



DESIGNING AND DELIVERING
A SUSTAINABLE FUTURE

APPENDIX 11

NOISE & VIBRATION

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APPENDIX 11.1

BASELINE NOISE MEASUREMENTS

Baseline Noise Measurements

Baseline noise monitoring was undertaken at six receptor locations, to establish the existing background noise levels at noise sensitive locations in the vicinity of the proposed wind farm site. These six locations represent the nearest residential locations to the north, south, east and west of the proposed wind farm.

Baseline noise measurements are used to define the construction noise limits. These are summarised at the end of this Appendix.

In addition, the baseline noise measured are summarised for the substation noise assessment at the end of this chapter.

Selection of Monitoring Locations

Section 2.2.5 of the Institute of Acoustics', *A Good Practice Guide to the Application of ETUS-R-97 for the Assessment at Rating of Wind Turbine Noise* (2013) regarding use of proxy locations states "*When choosing a location that will serve as a proxy for others, the basis for selection is that it can reasonably be claimed, from inspection and observation, to be representative of the non-surveyed locations, in line with the criteria of Section 2.5. Measurement locations outside a property's curtilage (such as an adjacent field) may be used when access to a representative property cannot be obtained, provided that such a location can be justified as being representative. No general guidance can therefore be given on the number of measurement locations as this will be site-specific.*" Section 2.5 of the GPG is summarised in Table A11.1.1 with the applicability of the proxy locations selected for Littleton Wind Farm.

Table A11.1.1: IOA GPG Section 2.5 Criteria and Applicability to Littleton Wind Farm Monitoring Locations

Requirements of Section 2.5	Littleton Wind Farm Monitoring Locations
2.5.1 <i>Where possible, measurements should be made in the vicinity of a dwelling in an area frequently used for rest and recreation.</i>	Location N3 was located at edge of property near farm buildings at the property.
2.5.2 <i>Equipment should be placed at outdoor positions where noise levels are representative of typical 'low' levels likely to be experienced in the vicinity of a dwelling (or group of dwellings if the measurements are intended to be applied to more than one dwelling). The overriding consideration is that <u>it can reasonably be claimed, from inspection and observation, that there are no other suitable noise-sensitive locations, in the vicinity of any selected location and close to a dwelling, where background noise levels would be expected to be consistently lower than the levels at the selected position.</u></i>	All locations met this requirement.
2.5.3 <i>Ideally the position should be one which would be exposed to noise from the wind turbines whilst being best-screened from other noise sources such as nearby roads or vegetation.</i>	All locations met this requirement.
2.5.4 <i>The background surveys provide the basis for setting both daytime and night-time noise limits: the measurement position must therefore reasonably represent external areas (for daytime noise) and also building façades containing windows (for night-time noise).</i>	All locations met this requirement.
2.5.5 <i>In most locations, background noise levels will be determined by wind in trees and vegetation and noise sources external to the property such as traffic noise. The presence of local noise sources such as boiler flues, garden fountains, domestic drains, watercourses and farm equipment should be identified.</i>	All locations met this requirement. If measurements were made next to vegetation (e.g. N5) this was representative of the noise environment at this property.
2.5.6 <i>Where it is not possible to exclude the influence of variable local noise sources by selection of monitoring position, it is generally possible to identify such data from inspection of noise level time histories and therefore to exclude it from the data set used to derive noise limits</i>	No other noise sources were noted during the survey. Noise sources noted during equipment deployment and setup are described below and atypical data has been removed from the graphs.

Requirements of Section 2.5	Littleton Wind Farm Monitoring Locations
2.5.7 <i>In all cases, microphones should be supported at a height of 1.2 – 1.5 metres above the ground and no closer than 3.5 metres to any significant reflecting surface (such as a building or fence), except the ground. The position should be within 20 metres of the dwelling unless there are particular reasons for measuring at a more distant position (such as the presence of vegetation or denial of access); if so, the reasons should be explained.</i>	In terms of the distance from the microphone to the nearest noise sensitive property, Location N3 was placed away from the property to avoid screening from the proposed windfarm location and the farm buildings at the property. All other locations met this requirement of distance from property. All locations met the requirement for height above ground and distance to reflecting surfaces.
2.5.8 <i>A resident at a selected property may request that measurements are made at a position which is considered inappropriate; perhaps because the preferred location(s) are inconvenient (it might obstruct lawn mowing, for example). In this situation the consultant should explain clearly the reasons why the measurements could be compromised; if no agreement can be reached, an alternative property or location should be sought. The assistance of the EHO may help to resolve these situations.</i>	This was not an issue at any location.

Monitoring Locations

Noise monitoring was conducted at six locations, selected for obtaining a detailed representation of the background noise levels at receptors surrounding the proposed development. Details of the six noise monitoring locations are provided in Table A.11.1.2. The position of the monitoring locations is shown in Figure 11.2, Volume 4 of this EIAR.

Table A11.1.2: Details on the Noise Monitoring Locations

Location ID	Easting	Northing	Description	Photograph
N1a	624078	659047	North of the proposed windfarm, In the front garden in direction of property windfarm, 5m from the property facade. Screened from traffic noise to the north	Plate A11.1-1
N2	625689	657056	At northern side of property, approximately 5m from the corner of the property at end of cul de sac, near to forested area.	Plate A11.1-2
N3	624825	655721	Behind farm buildings at a property, approximately 100m from property façade.	Plate A11.1-3

Location ID	Easting	Northing	Description	Photograph
N4	621749	652771	In rear garden of property, with view of proposed windfarm to north. Approximately 18m from the rear façade and 3.5m from garden fence.	Plate A11.1-4
N5	622066	650342	Near a track to the front (west of the house), some distance from local road, 17m from façade.	Plate A11.1-5
N6	622373	658422	In rear garden of property, approximately 13m from the property.	Plate A11.1-6

Location N1, This location was to the north of the proposed windfarm. The noise meter was located in the front garden in the direction of the proposed windfarm, approximately 5m from the property facade. As there was noise from the M8 motorway to the north, the meter was located in the front garden overlooking the adjacent local road, at the quietest point in the front garden.



Plate A11.1-1: Monitoring Location N1

Location N2, This location was located in a cul de sac and near to a wooded area, east of the proposed windfarm. The noise meter was located in the front garden north of the property in the direction of the proposed windfarm, approximately 5m from the property.



Plate A11.1-2: Monitoring Location N2

Location N3, This was located north west of a cottage, behind farm buildings in the direction of the proposed windfarm. The location is approximately 100m from the property. There is a wooded area, at the edge of the field approximately 200m from the measurement location.

This represents a group of properties to the north east of the measurement location. There was noise from livestock at an adjacent barn observed when equipment was deployed. The meter was set up at 3.5m from the base of the hay bales.



Plate A11.1-3: Monitoring Location N3

Location N4, This location is in the rear garden of the property, behind a shed in the rear garden. The measurement location is approximately 18m from the rear façade of the property. There is a slight embankment along the rear boundary of the property and some hawthorn in the next field.



Plate A11.1-4: Monitoring Location N4

Location N5, This location is near to a track close to the front (west) of the house. The house is on a farm, located approximately 680m from the local road. The measurement location overlooks the windfarm and is away from trees to the north of the property. The measurement location is approximately 17m from the property.



Plate A11.1-5: Monitoring Location N5

Location N6, This location is on a local road off the R639 and approximately 800m from the M8 motorway. The noise monitor was located in the rear garden, approximately 13m from the property in the direction of the proposed windfarm at the quietest point in the property. The monitoring location is next to a field of sheep and also the location of the rain gauge. The main noise source at this location was from the M8 motorway.



Plate A11.1-6: Monitoring Location N6

Measurement Periods

The IOA GPG states *“The duration of a background noise survey is determined only by the need to acquire sufficient valid data over the range of wind speeds. It is unlikely that this requirement can be met in less than 2 weeks.”* If insufficient wind data is collected after two weeks, the monitoring period will be extended subject to acquiring sufficient valid data over the range of wind speeds. Sufficient data was captured at all monitoring locations with a minimum of two and a half weeks’ worth of data captured at all monitoring locations.

Definition of Time Periods

The 2006 DoEHLG Wind Energy Development Guidelines do not provide the specific periods which are represented by daytime and night-time hours. The noise data has been analysed based on the Amenity and night time hours defined in ETSU-R-97:

Amenity/Quiet Daytime hours	18:00 – 23:00 Monday to Friday
	13:00 – 18:00 Saturday
	07:00 – 18:00 Sunday
Night-time hours	23:00 – 07:00

Monitoring Equipment

Baseline noise monitoring was carried out using Svantek 307, Svantek 977 and Larson Davis SoundExpert Lxt Class 1 sound level meters. Details of the noise monitoring equipment are presented in Table A11.1.3. The sound level meters were fitted with 1/2” microphones. The microphones connected to the Svantek sound level meters were fitted with a wind shield made from open-pored polyurethane foam with a diameter of 130mm. Both the Svantek 977 and the Larson Davis sound level meters were fitted with a 90mm diameter windshield with a secondary windshield. The setup used is in keeping with ESTU W/13/00386/REP, Noise Measurements in Windy Conditions and IOA Good Practice Guidelines, 2013. Calibration certificates for each sound level meter and the calibrator are provided in Appendix 11.2.

Table A11.1.3: Details of Noise Monitoring Equipment

Monitoring Location	Meter Type	Serial Number
N1	Larson Davis SoundExpert	LXT0006870
N2	Svantek 977	34173
N3	Svantek 307	104985
N4	Larson Davis SoundExpert	LXT0006603
N5	Larson Davis SoundExpert	LXT0006850
N6	Svantek 307	104990

A Campbell Scientific ARG100 Tipping Bucket Raingauge and CR800 series datalogger was used to record rainfall and this was located at monitoring location N6. This meteorological data was acquired every 10 minutes synchronised to the hour, simultaneously with noise data.

Monitoring Protocol

Baseline noise measurements were undertaken at six locations near the proposed wind farm. Equipment was installed by FT between 18th November 2021 and the 9th December 2021.

The following monitoring protocol was carried out at each of the monitoring locations:

1. The sound level meters were calibrated on-site and set to log L_{A90} statistics on a fast time weighted response every ten minutes.
2. Each sound level meter microphone was mounted at 1.5 m above ground level and fitted with an enhanced windshield. Each microphone was placed at least 3.5 m from reflecting surfaces to obtain 'free field' conditions.
3. Wind speed and wind direction measurements were taken from a permanent mast installed on site. Wind speed was measured at a range of heights and data from anemometers at 80m and 100m and were used to extrapolate the wind speed data up to a hub height of 119m.
4. The standardised 10 m wind speed was obtained from the turbine hub height wind speed by correcting it to 10 m height using a ground roughness factor of 0.05 m. Roughness length (or logarithmic) shear profile:

$$U_1 = U_2 \frac{\ln(H_1/z)}{\ln(H_2/z)}$$

where U_1 is the wind speed to be calculated, U_2 is the measured wind speed, H_1 is the height of the measured wind speed to be calculated (10m), H_2 is the height of the measured wind speed and z is the ground roughness length (m). A roughness length of 0.05m is used to standardise hub height wind speeds to 10m height in the IEC 61400-11:2012 standard.

5. The L_{A90} statistic measurements were synchronised with the 10 m standardised wind speeds derived from the on-site meteorological mast data.

6. A logging rain gauge was also installed (at Monitoring Location N6) and similarly logged rainfall events over successive 10-minute intervals, also synchronised to the noise level and wind speed measurements.
7. After the monitoring was completed, the noise meters were re-tested using the calibration noise source to ensure that the meters had not drifted.

Analysis of the Baseline Data

Following collection of the site data, the following protocol was used to analyse the baseline data:

1. The raw baseline L_{A90} noise data was reviewed to determine whether there are any periods of non-consistent noise level due to equipment malfunction.
2. The raw noise level data was then correlated with the time synchronised wind speed and rainfall data. Preliminary data analysis was used to remove datasets (L_{A90} , wind speed and occurrence of rainfall event) which contain a rainfall event as these data sets are required to be removed from further analysis in line with best practice as outlined in the IOA Good Practice Guide and Supplementary Guidance Note 2 on Data Processing.
3. The prevailing background noise during for daytime periods uses the amenity/quiet daytime hours. The prevailing background noise during night-time periods excludes early morning periods to remove the dawn chorus which is not prevalent through that whole year, with data recorded between 04:00 and 07:00 removed from further analysis in accordance with the guidance outlined in the IOA GPG.
4. Once the rainfall events have been accounted for, the remaining data was graphed using a wind speed based plot to establish whether there are any remaining data outliers, representing atypical noise sources or events. Location N6 data was affected by M8 Motorway noise. Atypical noise was removed from location N4. The source of this noise was not apparent from observations made on site.
5. Once the remaining data sets were found to be representative of the noise environment, they were analysed to ensure that sufficient data remained to provide sufficient data coverage over the necessary wind speeds. The IOA Good Practice Guide (May 2013) requires, as a minimum, no fewer than five valid data sets across each 1 m/s wind speed from turbine cut-in to rated power. Where integer wind speeds have less than five valid data sets, the prevailing background noise trend will not be extended beyond the range covered by adequate data sets. See Section 'Data Available for Determination of Prevailing Background Noise Levels' for details.
6. A 'best fit' trend (not higher than a fourth order polynomial) was then derived to present the assumed prevailing background noise level at each monitoring location. See Section 'Results' for details.

Data Available for Determination of Prevailing Background Noise Levels

The requirement for the survey duration is dictated by the range of wind speeds to be collected. The IOA Good Practice Guide to the Application of ETSU-R-97¹ for the Assessment and Rating of Wind Turbine Noise, (May 2013) states that *"As a guideline, no fewer than 200 data points should be recorded in each of the amenity hours and night-time periods with no fewer than 5 data points in any 1 m/s wind speed bin."*

The Wind Energy Development Guidelines (Department of Environment, Heritage and Local Government, 2006) do not provide the specific periods which are represented by daytime and night-time hours. The definitions from ETSU-R-97 are taken as 23:00 to 07:00 hrs for night-time, and the Amenity/Quiet Daytime

¹ Department of Trade and Industry (1996), The Assessment and Rating of Noise from Wind Farms Report ETSU-R-97

hours (18:-23:00 Monday to Saturday, 13:00-18:00 Saturday and 07:00-18:00 Sunday. Prevailing background noise levels were derived for daytime and night-time periods. The number of valid datasets are shown in Tables A11.1.4 and A11.1.5 with wind speed ranges greyed out which did not satisfy the criteria of at least 5 data points in any 1 m/s wind speed bin. The daytime range of windspeeds was between 2 and 10m/s. The night time range of windspeeds was between 2 and 12m /s. Therefore an adequate range of windspeeds was achieved in accordance with the IOAGPG. This guidance recommends an upper limit of 10 m/s, noting that in some cases the top turbine sound power is achieved at lower windspeeds.

