels for industry 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 two separate criteria: intrusiveness criteria and amenity criteria. The fundamental difference being intrusiveness criteria apply over 15 minutes in any period (day, evening or night), whereas the amenity criteria apply to the entire assessment period (day, evening or night).

4.1.1 Intrusiveness criteria

The intrusiveness criteria apply to residential receivers, which requires that $L_{Aeq\ (15\ min)}$ noise levels from the proposed development do not exceed the RBL by more than 5 dB. Measured RBLs have been used to derive intrusiveness criteria at each noise monitoring location. Where the RBL is below minimum assumed background levels, the minimum assumed background level has been adopted as per Table 3.3. It is noted that intrusiveness noise levels are only applicable at residential assessment locations.

Table 4.1 presents the intrusive noise criteria determined for the proposal based on the adopted RBLs.

Table 4.1 Intrusive noise criteria

Assessment location	Representative NM[1]	Measured background noise level, RBL, dB[2]			Intrusive noise criteria $L_{Aeq,15min}$, dB[3,4]		
		Day	Evening	Night	Day	Evening	Night
NCA1	NM1	40	39	34	45	44	39
NCA2	NM2	35(34)	35(36)	30	40	40	35
NCA3	NM3	35(30)	34	30	40	39	35
N/A	NM4	35(29)	30(36)	30	40	40	38

Notes. 1. Noise measurement location (NM) shown in Figure 3.1.

2.The daytime is 7.00 am to 6.00 pm; evening 6.00 pm to 10.00 pm; night-time 10.00 pm to 7.00 am. On Sundays and Public Holidays, the daytime is 8.00 am to 6.00 pm; evening 6.00 pm to 10.00 pm; night-time 10.00 pm to 8.00 am.

3. The RBL is a NPfI term and is used represent the background noise level.

4. L_{Aeq} is the energy averaged noise level over the measurement period and representative of general ambient noise.

5. Where the evening RBL is greater than the daytime RBL, the project intrusiveness level for the evening should be no greater than that set for the daytime level. This also applies for where the night is greater than the evening (ie night is set to the evening intrusiveness noise level)

4.1.2 Amenity criteria

The assessment of amenity is based on noise criteria specific to the land use. The amenity criteria are used to assess the cumulative impacts of industrial noise. Where the measured existing industrial noise approaches recommended amenity criteria, it needs to be demonstrated that noise levels from new industry will not contribute to existing industrial noise such that criteria 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 development is the recommended amenity noise level (outlined in Table 2.2 of the NPfI) minus 5 dB.

The proposal includes a significant cluster of industrial sites. The amenity noise target for multiple industrial sources is based on contribution from three to four sites [2.4.2 para 2]. As such guidance is taken from Section 2.4.2 of the NPfI which provides guidance for greenfield sites where a cluster of industrial sites are proposed.

Noise from each industrial site should not exceed the individual project amenity noise level which is described by the following equation:

$$Individual\ project\ amenity\ noise\ level = 10\log\left(\frac{10^{ANL-\frac{5dB}{10}}}{N}\right) \qquad Equation\ 1$$

Where:

ANL = relevant recommended amenity noise level from Table 2.2 (NPfI); and

N = number of proposed additional premises.

Given that receivers surrounding the site are not impacted by existing industrial sources, the ANL – 5dB can be substituted by the ANL only.

It should be noted that Equation 1 is a strict division of the project amenity noise level (ie an allotment farthest away from assessment locations would be proportioned the same criteria as those closest to assessment locations). In practice, a larger portion of the development cumulative noise criteria may be proportioned to lots which are closer to sensitive land uses and avoid unnecessary acoustic treatment to achieve the overall cumulative noise target. This should be considered as part of the development masterplan such that suitable noise criteria may be proportioned to each allotment whilst achieving the cumulative project amenity noise target.

Table 2.3 of the NPfI provides guidance on the selection of amenity noise categories based on the RBL in the area. In this regard, the following categories have been selected for assessment locations in the vicinity of the site:

- assessment locations on the eastern side of Luddenham Road have been considered as ‘suburban’ based on noise monitoring conducted at NM1; and
- assessment locations on the western side of Luddenham Road, where the rear of the property faces the Site, have been considered ‘rural’ based on noise monitoring conducted at NM2.

The corresponding recommended amenity criteria for the proposed development are given in Table 4.2.

Table 4.2 Amenity criteria

Receiver type	Indicative area	Period[1]	Recommended noise level dB, $L_{Aeq\ (period)}$
Residential	Rural	Day	50
		Evening	45
		Night	40
	Suburban	Day	55
		Evening	45
		Night	40
Active recreation	All	When in use	55

Notes. 1. The daytime is 7.00 am to 6.00 pm; evening 6.00 pm to 10.00 pm; night-time 10.00 pm to 7.00 am. On Sundays and Public Holidays, the daytime is 8.00 am to 6.00 pm; evening 6.00 pm to 10.00 pm; night-time 10.00 pm to 8.00 am.

4.1.3 Project noise trigger level

In the assessment of new developments, noise emissions from a particular site would be assessed against the project noise trigger level (PNTL), which is the lower of the calculated intrusive or amenity criteria.

However, given the absence of any major industrial noise source in the area, assessment against the intrusiveness criteria would be overly restrictive at this time particularly given the planned growth of the area (ie major transport infrastructure, industrial, retail, commercial and high density residential).

Consideration is given to the intrusiveness and amenity criteria when comparing noise emissions from the operation of the Site in Section 5.3.

A summary of the PNTL for assessment of operational noise from the Site is presented in Table 4.3. These would ordinarily apply to individual sites and would be assessed at the DA stage once all noise sources are known for each individual property.

Table 4.3 Project noise emission objectives – residential receivers

Assessment locations	Assessment period[1]	Intrusiveness noise level, $L_{Aeq,15min}$, dB	Amenity noise level[2], $L_{Aeq,15min}$, dB
R1-R14 & R21 (NM1)	Day	45	58
	Evening	44	48
	Night	39	43
R16-R20 & R22 (NM2)	Day	40	53
	Evening	40	48
	Night	35	43
R23, R24 (NM3)	Day	40	53
	Evening	39	48
	Night	35	43

Notes: 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; Morning shoulder: 6 am to 7 am Monday to Saturday, 6 am to 8 am Sundays and public holidays; Night: remaining periods.

2. Project amenity $L_{Aeq,15min}$ noise level is the recommended amenity noise level $L_{Aeq,period}$ +3 dB as per the NPfI. In the absence of existing or future industrial noise sources, the amenity level has not been adjusted 5dB.

The amenity noise levels for uses other than residential are provided Table 4.4.

Table 4.4 Project noise emission objectives – uses other than residential

Receiver type	Amenity noise level[1], $L_{Aeq,15min}$ dB
Active recreation (R15)	58 – when in use

Notes: 1. Project amenity $L_{Aeq,15min}$ noise level is the recommended amenity noise level $L_{Aeq,period}$ +3 dB as per the NPfI. In the absence of existing or future industrial noise sources, the amenity level has not been adjusted 5dB.

4.1.4 Sleep disturbance criteria

The development may operate during the night-time period (10 pm to 7 am) and therefore, in accordance with the NPfI, the potential for sleep disturbance has been assessed.

The NPfI suggests that a detailed maximum noise level event assessment should be undertaken where the development/premises night-time noise levels at a residential location exceed:

- $L_{Aeq,15min}$ 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).

Some guidance regarding potential for sleep disturbance is also provided in the DECCW's Road Noise Policy (RNP) (2011). The RNP calls upon a number of studies that have been conducted into the effect of maximum noise levels on sleep. The RNP acknowledges that, at the current 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 that a facade including a partially open window will reduce external-to-internal 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 cause awakening affects.

The sleep disturbance criteria for all residential assessment locations are provided in Table 4.5.

Table 4.5 Maximum noise level event screening criteria

Assessment location	Assessment period[1]	Adopted RBL, dB(A)	Maximum noise level event screening criteria, dB	
			RBL +5 dB or standard[1]	RBL +15 dB or standard[1]
			$L_{Aeq,15min}$	L_{Amax}
NCA1	Night	34	40	52
NCA2 & NCA3	Night	30	40	52

Notes: 1. Whichever is greater.

4.2 Construction noise and vibration

The Interim Construction Noise Guideline (ICNG) (DECC 2009) has been jointly developed by NSW Government agencies including the EPA and Department of Planning, Industry and Environment (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):

- Monday to Friday 7.00 am to 6.00 pm;
- Saturday 8.00 am to 1.00 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.

The assessment of the masterplan would be undertaken using a quantitative approach.

4.2.1 Noise management levels

Table 2 of the ICNG provides guidance on establishing noise management levels (NML) for residential receivers during standard hours and has been reproduced in Table 4.6.

Table 4.6 ICNG residential NMLs

Time of day	NML $L_{Aeq,15min}$	How to apply
Recommended standard hours: Monday to Friday 7.00 am to 6.00 pm Saturday 8.00 am to 1.00 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 $L_{Aeq,15min}$ 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.
Recommended standard hours: Monday to Friday 7.00 am to 6.00 pm Saturday 8.00 am to 1.00 pm	Highly noise affected 75 dB(A)	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:

Table 4.6 ICNG residential NMLs

Time of day	NML $L_{Aeq,15min}$	How to apply
No work on Sundays or public holidays		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. if the community is prepared to accept a longer period of construction in exchange for restrictions on construction times.

Source: ICNG (DECC 2009).

Table 4.7 summarises noise management levels for non-residential land uses as defined in the ICNG.

Table 4.7 ICNG noise management levels at other land uses

Land use	Management level, $L_{Aeq,15\ minute}$
Active recreation	65

Source: ICNG (DECC, 2009).

4.2.2 Project construction NMLs

The construction NMLs for residential assessment locations have been based on the RBLs provided in Table 3.2. The NMLs for standard construction hours adopted for this assessment were derived in accordance with the ICNG for all assessment locations and are presented in Table 4.8.

Table 4.8 Construction NMLs for standard hours

Assessment location	Period	RBL, dB(A)[1]	NML, $L_{Aeq,15min}$, dB	HNL[2]
R1-R14 & R21 (NM1)	Day (standard ICNG hours)	40	50	75
R16-R20 & R22 (NM2)		35	45	75
R23, R24 (NM3)		35	45	75

Notes: 1. Based on the day period RBL established in Table 4.1.
2. HNL – highly noise affected level

4.3 Road traffic noise

Construction traffic requires assessment for potential noise impact. The principle guidance to assess the impact of the road traffic noise on assessment locations is in the NSW RNP.

The road traffic noise assessment criteria for residential land uses (ie assessment locations) for traffic associated with construction works is presented in Table 4.9, reproduced from Table 3 of the RNP for relevant road categories.

Table 4.9 Road traffic noise assessment criteria for residential land uses

Road Category	Type of project/development	Assessment criteria – dBA	
		Day (7:00 am to 10:00 pm)	Night (10:00 pm to 7:00 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)

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 +2 dB.

5 Assessment of operational noise impacts

5.1 Assessment methodology

Noise generated by the development will be generally associated with the use of loading docks, on-site vehicle movements and road traffic noise generation on Luddenham Road.

Noise associated with internal warehouse operations and mechanical plant servicing those warehouses can be acoustically treated to suit the operation. In this regard, internal operations will not be a limiting factor in the determination of reasonable noise from the development.

The indicative masterplan and structure plan in Figure 5.1 and has been utilised as a basis for the assessment to determine likely levels of noise at surrounding assessment locations from the use of the Site as proposed. This may be used to inform:

- site layouts for the development masterplan;
- acoustic treatment which may be employed to reduce noise emissions from the site; and
- noise management which may be employed to reduce noise from the use as practically possible.

Noise from the operation of loading docks and on-site vehicles has been modelled with consideration to the indicative masterplan staging. These predictions have been prepared to provide an indication as to the overall noise impact associated with the masterplan.

Alspec Industrial Business Park

3-Sep-21 SK022f

TOTAL SITE AREA (m²)	**1,466,103**
AIBP Total Site Area	1,253,713
Additional Land Total Site Area	212,390

Constraints (m²)	SITE AREA (m2)
Outer Sydney Orbital	360,412
Western Sydney Freight (exld. overlaps)	6,089
Electrical Easement (exld. overlaps)	23,335
Enviro. Management & Basins (incl. severed land)	84,259
Luddenham Road Widening Corridor (exld. overlaps)	21,238
Road Reserves	79,755
CONSTRAINTS TOTAL	575,088
TOTAL DEVELOPABLE AREA (m²)	891,015

STAGE 1 AREA (m²) (incl. internal constraints)	414,375
LOT 1 - Alspec	
Landtake area	**87,227**
Total Warehouse	47,191
Total Office	900
Total Building Area	**48,091**
Lot FSR	0.55:1
Carparking Achieved	500
LOT 3	
Landtake area	**50,784**
Total Warehouse	25,934
Total Office	1,600
Total Building Area	**27,534**
Lot FSR	0.54:1
Carparking Achieved	275
LOT 4	
Landtake area	**38,022**
Total Warehouse	19,806
Total Office	1,300
Total Building Area	**21,106**
Lot FSR	0.56:1
Carparking Achieved	214
LOT 5	
Landtake area	**69,993**
Total Warehouse	39,795
Total Office	2,200
Total Building Area	**41,995**
Lot FSR	0.6:1
Carparking Achieved	420
LOT 6	
Landtake area	**64,905**
Total Warehouse	37,834
Total Office	2,200
Total Building Area	**40,034**
Lot FSR	0.62:1
Carparking Achieved	402

STAGE 2 AREA (m²) (incl. internal constraints)	284,749
LOT 7	
Landtake area	**65,202**
Total Warehouse	36,917
Total Office	2,200
Total Building Area	**39,117**
Lot FSR	0.6:1
Carparking Achieved	392
LOT 8	
Landtake area	**65,988**
Total Warehouse	37,822
Total Office	2,200
Total Building Area	**40,022**
Lot FSR	0.61:1
Carparking Achieved	400
LOT 9	
Landtake area	**41,001**
Total Warehouse	20,521
Total Office	1,100
Total Building Area	**21,621**
Lot FSR	0.53:1
Carparking Achieved	217
LOT 10	
Landtake area	**42,726**
Total Warehouse	23,744
Total Office	1,300
Total Building Area	**25,044**
Lot FSR	0.59:1
Carparking Achieved	251
LOT 11	
Landtake area	**45,585**
Total Warehouse	23,713
Total Office	1,300
Total Building Area	**25,013**
Lot FSR	0.55:1
Carparking Achieved	251

STAGE 3 AREA (m²) (incl. internal constraints)	373,736
LOT 12	
Landtake area	**29,711**
Total Warehouse	16,032
Total Office	800
Total Building Area	**16,832**
Lot FSR	0.57:1
Carparking Achieved	168
LOT 13	
Landtake area	**32,111**
Total Warehouse	16,595
Total Office	800
Total Building Area	**17,395**
Lot FSR	0.54:1
Carparking Achieved	174
LOT 14	
Landtake area	**35,902**
Total Warehouse	17,217
Total Office	1,300
Total Building Area	**18,517**
Lot FSR	0.52:1
Carparking Achieved	187
LOT 15	
Landtake area	**35,583**
Total Warehouse	16,897
Total Office	1,300
Total Building Area	**18,197**
Lot FSR	0.51:1
Carparking Achieved	186
ADDITIONAL LAND	
Landtake area	**186,275**
Total Warehouse	87,549
Total Office	5,588
Total Building Area	**93,138**
Lot FSR	0.5:1
Carparking Achieved	935

Total Landtake	891,015
Total Warehouse Area	467,567
Total Office Area	26,088
Total Building Area	493,656
Site FSR	0.55:1
Total Car Parking	4,972
Required Car Parking	4,937

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0 60 150 300m

Alspec Industrial Business Park

Luddenham Road, Orchard Hills - NSW

Updated Masterplan

Title

Scale 1:3000 @ A1

Date August 2021

Number 11178_SK022f

nettletontribe

Legend

- E2
- IN1
- IN2
- RU2
- SP2
- OSO CORRIDOR
- REZONING AREA
- STRUCTURE PLAN AREA
- INDUSTRIAL CONNECTOR ROAD
- CUL-DE-SAC

SP2
RU2
SP2
RU2
E2
E2
IN1
IN2
RU2
RU2
POTENTIAL LUDDENHAM ROAD WIDENING RESERVE SHOWN DASHED

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0 60 150 300m

Alspec Industrial Business Park

Luddenham Road, Orchard Hills - NSW

Title: Structure Plan
Scale: 1:6000 @ A1
Date: Aug 2021
Number: 11178_SK023j

nettletontribe

5.2 Modelling assumptions

5.2.1 Noise modelling parameters

Noise modelling was conducted using SoundPlan™ noise modelling software. The acoustic model utilises 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.

The modelling parameters adopted for the assessment are provided in Table 5.1.

Table 5.1 Modelling Standard Parameters

Modelling Parameter	Input
Model	ISO 9613-2:1996
Environmental conditions	Humidity 70% Temperature 10°C Air pressure [mbar] 1013.3
Elevation contours	Contours adopted from DEM of Australia derived from LiDAR 5 metre grid
Receiver height	1.5m above ground for single storey 4.5m above ground for double storey
Ground absorption factor	75% over open grass 10% over rail yards

5.2.2 On-site vehicle movements

On-site vehicle movements relate to each warehouse lot, including those associated with carparks and loading docks.

Noise associated with on-site vehicles is addressed using the sound power levels in Table 5.2. Noise modelling has conservatively assumed that all sources are operating simultaneously. The vehicle noise sources in Table 5.2 have been assessed based on design plans supplied by HBB Property. The development will incorporate driveways around the perimeter of each building which will be utilised by emergency vehicles in the event of fire. General site traffic will not utilise these driveways.

Table 5.2 Site traffic noise sources and expected volumes

Traffic source	Source SWL, L_{Aeq} dB(A)	Source SWL, L_{max} dB(A)	Vehicle movements
Semi-trailer	105 at 10 km/h	110 (airbrake discharge)	4 in / 4 out
	95		Idling for 5 minutes on hardstand
Forklift	100	110 (pallet drop)	15 minutes operation per heavy vehicle movement on hardstand
Cars	83 at 10 km/h	94 (car starting)	Carpark emptying within 1-hour period

Traffic volumes have been provided to EMM by the project traffic engineer Arcadis. Expected traffic generation is provided in Table 5.3 which nominates the following two-way traffic movements.

Baseline road traffic volumes have been provided by Arcadis and are included in the assessment of road traffic noise generation in Section 0.

Table 5.3 Expected traffic generation (Arcadis)

Stage	Vehicle movements north of Patons Lane		Vehicles south of Patons Lane	
	Day – 7am to 10pm	Night – 10pm to 7am	Day – 7am to 10pm	Night – 10pm to 7am
1	2,063 (11.6%)	364 (25%)	1,375 (11.6%)	243 (25%)
2	3,742 (11.6%)	660 (25%)	2,495 (11.6%)	440 (25%)
3	4,600 (11.6%)	812 (25%)	3,067 (11.6%)	541 (25%)

Note: 1. Percentage heavy vehicles in brackets

Heavy vehicles potentially accessing each warehouse between 7.00am to 10.00pm equates to approximately 2.4 movements per hour. This has been conservatively modelled as four movements per hour, assuming two vehicles in, two vehicles out.

Heavy vehicles accessing each warehouse between 10.00pm and 7.00am equates to approximately 1.5 movements per hour. This has been conservatively modelled as two movements per hour, assuming one vehicle in, one vehicle out.

5.2.3 Carparking

Each warehouse will include staff parking. For the most part, these carparks are typically located away from the precinct boundaries and are shielded from surrounding assessment locations due to intervening structures (ie warehouses).

The assessment of noise from carparks have been based on each carpark emptying within a 1-hour period consistent with shift change.

5.2.4 Warehouse noise

At this stage, the internal use of each warehouses is unknown. It is expected that typical uses would include storage, distribution and manufacturing.

It is noted that noise breakout from internal activities can be controlled by acoustically treating the building façade including any ventilation systems and openings.

The limiting factor for any industrial development will typically be due to the on-site vehicle movements such as heavy vehicles on a loading dock hardstand. Given that noise from internal warehouse operations can be suitably managed with appropriate architectural treatment to the warehouse structure, contribution from this noise source has not been included in this broad assessment.

5.3 Predicted noise levels

Predicted noise levels due to the operation of the development are provided in Table 5.4. Noise predictions are predominantly associated with heavy vehicle movements and loading dock activities.

Table 5.4 Predicted operational noise levels

Stage	Time of day	Noise catchment area	Predicted noise level, dB $L_{Aeq\ 15min}$	Amenity noise limit, dB $L_{Aeq,\ 15min}$	Exceedance of amenity noise limit, dB $L_{Aeq\ 15min}$	Intrusiveness noise limit, dB $L_{Aeq\ 15min}$	Exceedance of intrusiveness limit
1	Day	NCA1	43	58	-	45	
		NCA2	43	48	-	40	3
		NCA3	31	43	-	40	-
	Evening	NCA1	43	53	-	44	-
		NCA2	43	48	-	40	3
		NCA3	31	43	-	39	-
	Night	NCA1	40	53	-	39	1
		NCA2	40	48	-	35	5
		NCA3	28	43	-	35	-
2	Day	NCA1	44	58	-	45	
		NCA2	44	48	-	40	4
		NCA3	40	43	-	40	-
	Evening	NCA1	44	53	-	44	-
		NCA2	44	48	-	40	4
		NCA3	40	43	-	39	1
	Night	NCA1	41	53	-	39	2
		NCA2	41	48	-	35	6
		NCA3	37	43	-	35	2
3	Day	NCA1	44	58	-	45	
		NCA2	44	48	-	40	4
		NCA3	41	43	-	40	1
	Evening	NCA1	44	53	-	44	-
		NCA2	44	48	-	40	4
		NCA3	41	43	-	39	2
	Night	NCA1	41	53	-	39	2
		NCA2	41	48	-	35	6
		NCA3	38	43	-	35	3

Predicted noise levels at non-residential assessment locations are provided in Table 5.5.

Table 5.5 Predicted operational noise levels (non-residential)

Stage	Time of day	Noise catchment area	Predicted noise level, dB $L_{Aeq\ 15min}$	Amenity noise target, dB $L_{Aeq\ 15min}$	Exceedance of amenity noise target
1	When in use	NCA2 (R15)	50	58	-
2		NCA2 (R15)	50	58	-
3		NCA2 (R15)	50	58	-

5.4 Sleep disturbance assessment

Maximum noise levels from the development during the night period with the potential to cause sleep disturbance at nearby residences have been assessed in accordance with the NPfI.

In this instance, the $L_{Aeq,15min}$ intrusive criteria will be more stringent than the $L_{Aeq,15min}$ sleep disturbance criteria. As such compliance with the levels provided in Table 5.4 will indicate compliance with the $L_{Aeq,15min}$ sleep disturbance criteria.

Sleep disturbance due to instantaneous noise events (eg truck brake discharge, pallets dropping, cars starting) have been assessed. The predicted noise levels from these events are provided in Table 5.6.

Table 5.6 Predicted maximum noise levels at residential assessment locations

Stage	Noise catchment area	Predicted noise level, dB L_{Amax}	Screen criteria, dB L_{Amax}	Exceedance of screening criteria
1	NCA1	56	52	4
	NCA2	55	52	3
	NCA3	38	52	-
2	NCA1	56	52	4
	NCA2	55	52	3
	NCA3	47	52	-
3	NCA1	56	52	4
	NCA2	56	52	3
	NCA3	47	52	-

5.5 Road traffic noise generation

Road traffic noise generated by additional traffic movements from the Site has been addressed for assessment locations along Luddenham Road.

The ultimate traffic volumes generated by the Site would be realised over the course of the development and not immediately upon inception of first stage within the development. In this regard, increases in traffic volume and inherently road traffic noise would be gradual and experienced over periods of years. Projected traffic volumes have been adopted from advice provided by Arcadis. Road noise modelling has been conducted to substantiate potential increases in road traffic noise level due to site generated traffic when compared against the natural growth of road traffic volumes along Luddenham Road in the absence of the development.

The data in Table 5.7 describes the following:

- traffic volumes in the absence of the development for each staged year ('no-build');
- traffic volumes expected to be generated by the development ('development traffic'); and
- the combined traffic volumes due to the development and under the 'no-build' scenario.

The increase in road traffic noise level due to the project is provided in Table 5.7 and Table 5.8, which also shows the comparison between the volumes with and without the development. The traffic volumes for each stage include the cumulative volumes from the preceding stage/s.

Additional road traffic associated with industrial development within the IN2 zone has also been considered. This has been labelled as "Stage 3 + additional zoning 2025".

Existing road traffic noise levels as measured at the site indicate that road traffic noise is estimated to be 61dB $L_{Aeq\ 15\ hour}$ and 57dB $L_{Aeq\ 9\ hour}$ façade corrected as measured at NM1. As such, existing noise levels exceed the RNP road noise planning levels.

Table 5.7 Predicted increase in road traffic noise level (7am to 10pm)

Direction	Stage / year	No-build		Development traffic		Build		Increase in road traffic noise level, dB $L_{Aeq,\ 15hr}$
		Traffic volume	HV %	Traffic volume	HV %	Traffic volume	HV %	
Northbound	Stage 1 2023	9,479	6%	1,916	11.6%	11,395	7%	+0.9
	Stage 2 2024	10,208	6%	3,533	11.6%	13,741	8%	+1.5
	Stage 3 2025	10,937	6%	4,295	11.6%	15,232	8%	+1.6
	Stage 3 + additional zoning 2025[3]	10,937	6%	5,293	11.6%	16,230	8%	+1.8
Southbound	Stage 1 2023	5,597	8%	1,278	11.6%	6,875	9%	+1
	Stage 2 2024	6,028	8%	2,356	11.6%	8,384	9%	+1.6

Table 5.7 Predicted increase in road traffic noise level (7am to 10pm)

Direction	Stage / year	No-build		Development traffic		Build		Increase in road traffic noise level, dB $L_{Aeq, 15hr}$
		Traffic volume	HV %	Traffic volume	HV %	Traffic volume	HV %	
	Stage 3 2025	6,458	8%	2,863	11.6%	9,321	9%	+1.7
	Stage 3 + additional zoning 2025[3]	6,458	8%	3,529	11.6%	9,987	9%	+1.9

Notes: 1. Provided by the project traffic consultant (Arcadis).

2. Traffic distribution from the site is approximately 60% of vehicles to the north and 40% to the south.

3. Additional traffic associated with the rezoning of the lots between the site and Luddenham Road has been provided by Arcadis.