Table A11.1.4: Number of Valid Datasets: Noise Monitoring Locations -Daytime

Wind Speed (at standardised 10 m height), m/s	Valid Datasets					
	N1	N2	N3	N4	N5	N6
0	1	1	1	1	1	1
1	3	3	3	3	3	3
2	56	59	57	46	57	57
3	87	88	88	54	88	89
4	80	88	85	77	88	88
5	150	150	150	130	151	151
6	184	184	182	131	185	185
7	113	117	115	85	115	115
8	73	76	71	48	74	74
9	32	33	30	25	32	32
10	11	11	10	10	11	11
11	2	2	2	2	2	2
12	4	5	4	0	4	4
13	9	10	9	0	9	9
14	6	7	6	0	6	6
Total Number of Data Points	811	834	813	612	826	827
	Did not satisfy the criteria of at least 5 data points in any 1 m/s wind speed bin					

Table A11.1.5: Number of Valid Datasets: Noise Monitoring Locations– Night-time

Wind Speed (at standardised 10 m height), m/s	Valid Datasets					
	N1	N2	N3	N4	N5	N6
0	2	2	2	2	2	2
1	16	16	16	14	16	16
2	41	41	41	40	41	41
3	15	15	15	14	15	15
4	75	75	75	58	75	75
5	135	135	135	106	135	135
6	81	82	81	53	81	81
7	55	56	55	37	54	55
8	57	61	57	45	56	57
9	29	29	29	29	29	29
10	21	22	21	21	21	21
11	11	12	11	11	11	11
12	7	7	7	7	7	7
13	1	1	1	1	1	1
Total Number of Data Points	546	554	546	438	544	546
	Did not satisfy the criteria of at least 5 data points in any 1 m/s wind speed bin					

Results

In this section, the prevailing background noise level in dB L_{A90} relative to standardised 10 m height wind speeds are provided for each monitoring location as per the requirements of the survey. The prevailing background noise level is plotted as a solid line for each daytime and night-time periods at each monitoring location. In all cases, the highest order of polynomial used is a third order polynomials provided lines of best fit to the scatter data.

Figure A11.1: Prevailing Amenity/Daytime Background (LA90) Noise Levels at N1

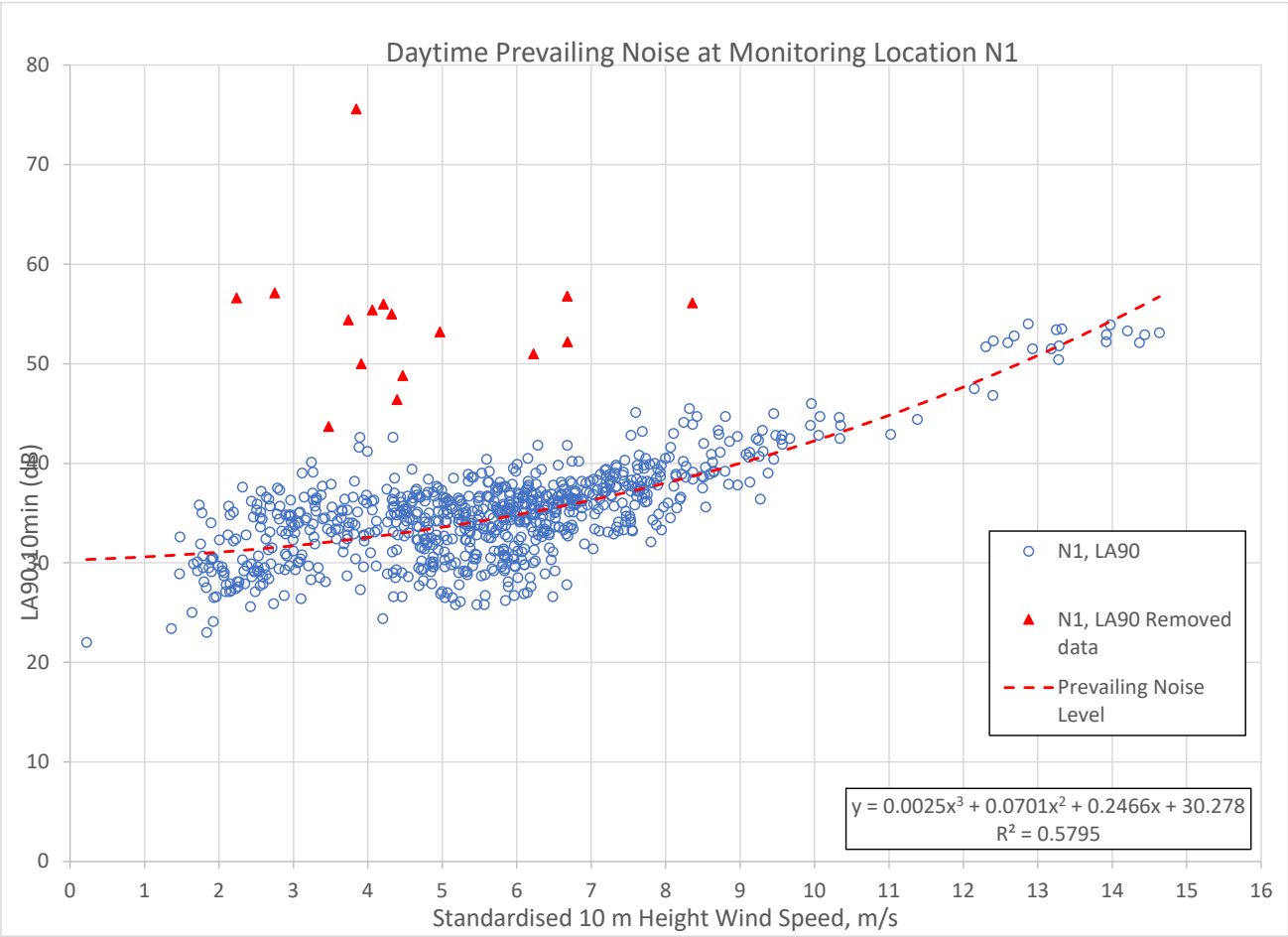


Figure A11.2: Prevailing Amenity/Daytime Background (LA90) Noise Levels at N2

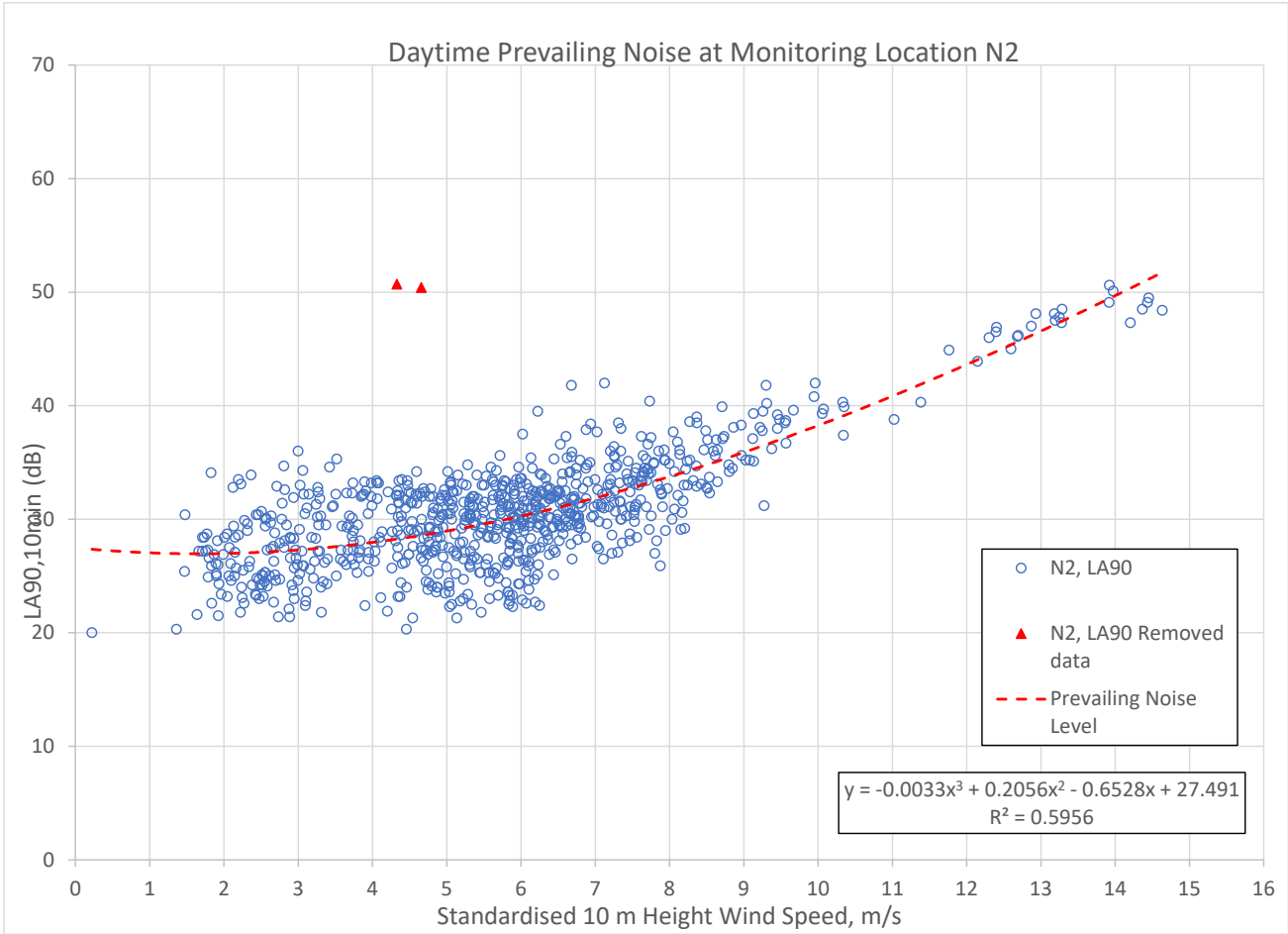


Figure A11.3: Prevailing Amenity/Daytime Background (LA90) Noise Levels at N3

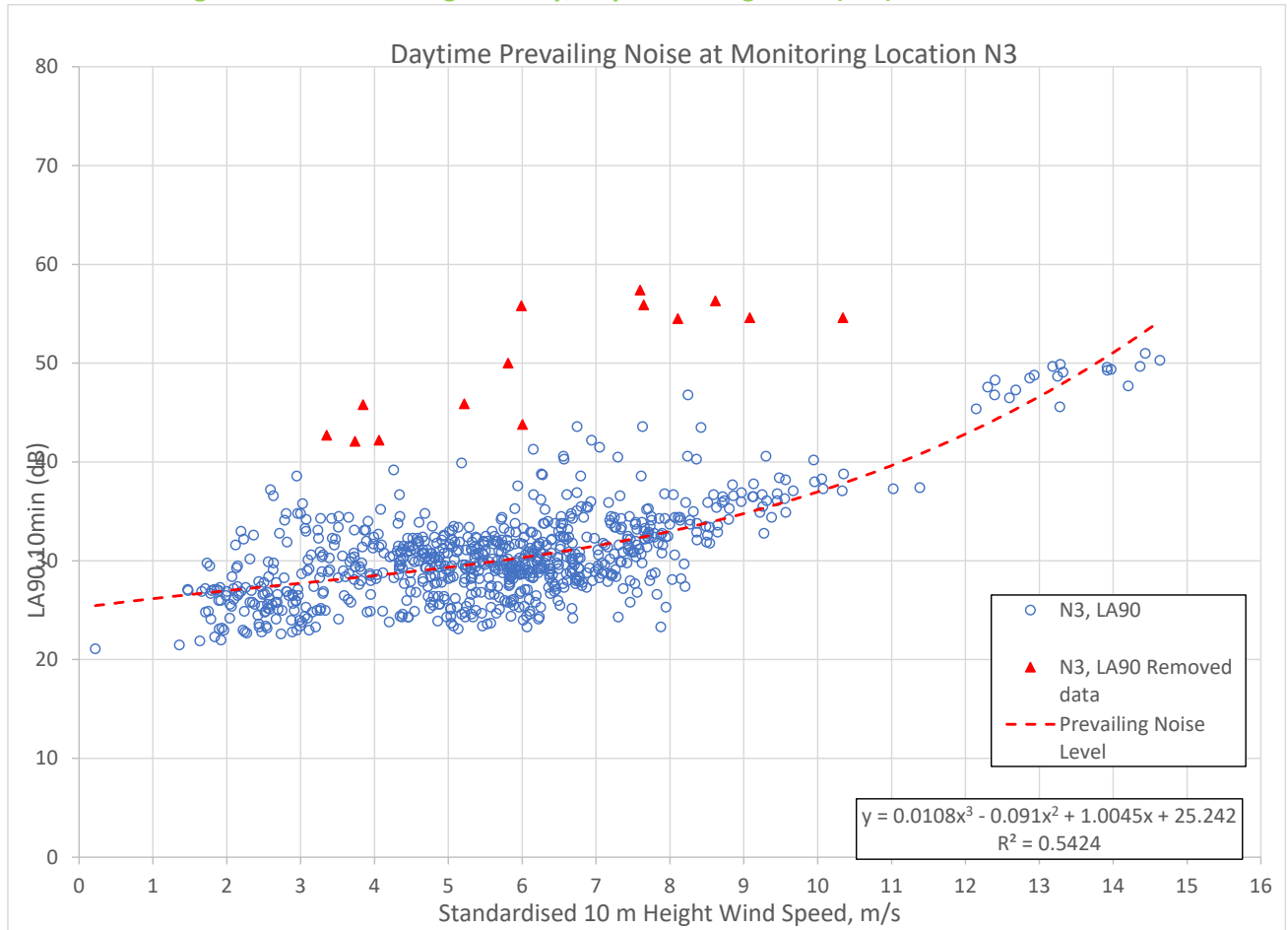


Figure A11.4: Prevailing Amenity/Daytime Background (L_{A90}) Noise Levels at N4

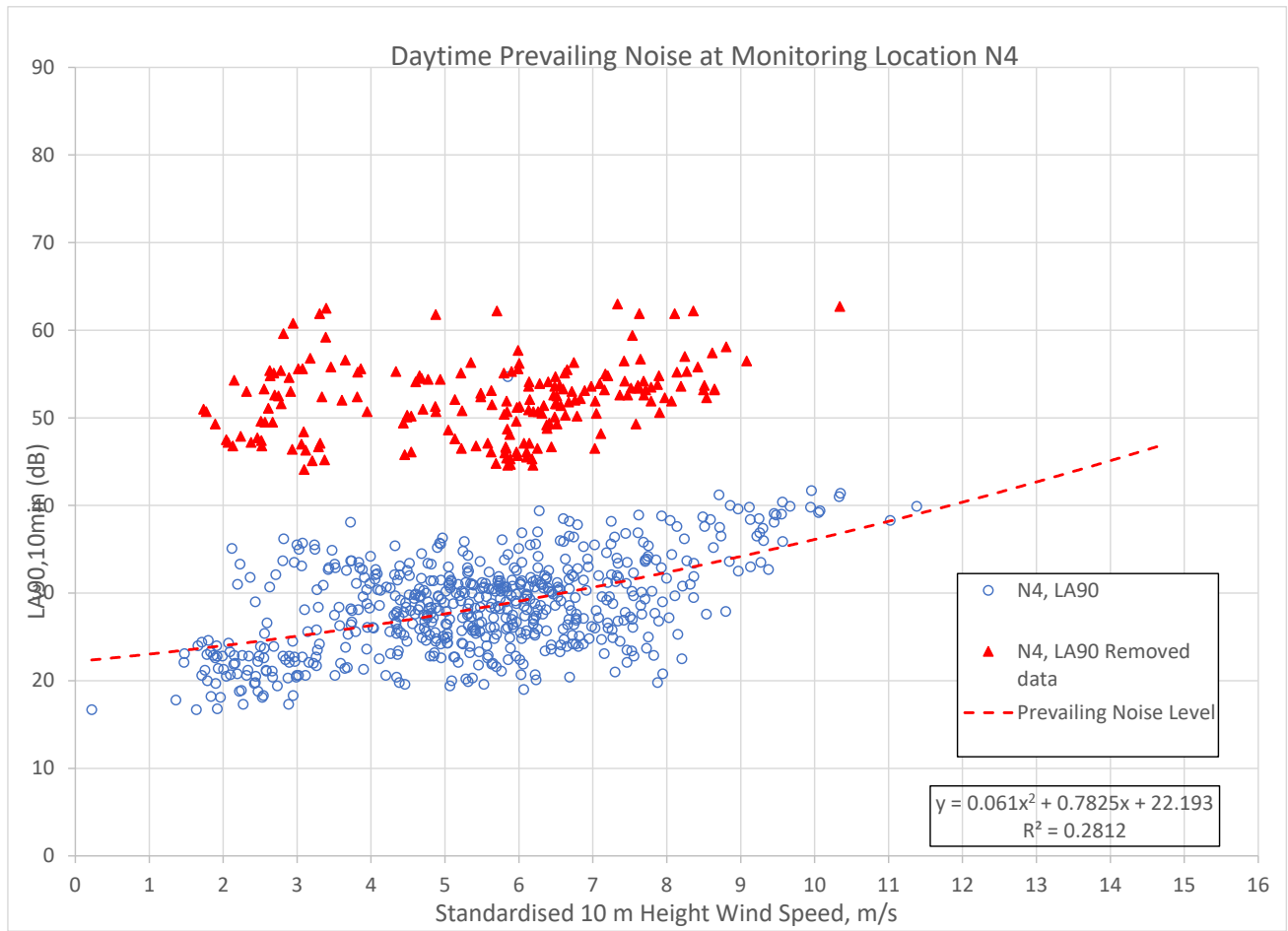


Figure A11.5: Prevailing Amenity/Daytime Background (LA90) Noise Levels at N5

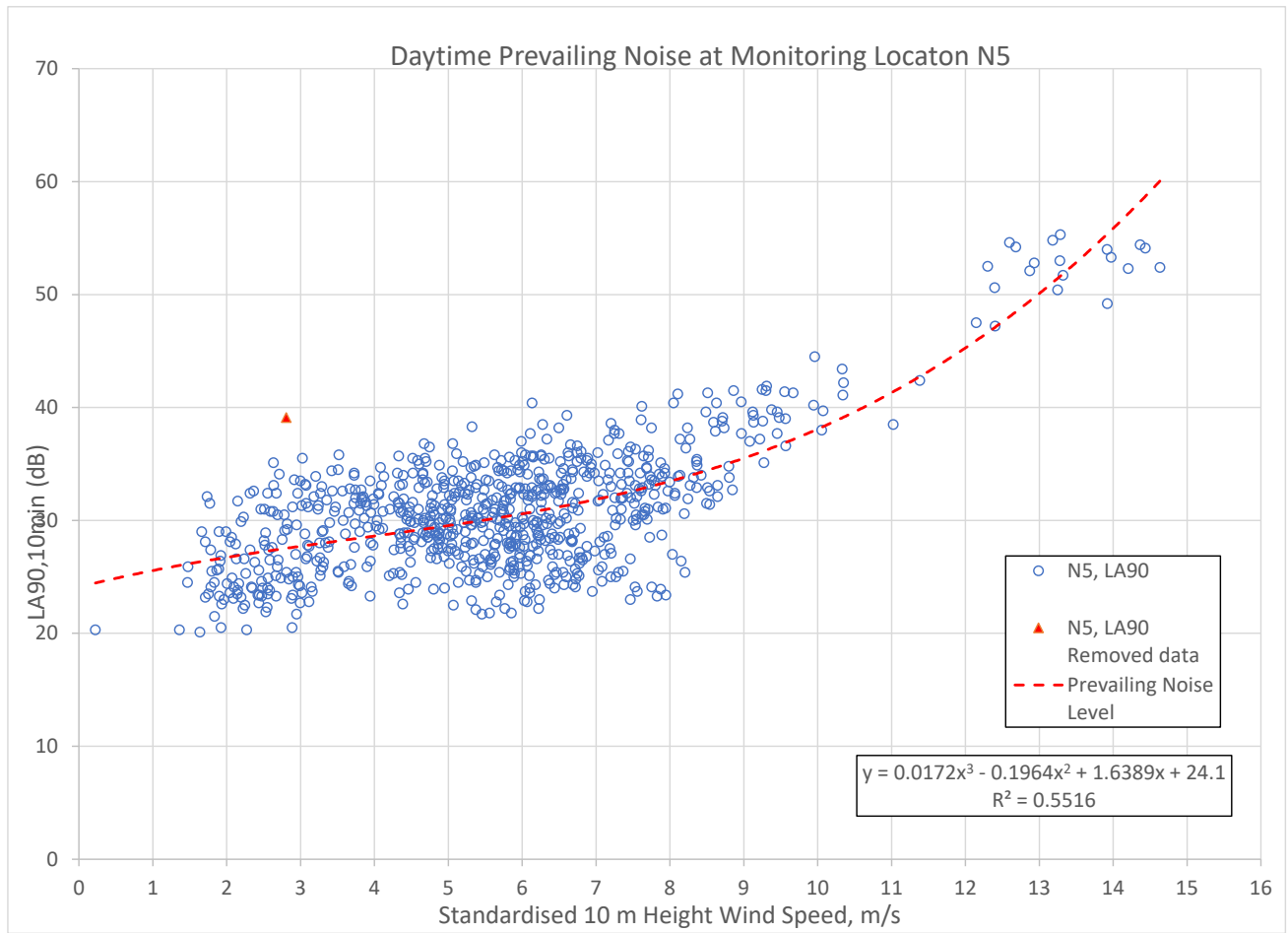


Figure A11.6: Prevailing Amenity/Daytime Background (LA90) Noise Levels at N6

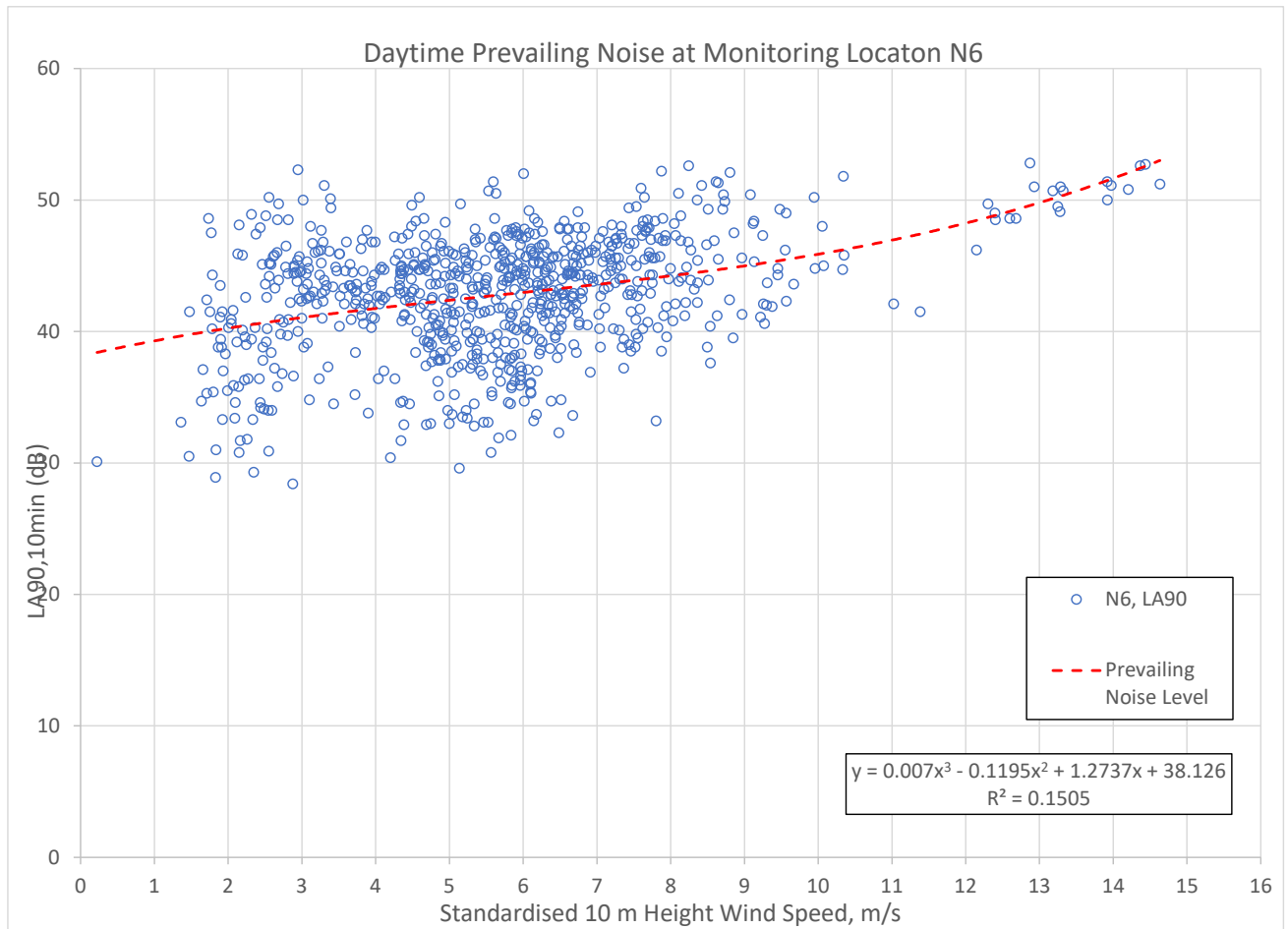


Figure A11.7: Prevailing Night-time Background (L_{A90}) Noise Levels at N1

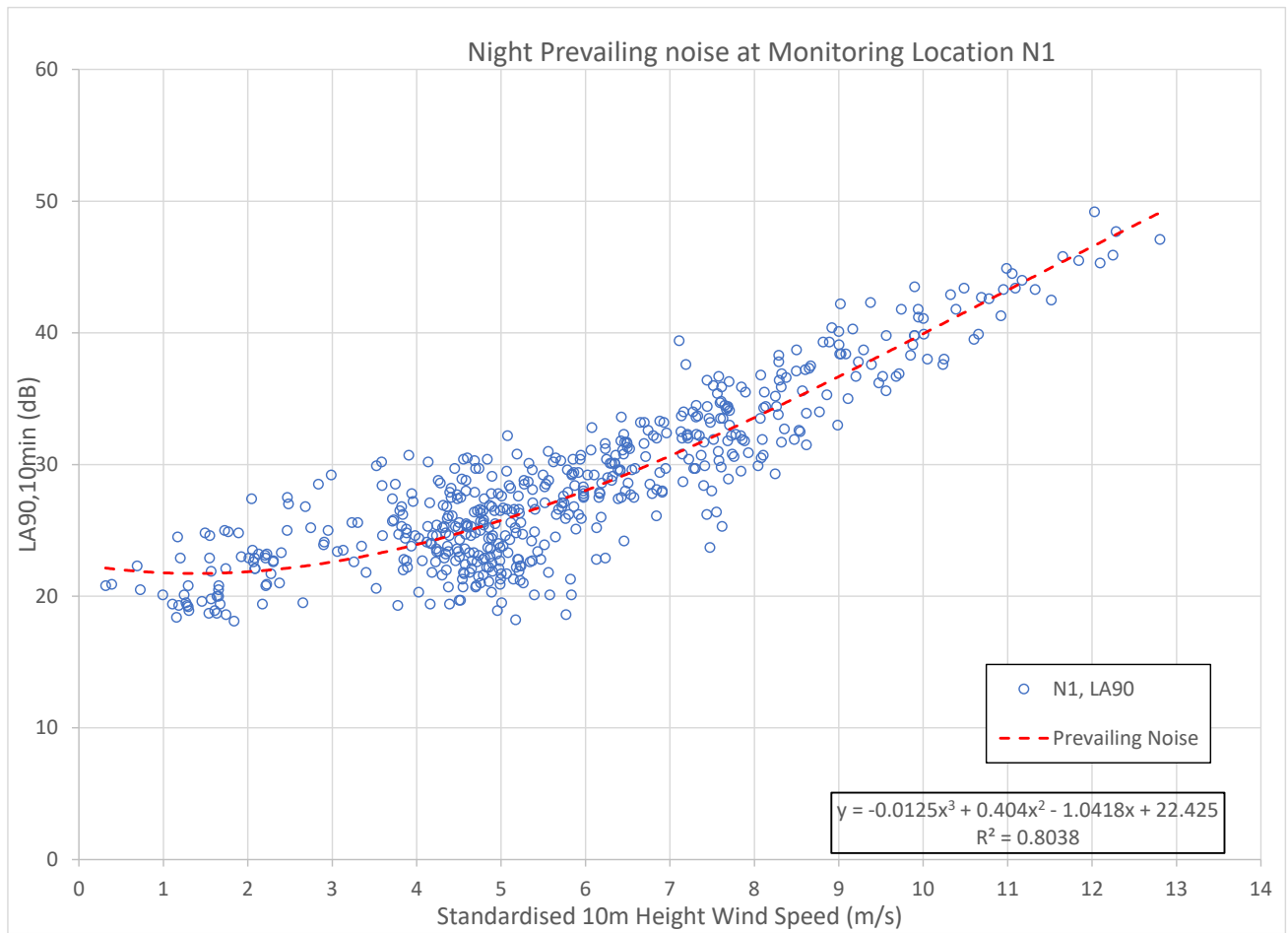


Figure A11.8: Prevailing Night-time Background (LA90) Noise Levels at N2

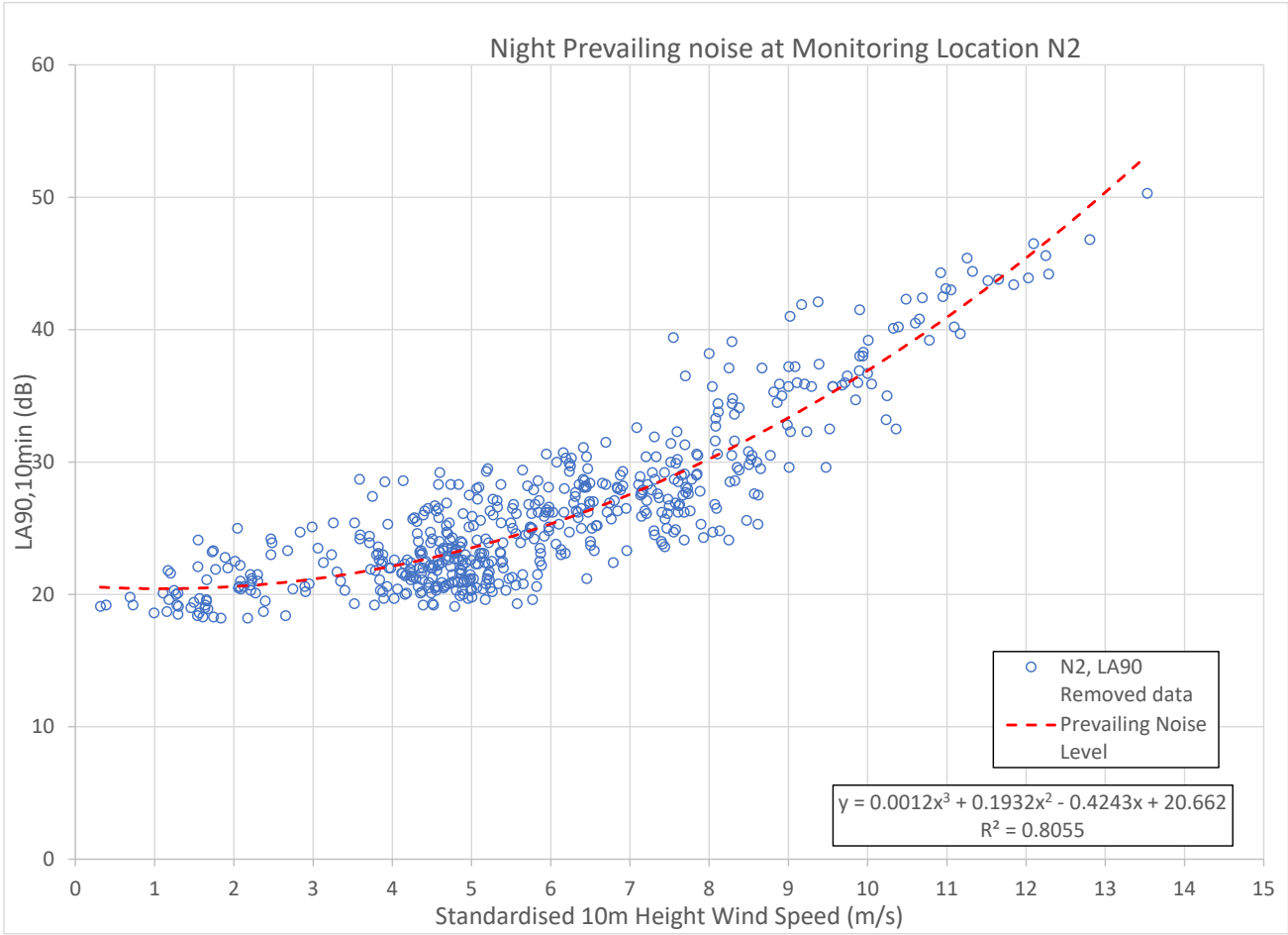


Figure A11.9: Prevailing Night-time Background (L_{A90}) Noise Levels at N3

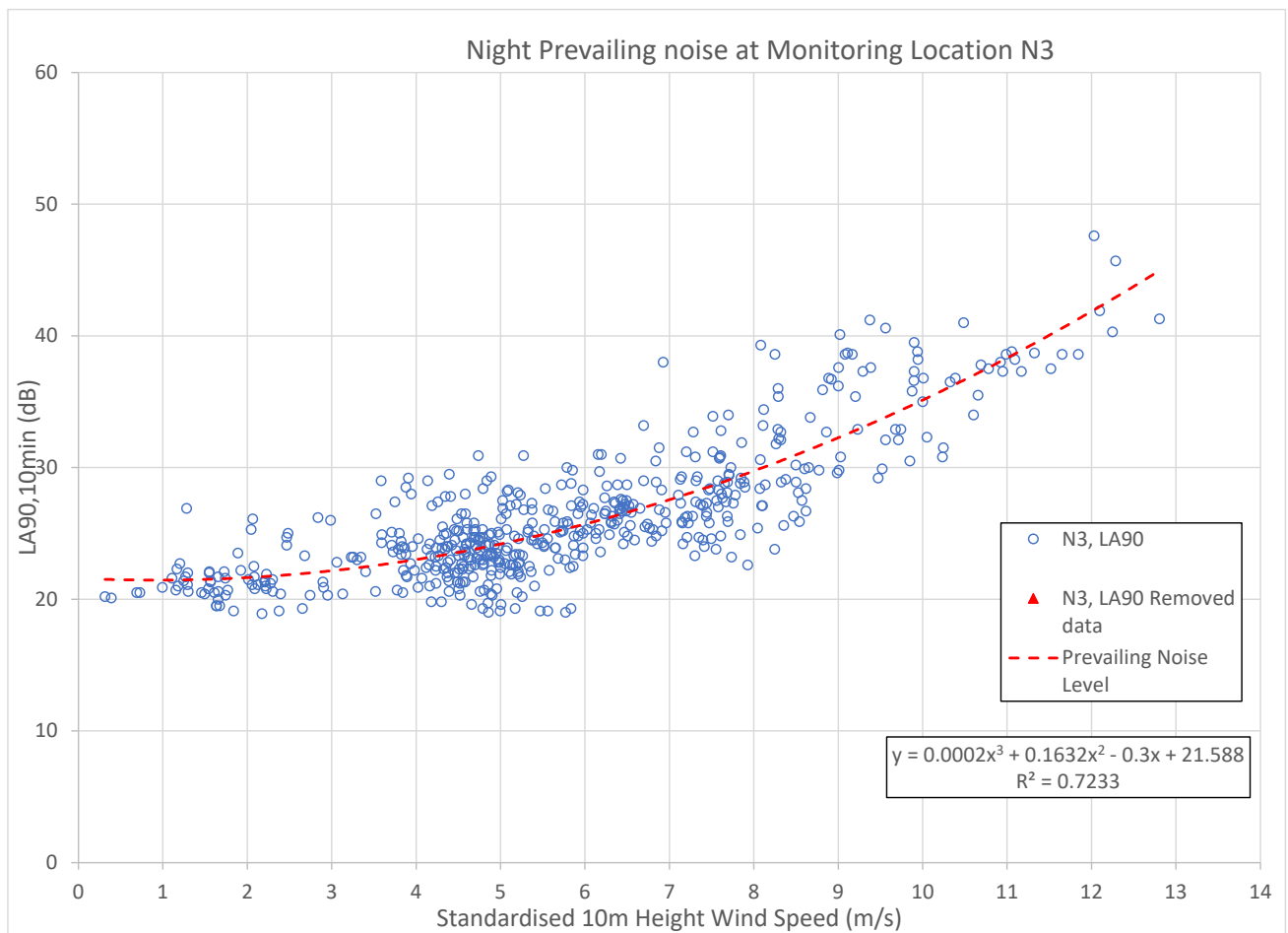


Figure A11.10: Prevailing Night-time Background (L_{A90}) Noise Levels at N4

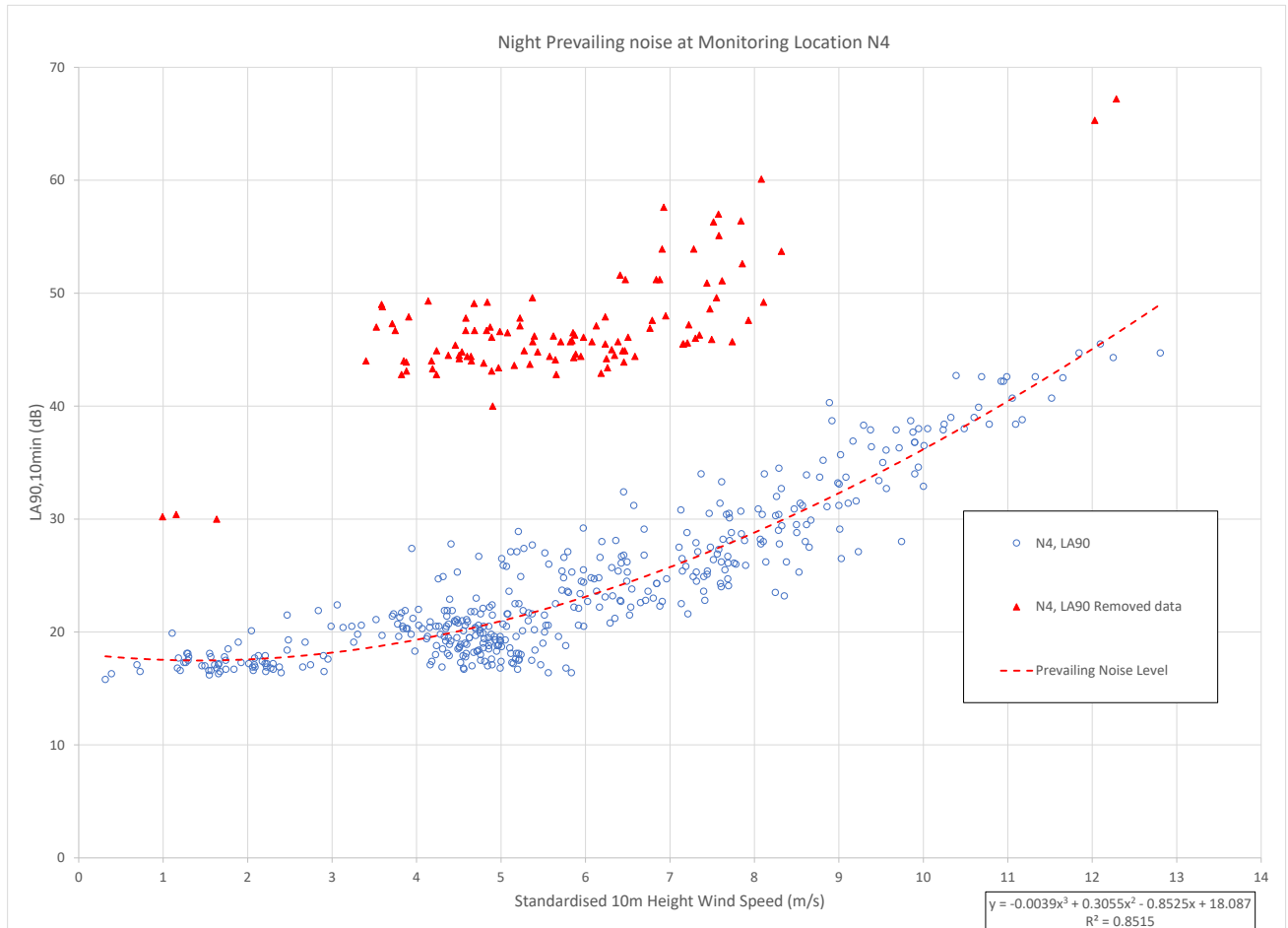


Figure A11.11: Prevailing Night-time Background (L_{A90}) Noise Levels at N5

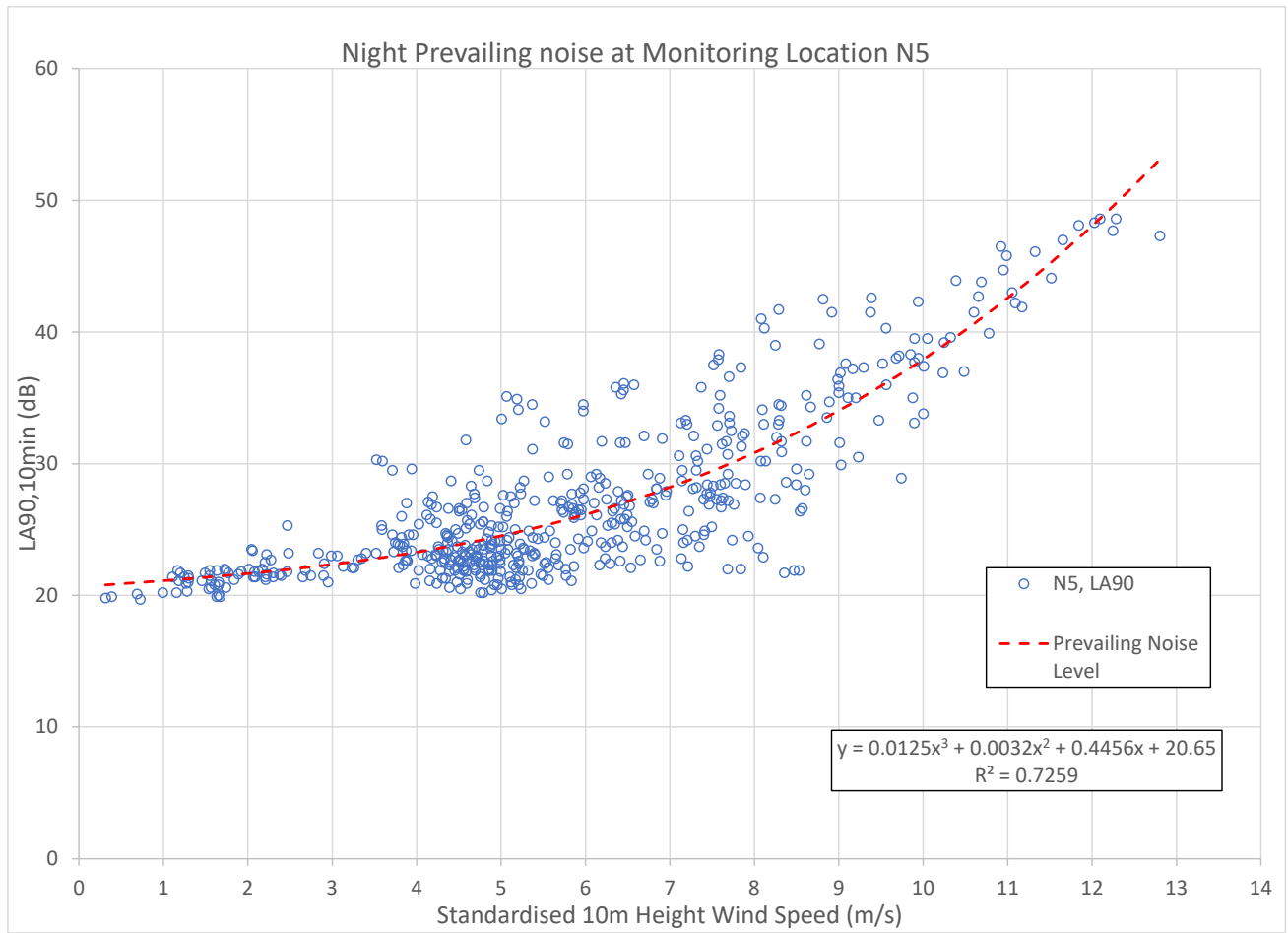


Figure A11.12: Prevailing Night-time Background (L_{A90}) Noise Levels at N6

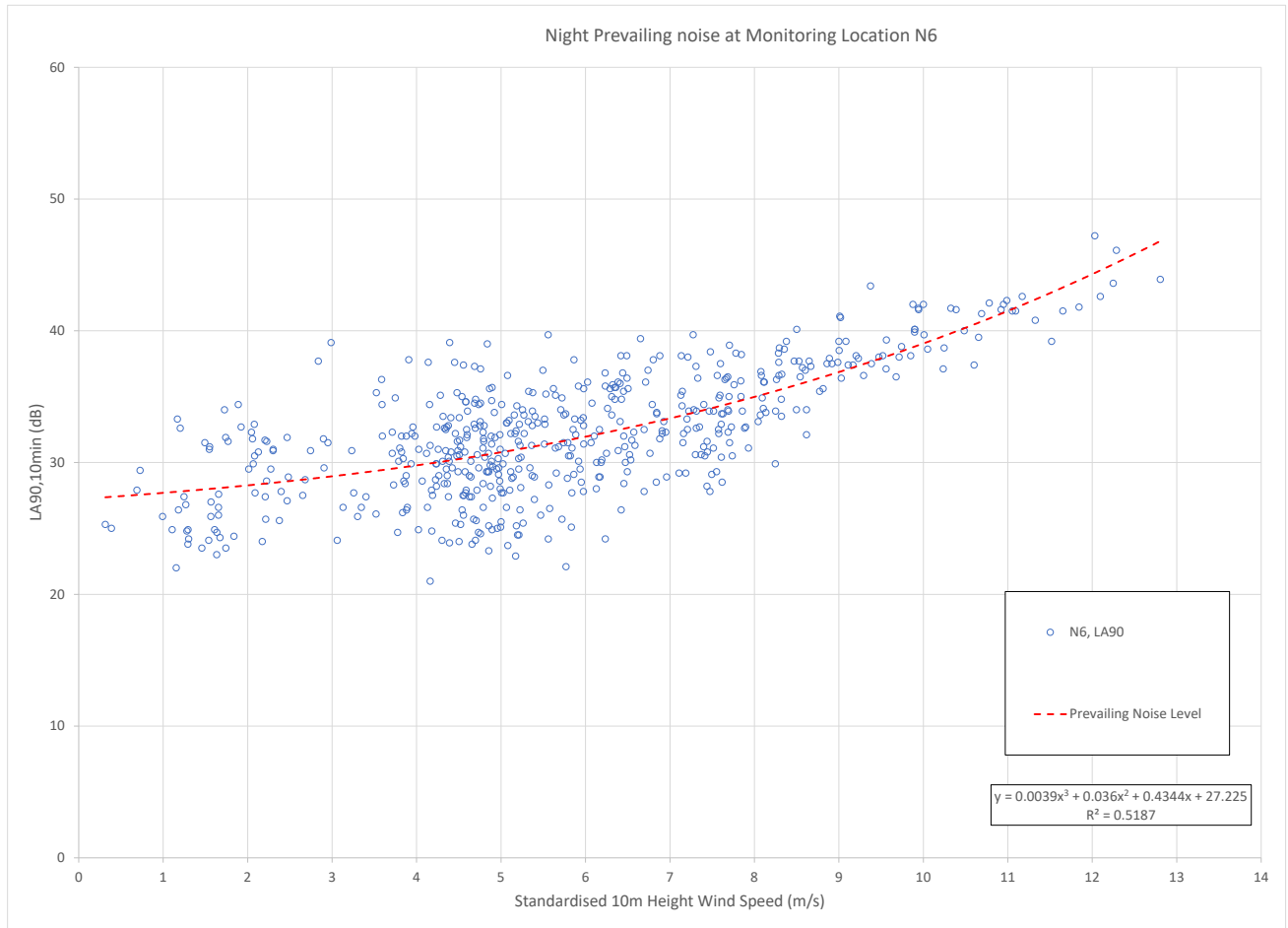


Table A11.1.6: Prevailing Background Noise – Daytime Periods

Loc Ation	Prevailing Background Noise $L_{A90,10min}$ (dB) at Standardised 10 m Height Wind Speed (m/s)													
	1	2	3	4	5	6	7	8	9	10	11	12	13	14
N1	30.6	31.1	31.7	32.5	33.6	34.8	36.3	38.0	40.0	42.3	44.8	47.7	50.8	54.3