Table 5.8 Predicted increase in road traffic noise level (10pm to 7am)

Direction	Stage / year	No-build		Development traffic		Build		Increase in road traffic noise level, dB $L_{Aeq, 15hr}$
		Traffic volume	HV %	Traffic volume	HV %	Traffic volume	HV %	
Northbound	Stage 1 2023	1,492	6%	338	25%	1,830	9%	+0.7
	Stage 2 2024	1,607	6%	623	25%	2,230	10%	+1.4
	Stage 3 2025	1,722	6%	757	25%	2,479	11%	+1.8
	Stage 3 + additional zoning 2025[3]	1,722	6%	933	25%	2,655	11%	+2
Southbound	Stage 1 2023	881	8%	225	25%	1,106	10	+1.1
	Stage 2 2024	949	8%	415	25%	1,364	12%	+1.8
	Stage 3 2025	1,017	8%	505	25%	1,522	12%	+1.9
	Stage 3 + additional zoning 2025[3]	1,017	8%	622	25%	1,639	12%	+2.1

Notes: 1. Provided by the project traffic consultant (Arcadis).

2. Traffic distribution from the site is approximately 60% of vehicles to the north and 40% to the south.

3. Additional traffic associated with the rezoning of the lots between the site and Luddenham Road has been provided by Arcadis.

5.6 Operational noise associated with IN2 rezoning

The rezoning of land to the east of the site between the development and Luddenham Road will make way for additional industrial development which is currently outside of this masterplan. Given there is no specific design, noise impacts associated with this rezoning is discussed in principle only.

The structure plan provided in Figure 5.2 indicates a road accessway up the middle of the IN2 zoning. By incorporating loading docks or openings facing onto the internal roadway, the built form structures would create a noise barrier between the noisier areas and sensitive noise receptors across Luddenham Road. With appropriate planning of warehouse built form, it is envisaged that minimal additional acoustic treatment by way of acoustic screens would be required to address vehicle noise on loading dock hardstands or similar.

As with warehouses addressed as part of Stages 1 to 3 of the Alspec Industrial Business Park masterplan, internal noise breakout can be suitably managed using upgraded building construction if required. As such, manufacturing or internal operational noise does not present a significant noise risk.

The potential increase for road traffic noise on Luddenham Road has been addressed in Section 5.2.

6 Construction noise

At this stage, a detailed construction methodology has not been undertaken. However, a development of this nature is not atypical and can be suitably managed to minimise noise impacts on surrounding noise sensitive receivers.

Noise mitigation strategies which would be considered as part of the masterplan construction noise and vibration assessment may include the following.

6.1 Construction noise mitigation

Mitigation measures which may be employed to minimise noise impacts from the construction of the project are discussed in this section. These can include physical measures, such as acoustic screens or shrouds, or noise management measures such as scheduling, community consultation and the like.

6.1.1 Community consultation

Community consultation and complaints handling procedures should be developed such that noise affected receivers may be kept apprised of:

- construction timeline;
- expected noisy works particularly concrete pours which may extend into the evening; and
- readily available avenues to address noise complaint.

6.1.2 Acoustically rated site hoarding

Acoustically rated site hoarding may be employed between the site and surrounding receiver locations. The use of imperforate materials such as plywood (a typically standard hoarding material) can provide realistic noise reductions in the order of 10-15 dB assuming that the barrier inhibits line of sight to receptor locations.

6.1.3 Temporary noise barriers

Temporary noise barriers may be incorporated around particularly noisy static equipment to minimise noise being transmitted to surrounding noise sensitive locations.

6.1.4 Scheduling of works

Noisy works may be scheduled to times which are more mutually agreeable to surrounding noise receptors. This can also include scheduling works such that multiple pieces of noisy plant equipment are not being utilised in close proximity to a particular noise receptor.

6.1.5 Plant and equipment

Additional measures for plant and equipment 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.

6.1.6 Work practices

Work practice methods include:

- regular reinforcement (such as at toolbox talks) of the need to minimise noise and vibration;
- regular identification of noisy activities and adoption of improvement techniques;
- avoiding the use of portable radios, public address systems or other methods of site communication that may unnecessarily impact upon nearby residents;
- locating vehicles to minimise noise;
- where possible, avoid the use of equipment that generates impulsive noise (ie hammering);
- minimise the movement of materials and plant and unnecessary metal-on-metal contact; and
- minimise truck movements.

7 Discussion

7.1 Operational noise levels

Acoustic modelling of operational conditions based on an indicative masterplan have been undertaken. The outcomes from this modelling are discussed for each stage herein. The following commentary is provided with regard to the worst case affected assessment location in each NCA.

7.1.1 Stage 1 – operational conditions

Stage 1 of the indicative masterplan has development predominantly located along the northern and western boundary of the site which maximises distance between warehouses and assessment locations along Luddenham Road. Warehouse 1a and 1b are proposed along the northern and eastern boundary of the development, the operation of which is the main contributor to noise received at assessment locations to the east of the site.

Predicted noise levels indicate amenity noise levels will be achieved but that:

- exceedances of the day intrusive noise target of:
  - nil for NCA1;
  - 3dB for NCA2; and
  - nil for NCA3;
- exceedances of the evening intrusive noise target of:
  - nil for NCA1;
  - 3dB for NCA2; and
  - nil for NCA3;
- exceedance of the night intrusive noise target of:
  - 1dB for NCA1;
  - 5dB for NCA2; and
  - nil for NCA3;
- exceedances of the night-time sleep disturbance targets of:
  - 4dB for NCA1;
  - 3dB for NCA2; and
  - no exceedance for NCA3.

There are no exceedances of the amenity noise targets due to Stage 1 operation. As such, the operation of Stage 1 is predicted to satisfy the amenity noise targets which are the more appropriate and reasonable noise targets given the size of the precinct.

No exceedances of the amenity noise target at non-residential assessment locations are expected.

Warehouses 1a and 1b are located along Luddenham Road in proximity to the nearest assessment locations. Assessment locations have a direct line of sight to the loading dock and carpark of these warehouses, which is the main contributor to noise associated with Stage 1 and ongoing stages.

Consideration should be given to the orientation of these warehouses or the incorporation of acoustic barriers such that the loading dock hardstands are acoustically screened from receiver locations along Luddenham Road and to the south of Warehouses 1a and 1b.

It should be noted that the exceedances of the night-time sleep disturbance screening criteria should also consider the advice provided in the RNP which states that maximum internal noise levels (L_{Amax}) below 50 to 55 dB are unlikely to awaken people from sleep. As discussed in Section 4.1.4, this corresponds to an external noise level of 60-65 dB. It should also be noted the vehicle pass-bys along Luddenham Road would far exceed this level for receivers within NCA1 which face the roadway.

7.1.2 Stage 2 – operational conditions

Stage 2 of the indicative masterplan has development located on the western and southern boundaries of the site. The loading docks of Warehouse 9-11 are open at the southern end which provides a line of sight to R23 (405 Luddenham Road).

Predicted noise levels indicate amenity noise levels will be achieve but that:

- exceedances of the day intrusive noise target of:
  - nil for NCA1;
  - 4dB for NCA2; and
  - nil for NCA3;
- exceedances of the evening intrusive noise target of:
  - nil for NCA1;
  - 4dB for NCA2; and
  - 1dB for NCA3;
- exceedance of the night intrusive noise target of:
  - 2dB for NCA1;
  - 6dB for NCA2; and
  - 2dB for NCA3;
- exceedances of the night-time sleep disturbance targets of:

- 4dB for NCA1;
- 3dB for NCA2; and
- no exceedance for NCA3.

There are no exceedances of the amenity noise targets due to the cumulative Stage 1 and Stage 2 operation. No exceedances of the amenity noise target at non-residential assessment locations are expected.

Consideration should be given to re-orientating Warehouses 9-11 such that loading dock hardstands are acoustically screened from this receiver location. An acoustic barrier may also be considered along this southern boundary.

It should also be noted that the Western Sydney Freight Line and Outer Sydney Orbital are currently proposed between the development and receiver R23 which is the main receiver of noise associated with Stage 2 operations. Noise impacts from the operation of the proposal are unlikely to be substantial in comparison with noise associated with this transport infrastructure.

7.1.3 Stage 3 – operational conditions

The introduction of Stage 3 would generally result in a reduction in noise impact from the operation of the development given that warehouses 12a and 12b along the eastern boundary and 14a and 14b along the southern boundary would provide significant screening for warehouses as part of Stage 1 and 2.

Predicted noise levels indicate amenity noise levels will be achieve but that:

- exceedances of the day intrusive noise target of:
  - nil for NCA1;
  - 4dB for NCA2; and
  - 1dB for NCA3;
- exceedances of the evening intrusive noise target of:
  - nil for NCA1;
  - 4dB for NCA2; and
  - 2dB for NCA3;
- exceedance of the night intrusive noise target of:
  - 2dB for NCA1;
  - 6dB for NCA2; and
  - 3dB for NCA3;
- exceedances of the night-time sleep disturbance targets of:
  - 4dB for NCA1;

- 3dB for NCA2; and
- no exceedance for NCA3.

There are no exceedances of the amenity noise targets due to the cumulative Stage 1, Stage 2 and Stage 3 operation. No exceedances of the amenity noise target at non-residential assessment locations are expected.

7.1.4 Compliance with cumulative noise objectives

The cumulative noise from all stages of the indicative masterplan is predicted to satisfy the project amenity noise targets. As stated previously, compliance with the intrusiveness noise target of background + 5 dB for the whole development would be overly restrictive and not appropriate in the application of the NPfI. As such compliance with the amenity noise target would be the overarching objective for the assessment of the entire masterplan. Once known, individual uses would also need to demonstrate that the intrusiveness criteria can be achieved.

7.2 Road traffic noise

Predicted road traffic noise levels with and without the development indicate:

- a 1.2 dB increase in road traffic noise is expected from Stage 1;
- a 1.9 dB increase will result from the Stage 2 works; and
- a 2 dB increase will result from the Stage 3 works.

It is noted that these are the cumulative values. The overall increase from all stages will result in a 2 dB increase in road traffic noise level in comparison with road traffic noise levels in the absence of the development which satisfies the 2dB maximum allowable increase of the RNP.

Road traffic associated with the additional IN2 rezoning between the site and Luddenham Road will result in a 1.9 dB and 2.1 dB increase in road noise level assessed cumulatively with the preceding Stages 1-3 for the daytime and night time periods respectively. The 0.1 dB exceedance of the maximum allowable increase criteria at night is imperceptible and would have no real impact on receivers along Luddenham Road. However, according to the EPA's RNP this triggers the need for all feasible and reasonable noise mitigation and management measures.

It should also be noted that the additional zoning would likely be incorporated as an additional stage subsequent to Stage 3. As such, the future baseline traffic volumes would likely be higher and therefore further increases in traffic noise are likely to be within the 2dB maximum allowable increase criteria.

7.3 Operational noise associated with IN2 rezoning

Potential operational noise impacts associated with future uses within the IN2 zoning have been discussed. It is expected that with suitable planning of warehouse structures, noise impacts from the operation of uses within this zone would be capable of meeting noise emission requirements.

It is further noted that the built form within the IN2 zoning would provide acoustic screening to development within Stages 1-3.

8 Recommendations

Noise mitigation from industrial uses should consider the three control strategies provided in Section 3.4 of the NPfI which are:

- reducing noise at the source;
- reducing noise in transmission to the receiver; and
- reducing noise at the receiver.

Acoustic treatments and management control incorporating the aforementioned strategies are discussed in the following.

8.1 Reducing noise at the source

Reducing noise at the source for a warehousing, manufacturing and/or distribution type facility may include:

- acoustically treating the building envelope to minimise noise breakout from internal operations;
- acoustic treatment to mechanical plant servicing the facility; and
- appropriate selection of on-site vehicles and appliances (eg gas or electric forklifts, broadband reverse beepers).

Consideration may also be given to the staging of the project such that warehouses on allotments designated in earlier stages provide acoustic screening to allotments in the latter stages of the development.

8.2 Reducing noise in transmission

This may include the appropriate planning of the development such that particularly noisy areas are located further away from receiver locations or incorporating built form (ie warehouse structure) is incorporated between such areas and assessment locations.

Acoustic screening should be considered for the loading dock areas which inhibits line of sight for semi-trailers and loading dock equipment (ie forklifts). This can be undertaken by orientating warehouses such that built form acts as a screen between the loading dock hardstand and surrounding assessment locations.

Where this cannot be undertaken, acoustic fences or barriers would need to be considered. The height of these barriers would be dependent on the finished floor height of the loading dock hardstand in context with surrounding assessment locations.

8.3 Reducing noise at the receiver

Reducing noise at the receiver should only be considered in select circumstances where all other feasible and reasonable measures of site mitigation and management have been exhausted. Such treatments would require close consultation with noise affected land holders, but may include treatments such as acoustic fences, acoustic treatment to the receiver building façade and/or the incorporation of mechanical ventilation to permit windows to be closed.

9 Conclusion

EMM has completed a review of potential noise impacts associated with the proposed Alspec Industrial Business Park to be located at 221-227 & 289-317 Luddenham Road, Orchard Hills NSW. The assessment considered the potential for noise impacts of the project and has been prepared in accordance with the methodologies outlined in the ICNG, NPfI and RNP, as well as other relevant guidelines and standards.

This assessment has been conducted to support the land rezoning application and inform strategic planning of the future masterplan application of the site. Typical noise sources associated with the industrial use have been identified and addressed using an indicative masterplan for the site.

Noise management and trigger levels for the construction and operation of the project have been established based on the results of ambient noise monitoring and methodology provided in the ICNG and NPfI. Specific noise targets for each allotment would be determined as part of the masterplan application, and the more rigorous DA stages for each separate development.

Operational activities have been conservatively modelled at all assessment locations for noise-enhancing meteorological conditions. Main operational activities modelled included on-site vehicle movements associated with loading docks, hardstand operations and carparks. Noise from internal warehouse uses and mechanical plant can be mitigated using architectural and mechanical acoustic treatments and would not usually be a limiting factor in relation to noise generated by the site.

Findings of the assessment are summarised as follows:

- The cumulative noise from all stages is predicted to satisfy the project amenity noise targets, which for a project of this size would be the more applicable noise criteria.

- The assessment found that noise levels during operation could exceed the intrusiveness noise targets at the nearest assessment locations without appropriate controls that would need to be designed once specific details are known for each individual use. Noise barriers, strategic planning of warehouse structures and management controls would be required to mitigate noise from each of the uses.

- The sleep disturbance assessment demonstrated that some exceedance of the NPfI night-time maximum screening noise level is predicted without applying additional measures. Acoustic strategies implemented for the mitigation of general operational noise would likely also mitigate sleep disturbance events. It is also noted that noise levels are not likely to exceed the recommended maximum targets for sleep disturbance provided in the RNP. Furthermore, existing maximum noise levels from passing vehicles on Luddenham Road are higher than those likely from site. If existing dwellings are currently adequately mitigating such road traffic noise (eg if dwelling treatment is currently in place), then impacts from future operations of the site will too be mitigated.

- The project will result in additional road traffic movements during the project operation. Increases in road traffic noise along Luddenham Road due to site generated traffic is not expected to exceed the 2dB requirement of the RNP.

A high-level review of potential noise impacts associated with the rezoning of lands to the east of the site, between the project and Luddenham Road has been conducted. These allotments have been included in the structure plan for rezoning to industrial use (IN2).

The outcomes of the review indicate:

- operational noise associated with internal warehousing and manufacturing uses can be suitably mitigated with additional acoustic treatment to building structures if required;

- operational noise associated with vehicle movements on loading dock hardstands can be suitably mitigated using the built form of warehouse structures as noise barriers (ie locating warehouses between loading docks and noise sensitive receptors across Luddenham Road); and

- increased road traffic noise generation on Luddenham Road due to the incorporation of additional industrial allotments will result in a 0.1dB exceedance of the RNP maximum allowable increase criteria which will be imperceptible and would have no real impact on receivers along Luddenham Road. However, according to the EPA's RNP this triggers the need for all feasible and reasonable noise mitigation and management measures. It is likely that this additional stage will follow other stages and hence be developed many years into the future whereby baseline traffic volumes would likely be higher and therefore incremental increases in traffic noise at that time are likely to be within the 2dB maximum allowable increase criteria.

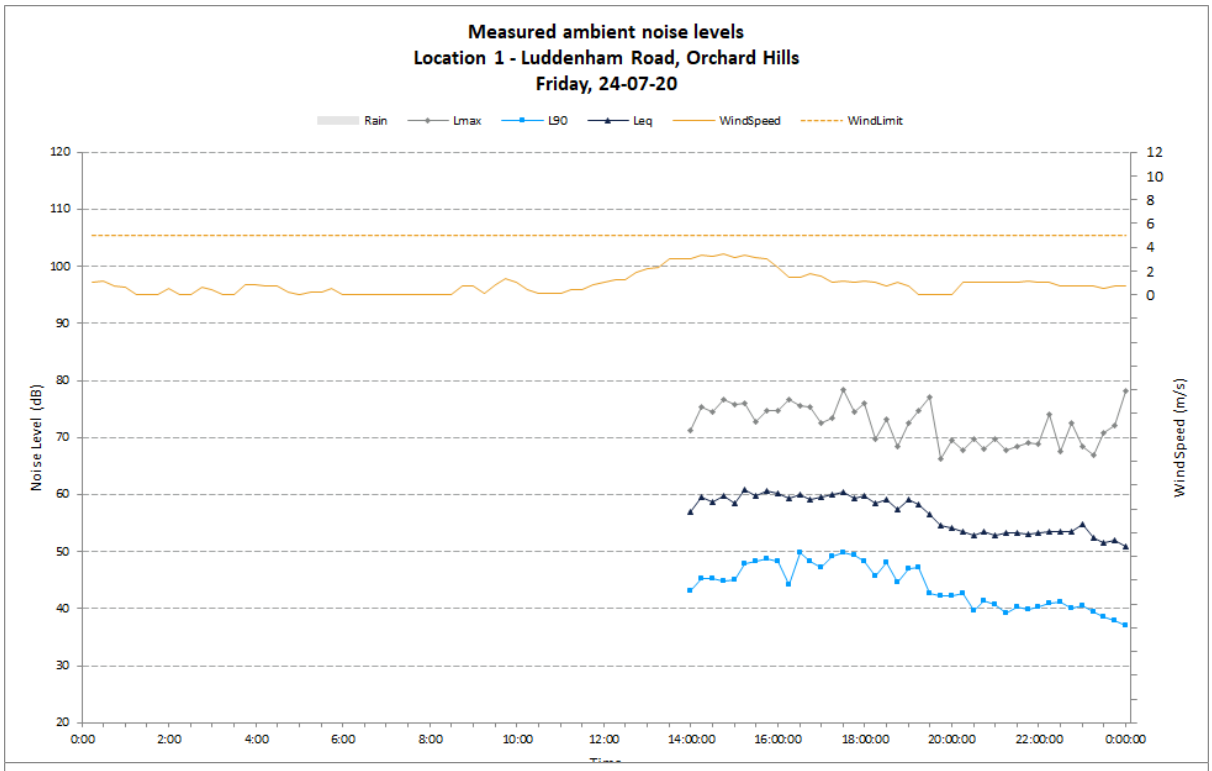
Appendix A

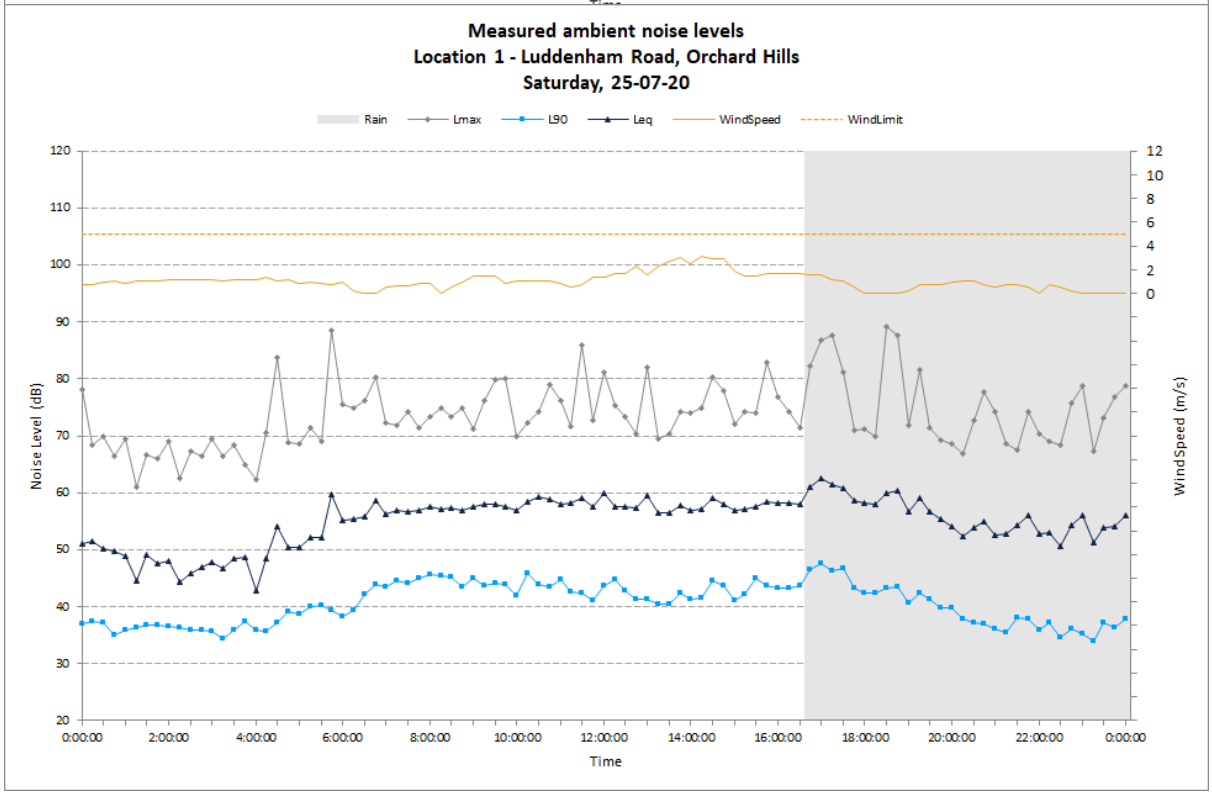
Unattended noise monitoring results

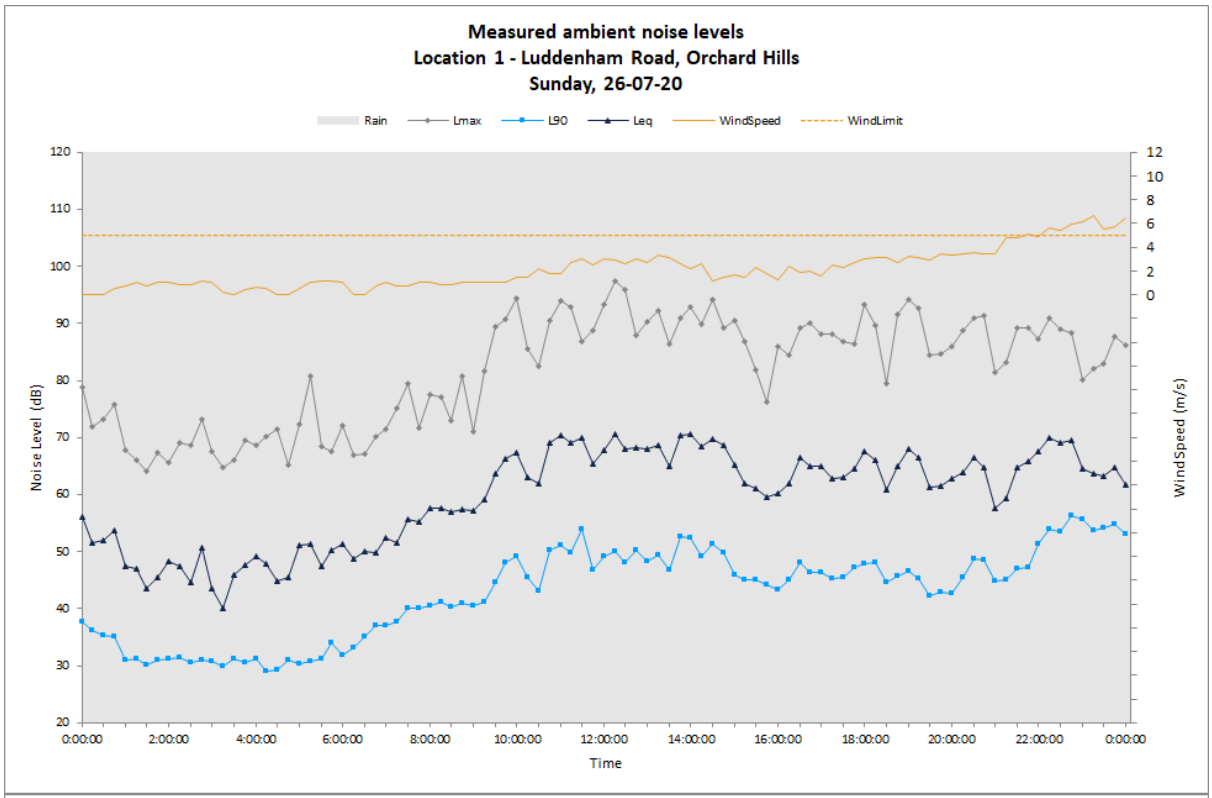
Table A.1 Summary of daily noise logging results – NM1

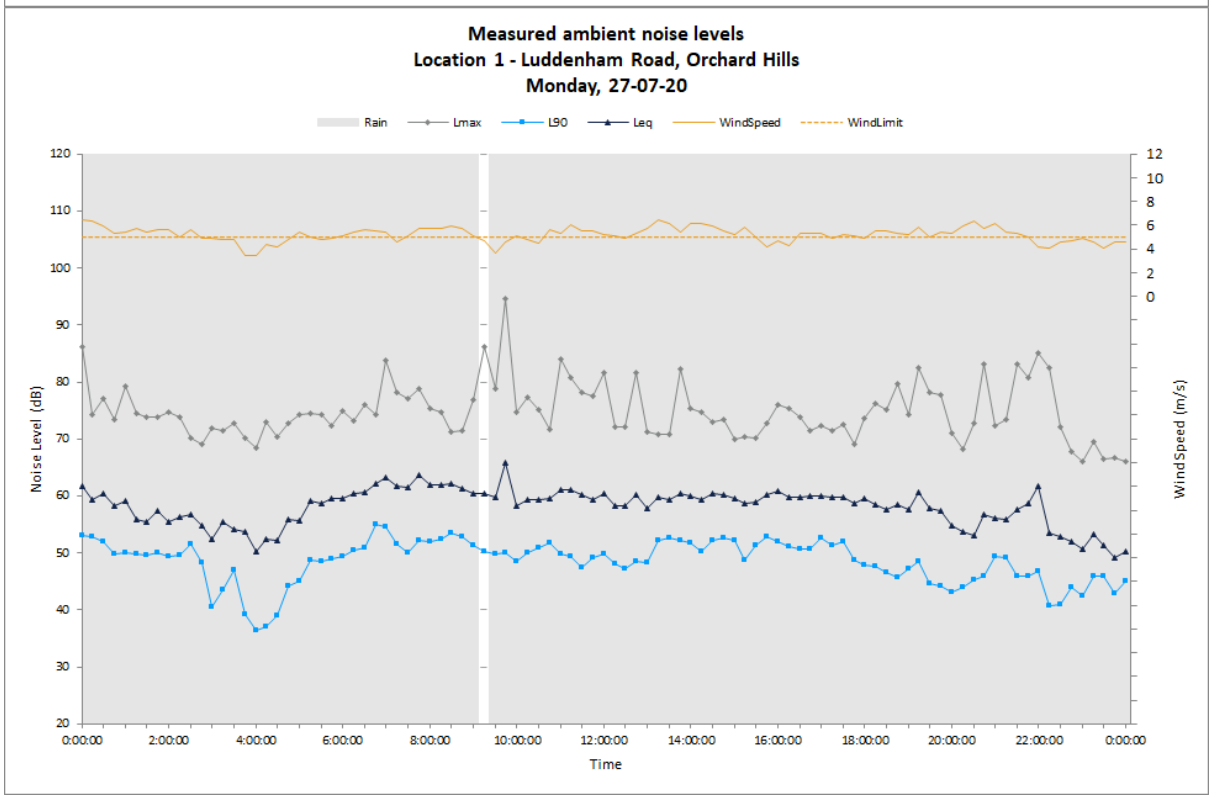
Date	ABL Day[1]	ABL Evening[1]	ABL Night[1]
Saturday, 25-07-20	41	0	0
Sunday, 26-07-20	0	0	0
Monday, 27-07-20	0	0	0
Tuesday, 28-07-20	41	39	35
Wednesday, 29-07-20	40	39	34
Thursday, 30-07-20	40	35	33
Friday, 31-07-20	39	41	36
Saturday, 01-08-20	41	39	34
Sunday, 02-08-20	40	40	34
Monday, 03-08-20	40	39	0
Summary Values	40	39	34

Notes: 1. A "0" indicates insufficient data samples due to adverse weather or other extraneous effects.


Measured ambient noise levels
Location 1 - Luddenham Road, Orchard Hills
Friday, 24-07-20
Rain
Lmax
L90
Leq
WindSpeed
WindLimit
Noise Level (dB)
WindSpeed (m/s)
Time


Measured ambient noise levels
Location 1 - Luddenham Road, Orchard Hills
Saturday, 25-07-20
Rain
Lmax
L90
Leq
WindSpeed
WindLimit
Noise Level (dB)
WindSpeed (m/s)
Time


Measured ambient noise levels
Location 1 - Luddenham Road, Orchard Hills
Sunday, 26-07-20
Rain
Lmax
L90
Leq
WindSpeed
WindLimit
Noise Level (dB)
WindSpeed (m/s)
Time


Measured ambient noise levels
Location 1 - Luddenham Road, Orchard Hills
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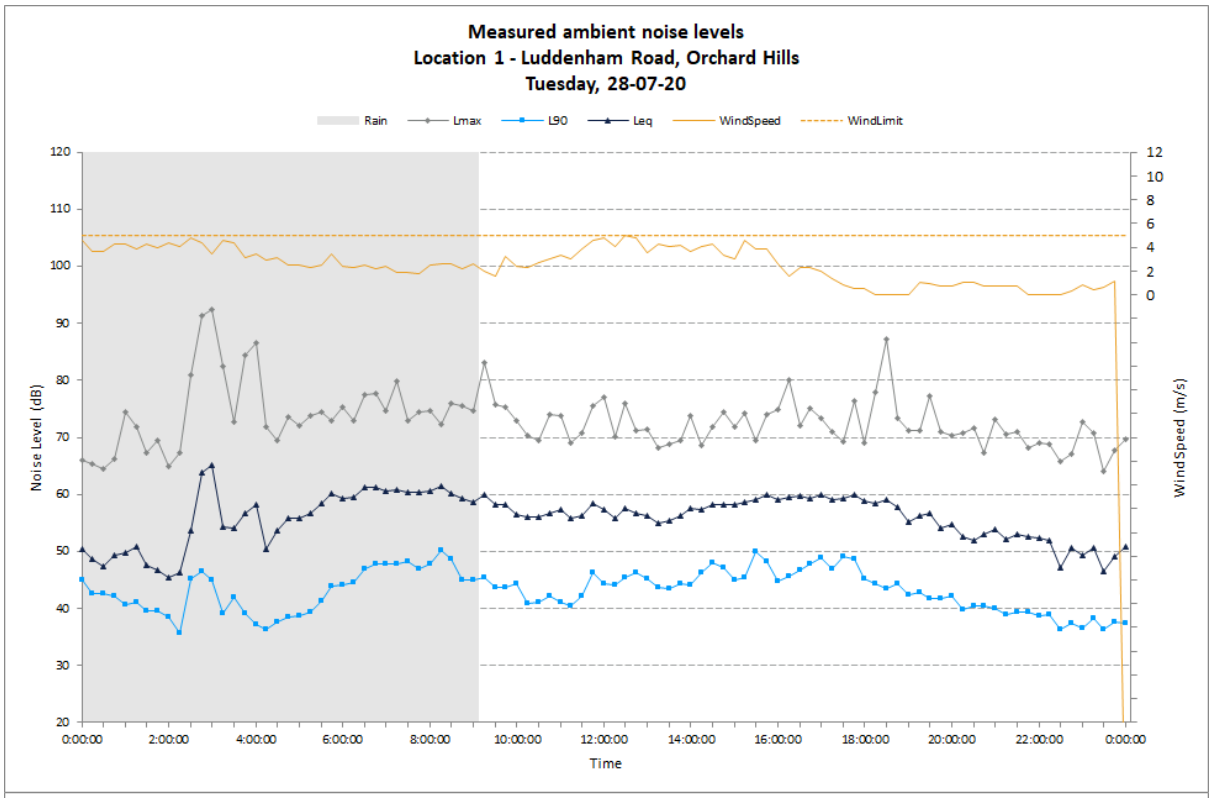
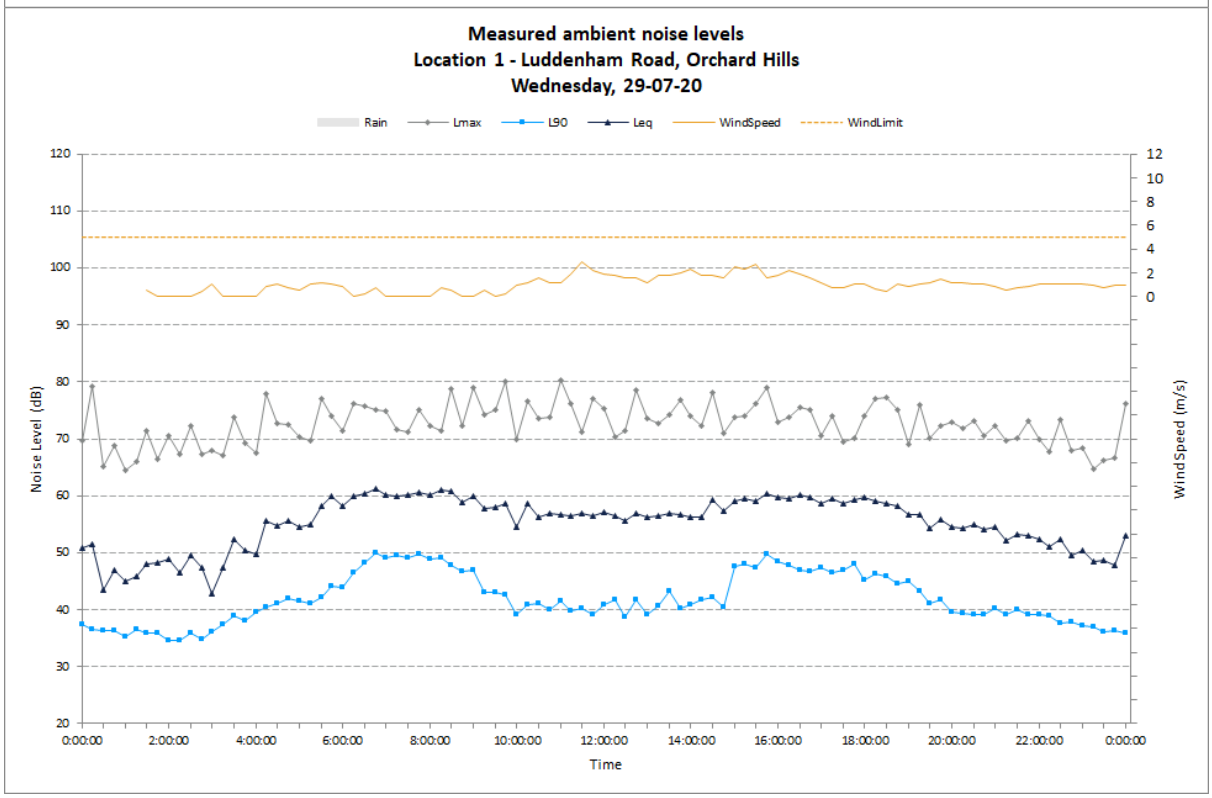
Rain
Lmax
L90
Leq
WindSpeed
WindLimit
Noise Level (dB)
WindSpeed (m/s)
Time


Measured ambient noise levels
Location 1 - Luddenham Road, Orchard Hills
Tuesday, 28-07-20
Rain
Lmax
L90
Leq
WindSpeed
WindLimit
Noise Level (dB)
WindSpeed (m/s)
Time
0:00:00
2:00:00
4:00:00
6:00:00
8:00:00
10:00:00
12:00:00
14:00:00
16:00:00
18:00:00
20:00:00
22:00:00
0:00:00


Measured ambient noise levels
Location 1 - Luddenham Road, Orchard Hills
Wednesday, 29-07-20
Rain
Lmax
L90
Leq
WindSpeed
WindLimit
Noise Level (dB)
WindSpeed (m/s)
Time
0:00:00
2:00:00
4:00:00
6:00:00
8:00:00
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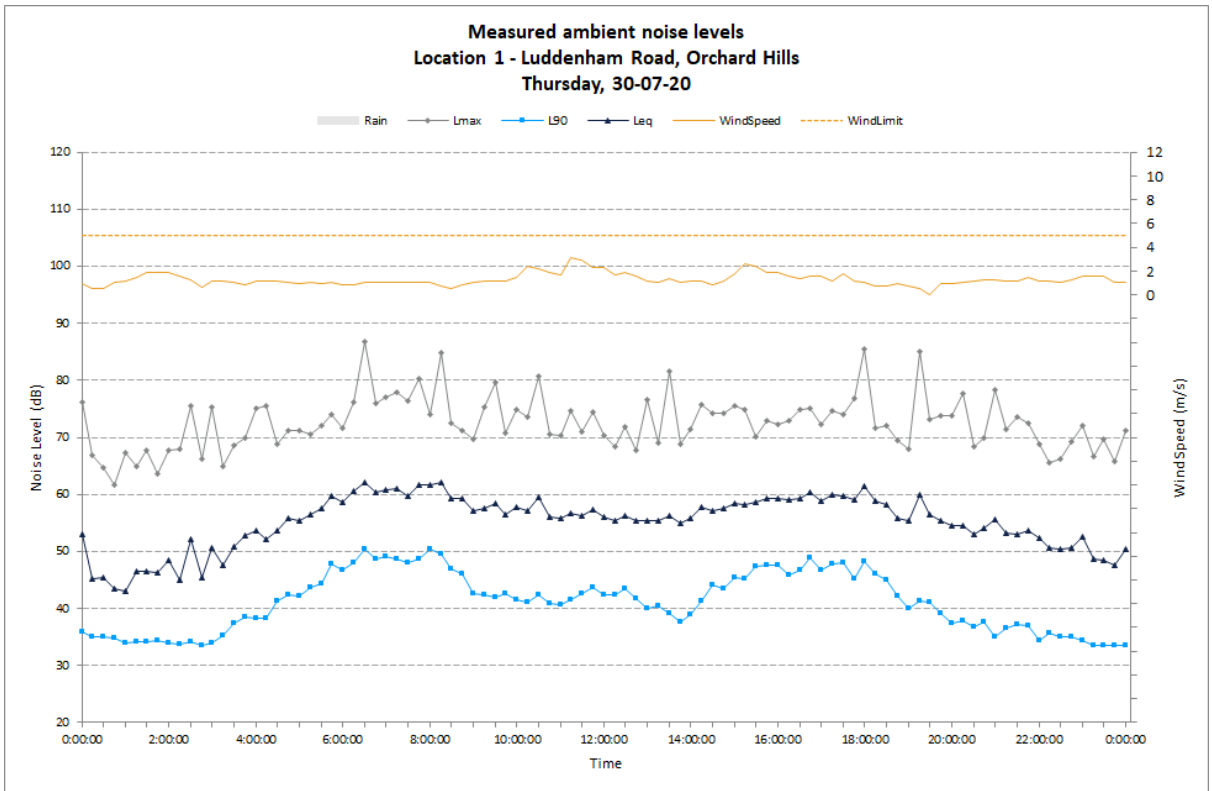
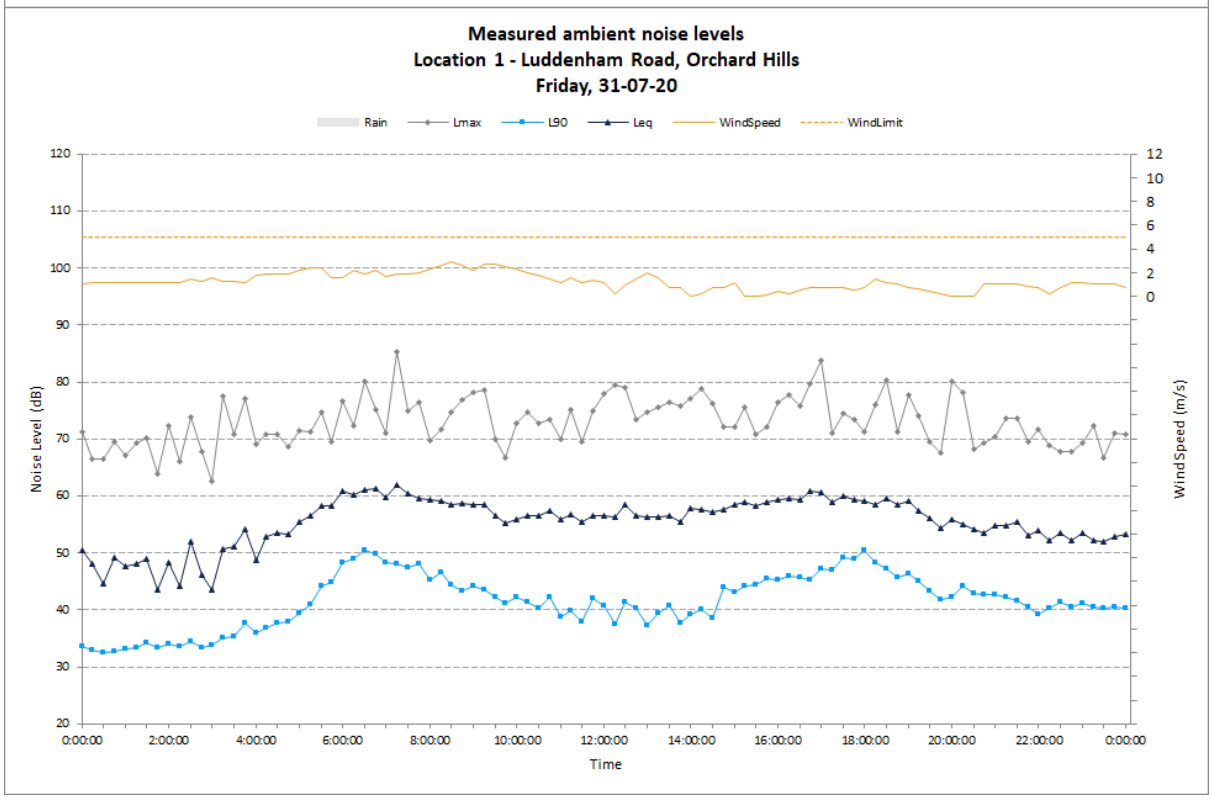
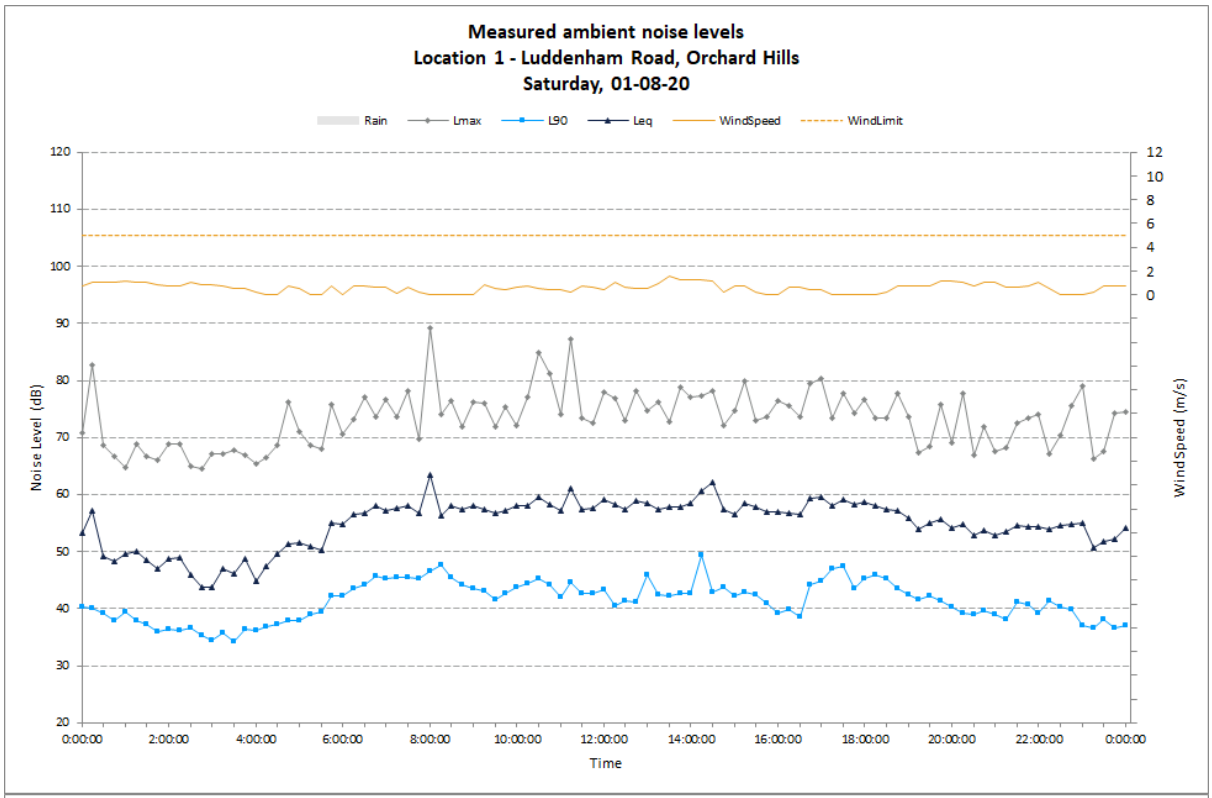
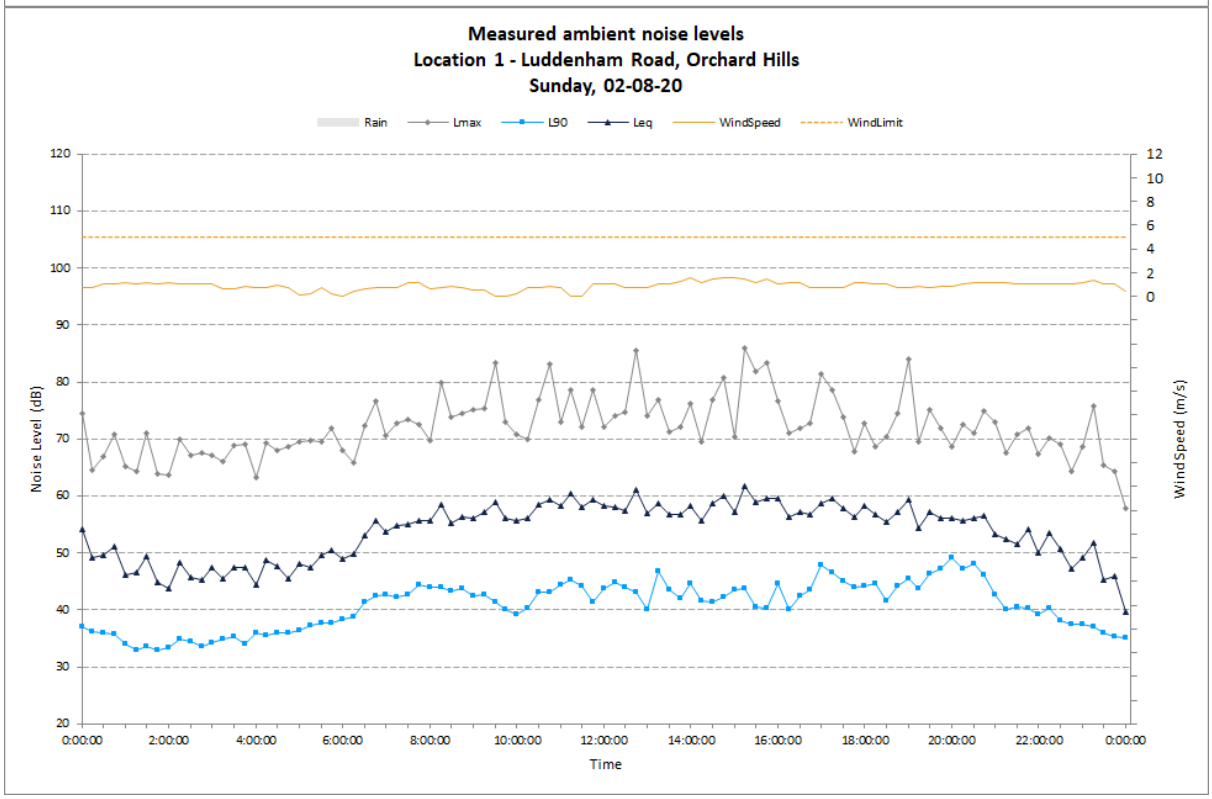
18:00:00
20:00:00
22:00:00
0:00:00


Measured ambient noise levels
Location 1 - Luddenham Road, Orchard Hills
Thursday, 30-07-20
Rain
Lmax
L90
Leq
WindSpeed
WindLimit
Noise Level (dB)
WindSpeed (m/s)
Time


Measured ambient noise levels
Location 1 - Luddenham Road, Orchard Hills
Friday, 31-07-20
Rain
Lmax
L90
Leq
WindSpeed
WindLimit
Noise Level (dB)
WindSpeed (m/s)
Time


Measured ambient noise levels
Location 1 - Luddenham Road, Orchard Hills
Saturday, 01-08-20
Rain
Lmax
L90
Leq
WindSpeed
WindLimit
Noise Level (dB)
WindSpeed (m/s)
Time


Measured ambient noise levels
Location 1 - Luddenham Road, Orchard Hills
Sunday, 02-08-20
Rain
Lmax
L90
Leq
WindSpeed
WindLimit
Noise Level (dB)
WindSpeed (m/s)
Time