N2	27.0	27.0	27.3	28.0	29.0	30.3	31.9	33.7	35.9	38.2	40.8	43.6	46.5	49.6
N3	26.2	27.0	27.7	28.5	29.3	30.3	31.5	33.0	34.8	37.0	39.7	42.9	46.6	51.1
N4	23.0	24.0	25.1	26.3	27.6	29.1	30.7	32.4	34.2	36.1	38.2	40.4	42.7	45.1
N5	25.6	26.7	27.7	28.6	29.5	30.6	31.8	33.4	35.5	38.0	41.3	45.2	50.0	55.7
N6	39.3	40.3	41.1	41.8	42.4	43.0	43.6	44.3	45.0	45.9	47.0	48.3	49.9	51.7
§ - noise level restricted to the highest derived point * - noise level restricted to lowest derived point Shaded areas indicate windspeeds which did not satisfy the criteria of at least 5 data points in any 1m/s wind speed bin.														

Table A11.1.7: Prevailing Background Noise – Nighttime Periods

Loc ation	Prevailing Background Noise $L_{A90,10min}$ (dB) at Standardised 10 m Height Wind Speed (m/s)											
	1	2	3	4	5	6	7	8	9	10	11	12
N1	21.8	21.9	22.6	23.9	25.8	28.0	30.6	33.5	36.7	39.9	43.2	46.5
N2	20.4	20.6	21.2	22.1	23.5	25.3	27.6	30.2	33.4	36.9	41.0	45.5
N3	21.5	21.6	22.2	23.0	24.2	25.7	27.6	29.7	32.3	35.1	38.3	41.8
N4	17.5	17.6	18.2	19.3	21.0	23.1	25.8	28.8	32.3	36.2	40.5	45.1
N5	21.1	21.7	22.4	23.3	24.5	26.1	28.2	30.8	34.0	37.9	42.6	48.1
N6	27.7	28.3	29.0	29.8	30.8	32.0	33.4	35.0	36.9	39.1	41.6	44.4
§ - noise level restricted to the highest derived point * - noise level restricted to lowest derived point												

Construction Noise Baseline Measurements

Based on noise monitoring conducted at the windfarm as detailed above, baseline noise measurements at the six locations described above have been summarised for the purpose of setting construction noise limits. Noise was averaged across the construction noise daytime period (0700-1900) and compared with the BS5228 ABC category, as discussed in Table 11.1 and Section of Chapter 11 Noise and Vibration. Periods with rain were removed and the data only includes information where windspeeds were less than or equal to 5m/s