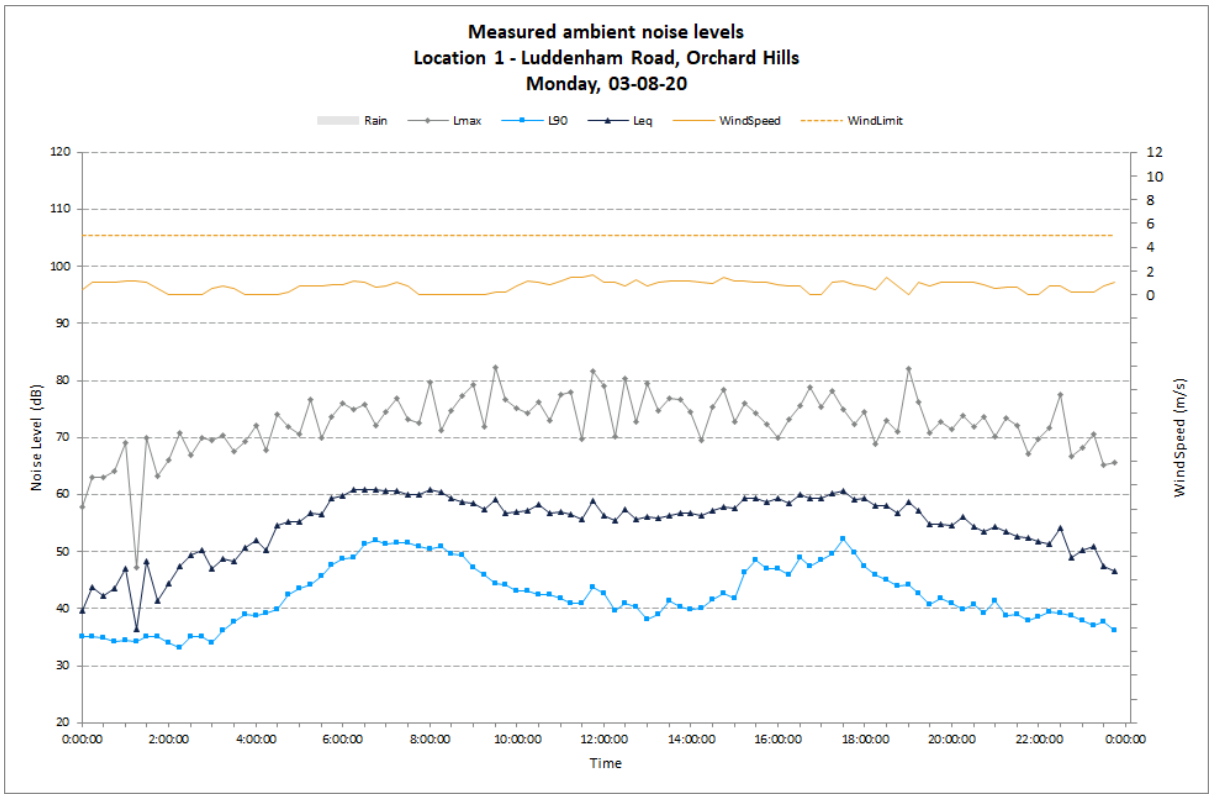
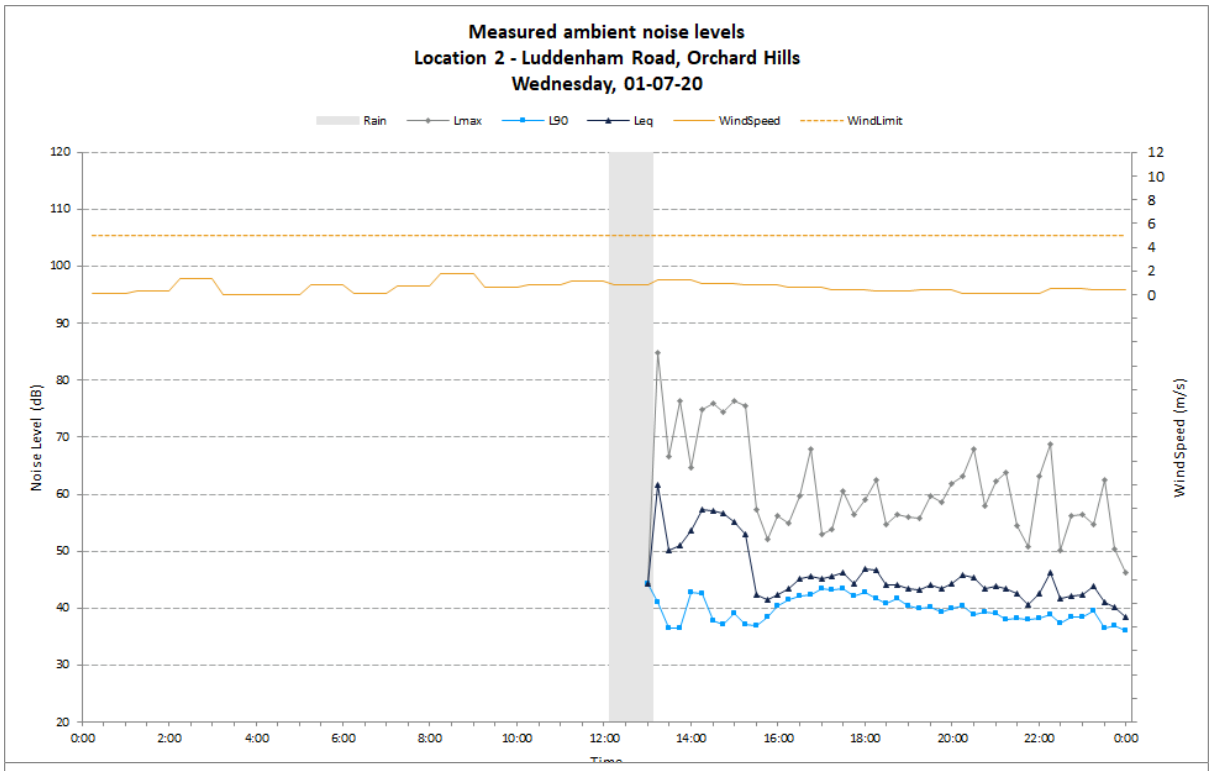
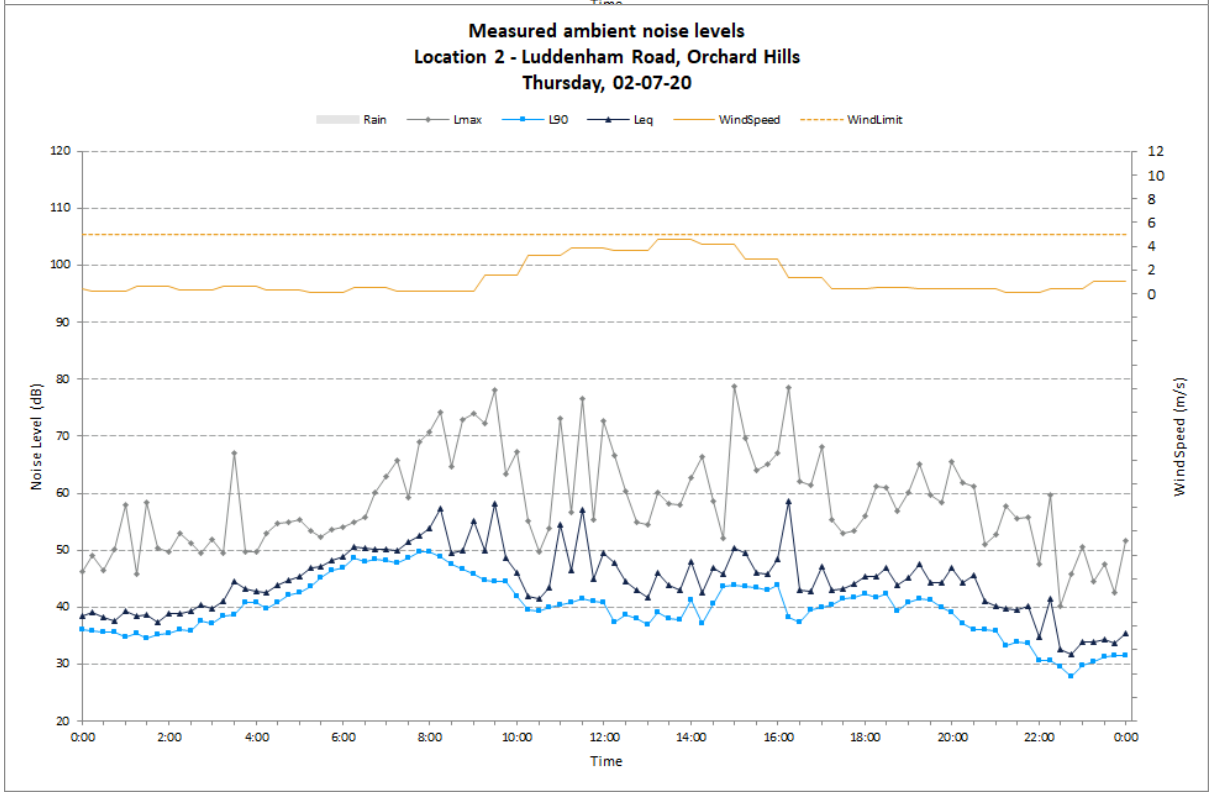

Measured ambient noise levels
Location 1 - Luddenham Road, Orchard Hills
Monday, 03-08-20
Rain
Lmax
L90
Leq
WindSpeed
WindLimit
Noise Level (dB)
WindSpeed (m/s)
Time
120
110
100
90
80
70
60
50
40
30
20
12
10
8
6
4
2
0
0:00:00
2:00:00
4:00:00
6:00:00
8:00:00
10:00:00
12:00:00
14:00:00
16:00:00
18:00:00
20:00:00
22:00:00
0:00:00

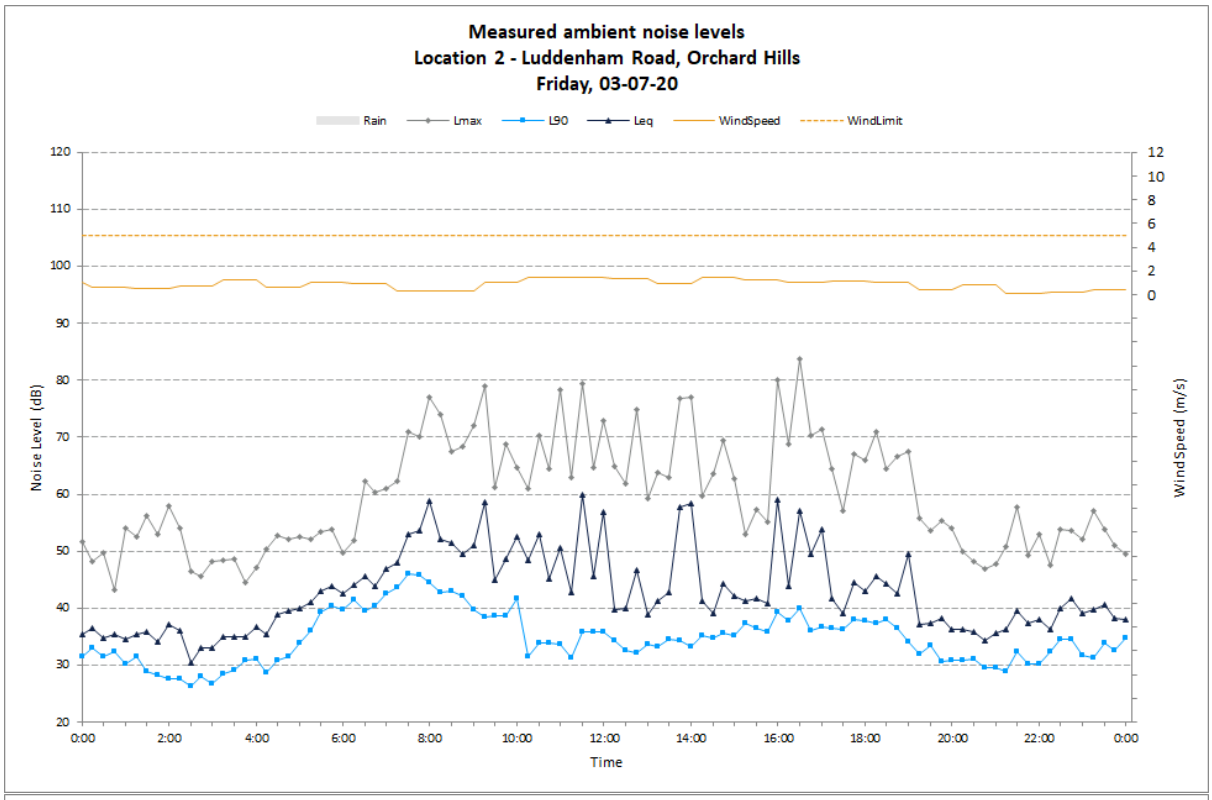
Table A.2 Summary of daily noise logging results – NM2

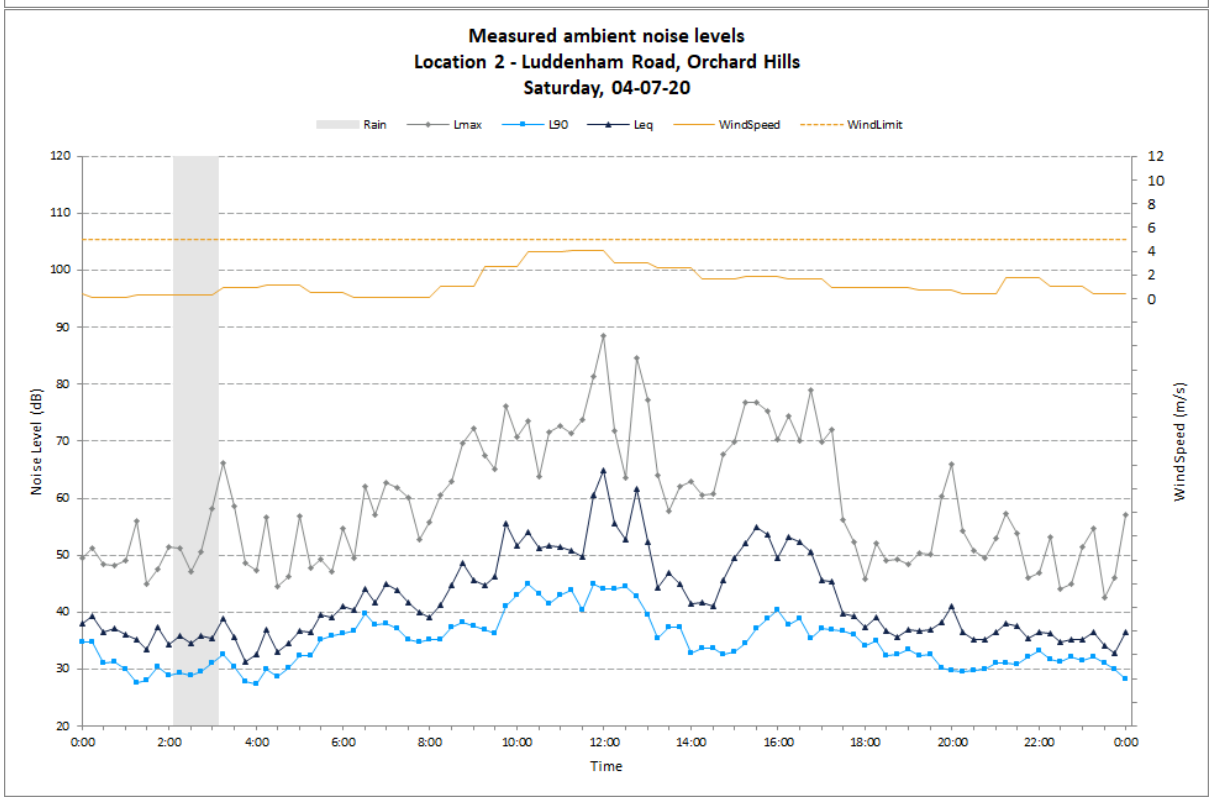
Date	ABL Day[1]	ABL Evening[1]	ABL Night[1]
Thursday, 02-07-20	38	33	28
Friday, 03-07-20	33	30	28
Saturday, 04-07-20	34	30	27
Sunday, 05-07-20	37	30	28
Monday, 06-07-20	32	36	27
Tuesday, 07-07-20	33	0	30
Wednesday, 08-07-20	34	38	34
Thursday, 09-07-20	36	41	34
Friday, 10-07-20	37	36	0
Saturday, 11-07-20	0	36	30
Sunday, 12-07-20	32	30	30
Monday, 13-07-20	0	0	0
Summary Values	34	36	30

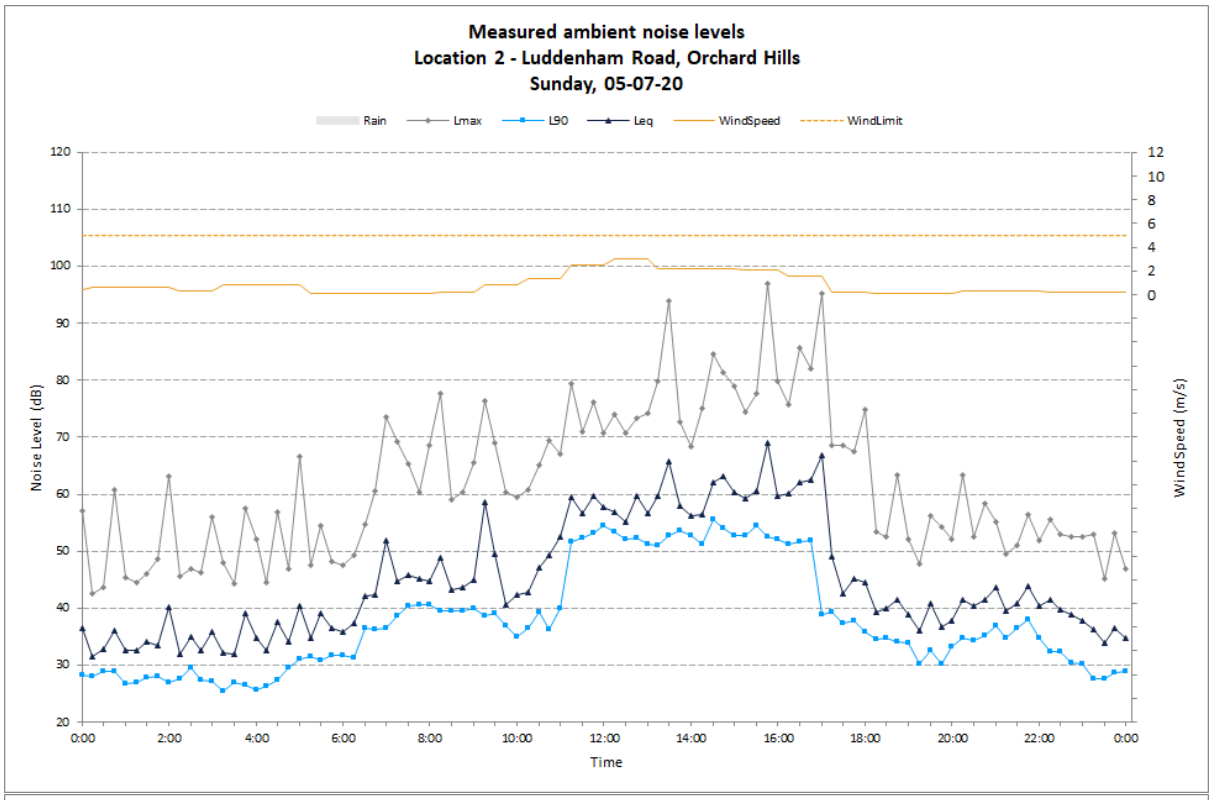
Notes: 1. A “0” indicates insufficient data samples due to adverse weather or other extraneous effects.


Measured ambient noise levels
Location 2 - Luddenham Road, Orchard Hills
Wednesday, 01-07-20
Rain
Lmax
L90
Leq
WindSpeed
WindLimit
Noise Level (dB)
WindSpeed (m/s)
Time


Measured ambient noise levels
Location 2 - Luddenham Road, Orchard Hills
Thursday, 02-07-20
Rain
Lmax
L90
Leq
WindSpeed
WindLimit
Noise Level (dB)
WindSpeed (m/s)
Time


Measured ambient noise levels
Location 2 - Luddenham Road, Orchard Hills
Friday, 03-07-20
Rain
Lmax
L90
Leq
WindSpeed
WindLimit
Noise Level (dB)
WindSpeed (m/s)
Time


Measured ambient noise levels
Location 2 - Luddenham Road, Orchard Hills
Saturday, 04-07-20
Rain
Lmax
L90
Leq
WindSpeed
WindLimit
Noise Level (dB)
WindSpeed (m/s)
Time


Measured ambient noise levels
Location 2 - Luddenham Road, Orchard Hills
Sunday, 05-07-20
Rain
Lmax
L90
Leq
WindSpeed
WindLimit
Noise Level (dB)
WindSpeed (m/s)
Time
0:00
2:00
4:00
6:00
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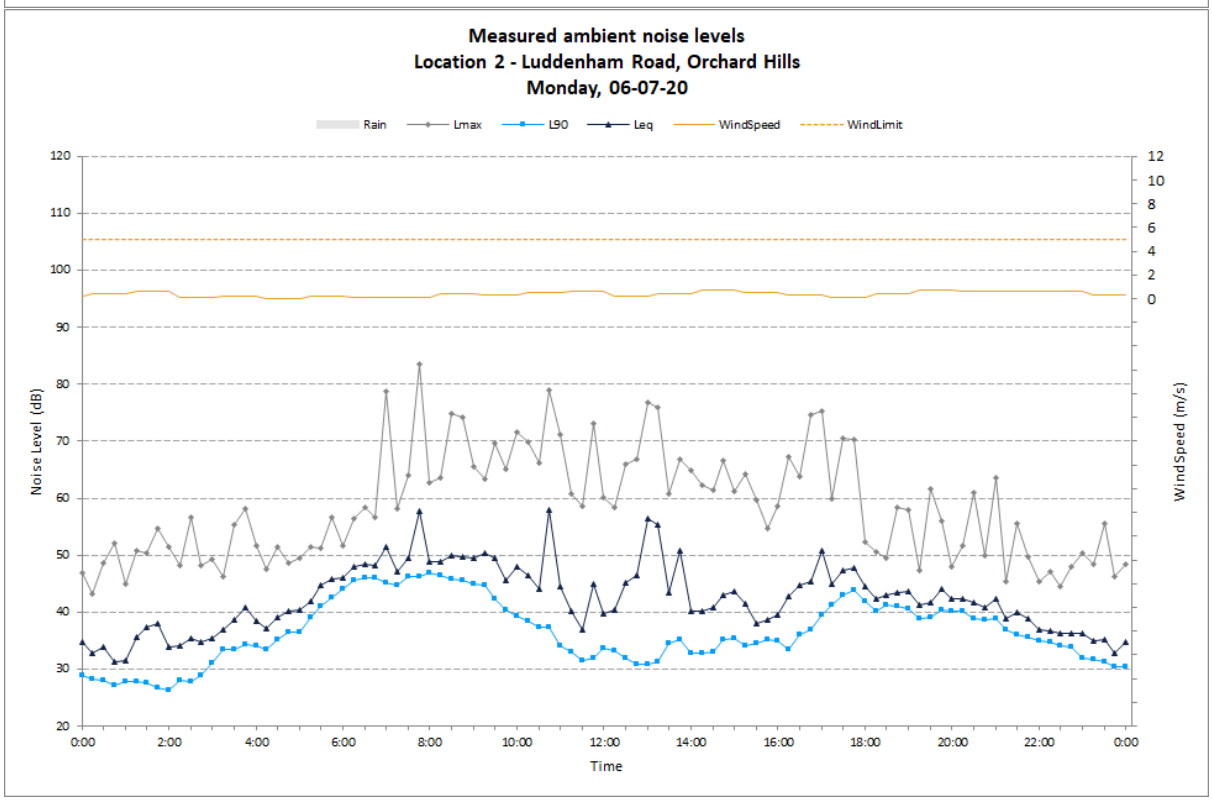
14:00
16:00
18:00
20:00
22:00
0:00


Measured ambient noise levels
Location 2 - Luddenham Road, Orchard Hills
Monday, 06-07-20
Rain
Lmax
L90
Leq
WindSpeed
WindLimit
Noise Level (dB)
WindSpeed (m/s)
Time
0:00
2:00
4:00
6:00
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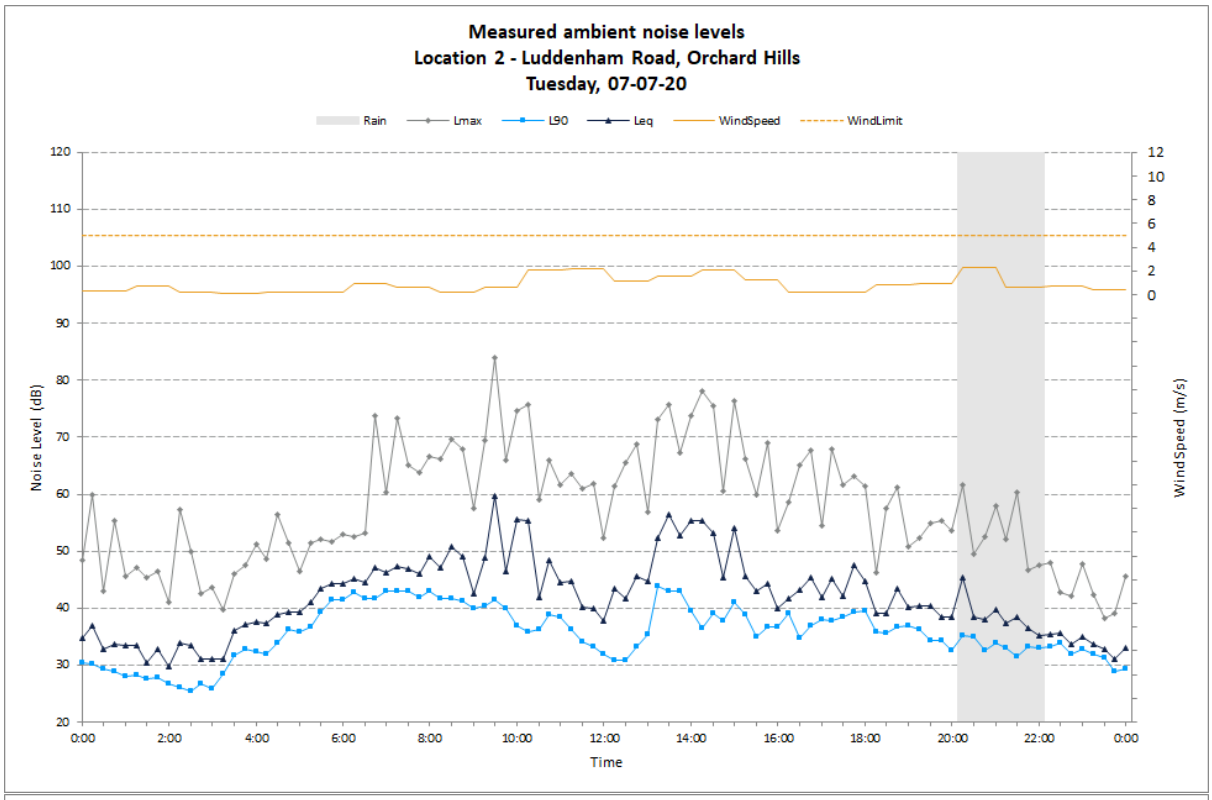
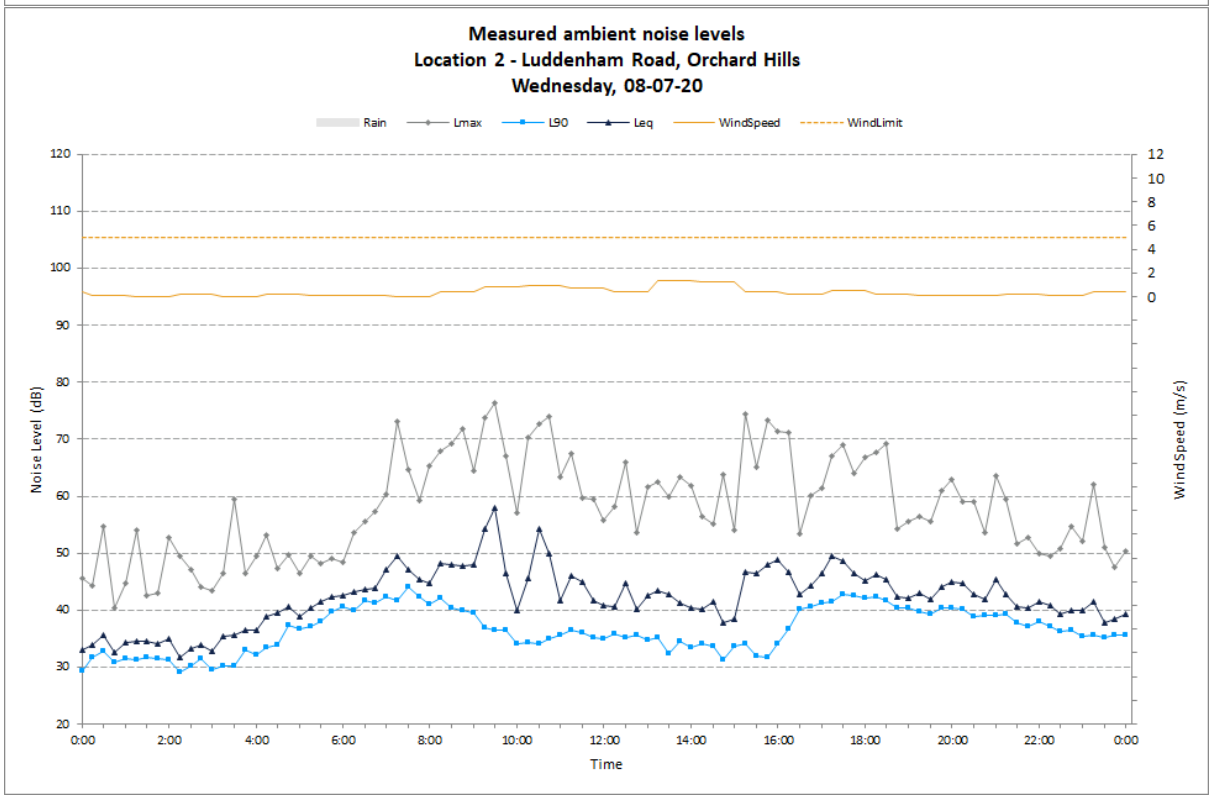
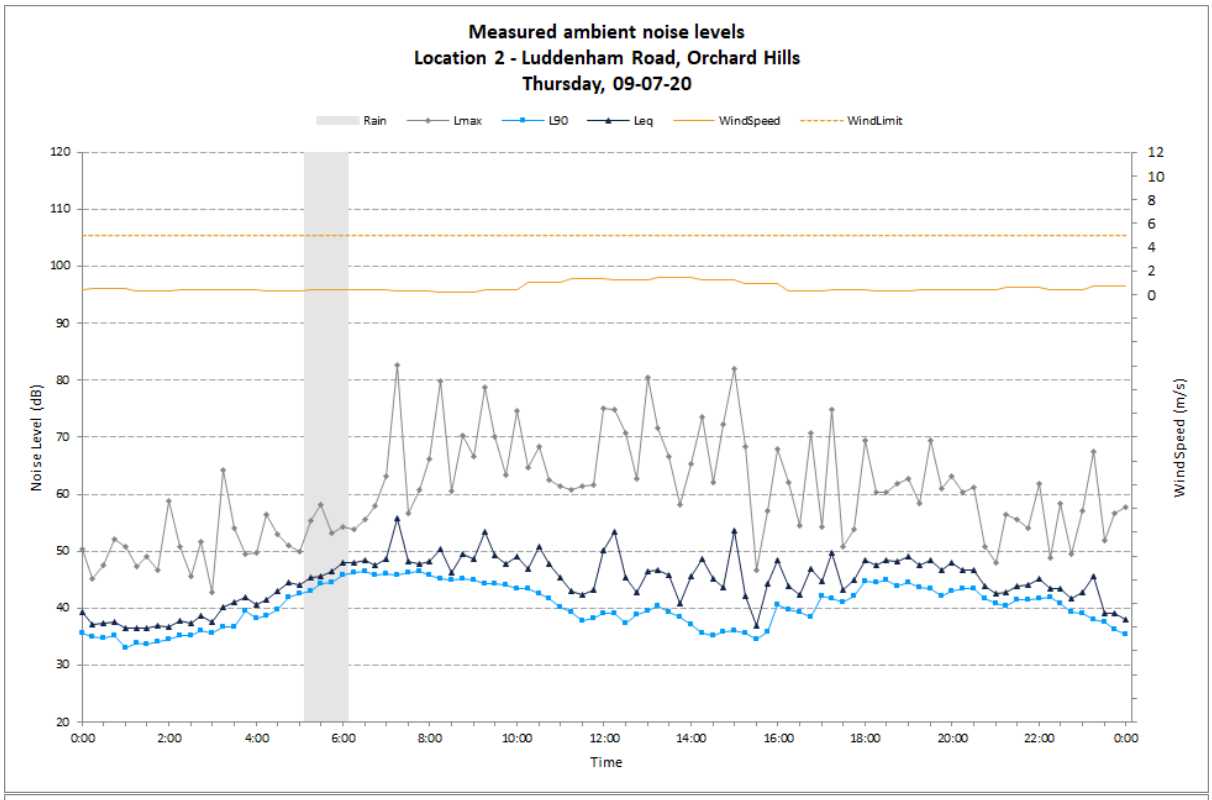
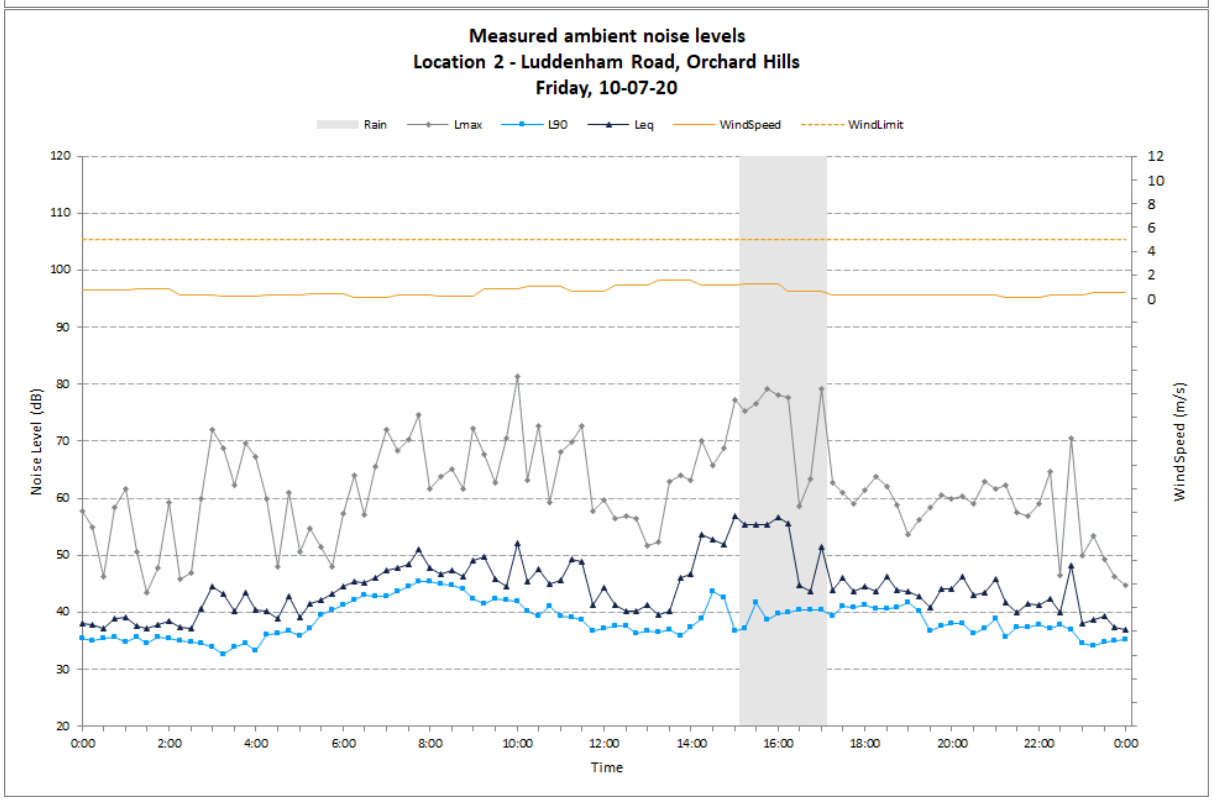
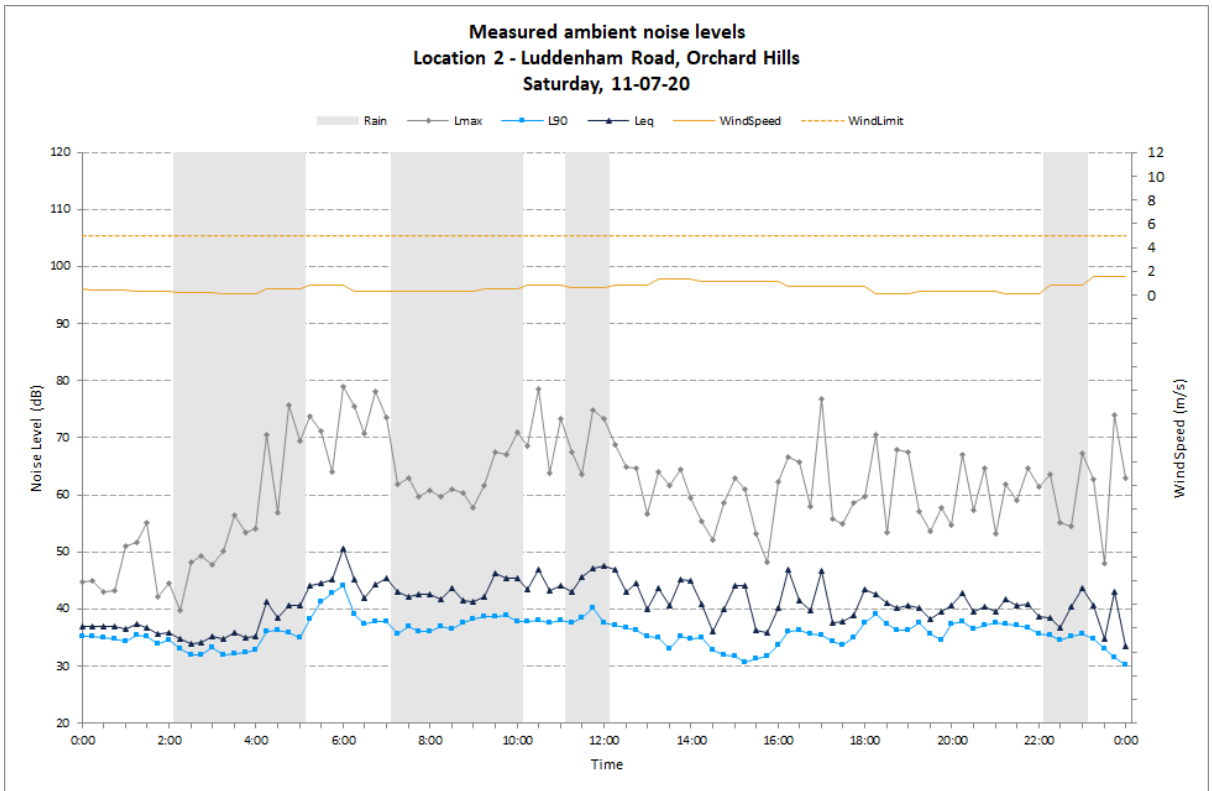
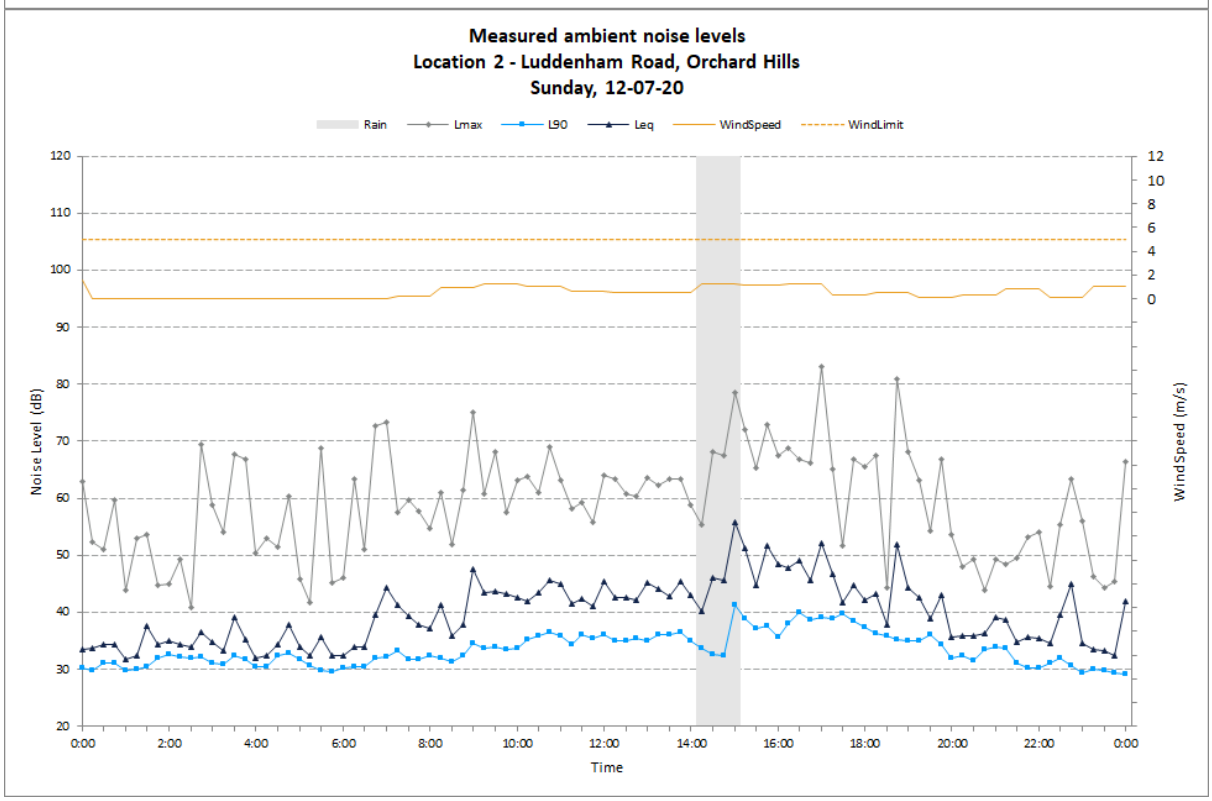

Measured ambient noise levels
Location 2 - Luddenham Road, Orchard Hills
Tuesday, 07-07-20
Rain
Lmax
L90
Leq
WindSpeed
WindLimit
Noise Level (dB)
WindSpeed (m/s)
Time


Measured ambient noise levels
Location 2 - Luddenham Road, Orchard Hills
Wednesday, 08-07-20
Rain
Lmax
L90
Leq
WindSpeed
WindLimit
Noise Level (dB)
WindSpeed (m/s)
Time


Measured ambient noise levels
Location 2 - Luddenham Road, Orchard Hills
Thursday, 09-07-20
Rain
Lmax
L90
Leq
WindSpeed
WindLimit
Noise Level (dB)
WindSpeed (m/s)
Time


Measured ambient noise levels
Location 2 - Luddenham Road, Orchard Hills
Friday, 10-07-20
Rain
Lmax
L90
Leq
WindSpeed
WindLimit
Noise Level (dB)
WindSpeed (m/s)
Time


Measured ambient noise levels
Location 2 - Luddenham Road, Orchard Hills
Saturday, 11-07-20
Rain
Lmax
L90
Leq
WindSpeed
WindLimit
Noise Level (dB)
WindSpeed (m/s)
Time


Measured ambient noise levels
Location 2 - Luddenham Road, Orchard Hills
Sunday, 12-07-20
Rain
Lmax
L90
Leq
WindSpeed
WindLimit
Noise Level (dB)
WindSpeed (m/s)
Time

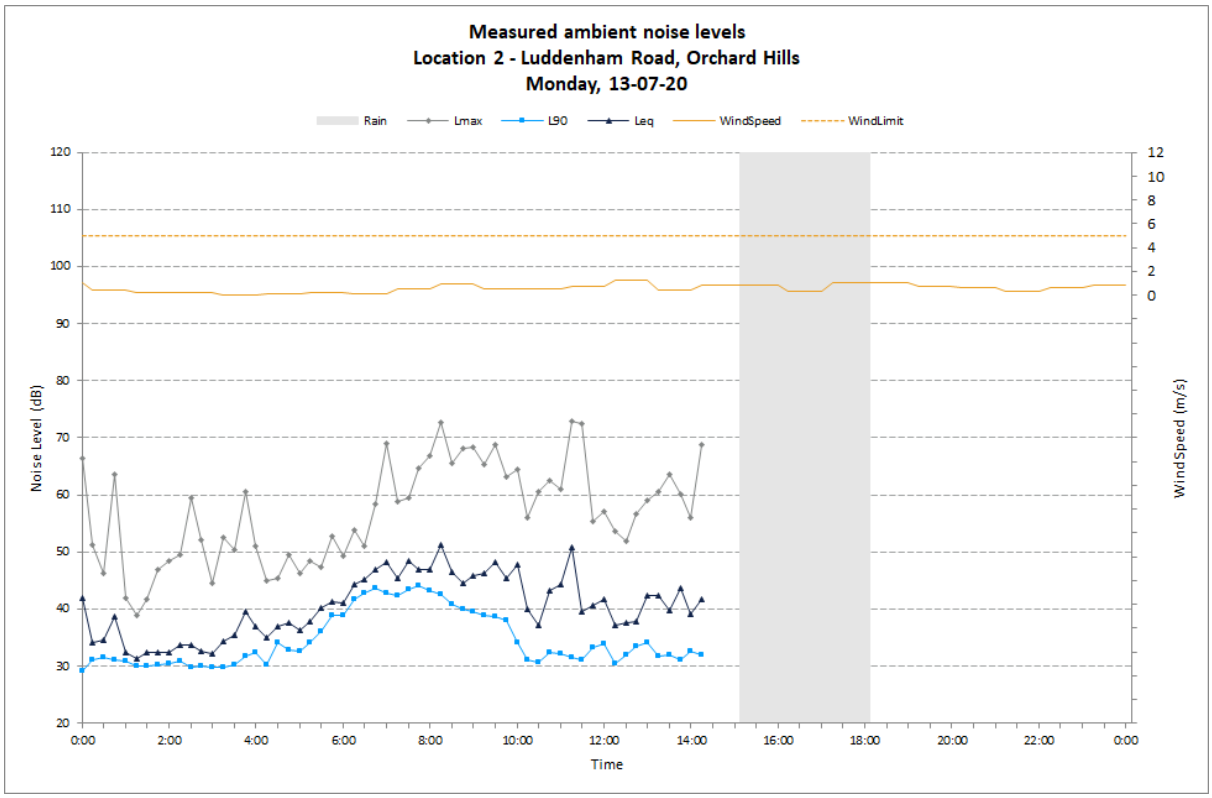
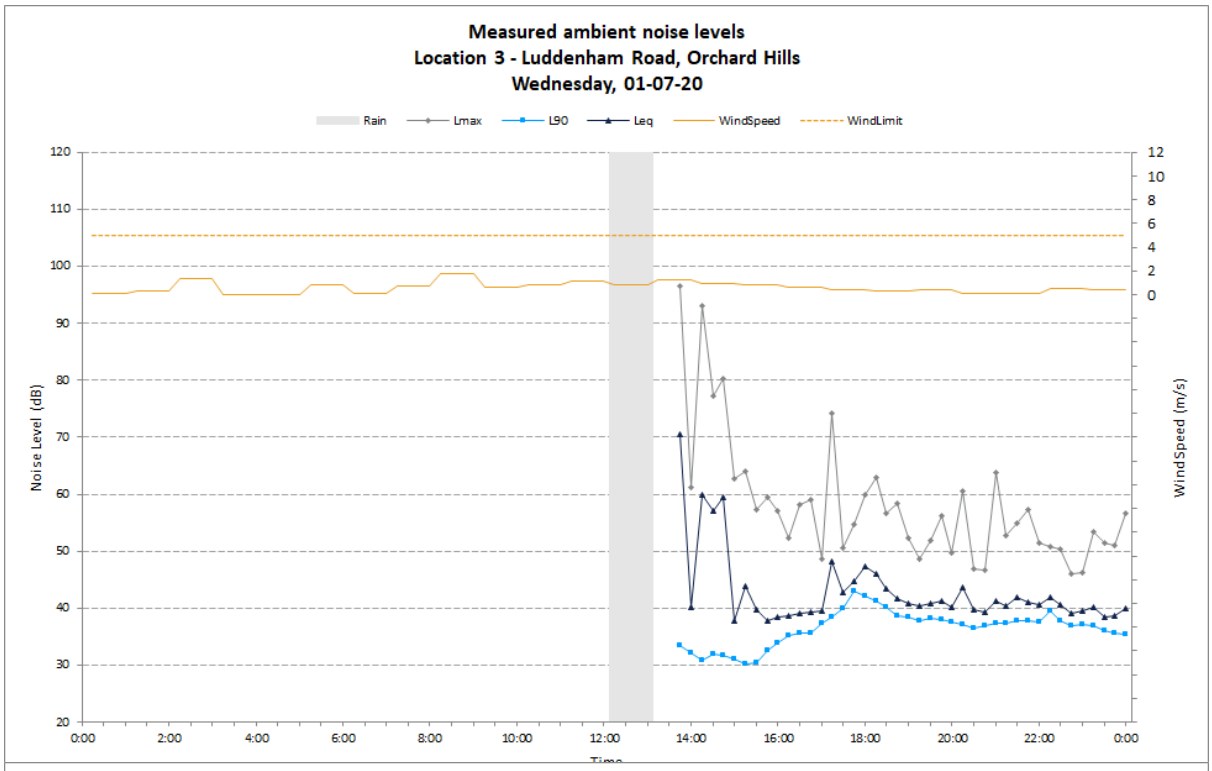
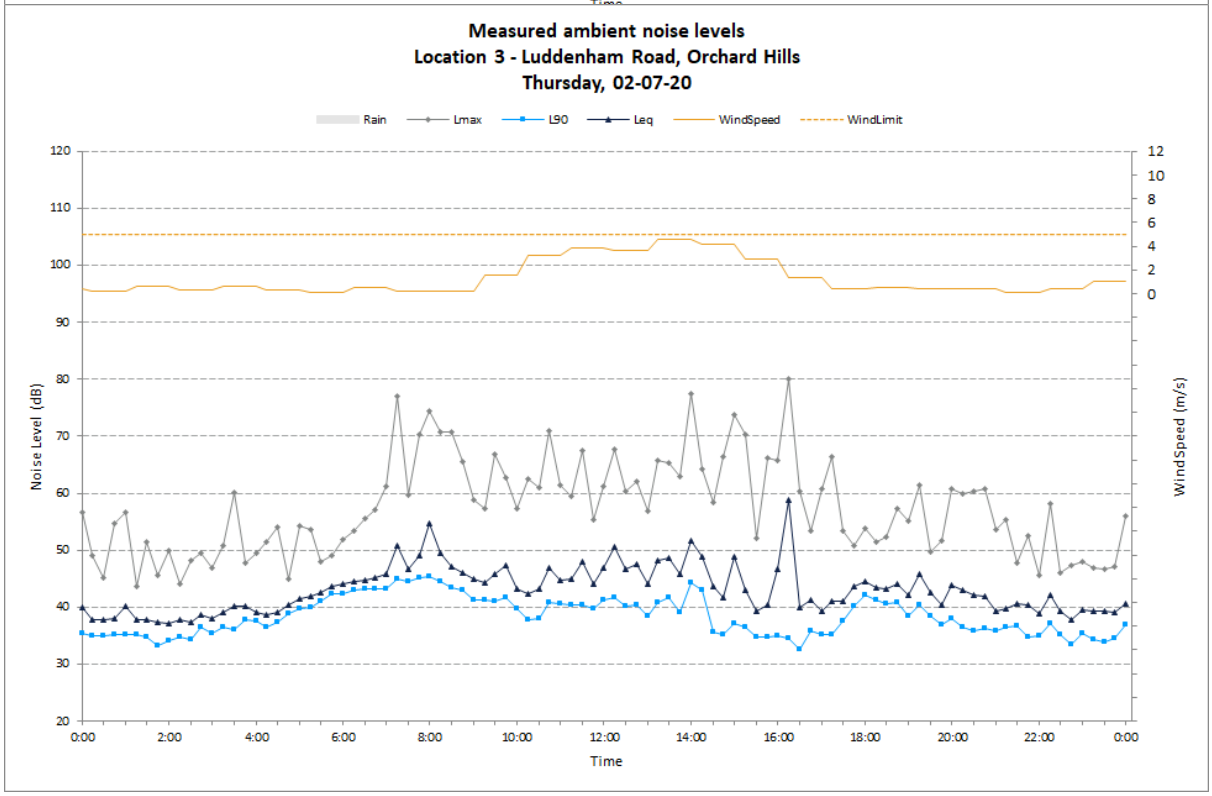

Measured ambient noise levels
Location 2 - Luddenham Road, Orchard Hills
Monday, 13-07-20
Rain
Lmax
L90
Leq
WindSpeed
WindLimit
Noise Level (dB)
WindSpeed (m/s)
Time
120
110
100
90
80
70
60
50
40
30
20
12
10
8
6
4
2
0
0:00
2:00
4:00
6:00
8:00
10:00
12:00
14:00
16:00
18:00
20:00
22:00
0:00

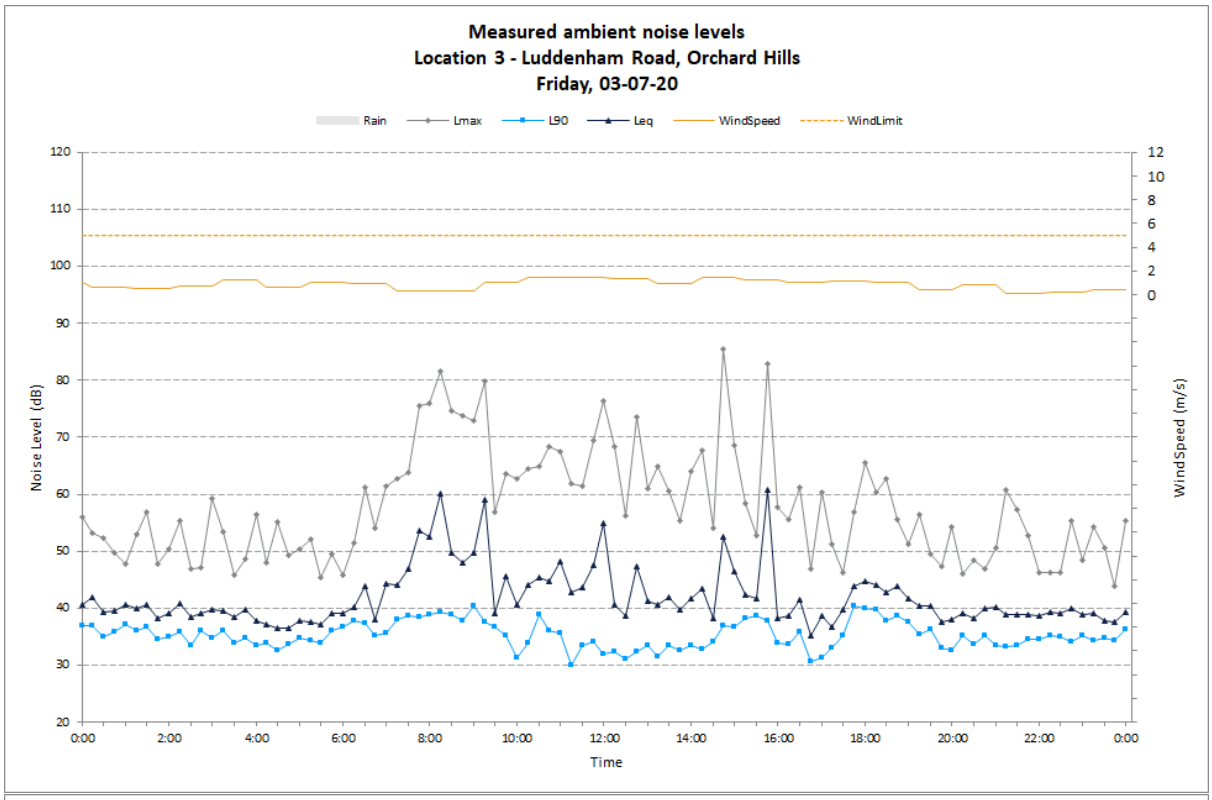
Table A.3 Summary of daily noise logging results – NM3