Table A11.1.8: Background Noise Summary – Construction Noise – Daytime Periods

Location	LAeq, 10mins*	BS5228 Category
N1	43	A:65 dB
N2	40	A:65 dB
N3	41	A:65 dB
N4	46	A:65 dB
N5	40	A:65 dB
N6	49	A:65 dB
* Arithmetic average of measured noise between 18th November and 6th December Category A: threshold values to use when ambient noise levels (when rounded to the nearest 5dB) are less than these values.		

Baseline Noise Measurements for BS4142 Assessment

Baseline noise measurements at the six locations described above have been summarised for the location closest to the proposed substation for the purpose of defining background and ambient noise levels.

The daytime and nighttime background (and residual) noise measurements ($L_{AF90, 10min}$ and $L_{Aeq, 10min}$) have been rounded to the nearest dB, filtered to exclude data for windspeeds above 5 m/s and any data where a rainfall event occurred. Data was categorised into daytime (0700-2300) and nighttime (2300-0700) periods. A summary of the main statistical results are presented in Table A11.1.9. A histogram of the noise data was used to determine the L_{Aeq} and L_{A90} during the measurement periods (See graphs). The mode (the most frequently occurring data) has been used to represent the data for the daytime and night time periods, as summarised in the table below.

Table A11.1.9: Background Noise Summary Substation Noise Assessment

	Daytime		Night time	
Location	$L_{Aeq, 10mins}^*$	$L_{A90, 10mins}^*$	$L_{Aeq, 10mins}^*$	$L_{A90, 10mins}^*$
N1	41	36	30	23