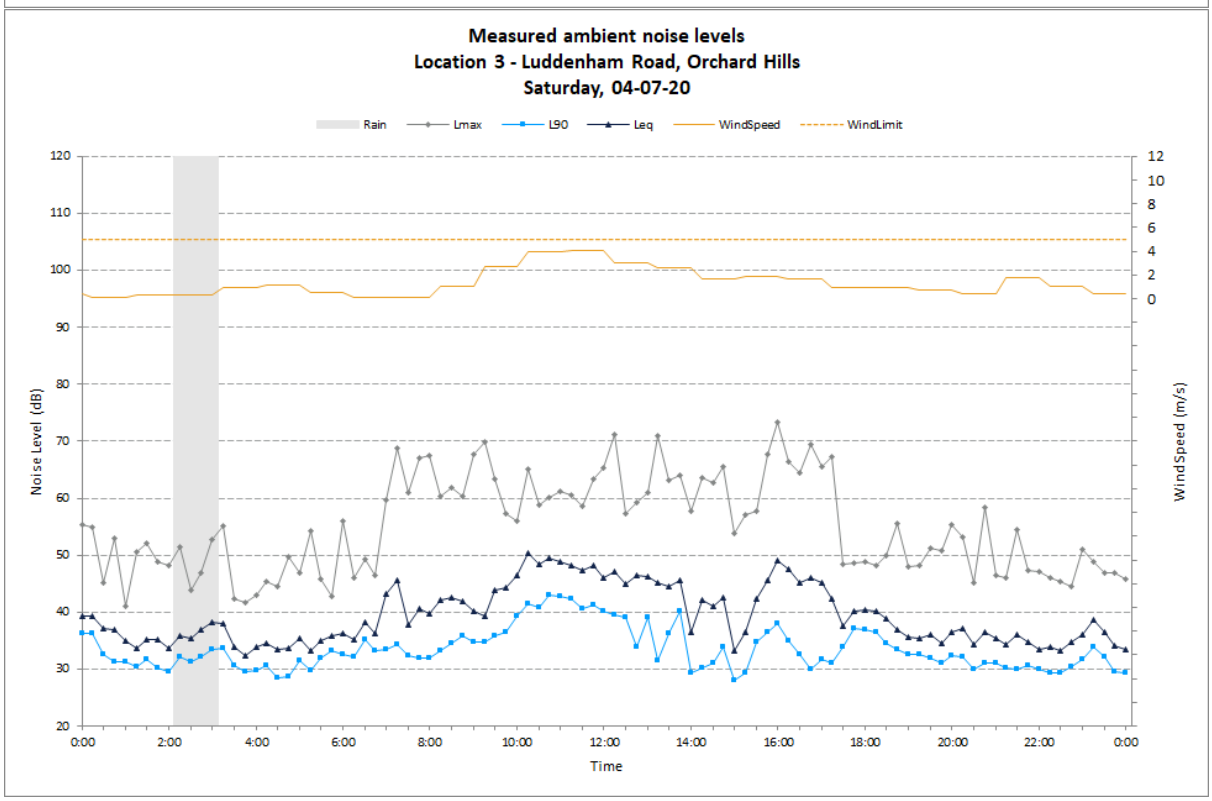
Date	ABL Day[1]	ABL Evening[1]	ABL Night[1]
Wednesday, 01-07-20	0	37	35
Thursday, 02-07-20	35	35	34
Friday, 03-07-20	31	33	30
Saturday, 04-07-20	30	30	25
Sunday, 05-07-20	31	30	26
Monday, 06-07-20	27	34	25
Tuesday, 07-07-20	29	0	30
Wednesday, 08-07-20	28	38	35
Thursday, 09-07-20	30	39	33
Friday, 10-07-20	33	34	0
Saturday, 11-07-20	0	37	30
Sunday, 12-07-20	28	34	33
Monday, 13-07-20	0	0	0
Summary Values	30	34	30

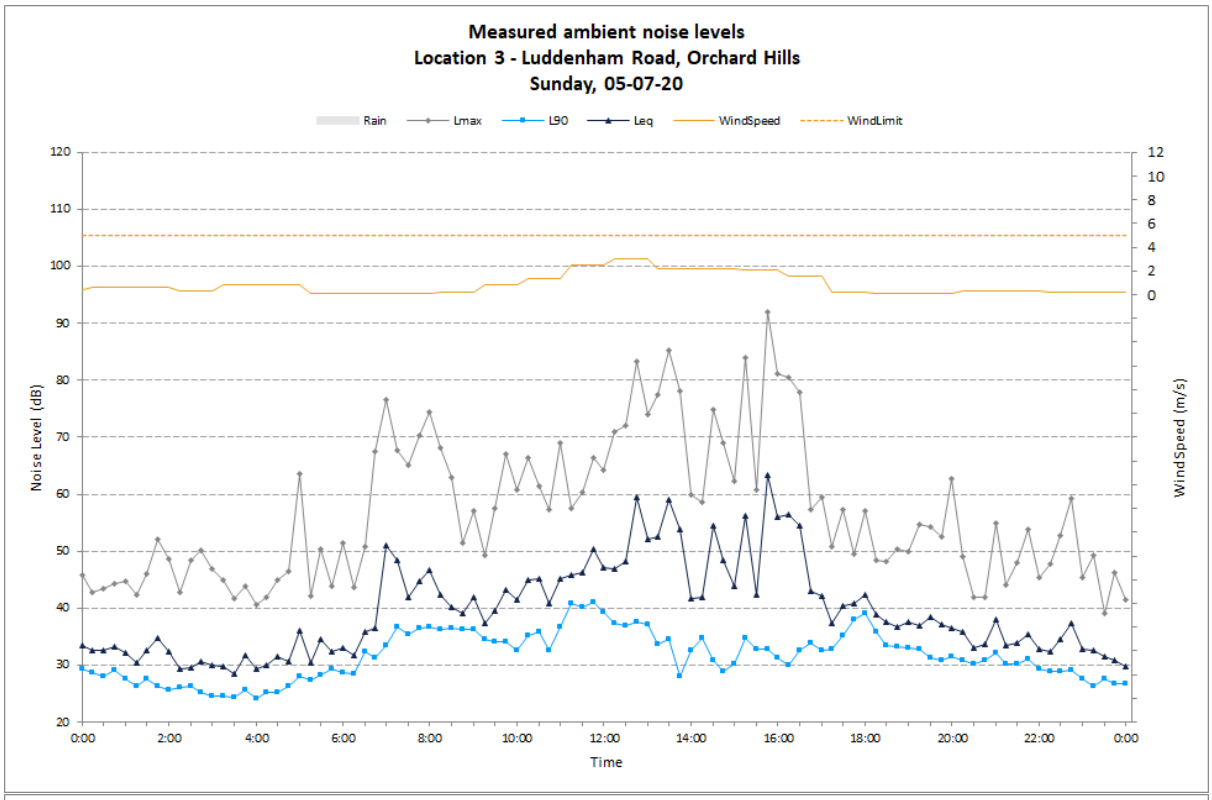
Notes: 1. A "0" indicates insufficient data samples due to adverse weather or other extraneous effects.

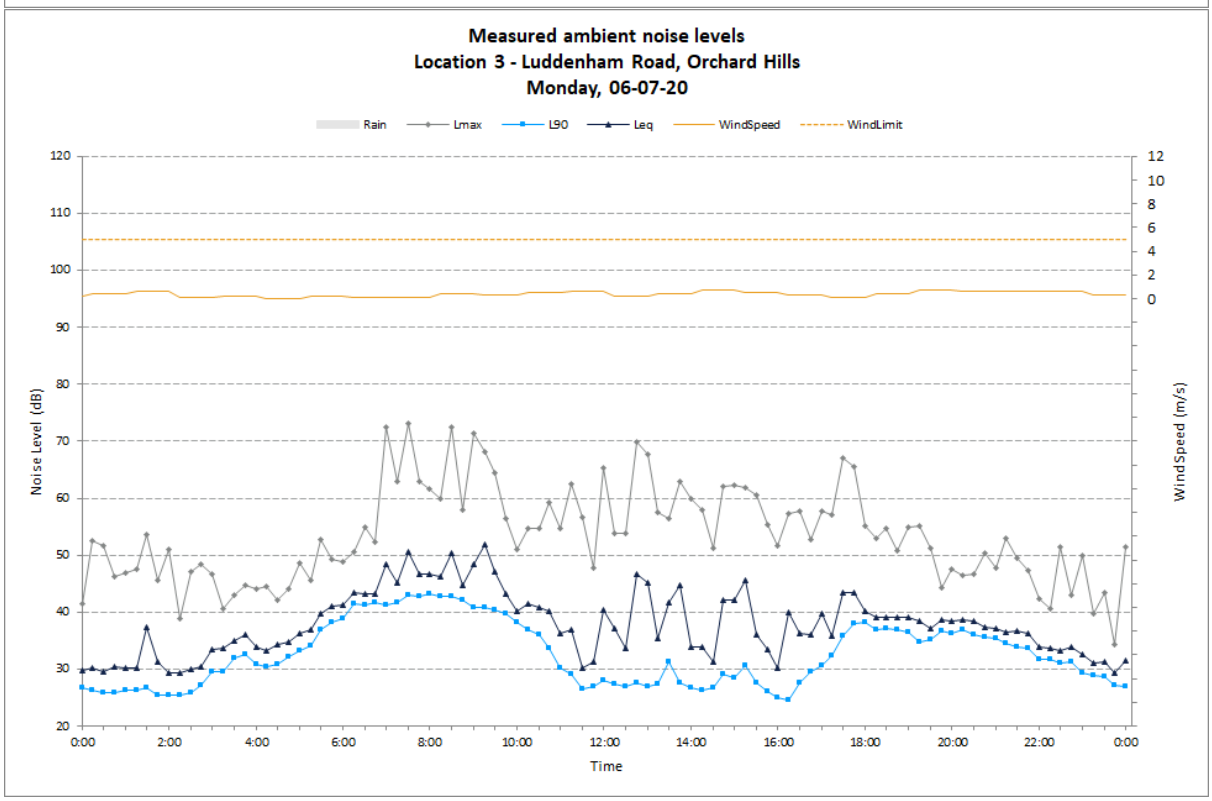

Measured ambient noise levels
Location 3 - Luddenham Road, Orchard Hills
Wednesday, 01-07-20
Rain
Lmax
L90
Leq
WindSpeed
WindLimit
Noise Level (dB)
WindSpeed (m/s)
Time

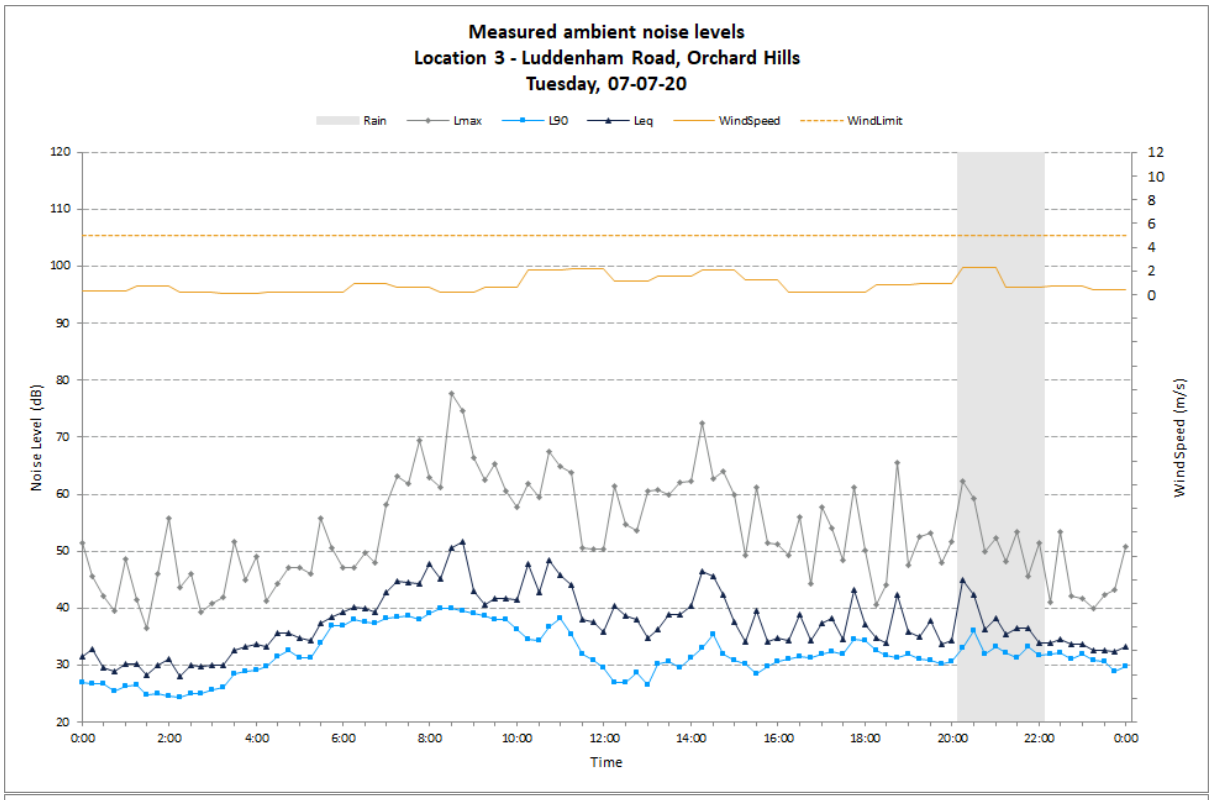

Measured ambient noise levels
Location 3 - Luddenham Road, Orchard Hills
Thursday, 02-07-20
Rain
Lmax
L90
Leq
WindSpeed
WindLimit
Noise Level (dB)
WindSpeed (m/s)
Time

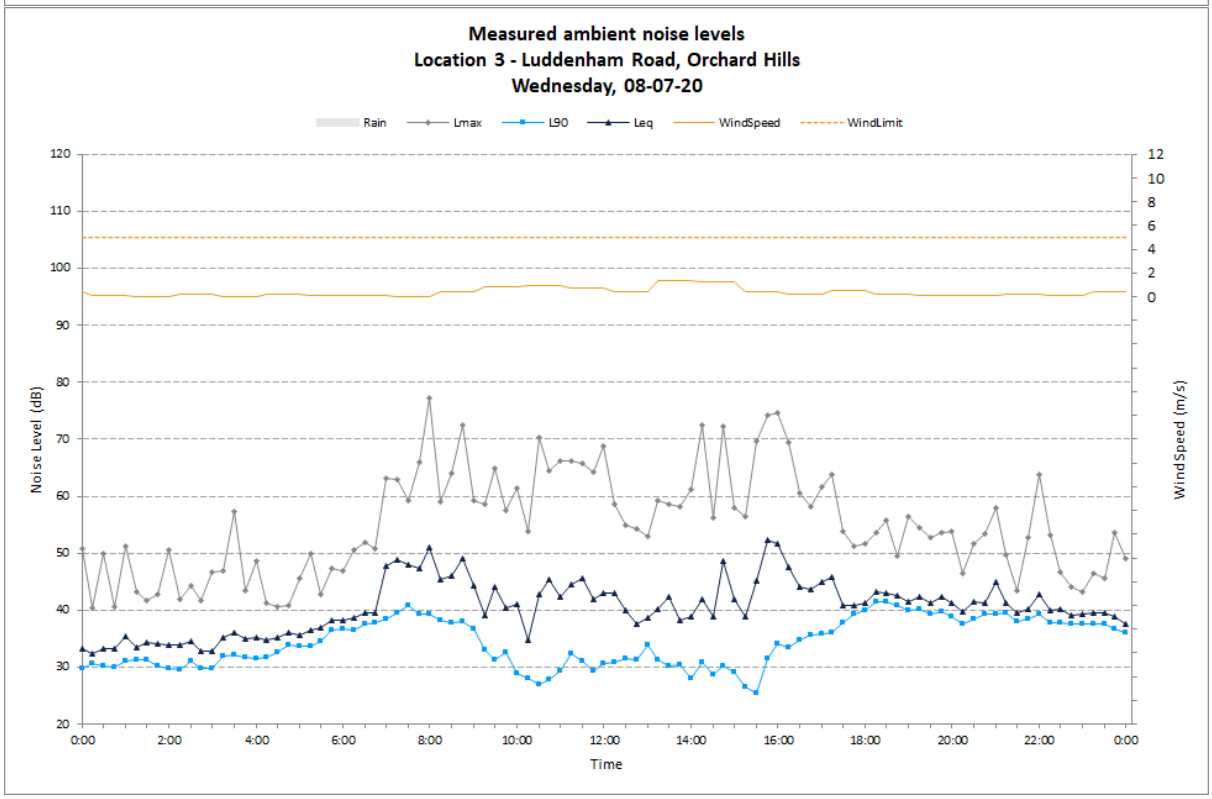

Measured ambient noise levels
Location 3 - Luddenham Road, Orchard Hills
Friday, 03-07-20
Rain
Lmax
L90
Leq
WindSpeed
WindLimit
Noise Level (dB)
WindSpeed (m/s)
Time

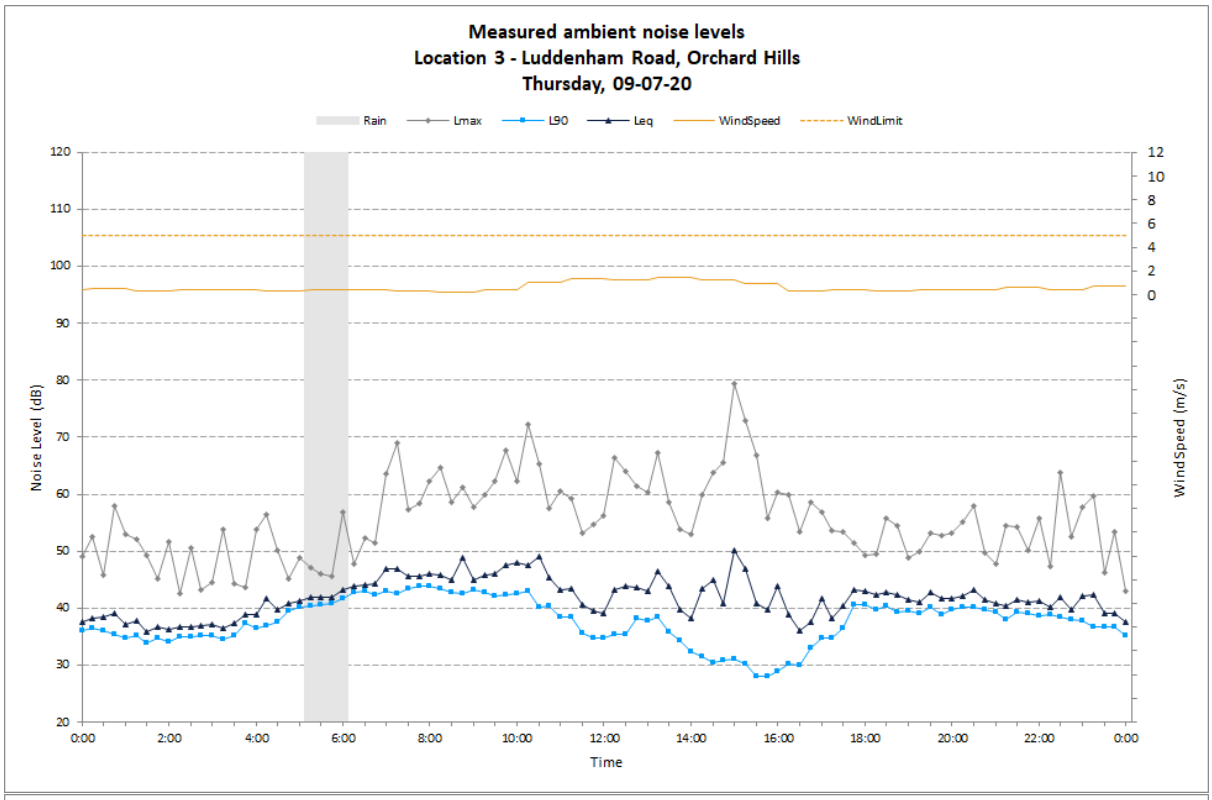

Measured ambient noise levels
Location 3 - Luddenham Road, Orchard Hills
Saturday, 04-07-20
Rain
Lmax
L90
Leq
WindSpeed
WindLimit
Noise Level (dB)
WindSpeed (m/s)
Time

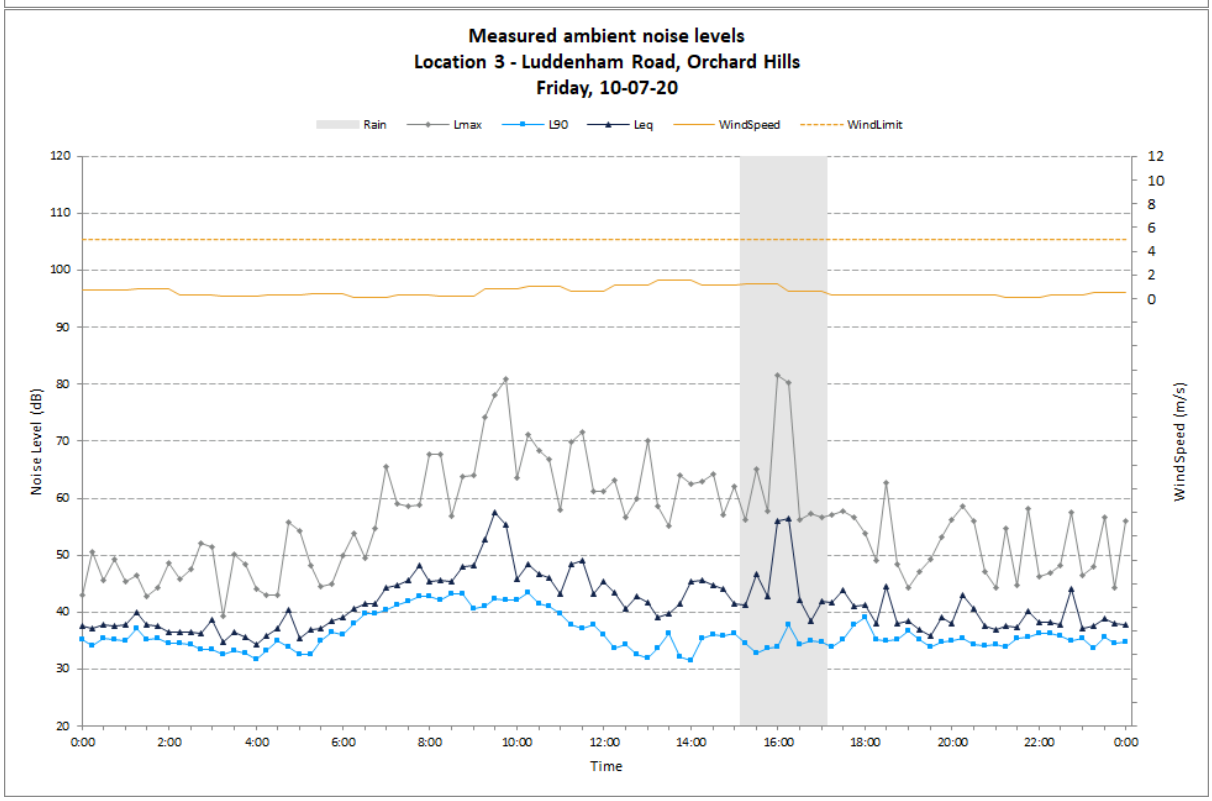

Measured ambient noise levels
Location 3 - Luddenham Road, Orchard Hills
Sunday, 05-07-20
Rain
Lmax
L90
Leq
WindSpeed
WindLimit
Noise Level (dB)
WindSpeed (m/s)
Time

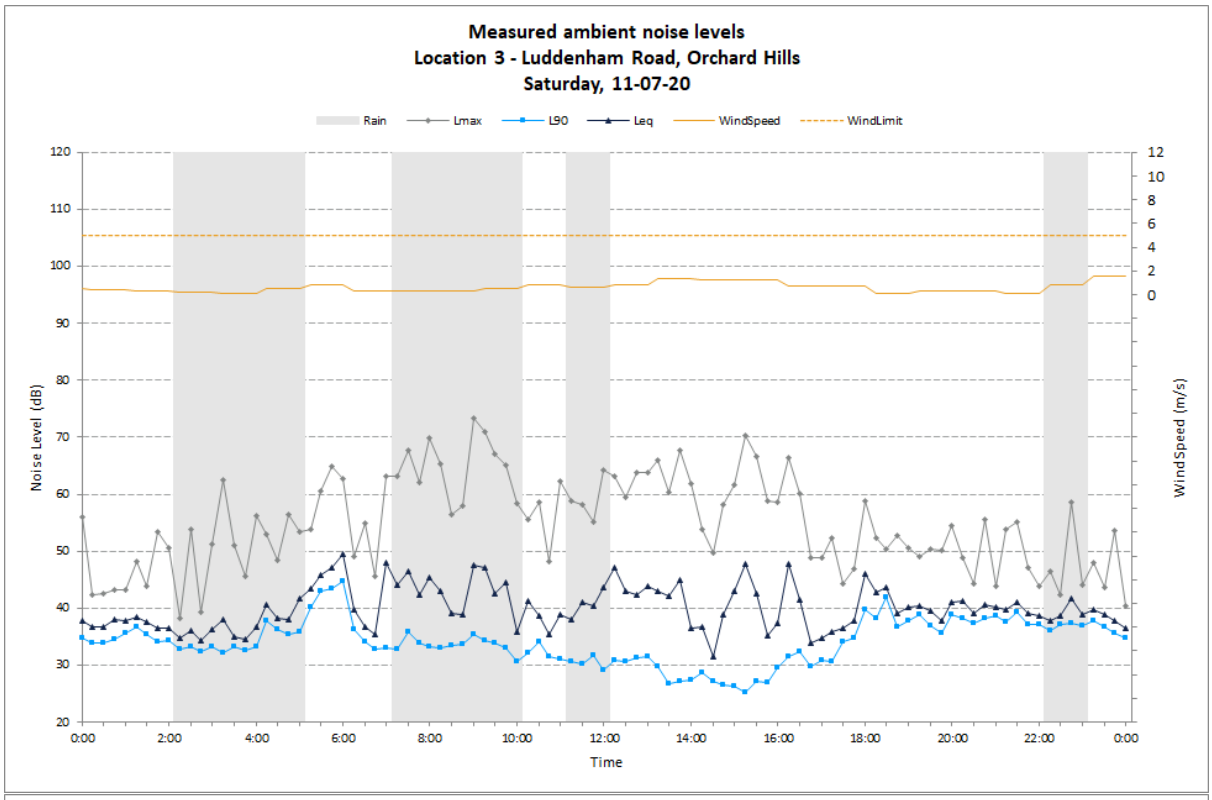

Measured ambient noise levels
Location 3 - Luddenham Road, Orchard Hills
Monday, 06-07-20
Rain
Lmax
L90
Leq
WindSpeed
WindLimit
Noise Level (dB)
WindSpeed (m/s)
Time

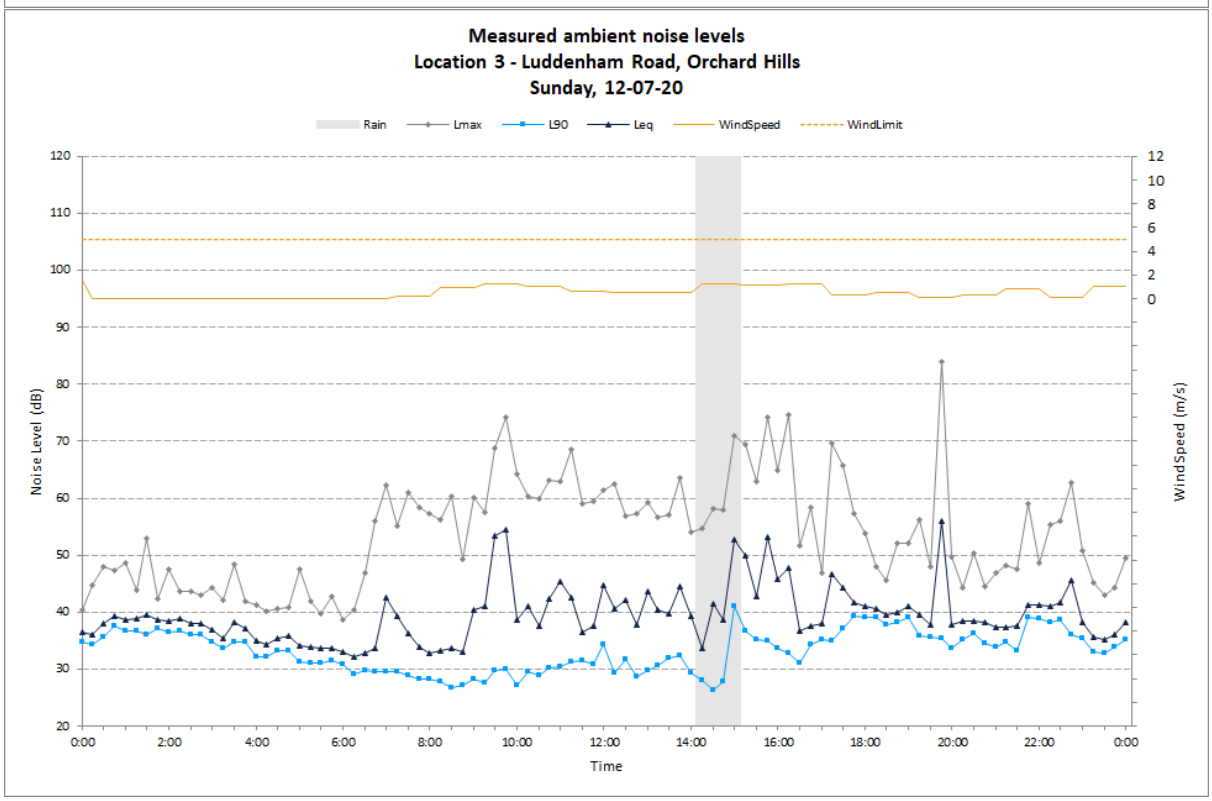

Measured ambient noise levels
Location 3 - Luddenham Road, Orchard Hills
Tuesday, 07-07-20
Rain
Lmax
L90
Leq
WindSpeed
WindLimit
Noise Level (dB)
WindSpeed (m/s)
Time
0:00
2:00
4:00
6:00
8:00
10:00
12:00
14:00
16:00
18:00
20:00
22:00
0:00


Measured ambient noise levels
Location 3 - Luddenham Road, Orchard Hills
Wednesday, 08-07-20
Rain
Lmax
L90
Leq
WindSpeed
WindLimit
Noise Level (dB)
WindSpeed (m/s)
Time
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
Location 3 - Luddenham Road, Orchard Hills
Thursday, 09-07-20
Rain
Lmax
L90
Leq
WindSpeed
WindLimit
Noise Level (dB)
WindSpeed (m/s)
Time


Measured ambient noise levels
Location 3 - Luddenham Road, Orchard Hills
Friday, 10-07-20
Rain
Lmax
L90
Leq
WindSpeed
WindLimit
Noise Level (dB)
WindSpeed (m/s)
Time


Measured ambient noise levels
Location 3 - Luddenham Road, Orchard Hills
Saturday, 11-07-20
Rain
Lmax
L90
Leq
WindSpeed
WindLimit
Noise Level (dB)
WindSpeed (m/s)
Time
0:00
2:00
4:00
6:00
8:00
10:00
12:00
14:00
16:00
18:00
20:00
22:00


Measured ambient noise levels
Location 3 - Luddenham Road, Orchard Hills
Sunday, 12-07-20
Rain
Lmax
L90
Leq
WindSpeed
WindLimit
Noise Level (dB)
WindSpeed (m/s)
Time
0:00
2:00
4:00
6:00
8:00
10:00
12:00
14:00
16:00
18:00
20:00
22:00

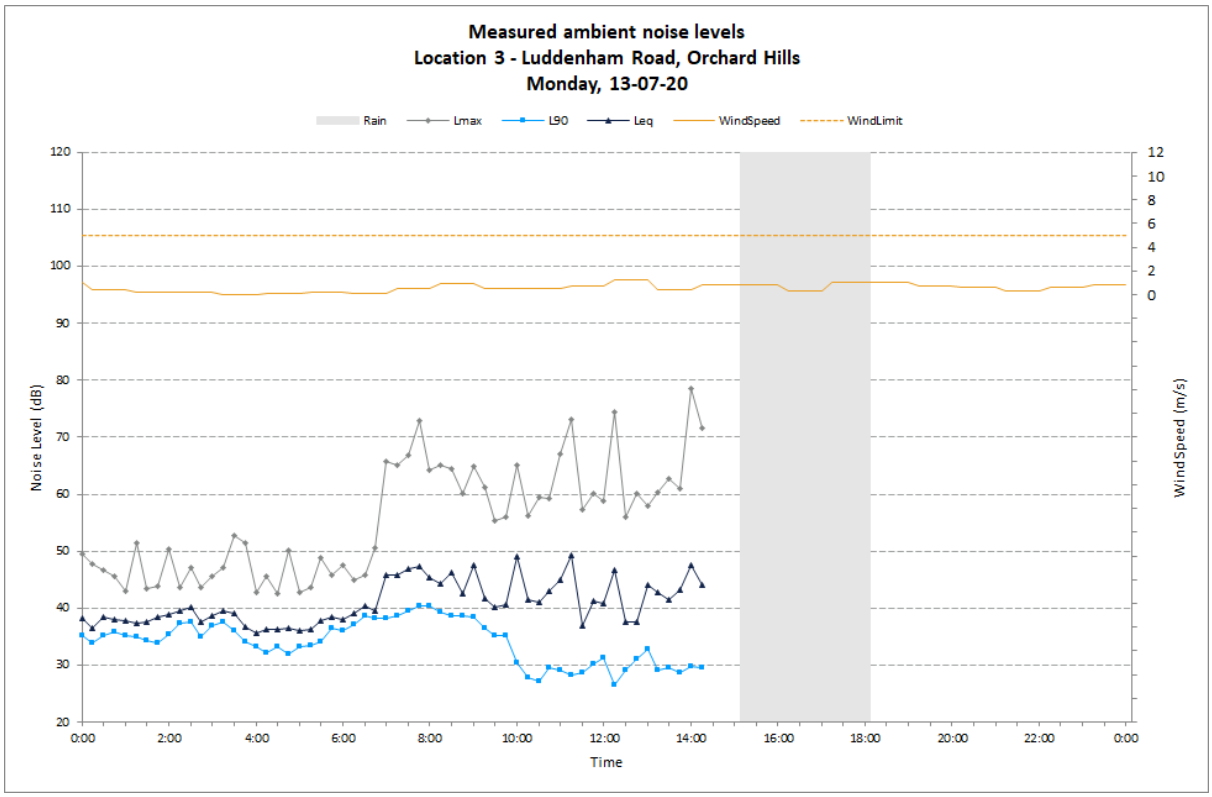
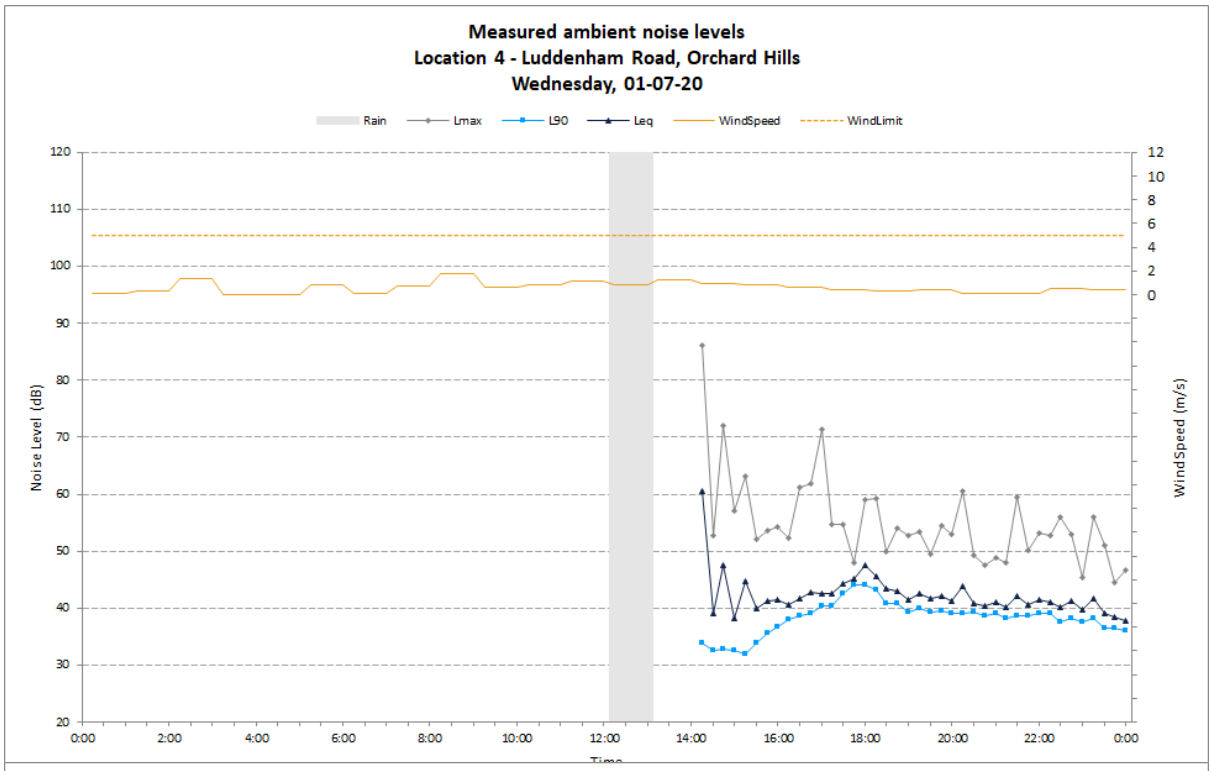
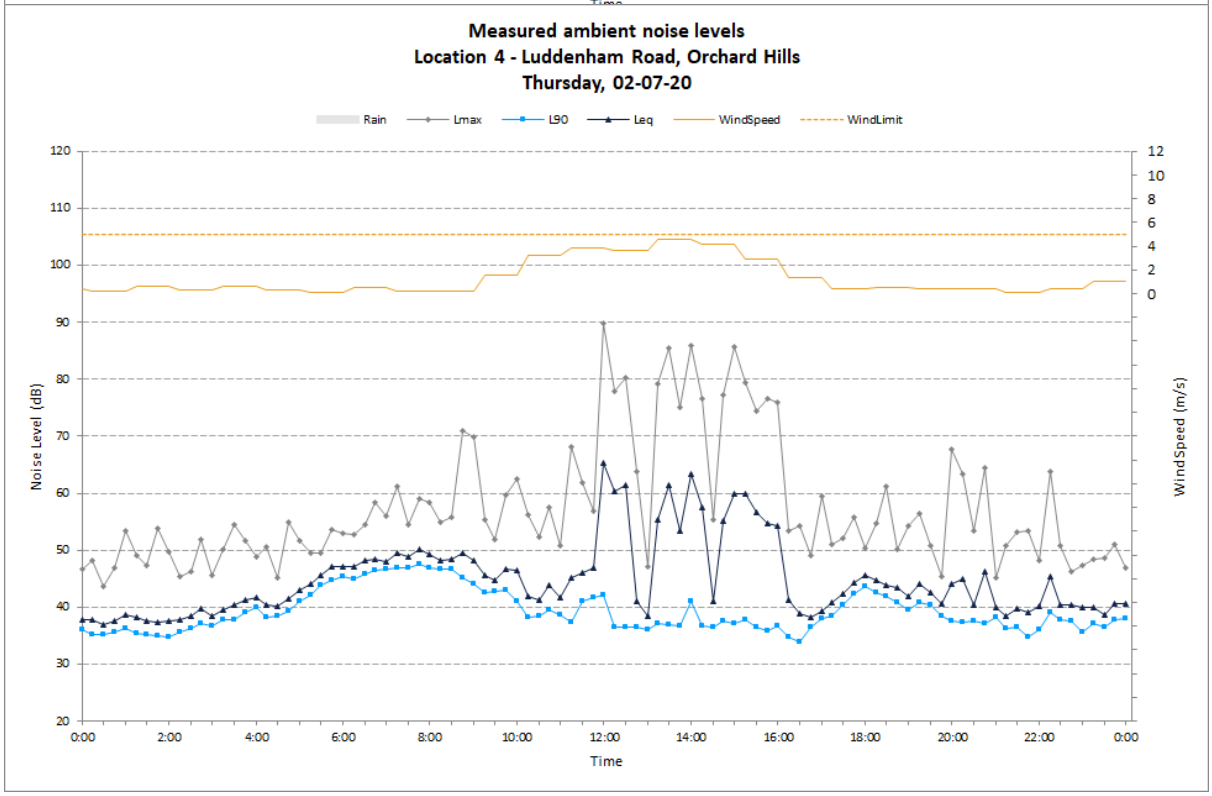

Measured ambient noise levels
Location 3 - Luddenham Road, Orchard Hills
Monday, 13-07-20
Rain
Lmax
L90
Leq
WindSpeed
WindLimit
Noise Level (dB)
WindSpeed (m/s)
Time
120
110
100
90
80
70
60
50
40
30
20
12
10
8
6
4
2
0
0:00
2:00
4:00
6:00
8:00
10:00
12:00
14:00
16:00
18:00
20:00
22:00
0:00

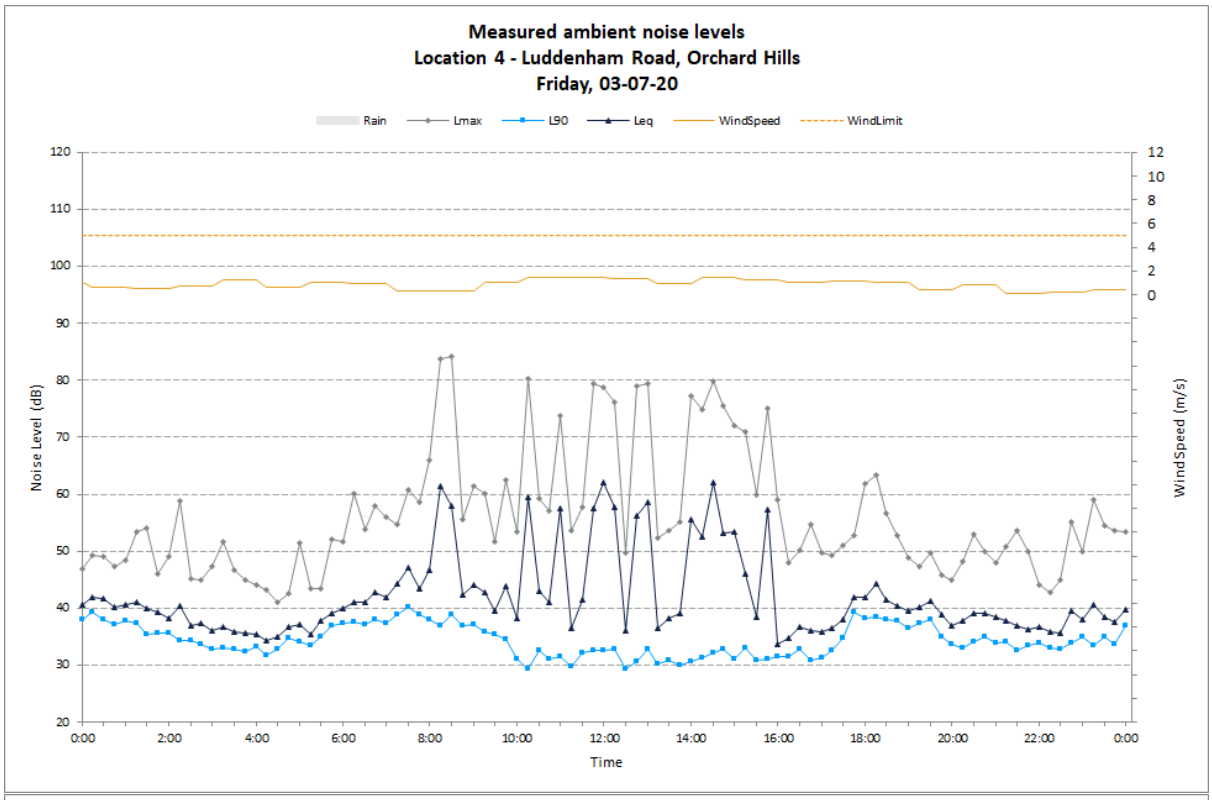
Table A.4 Summary of daily noise logging results – NM4

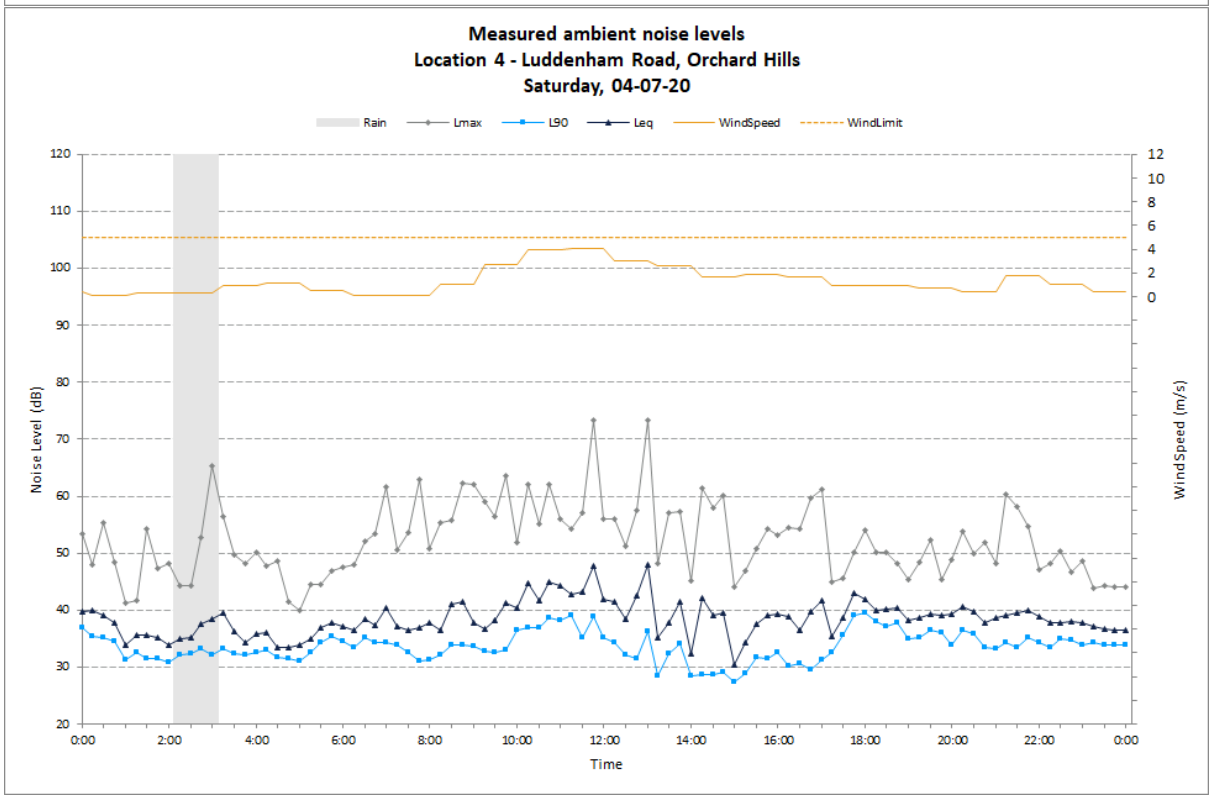
Date	ABL Day[1]	ABL Evening[1]	ABL Night[1]
Wednesday, 01-07-20	0	39	35
Thursday, 02-07-20	36	36	33
Friday, 03-07-20	30	33	32
Saturday, 04-07-20	29	33	30
Sunday, 05-07-20	29	33	29
Monday, 06-07-20	28	37	30
Tuesday, 07-07-20	28	0	33
Wednesday, 08-07-20	29	39	37
Thursday, 09-07-20	32	41	36
Friday, 10-07-20	32	36	0
Saturday, 11-07-20	0	36	31
Sunday, 12-07-20	28	34	34
Monday, 13-07-20	0	0	0
Summary Values	29	36	33

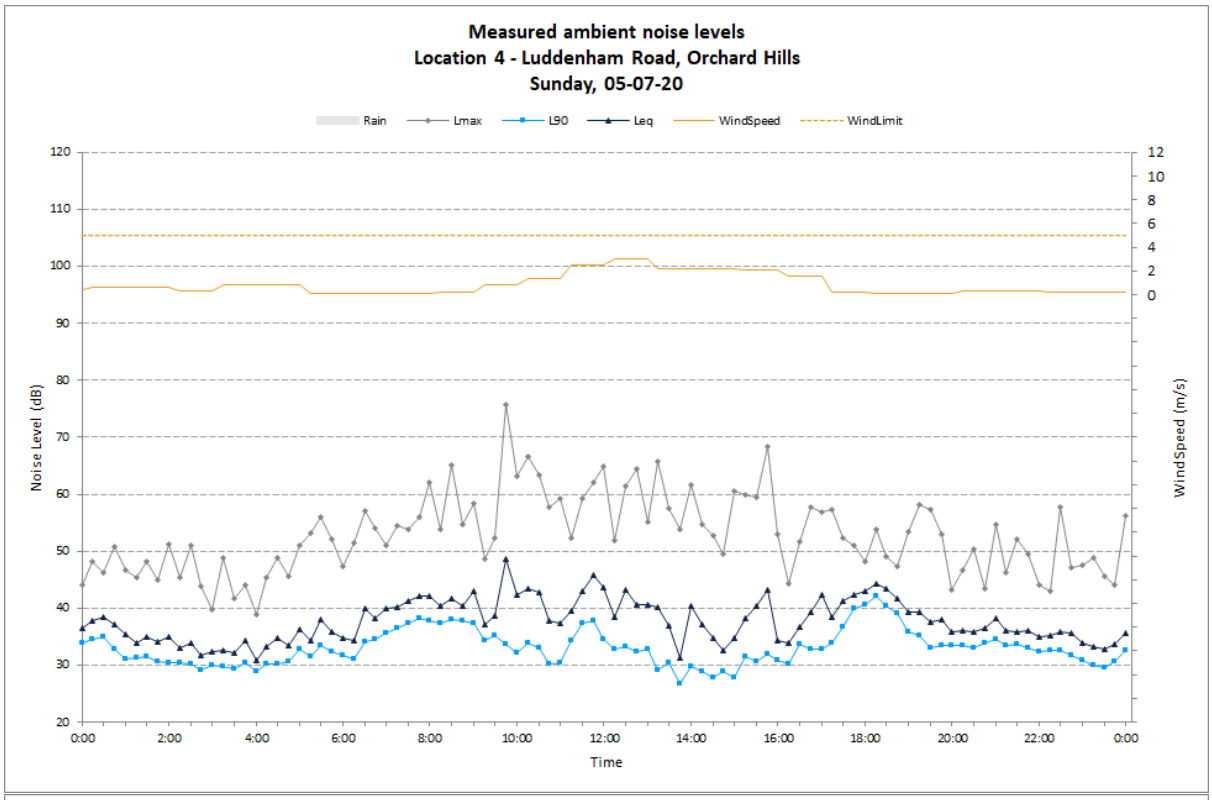
Notes: 1. A "0" indicates insufficient data samples due to adverse weather or other extraneous effects.