Figure A11.13: Night time (L_{Aeq}) Noise Levels at N1

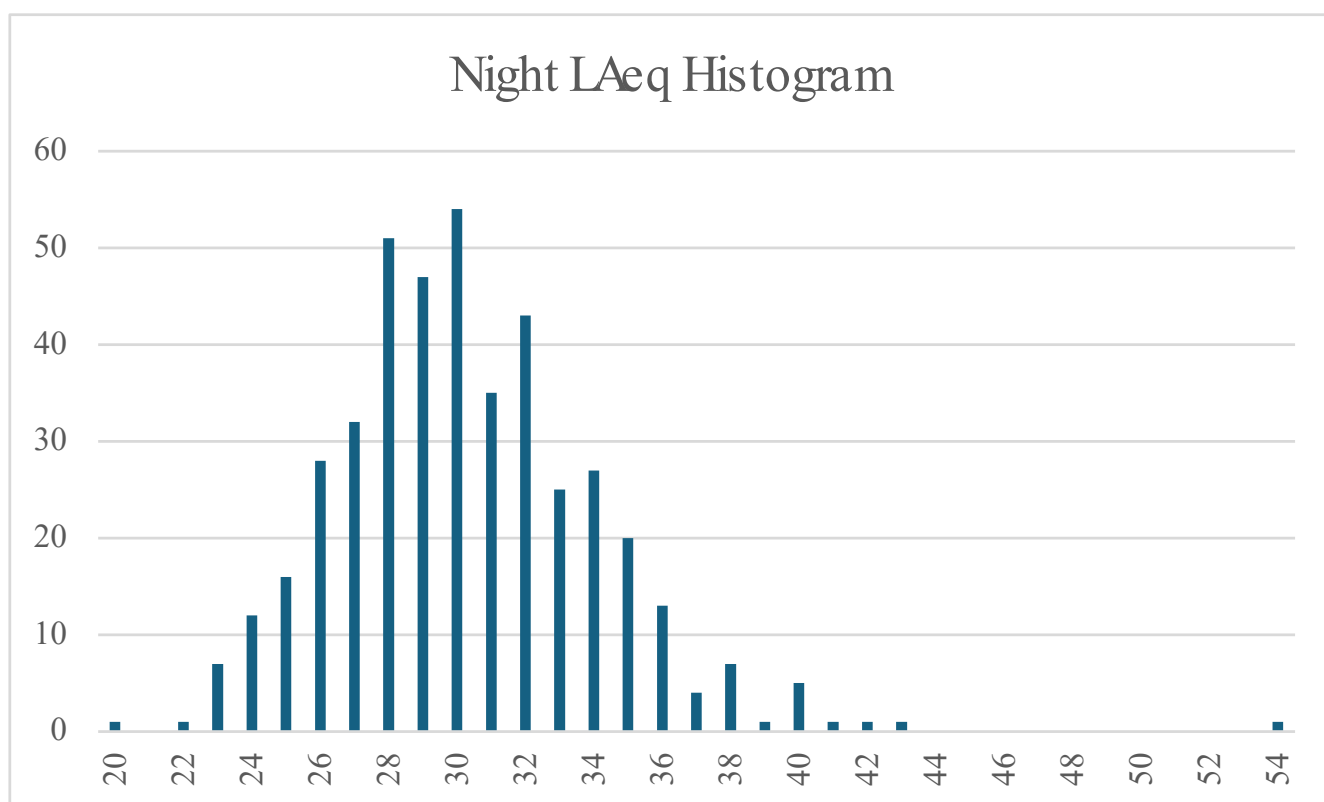


Figure A11.14: Night time background(L_{A90}) Noise Levels at N1

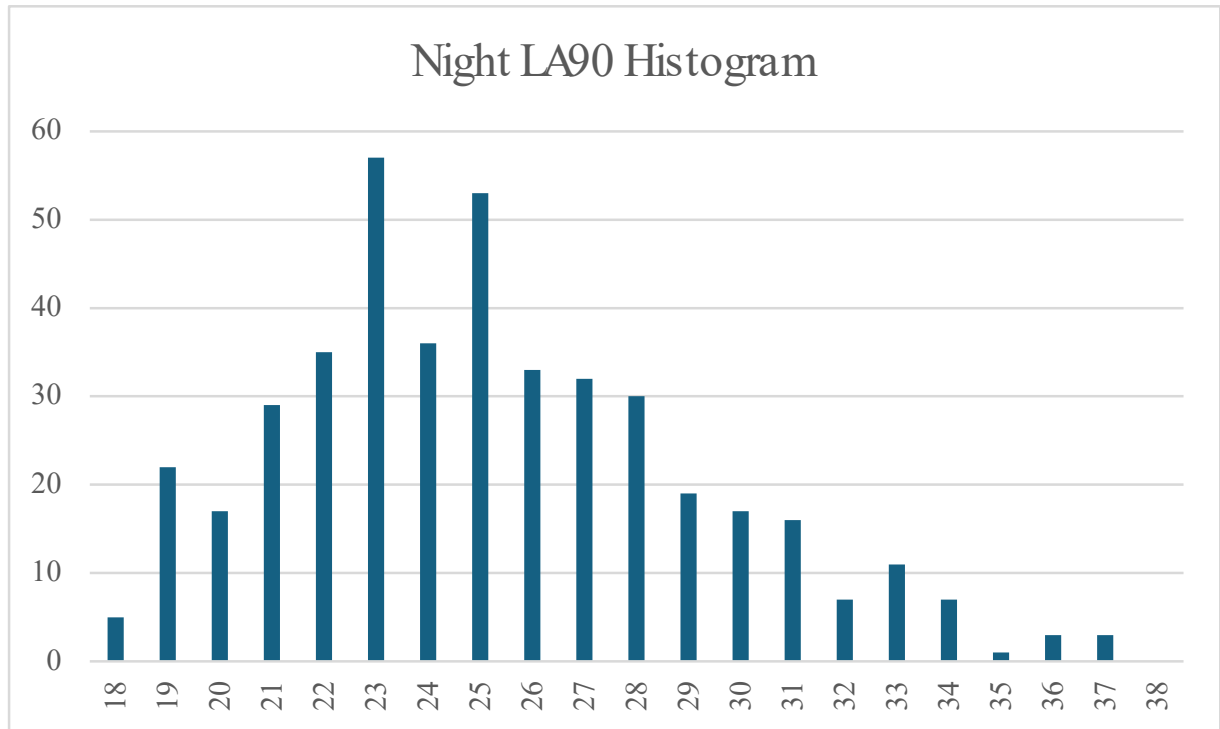


Figure A11.15: Day time (L_{Aeq}) Noise Levels at N1

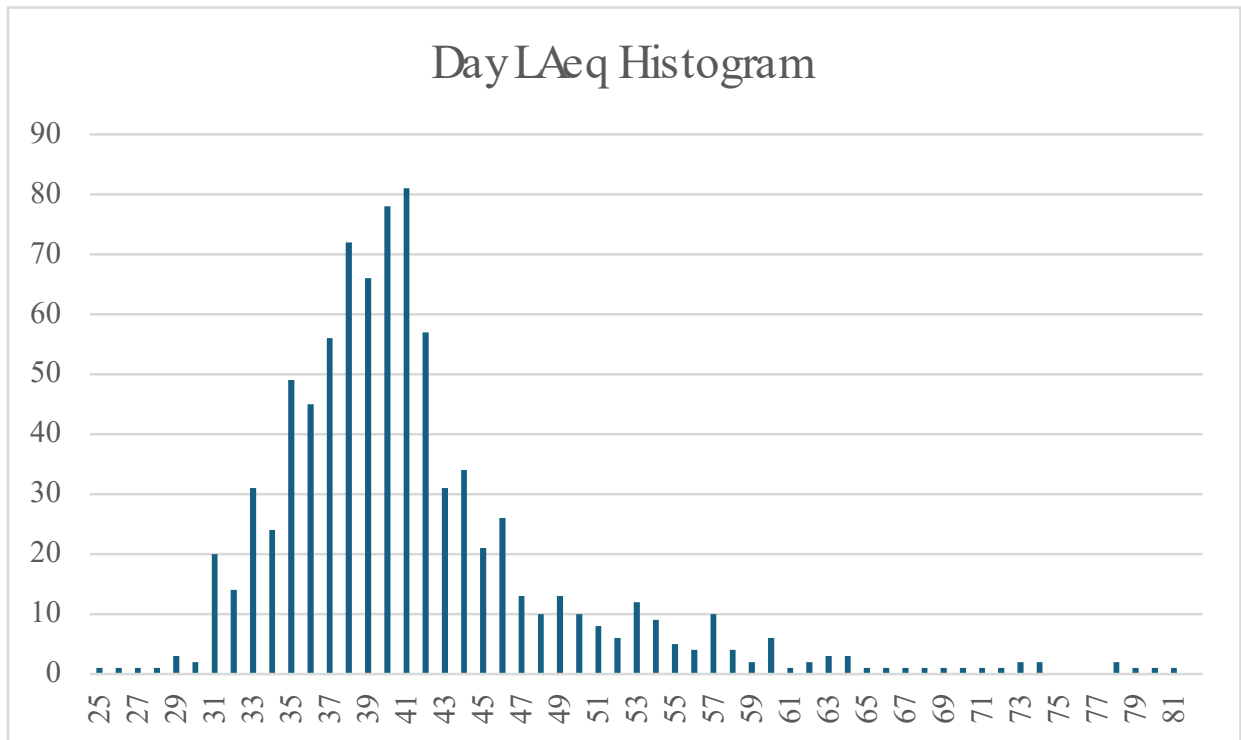
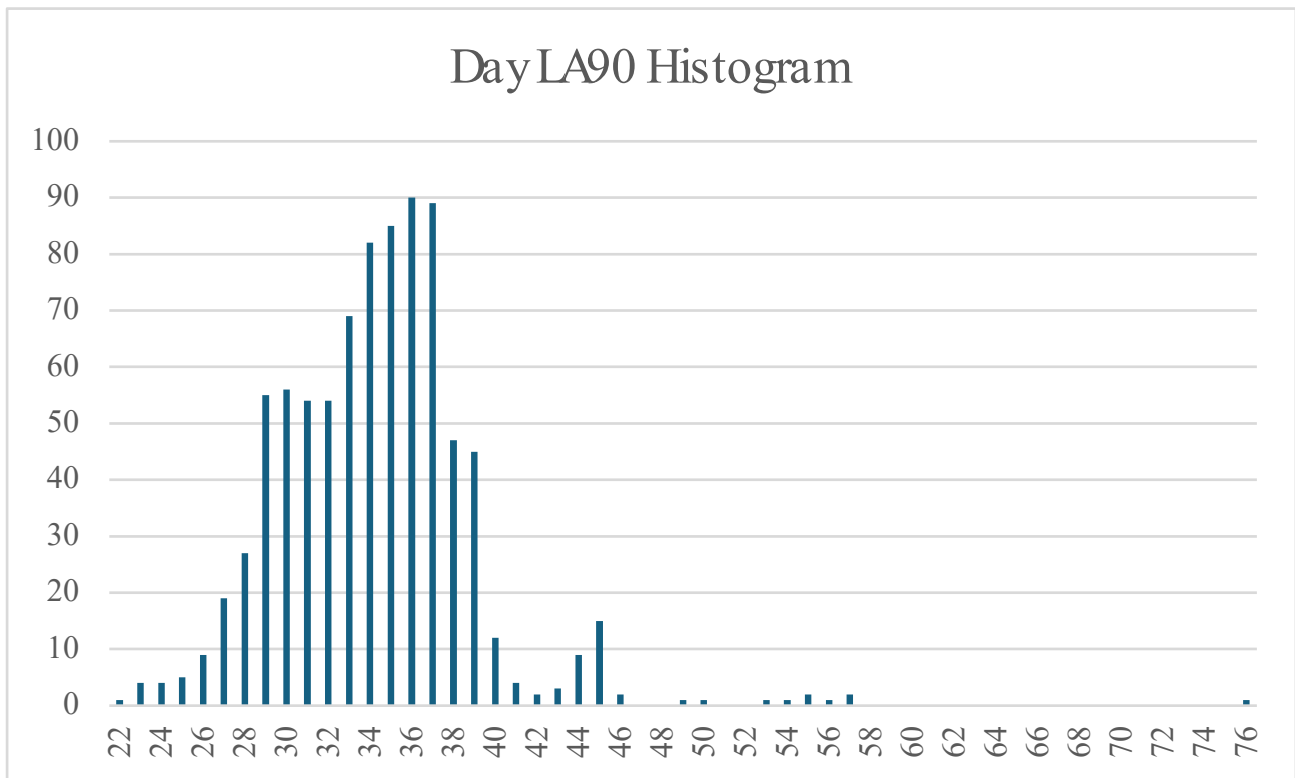


Figure A11.16: Day time background (L_{A90}) Noise Levels at N1



APPENDIX 11.2

EQUIPMENT CALIBRATION CERTIFICATES



NSAI

National Metrology Laboratory

Certificate of Calibration

Issued to Fehily Timoney & Company
J5 Plaza
North Business Park
North Road
Dublin 11

Attention of John Mahon

Certificate Number	180300
Item Calibrated	Svantek SVAN 977 Sound Level Meter with ACO 7052E Microphone
Serial Number	34876 (SLM) and 56429 (Microphone)
Client ID Number	#2
Order Number	6252
Date Received	24 Jan 2018
NML Procedure Number	AP-NM-09

Method The above sound level meter was allowed to stabilise for a suitable period in laboratory conditions. It was then calibrated by carrying out the verification tests detailed in IEC 61672-3 (2006), *Periodic tests, specification for the verification of sound level meters*. This standard specifies a procedure for the periodic verification of conformance of a sound level meter or integrating-averaging meter to IEC 61672-1 (2003).

Calibration Standards Norsonic 1504A Calibration System incorporating:
SR DS360 Signal Generator, No. 0735 [Cal Due Date: 21 Dec 2018]
Agilent 34401A Digital Multimeter, No. 0736 [Cal Due Date: 17 Nov 2018]
B&K 4134 Measuring Microphone, No. 0743 [Cal Due Date: 28 Apr 2019]
B&K 4228 Pistonphone, No. 0740 [Cal Due Date: 21 Mar 2019]
B&K 4226 Acoustical Calibrator, No. 0150 [Cal Due Date: 15 May 2018]

Calibrated by


David Fleming

Approved by


Paul Hetherington

Date of Calibration

31 Jan 2018

Date of Issue

31 Jan 2018



This certificate is consistent with Calibration and Measurement Capabilities (CMC's) that are included in Appendix C of the Mutual Recognition Arrangement (MRA) drawn up by the International Committee for Weights and Measures. Under the MRA, all participating institutes recognize the validity of each other's calibration certificates and measurement reports for quantities, ranges and measurement uncertainties specified in Appendix C (for details see www.bipm.org)



NSAI

National Metrology Laboratory

Certificate of Calibration

Issued to

Fehily Timoney & Company
J5 Plaza
North Park Business Park
North Road
Dublin 11

Certificate Number

242697

Item Calibrated

Svantek SVAN 977 Sound Level Meter with ACO 7052E Microphone

Serial Number

69552 (SLM) and 69543 (Microphone)

ID Number

None

Order Number

7629

Date Received

10 Jun 2024

NML Procedure Number

TFAP-NM-16

Method

The above sound level meter was allowed to stabilise for a suitable period in laboratory conditions. It was then calibrated by carrying out the verification tests detailed in IEC 61672-3 (2006), *Periodic tests, specification for the verification of sound level meters*. This standard specifies a procedure for the periodic verification of conformance of a sound level meter or integrating-averaging meter to IEC 61672-1 (2003).

Calibration Standards

Norsonic 1504A Calibration System incorporating:
SR DS360 Signal Generator, No. 0735 [Cal Due Date: 01 Sep 2024]
Agilent 34401A Digital Multimeter, No. 0736 [Cal Due Date: 01 Sep 2024]
B&K 4180 Measuring Microphone, No. 1069 [Cal Due Date: 15 Sep 2025]
B&K 4228 Pistonphone, No. 0741 [Cal Due Date: 14 Sep 2025]
B&K 4226 Acoustical Calibrator, No. 0150 [Cal Due Date: 04 Jan 2025]

Calibrated by

David Fleming

Approved by

Rory Hanrahan

Date of Calibration

03 Jul 2024

Date of Issue

03 Jul 2024



This certificate is consistent with Calibration and Measurement Capabilities (CMC's) that are included in Appendix C of the Mutual Recognition Arrangement (MRA) drawn up by the International Committee for Weights and Measures. Under the MRA, all participating institutes recognize the validity of each other's calibration certificates and measurement reports for quantities, ranges and measurement uncertainties specified in Appendix C (for details see www.bipm.org)



NSAI

National Metrology Laboratory

Certificate of Calibration

Issued to Fehily Timoney & Company
J5 Plaza
North Park Business Park
North Road
Dublin 11

Attention of John Mahon

Certificate Number	173660
Item Calibrated	Svantek SVAN 977 Sound Level Meter with ACO 7052E Microphone
Serial Number	34173 (SLM) and 54691 (Microphone)
Client ID Number	#3
Order Number	6308
Date Received	20 Oct 2017
NML Procedure Number	AP-NM-09

Method The above sound level meter was allowed to stabilise for a suitable period in laboratory conditions. It was then calibrated by carrying out the verification tests detailed in IEC 61672-3 (2006), *Periodic tests, specification for the verification of sound level meters*. This standard specifies a procedure for the periodic verification of conformance of a sound level meter or integrating-averaging meter to IEC 61672-1 (2003).

Calibration Standards Norsonic 1504A Calibration System incorporating:
SR DS360 Signal Generator, No. 0735 [Cal Due Date: 18 Nov 2017]
Agilent 34401A Digital Multimeter, No. 0736 [Cal Due Date: 07 Nov 2017]
B&K 4134 Measuring Microphone, No. 0742 [Cal Due Date: 18 Jan 2018]
B&K 4228 Pistonphone, No. 0741 [Cal Due Date: 08 Jan 2018]
B&K 4226 Acoustical Calibrator, No. 0150 [Cal Due Date: 15 May 2018]

Calibrated by


David Fleming

Approved by


Paul Hetherington

Date of Calibration

31 Oct 2017

Date of Issue

01 Nov 2017



This certificate is consistent with Calibration and Measurement Capabilities (CMC's) that are included in Appendix C of the Mutual Recognition Arrangement (MRA) drawn up by the International Committee for Weights and Measures. Under the MRA, all participating institutes recognize the validity of each other's calibration certificates and measurement reports for quantities, ranges and measurement uncertainties specified in Appendix C (for details see www.bipm.org)

ENVIRONMENTAL CONDITIONS

Temperature	Relative humidity	Ambient pressure
29 °C	37%	1005 hPa

TEST EQUIPMENT

Item	Manufacturer	Model	Serial no.	Description
1.	SVANTEK	SVAN 401	127	Signal generator
2.	SVANTEK	SVAN 912A	9537	Sound & Vibration Analyser
3.	KEITHLEY	2000	0910165	Digital multimeter
4.	SVANTEK	SV33	48878	Acoustic calibrator
5.	SVANTEK	ST02	-	Microphone equivalent electrical impedance (18pF)
6.	DYTRAN	3333A	1376	Reference accelerometer

CONFORMITY & TEST DECLARATION

1. Herewith Svantek company declares that this instrument has been calibrated and tested in compliance with the internal ISO9001 procedures and meets all specification given in the Manual(s) or respectively surpass them.
2. The acoustic calibration was performed using the Sound Calibrator and is traceable to the GUM (Central Office of Measures) reference standard - sound level calibrator type 4231 No 2292773.
3. The vibrational calibration was performed using the Back-to-Back Comparison method and is traceable to the GUM (Central Office of Measures) reference standard - accelerometer type 8305 No 1435233.
4. The information appearing on this sheet has been compiled specifically for this instrument. This form is produced with advanced equipment & procedures which permit comprehensive quality assurance verification of all data supplied herein.
5. This calibration sheet shall not be reproduced except in full, without written permission of the SVANTEK Ltd.

Calibration specialist: Krzysztof Kubel



Test date: 2018-06-01



ISO9001 certified

FACTORY CALIBRATION DATA OF THE SVAN 977A No. 69557

with preamplifier SVANTEK type SV12L No. 72140 and microphone ACO PACIFIC type 7052E No. 69617

SOUND LEVEL METER

1. CALIBRATION (electrical)

LEVEL METER function; Characteristic: A; $f_{\text{ref}}=1$ kHz; Input signal = 110.9 dB;

Range	Low (120dB)	High (137dB)
Indication [dB]	114.0	114.0
Error [dB]	0.0	0.0

2. CALIBRATION* (acoustical)

LEVEL METER function; Range: High; Reference frequency: 1000 Hz; Sound Pressure Level: 113.99 dB.

Characteristic	Correct value [dB]	Indication [dB]	Error [dB]
Z	113.99	113.97	-0.02
A	113.99	113.97	-0.02
C	113.99	113.97	-0.02

Calibration measured with the microphone ACO PACIFIC type 7052E No. 69617. Calibration factor: 0.02 dB.

3. LINEARITY TEST* (electrical)

LEVEL METER function; Range: Low; Characteristic: A; $f_{\text{ref}}=31.5$ Hz

Nominal result LEQ [dB]	24.0	25.0	26.0	28.0	30.0	40.0	60.0	80.0
Error [dB]	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0

LEVEL METER function; Range: Low; Characteristic: A; $f_{\text{ref}}=1000$ Hz

Nominal result LEQ [dB]	24.0	25.0	26.0	28.0	30.0	40.0	60.0	80.0	100.0	120.0
Error [dB]	0.1	0.0	0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0

LEVEL METER function; Range: Low; Characteristic: A; $f_{\text{ref}}=8000$ Hz

Nominal result LEQ [dB]	24.0	25.0	26.0	28.0	30.0	40.0	60.0	80.0	100.0	119.0
Error [dB]	0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0

LEVEL METER function; Range: High; Characteristic: A; $f_{\text{ref}}=31.5$ Hz

Nominal result LEQ [dB]	35.0	36.0	37.0	38.0	40.0	60.0	80.0	97.0
Error [dB]	0.1	0.1	0.1	0.0	0.0	-0.0	-0.0	0.0

LEVEL METER function; Range: High; Characteristic: A; $f_{\text{ref}}=1000$ Hz

Nominal result LEQ [dB]	35.0	36.0	37.0	38.0	40.0	60.0	80.0	100.0	120.0	137.0
Error [dB]	0.1	0.1	0.0	0.0	0.0	-0.0	-0.0	0.0	-0.0	-0.0

LEVEL METER function; Range: High; Characteristic: A; $f_{\text{ref}}=8000$ Hz

Nominal result LEQ [dB]	35.0	36.0	37.0	38.0	40.0	60.0	80.0	100.0	120.0	136.0
Error [dB]	0.0	0.0	0.0	-0.0	0.0	-0.0	-0.0	-0.0	-0.0	0.0

4. TONE BURST RESPONSE*

LEVEL METER function; Characteristic: A; $f_{\text{ref}}=4000$ Hz; Burst duration: 2 s

Range: Low; Steady level nominal result = 117dB

Result	Detector	Duration [ms]	1000	500	200	100	50	20	10	5	2	1	0.5	0.25
MAX	Fast	Indication [dB]	117.0	116.9	116.0	114.4	112.2	109.7	105.8	102.9	99.9	95.9	92.9	89.9
		Error [dB]	0.0	0.0	0.0	0.0	-0.0	-0.0	-0.1	0.0	-0.0	-0.1	-0.1	-0.1
	Slow	Indication [dB]	115.0	112.9	109.6	106.8	103.9	100.0	97.0	94.0	90.0	-	-	-
		Error [dB]	0.0	0.1	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-	-	-
SEL	-	Indication [dB]	117.0	114.0	110.0	107.0	104.0	100.0	97.0	94.0	90.0	86.9	83.9	80.9
		Error [dB]	0.0	-0.0	-0.0	0.0	-0.0	-0.0	0.0	-0.0	-0.0	-0.0	-0.1	-0.1

Issued to:

Fehily Timoney
J5 Plaza
North Park Business Park
North Road
Dublin 11

Calibration Reference

SLM200094

Test Date: 03/06/2020

Procedure: TP-SLM-1

Equipment

Item Calibrated:	Sound Level Meter	Model	977
Make:	Svantek	Serial Number:	69558

Calibration Procedure

The sound level meter was allowed to stabilize for a suitable period, as described in the manufacturer's instruction manual, in laboratory conditions. The sound level meter was calibrated by carrying out the verification tests detailed in IEC 61672-3 (2006), Periodic tests, specification of sound level meters. Tolerances for verification procedures are specified in IEC 61672-1 (2003).

Calibration Standards

Description	Serial Number
National Instruments PXI-4461	19C91D2
Stanford Research DS360	123803

The standards used in this calibration are traceable to NIST and/or other National Measurement Institutes (NMI's) that are signatories of the International Committee of Weights and Measures (CIPM) mutual recognition agreement (MRA).

Signed on behalf of Sonitus Systems:



Equipment Description

Model: Svantek **Serial Number:** 69558
Model: 977 **Microphone Model:** ACO 7052E

Ambient Conditions

Measurement conditions were within the tolerances defined in IEC 61672-1 and IEC 60942.

Barometric Pressure: 1030 hPa
Temperature: 23.4 °C
Relative Humidity: 39 %

Results Summary

IEC 61672 Test #	Test Description	Result
10	Self-generated noise	-
11	Frequency weighting (acoustical)	PASS
12	Frequency weighting (electrical)	PASS
13	Frequency and time weighting (1kHz)	PASS
14	Level linearity on reference level range	PASS
15	Level linearity with level range control	-
16	Toneburst response	PASS
17	Peak C sound level	PASS
18	Overload indication	PASS

As public evidence was available, from a testing organization responsible for approving the results of pattern evaluation tests, to demonstrate that the model of sound level meter fully conformed to the requirements for pattern evaluation described in IEC 61672:2003, the sound level meter tested is considered to conform to all the Class 1 requirements of IEC 61672:2003.

The manufacturer's guidelines concerning appropriate set up for measurement under various conditions should be observed during usage.

Prior to carrying out the verification tests the sound level meter was adjusted to read correctly using the acoustic calibrator held by the testing lab (Cirrus CR511ES, Serial number: 60871). The calibration procedure is described in the manufacturer's instruction manual.

Self-generated noise - IEC 61672-3 Test #10

SLM Measuring Mode: Leq

SLM Configuration	Freq. Weighting Network	SLM Reading
Microphone Installed	A	18.8
Microphone replaced by electrical input device fitted with short circuit	A	10.6
	C	10.6
	Z	10.6

Acoustical signal test of a frequency weighting - IEC 61672-3 Test #11

Range: reference level range

Frequency Weighting: C

Time Weighting: Slow

Input	Freq	Expected Level	Deviation	Tol +/-
94 dB	1000 Hz	94.0	0.0	1.0
	125 Hz	93.7	0.2	1.0
	4000 Hz	92.3	0.5	1.0

The frequency response was tested using an electrostatic actuator. Appropriate correction factors were applied where available from the manufacturer's instruction manual.

Electrical tests of frequency weighting - IEC 61672-3 Test #12

Range: reference level range

A-weighting

Freq	Expected Level	SLM Reading	Deviation	Tol +	Tol -
63	95.0	95.0	0.0	1.5	-1.5
125	95.0	94.9	-0.1	1.5	-1.5
250	95.0	94.9	-0.1	1.4	-1.4
500	95.0	95.0	0.0	1.4	-1.4
1000	95.0	95.0	0.0	1.1	-1.1
2000	95.0	95.0	0.0	1.6	-1.6
4000	95.0	95.1	0.1	1.6	-1.6
8000	95.0	95.1	0.1	2.1	-3.1
16000	95.0	94.7	-0.3	3.5	-17.0

C-weighting

Freq	Expected Level	SLM Reading	Deviation	Tol +	Tol -
63	95.0	95.0	0.0	1.5	-1.5
125	95.0	95.4	0.4	1.5	-1.5
250	95.0	95.0	0.0	1.4	-1.4
500	95.0	95.0	0.0	1.4	-1.4
1000	95.0	95.0	0.0	1.1	-1.1
2000	95.0	95.1	0.1	1.6	-1.6
4000	95.0	95.1	0.1	1.6	-1.6
8000	95.0	95.1	0.1	2.1	-3.1
16000	95.0	94.7	-0.3	3.5	-17.0

Linear

Freq	Expected Level	SLM Reading	Deviation	Tol +	Tol -
63	95.0	95.0	0.0	1.5	-1.5
125	95.0	95.0	0.0	1.5	-1.5
250	95.0	95.0	0.0	1.4	-1.4
500	95.0	95.0	0.0	1.4	-1.4
1000	95.0	95.0	0.0	1.1	-1.1
2000	95.0	95.0	0.0	1.6	-1.6
4000	95.0	95.0	0.0	1.6	-1.6
8000	95.0	95.0	0.0	2.1	-3.1
16000	95.0	95.0	0.0	3.5	-17.0

Frequency and Time Weightings at 1 kHz IEC 61672-3 Test #13

Range: reference level range

Time Weighting	Freq. Weighting	Expected Level	Deviation	Tol +/-
Fast	A	94.0	ref	
	C	94.0	0.0	0.2
Slow	A	94.0	0.0	0.2
LEQ	A	94.0	0.0	0.2

Linearity level on reference range - IEC 61672-3 Test #14

Input frequency: 8 kHz

SLM Measuring Mode: SPL

Range	Expected Level	SLM Reading	Deviation	Tol +/-
123 dB	94.0	94.0	0.0	1.1
	99.0	99.0	0.0	1.1
	104.0	104.0	0.0	1.1
	109.0	109.0	0.0	1.1
	114.0	114.0	0.0	1.1
	119.0	119.0	0.0	1.1
	124.0	124.0	0.0	1.1
	129.0	129.0	0.0	1.1
	134.0	134.0	0.0	1.1
	135.0	135.0	0.0	1.1
	136.0	136.0	0.0	1.1
	137.0	137.0	0.0	1.1
	89.0	89.0	0.0	1.1
	84.0	84.0	0.0	1.1
	79.0	79.0	0.0	1.1
	74.0	74.0	0.0	1.1
	69.0	69.0	0.0	1.1
	64.0	64.0	0.0	1.1
	59.0	59.0	0.0	1.1
	54.0	54.0	0.0	1.1
	49.0	49.1	0.1	1.1
	44.0	44.1	0.1	1.1
	39.0	39.1	0.1	1.1
	38.0	38.1	0.1	1.1
	37.0	37.2	0.2	1.1
	36.0	36.2	0.2	1.1
	35.0	35.3	0.3	1.1

Toneburst response - IEC 61672-3 Test #16

Range: reference level range

Burst Type	Response	Expected Level	SLM Reading	Deviation	Tol +	Tol -
0.25 ms	LAF _{MAX}	111.0	110.8	-0.2	0.8	-0.8
2.0 ms	LAF _{MAX}	120.0	119.9	-0.1	1.3	-1.3
200 ms	LAF _{MAX}	137.0	137.0	0.0	1.3	-3.3
2.0 ms	LAS _{MAX}	111.0	111.3	0.3	0.8	-0.8
200 ms	LAS _{MAX}	130.6	130.6	0.0	1.3	-3.3

Peak C sound level - IEC 61672-3 Test #17

Range: reference level range

Pulse Type	Freq	Expected Level	SLM Reading	Deviation	Tol +/-
1 cycle	8 kHz	135.4	135.3	-0.1	2.4
Pos ½ cycle	500 Hz	137.4	137.4	0	1.4
Neg ½ cycle	500 Hz	137.4	137.4	0	1.4

Overload indication IEC 61672-3 Test #18

Test Description	Overload at	Meas. Diff. (Pos – Neg)	Tol +/-
Pos. ½ cycle at 4 kHz	142.5		
Neg. ½ cycle at 4 kHz	142.5		
Level difference		0.0	1.8

Calibration Notes

1. The manufacturer's instruction manual was accessed through the manufacturer's website.
2. The sound level meter was powered by a regulated 9V power supply provided by the testing laboratory.

ENVIRONMENTAL CONDITIONS

Temperature	Relative humidity	Ambient pressure
29 °C	37%	1005 hPa

TEST EQUIPMENT

Item	Manufacturer	Model	Serial no.	Description
1.	SVANTEK	SVAN 401	127	Signal generator
2.	SVANTEK	SVAN 912A	9537	Sound & Vibration Analyser
3.	KEITHLEY	2000	0910165	Digital multimeter
4.	SVANTEK	SV33	48876	Acoustic calibrator
5.	SVANTEK	ST02	-	Microphone equivalent electrical impedance (18pF)
6.	DYTRAN	3333A	1376	Reference accelerometer

CONFORMITY & TEST DECLARATION

1. Herewith SvanteK company declares that this instrument has been calibrated and tested in compliance with the internal ISO9001 procedures and meets all specification given in the Manual(s) or respectively surpass them.
2. The acoustic calibration was performed using the Sound Calibrator and is traceable to the GUM (Central Office of Measures) reference standard - sound level calibrator type 4231 No 2292773.
3. The vibrational calibration was performed using the Back-to-Back Comparison method and is traceable to the GUM (Central Office of Measures) reference standard - accelerometer type 8305 No 1435233.
4. The information appearing on this sheet has been compiled specifically for this instrument. This form is produced with advanced equipment & procedures which permit comprehensive quality assurance verification of all data supplied herein.
5. This calibration sheet shall not be reproduced except in full, without written permission of the SVANTEK Ltd.

Calibration specialist: Krzysztof Kubeł

Test date: 2018-06-01



ISO9001 certified

FACTORY CALIBRATION DATA OF THE SVAN 977A No. 69556

with preamplifier SVANTEK type SV12L No. 72145 and microphone ACO PACIFIC type 7052E No. 69608

SOUND LEVEL METER

1. CALIBRATION (electrical)

LEVEL METER function; Characteristic: A; $f_{ref}=1$ kHz; Input signal ≈ 110.9 dB;

Range	Low (120dB)	High (137dB)
Indication [dB]	114.0	114.0
Error [dB]	0.0	0.0

2. CALIBRATION* (acoustical)

LEVEL METER function; Range: High; Reference frequency: 1000 Hz; Sound Pressure Level: : 113.99 dB.