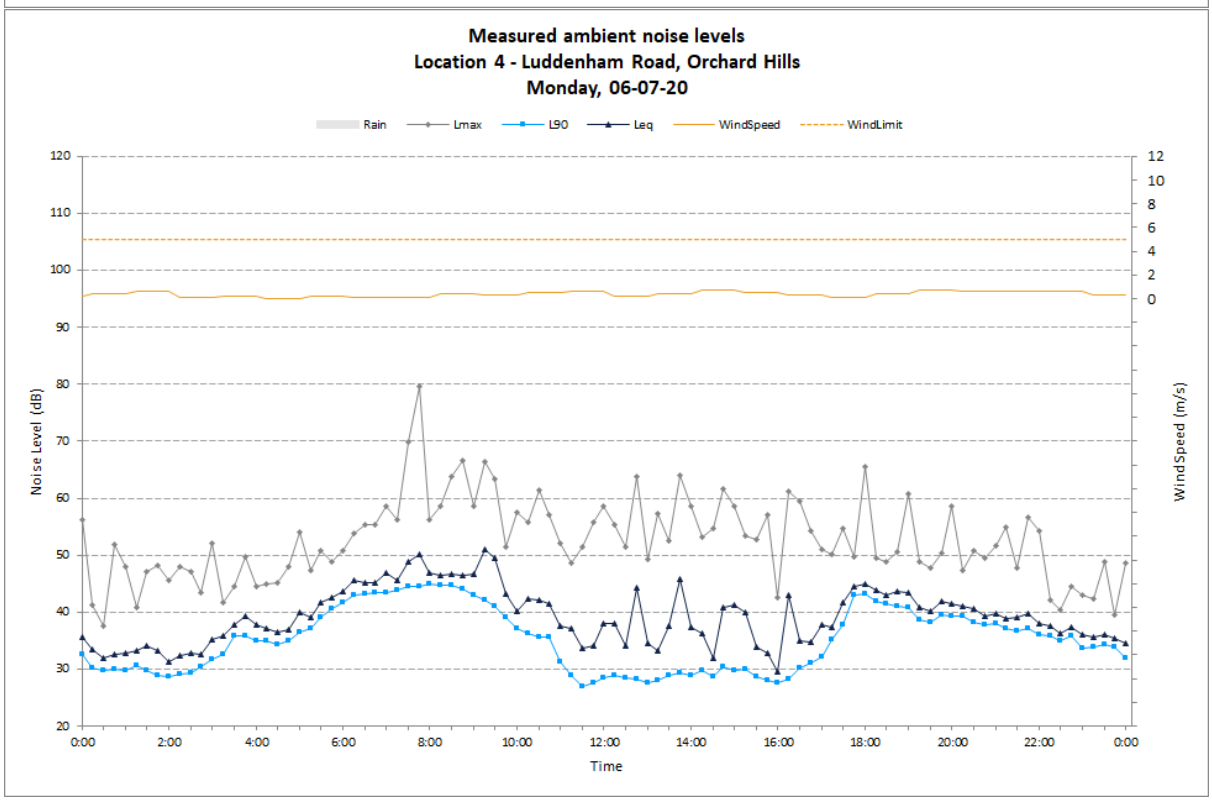

Measured ambient noise levels
Location 4 - Luddenham Road, Orchard Hills
Wednesday, 01-07-20
Rain
Lmax
L90
Leq
WindSpeed
WindLimit
Noise Level (dB)
WindSpeed (m/s)
Time

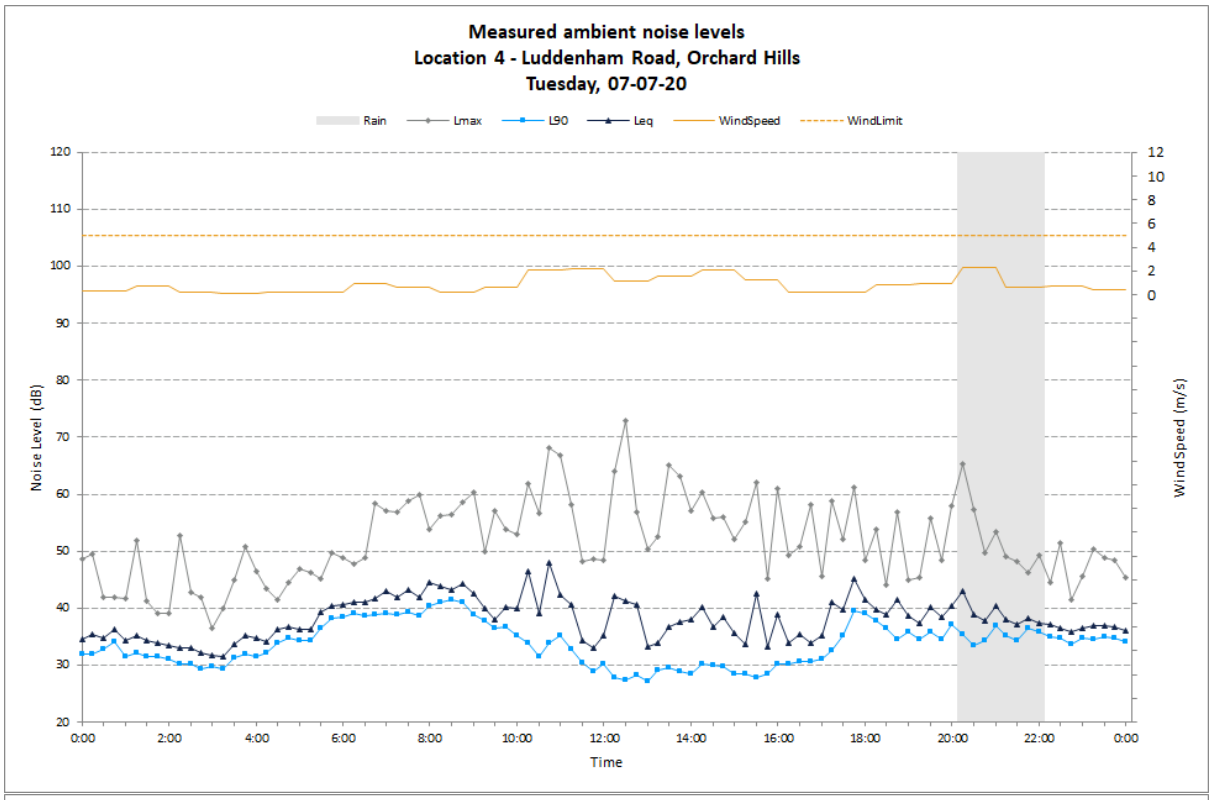

Measured ambient noise levels
Location 4 - Luddenham Road, Orchard Hills
Thursday, 02-07-20
Rain
Lmax
L90
Leq
WindSpeed
WindLimit
Noise Level (dB)
WindSpeed (m/s)
Time

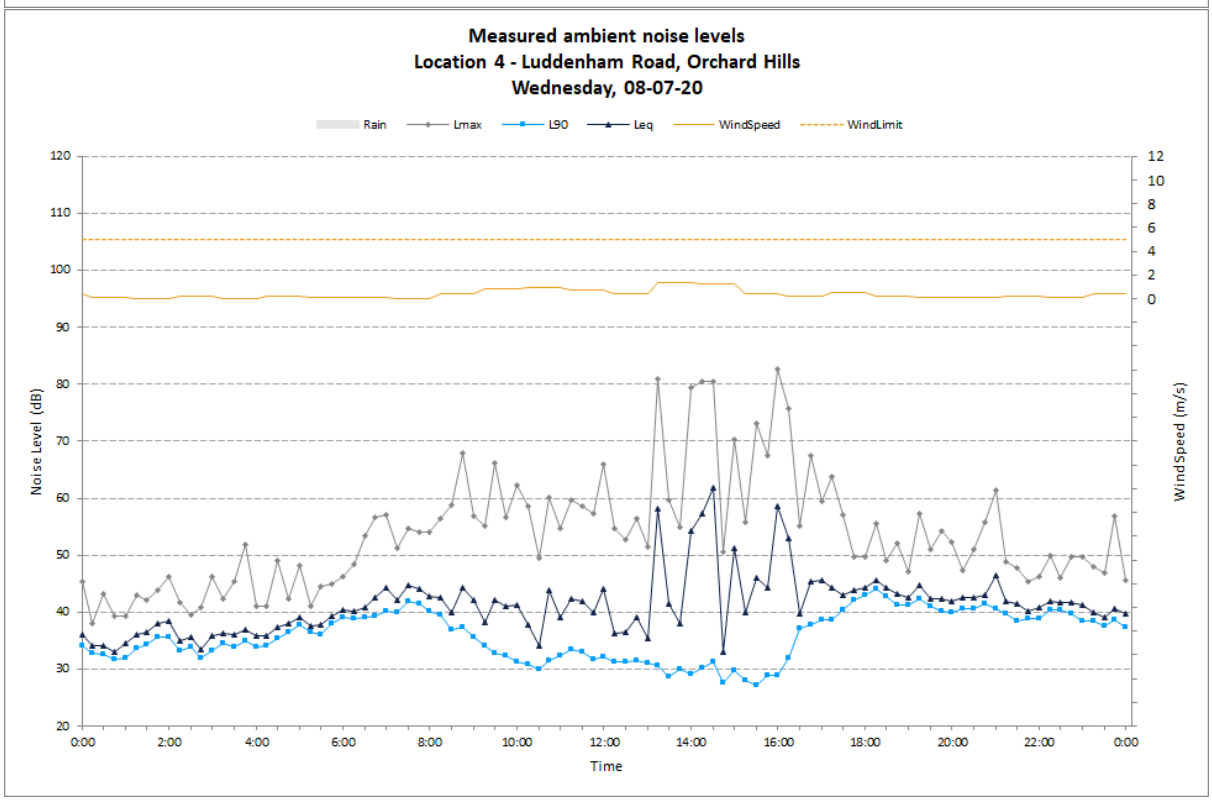

Measured ambient noise levels
Location 4 - Luddenham Road, Orchard Hills
Friday, 03-07-20
Rain
Lmax
L90
Leq
WindSpeed
WindLimit
Noise Level (dB)
WindSpeed (m/s)
Time
0:00
2:00
4:00
6:00
8:00
10:00
12:00
14:00
16:00
18:00
20:00
22:00
0:00

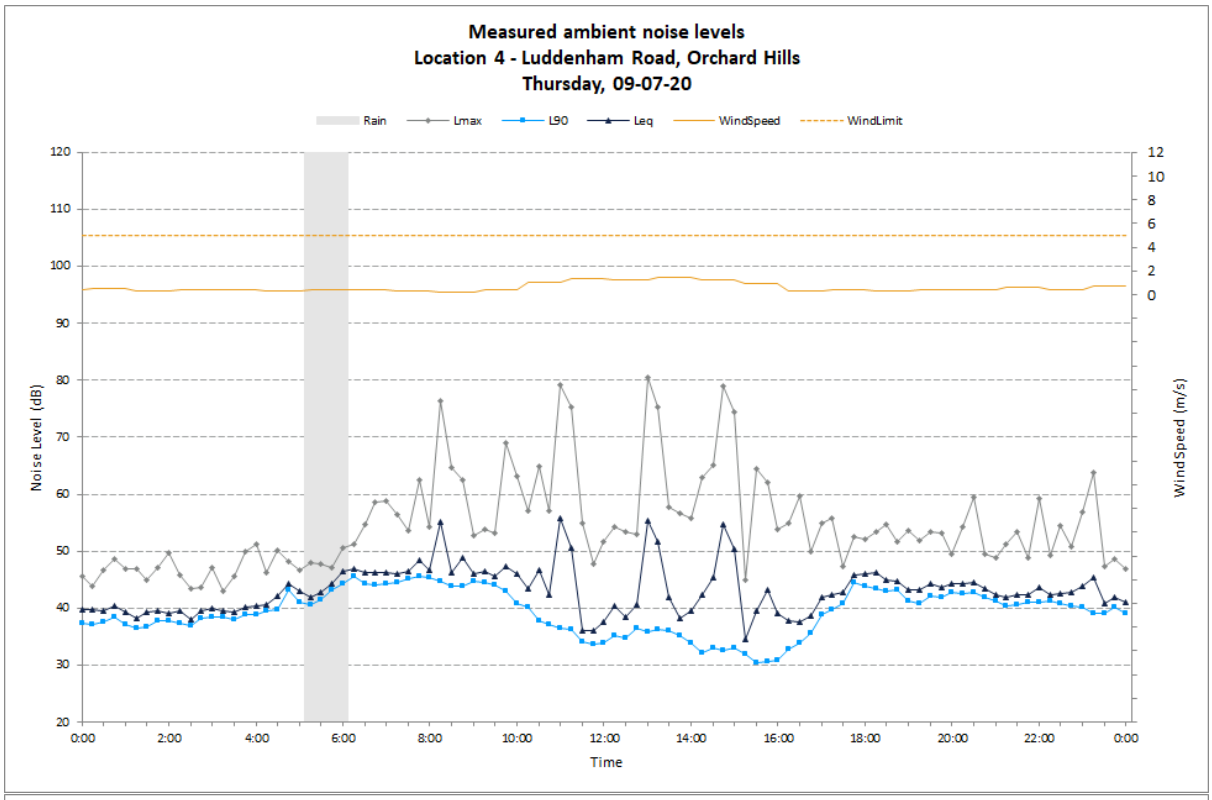

Measured ambient noise levels
Location 4 - Luddenham Road, Orchard Hills
Saturday, 04-07-20
Rain
Lmax
L90
Leq
WindSpeed
WindLimit
Noise Level (dB)
WindSpeed (m/s)
Time
0:00
2:00
4:00
6:00
8:00
10:00
12:00
14:00
16:00
18:00
20:00
22:00
0:00

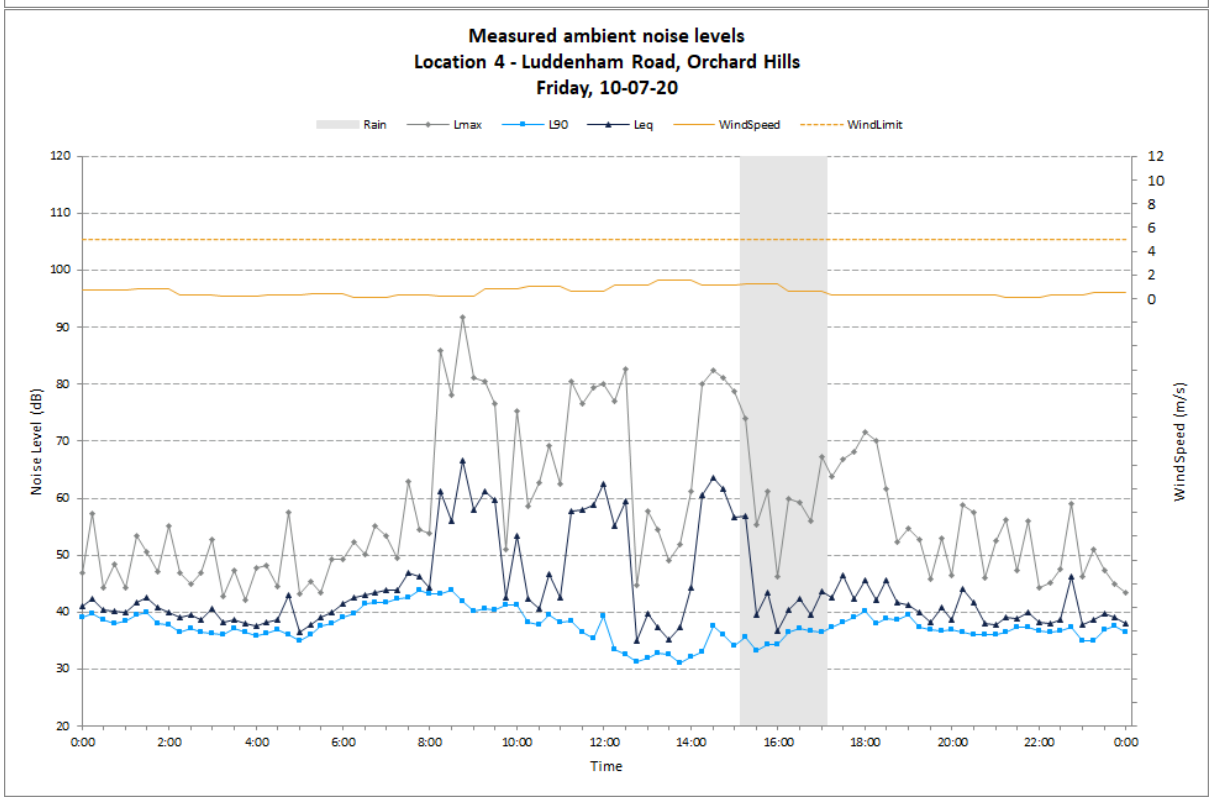

Measured ambient noise levels
Location 4 - Luddenham Road, Orchard Hills
Sunday, 05-07-20
Rain
Lmax
L90
Leq
WindSpeed
WindLimit
Noise Level (dB)
WindSpeed (m/s)
Time

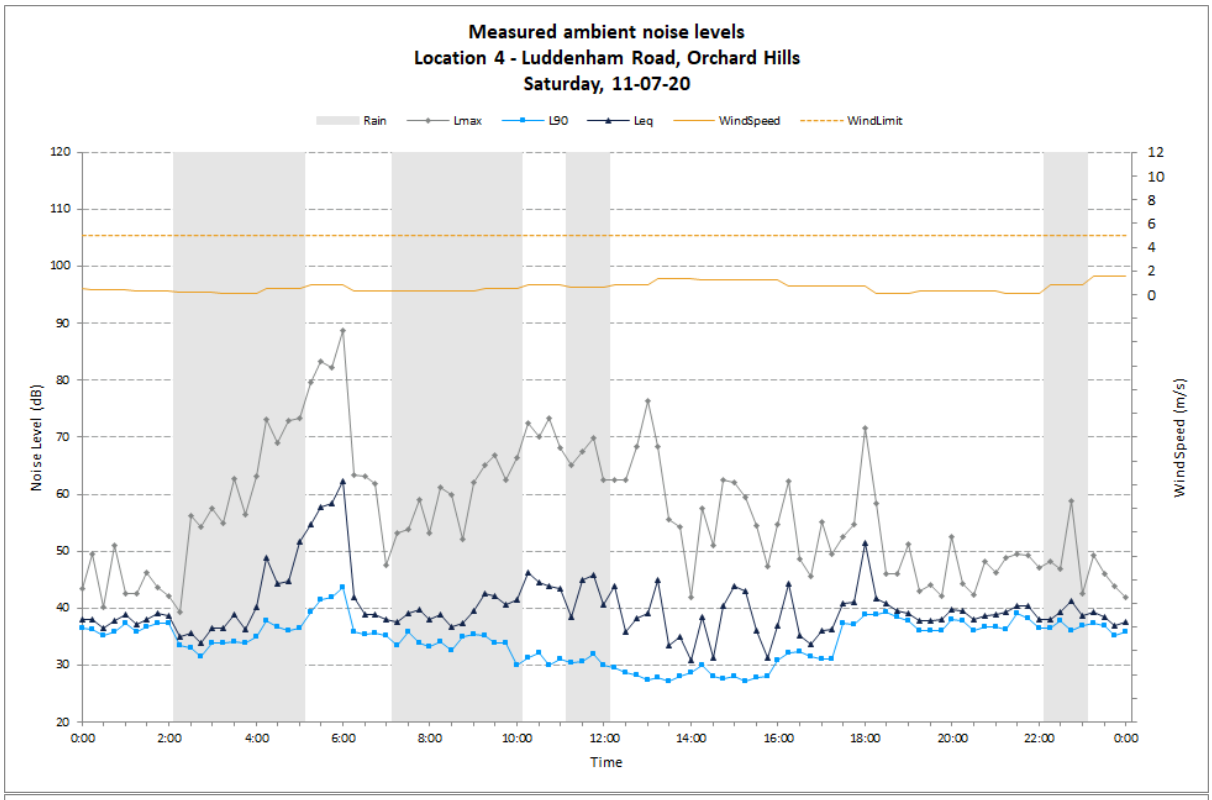

Measured ambient noise levels
Location 4 - Luddenham Road, Orchard Hills
Monday, 06-07-20
Rain
Lmax
L90
Leq
WindSpeed
WindLimit
Noise Level (dB)
WindSpeed (m/s)
Time

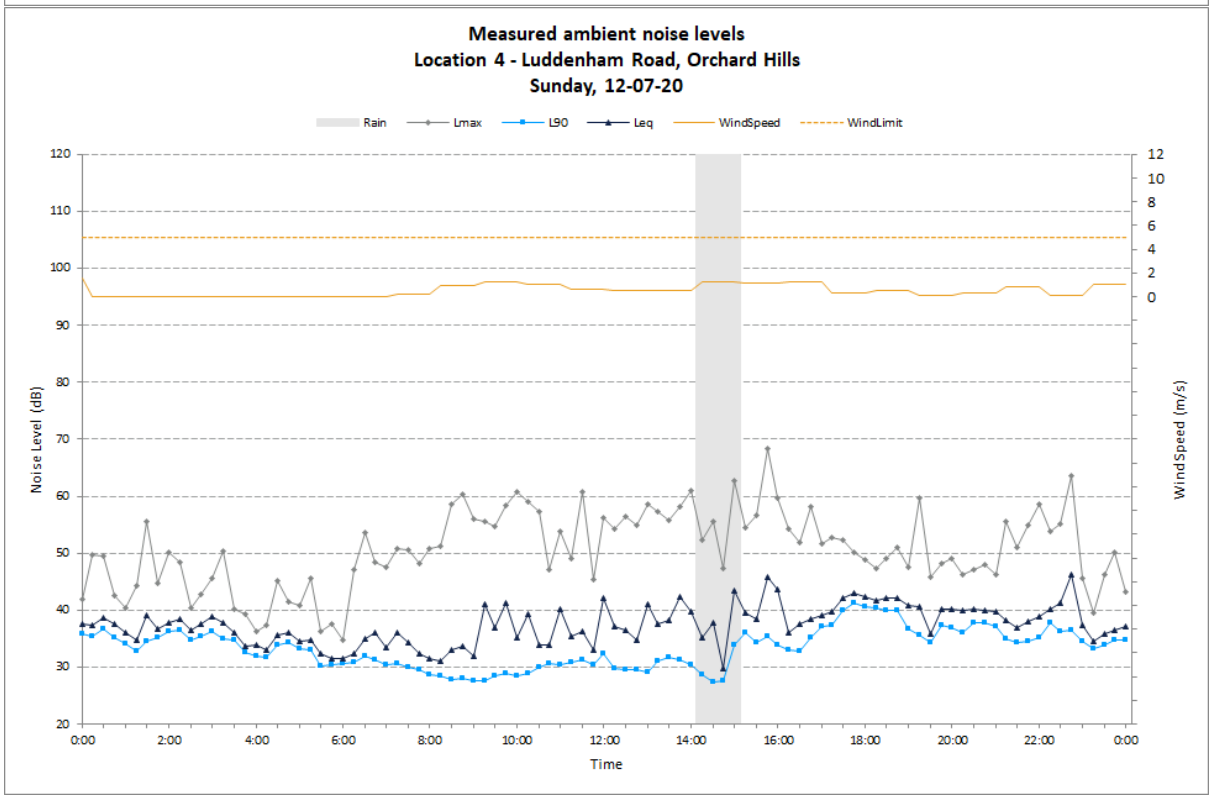

Measured ambient noise levels
Location 4 - Luddenham Road, Orchard Hills
Tuesday, 07-07-20
Rain
Lmax
L90
Leq
WindSpeed
WindLimit
Noise Level (dB)
WindSpeed (m/s)
Time

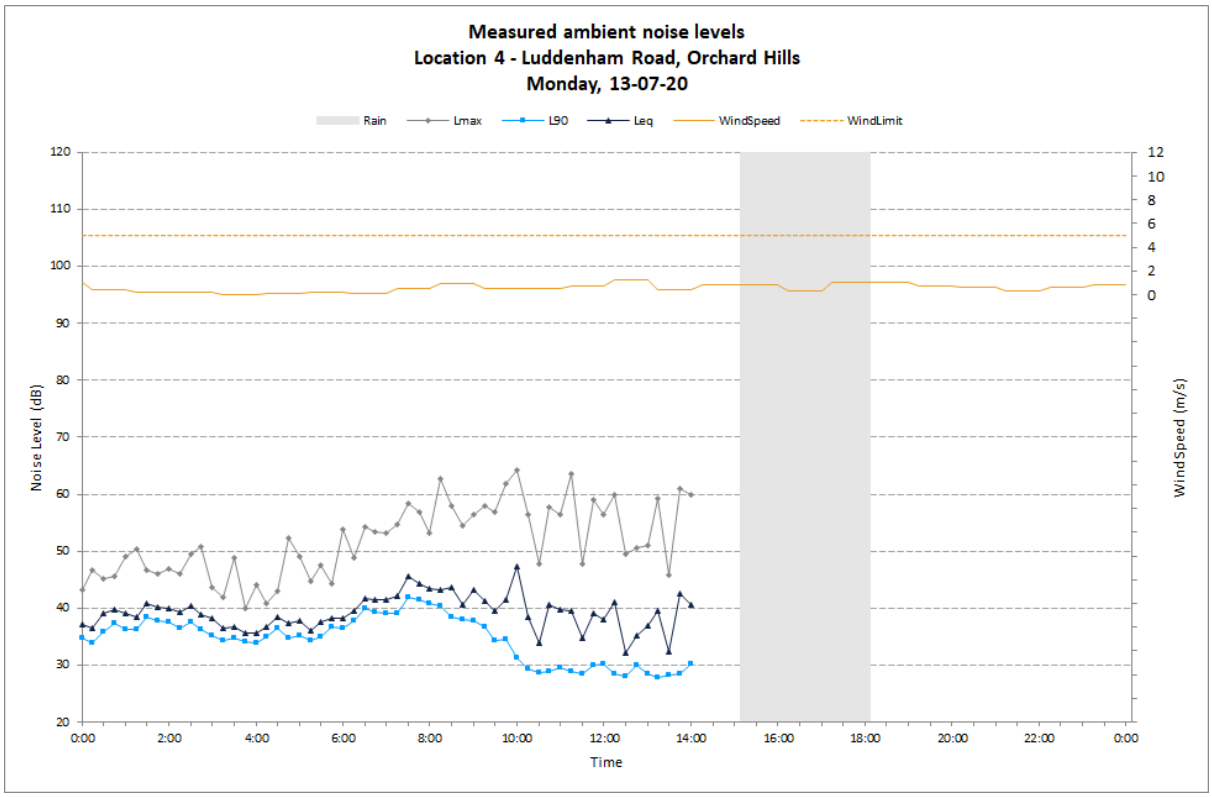

Measured ambient noise levels
Location 4 - Luddenham Road, Orchard Hills
Wednesday, 08-07-20
Rain
Lmax
L90
Leq
WindSpeed
WindLimit
Noise Level (dB)
WindSpeed (m/s)
Time


Measured ambient noise levels
Location 4 - Luddenham Road, Orchard Hills
Thursday, 09-07-20
Rain
Lmax
L90
Leq
WindSpeed
WindLimit
Noise Level (dB)
WindSpeed (m/s)
Time


Measured ambient noise levels
Location 4 - Luddenham Road, Orchard Hills
Friday, 10-07-20
Rain
Lmax
L90
Leq
WindSpeed
WindLimit
Noise Level (dB)
WindSpeed (m/s)
Time


Measured ambient noise levels
Location 4 - Luddenham Road, Orchard Hills
Saturday, 11-07-20
Rain
Lmax
L90
Leq
WindSpeed
WindLimit
Noise Level (dB)
WindSpeed (m/s)
Time


Measured ambient noise levels
Location 4 - Luddenham Road, Orchard Hills
Sunday, 12-07-20
Rain
Lmax
L90
Leq
WindSpeed
WindLimit
Noise Level (dB)
WindSpeed (m/s)
Time


Measured ambient noise levels
Location 4 - Luddenham Road, Orchard Hills
Monday, 13-07-20
Rain
Lmax
L90
Leq
WindSpeed
WindLimit
Noise Level (dB)
WindSpeed (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