Characteristic	Correct value [dB]	Indication [dB]	Error [dB]
Z	113.99	114.02	0.03
A	113.99	114.02	0.03
C	113.99	114.02	0.03

Calibration measured with the microphone ACO PACIFIC type 7052E No. 69608. Calibration factor: 0.63 dB.

3. LINEARITY TEST* (electrical)

LEVEL METER function; Range: Low; Characteristic: A; $f_{ref}=31.5$ Hz

Nominal result LEQ [dB]	24.0	25.0	26.0	28.0	30.0	40.0	60.0	80.0
Error [dB]	0.1	0.1	0.1	0.0	0.0	0.0	0.0	0.0

LEVEL METER function; Range: Low; Characteristic: A; $f_{ref}=1000$ Hz

Nominal result LEQ [dB]	24.0	25.0	26.0	28.0	30.0	40.0	60.0	80.0	100.0	120.0
Error [dB]	0.1	0.1	0.0	0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0

LEVEL METER function; Range: Low; Characteristic: A; $f_{ref}=8000$ Hz

Nominal result LEQ [dB]	24.0	25.0	26.0	28.0	30.0	40.0	60.0	80.0	100.0	119.0
Error [dB]	0.1	0.0	0.0	-0.0	-0.0	-0.0	-0.0	-0.0	0.0	-0.0

LEVEL METER function; Range: High; Characteristic: A; $f_{ref}=31.5$ Hz

Nominal result LEQ [dB]	35.0	36.0	37.0	38.0	40.0	60.0	80.0	97.0
Error [dB]	0.1	0.1	0.0	0.0	0.0	-0.0	-0.0	0.0

LEVEL METER function; Range: High; Characteristic: A; $f_{ref}=1000$ Hz

Nominal result LEQ [dB]	35.0	36.0	37.0	38.0	40.0	60.0	80.0	100.0	120.0	137.0
Error [dB]	0.1	0.1	0.0	0.0	0.0	-0.0	-0.0	-0.0	-0.0	0.0

LEVEL METER function; Range: High; Characteristic: A; $f_{ref}=8000$ Hz

Nominal result LEQ [dB]	35.0	36.0	37.0	38.0	40.0	60.0	80.0	100.0	120.0	136.0
Error [dB]	0.1	0.1	0.0	0.1	0.0	-0.0	-0.0	0.0	-0.0	0.0

4. TONE BURST RESPONSE*

LEVEL METER function; Characteristic: A; $f_{ref}=4000$ Hz; Burst duration: 2 s

Range: Low; Steady level nominal result = 117dB

Result	Detector	Duration [ms]	1000	500	200	100	50	20	10	5	2	1	0.5	0.25
MAX	Fast	Indication [dB]	117.0	116.9	116.0	114.4	113.3	108.7	105.8	102.9	99.0	96.0	92.9	89.9
		Error [dB]	0.0	0.0	0.0	-0.0	-0.0	-0.0	-0.1	0.0	-0.0	-0.1	-0.1	-0.1
	Slow	Indication [dB]	115.0	113.0	109.6	106.8	103.9	100.0	97.0	94.0	90.0	-	-	-
		Error [dB]	0.0	0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-	-	-
SEL	-	Indication [dB]	117.0	114.0	110.0	107.0	104.0	100.0	97.0	94.0	90.0	87.0	83.9	80.9
		Error [dB]	0.0	-0.0	-0.0	0.0	-0.0	0.0	-0.0	-0.0	-0.0	-0.1	-0.1	-0.1



NSAI

National Metrology Laboratory

Certificate of Calibration

Issued to Fehily Timoney & Company
J5 Plaza
North Park Business Park
North Road
Dublin 11

Attention of Maureen Marsden

Certificate Number	213366
Item Calibrated	Bruel & Kjaer Type 4231 Sound Level Calibrator
Serial Number	2169963
ID Number	FTC 02
Order Number	6925
Date Received	20 Aug 2021
NML Procedure Number	AP-NM-13

Method The above calibrator was allowed to stabilize for a suitable period in laboratory conditions. It was then calibrated by measuring the sound pressure level generated in its measuring cavity (half-inch configuration). The calibrator's operating frequency was also measured.

Calibration Standards Norsonic 1504A Calibration System incorporating:
Agilent 34401A Multimeter, No. 0736 [Cal due: 10 Jun 2022]
B & K 4134 Measuring Microphone, No. 0744 [Cal due: 31 Jan 2022]
B & K 4228 Pistonphone, No. 0740 [Cal due: 31 Jan 2022]

Calibrated by


David Fleming

Approved by


Paul Hetherington

Date of Calibration

06 Sep 2021

Date of Issue

07 Sep 2021



This certificate is consistent with Calibration and Measurement Capabilities (CMC's) that are included in Appendix C of the Mutual Recognition Arrangement (MRA) drawn up by the International Committee for Weights and Measures. Under the MRA, all participating Institutes recognize the validity of each other's calibration certificates and measurement reports for quantities, ranges and measurement uncertainties specified in Appendix C (for details see www.bipm.org)

APPENDIX 11.3

NOISE SENSITIVE LOCATION DETAILS

Table A11.3.1: Noise Sensitive Location Details within Study Area

Receptor ID	Description	ITM X	ITM Y
R1	Residential	620634	650791
R3	Residential	620541	650920
R14	Residential and Commercial	619829	651799
R49	Residential	619822	651659
R50	Residential	620256	652366
R61	Residential	619852	651637
R67	Residential	620435	652422
R68	Residential	620462	652443
R69	Residential	620450	652432
R97	Residential and Commercial	621205	650052
R101	Residential and Commercial	622082	650357
R112	Residential and Commercial	620850	650388
R117	Residential	621773	650096
R119	Residential	621034	650260
R122	Residential	624172	653971
R134	Residential and Commercial	623793	653919
R140_A	Residential	626368	655096
R141_A	Residential	626416	655450
R147_A	Residential	621228	657449
R154	Residential	622227	652596
R155	Residential	622201	652613
R156	Residential	621765	652780
R157	Residential	621734	652572
R158	Residential	621213	653095
R166	Residential	625147	655739
R167	Residential	625113	655658
R168	Residential and Commercial	624964	655869
R175	Residential	622270	652590
R189	Residential	622263	652635
R193	Residential	625693	657038
R199	Residential and Commercial	625014	655950
R200	Residential	625024	655978
R201	Residential	624998	655966
R238	Residential	624692	654680
R239	Residential	624297	654700
R248	Residential and Commercial	624922	655666
R284	Residential	626064	657651
R303	Residential and Commercial	623921	658709
R333	Residential	622397	652523
R334	Residential	622385	652597

Receptor ID	Description	ITM X	ITM Y
Locations Near Gaignaman WF			
R335	Residential	627216	654095
R336	Residential and Commercial	627142	654063
R337	Residential	627202	654106
R338	Residential	626917	653971
R339	Residential	627651	652931
R340	Residential	626850	653996
R341	Residential	626790	653941

APPENDIX 11.4

WIND TURBINE SOUND POWER LEVEL DATA

Table A11.4.1: Wind Turbine (Vestas 162) - Sound Power Data (10 Hz to 10 kHz) Corresponding to Wind Speeds Standardised to 10m from 119m Hub Height

Standardised 10 m Height Wind Speed (m/s)	Octave Band Centre Frequency [Hz]							
	63	125	250	500	1000	2000	4000	8000
2	87.3	90.4	88.8	87.6	87.6	85.6	78.9	67.8
3	87.8	90.8	88.6	86.5	87.3	85.9	78.1	65.3
4	89.2	92.0	89.9	88.0	90.1	88.7	81.2	66.9
5	90.3	93.9	93.1	92.4	94.9	93.2	86.4	73.2
6	91.9	95.9	96.6	96.4	99.1	97.5	90.1	74.6
7	90.4	97.4	98.8	98.6	99.6	99.4	94.8	83.4

Table A11.4.2: Wind Turbine (Vestas 162) – Overall Sound Power Data Corresponding to Wind Speeds Standardised to 10m from 119m Hub Height

Standardised 10 m Height Wind Speed (m/s)	Octave Band Centre Frequency [Hz]					
		3	4	5	6	7
V162	96.0	96.0	97.7	101.1	104.6	106.3

Table A11.4.3: Adjacent Windfarm coordinates for cumulative assessment

Windfarm	ITM X	ITM Y	Hub Height (m)
Lisheen WF	619471	667291	95
Lisheen WF	619126	667576	95
Lisheen WF	619546	667787	95
Lisheen WF	620895	668358	95
Lisheen WF	621122	668637	95
Lisheen WF	620899	668895	95
Lisheen WF	622145	665991	95
Lisheen WF	621830	666362	95
Lisheen WF	622031	666721	95
Lisheen WF	621715	666786	95
Lisheen WF	619992	666816	95
Lisheen WF	621156	666947	95
Lisheen WF	621478	667026	95
Lisheen WF	620260	667089	95
Lisheen WF	620885	667285	95
Lisheen WF	620304	667451	95
Lisheen WF	621144	667917	95
Lisheen WF	621228	668252	95
Lisheen WF	619982	667873	95
Lisheen WF	619895	667422	95

Windfarm	ITM X	ITM Y	Hub Height (m)
Lisheen WF	622015	664543	95
Lisheen WF	622658	664689	95
Lisheen WF	622417	664306	95
Lisheen WF	623077	664512	95
Lisheen WF	622833	664119	95
Lisheen WF	622649	663719	95
Lisheen WF	622101	663975	95
Lisheen WF	619343	668375	95
Lisheen WF	619187	668778	95
Lisheen WF	619755	668236	95
Graignaman	627322	653488	50
Balincurry	625898	648530	91
Balincurry	625741	648838	91

Table A11.4.4: Sound Power for Adjacent Windfarm cumulative assessment (Lisheen Vestas V90)

Standardised 10 m Height Wind Speed (m/s)	Octave Band Centre Frequency [Hz]									Overall PWL
	31.5	63	125	250	500	1000	2000	4000	8000	dBA
1.3	59	68	74	77	79	81	76	67	63	84
2	87	62	71	77	79	82	84	69	65	87
4	65	75	81	84	87	88	84	73	69	92
6	72	83	90	93	96	97	92	81	76	102
8	73	84	92	95	98	99	94	83	78	104

Table A11.4.5: Sound Power for Adjacent Windfarm cumulative assessment (Graignaman)

Standardised 10 m Height Wind Speed (m/s)	Octave Band Centre Frequency [Hz]								Overall PWL
	63	125	250	500	1000	2000	4000	8000	dBA
10	90.6	96.2	99.8	101.8	101.7	98.9	95.2	83.2	107.5
Overall sound power of turbine has been adjusted generate a noise calculated level of 43 dB LA90 at the closest noise sensitive location, as stated in the Graignaman EIAR. Octave band data is based on turbine spectrum within Wind Turbine Catalogue of iNoise prediction software									

Table A11.4.6: Sound Power for Adjacent Windfarm cumulative assessment at Ballincurry

Standardised 10 m Height Wind Speed (m/s)	Octave Band Centre Frequency [Hz]								Overall PWL
	63	125	250	500	1000	2000	4000	8000	dBA
10	82.7	88.3	91.9	93.9	93.8	91.0	87.3	75.3	99.6
Overall sound power of turbine based on meeting 34.9 dB at the closest noise sensitive location, as stated in the EIAR Planning Ref:15600561. Octave band data is based on turbine spectrum within Wind Turbine Catalogue of iNoise prediction software									

APPENDIX 11.5

PREDICTED NOISE LEVELS FROM WIND FARM AT NEARBY NOISE SENSITIVE LOCATIONS

Table A11.5.1: Predicted Operational Noise at Noise Sensitive Locations within the Study area, Littleton Windfarm only.

Receptor ID	Description	10m standardised Windspeed m/s					
		2	3	4	5	6	7
R1	Residential	30.2	30.3	31.8	34.6	37.8	39.1
R3	Residential	30.3	30.3	31.9	34.7	37.9	39.1
R14	Residential and Commercial	26.5	26.6	28.1	30.7	33.7	34.9
R49	Residential	26.5	26.6	28.1	30.7	33.7	34.9
R50	Residential	27.9	28	29.5	32.2	35.2	36.5
R61	Residential	26.7	26.8	28.3	30.9	34	35.2
R67	Residential	28.7	28.7	30.2	33	36	37.3
R68	Residential	28.7	28.7	30.2	32.9	36	37.3
R69	Residential	28.7	28.8	30.3	33	36.1	37.3
R97	Residential	27.1	27.1	28.6	31.3	34.4	35.6
R101	Residential and Commercial	27.6	27.7	29.2	31.9	35	36.2
R112	Residential and Commercial	28.7	28.8	30.3	33.1	36.2	37.4
R117	Residential	27	27.1	28.6	31.2	34.3	35.6
R119	Residential	28.4	28.5	30	32.8	35.9	37.1
R122	Residential	27.8	27.9	29.4	31.9	34.8	36
R134	Residential and Commercial	29.3	29.4	30.9	33.5	36.6	37.8
R154	Residential	26.8	26.9	28.3	30.8	33.7	34.9
R155	Residential	26.8	27	28.4	30.8	33.7	34.9
R156	Residential	27.2	27.4	28.8	31.3	34.2	35.4
R157	Residential	27.9	28.1	29.5	32.1	35.1	36.3
R158	Residential	26.6	26.7	28.1	30.6	33.4	34.6
R166	Residential	26.7	26.8	28.3	30.7	33.6	34.8
R167	Residential	26.8	26.9	28.4	30.8	33.7	34.9
R168	Residential and Commercial	27.8	27.9	29.3	31.9	34.8	36
R175	Residential	26.7	26.8	28.3	30.7	33.6	34.8
R189	Residential	26.7	26.8	28.2	30.7	33.5	34.7
R193	Residential	24.3	24.4	25.9	28.2	31	32.2
R199	Residential and Commercial	27.6	27.7	29.2	31.7	34.6	35.8
R200	Residential	27.6	27.7	29.1	31.6	34.6	35.8
R201	Residential	27.7	27.8	29.3	31.8	34.7	35.9
R238	Residential	27.5	27.6	29.1	31.5	34.4	35.6
R239	Residential	29.7	29.8	31.3	33.9	36.9	38.2
R240	Residential	29.2	29.3	30.8	33.4	36.4	37.6
R241	Residential	27.6	27.7	29.1	31.6	34.5	35.7
R247	Residential	27.1	27.2	28.7	31.1	34	35.2
R248	Residential and Commercial	27.8	27.9	29.3	31.8	34.8	36
R284	Residential	22.2	22.4	23.8	26	28.5	29.7
R303	Residential and Commercial	24.1	24.3	25.7	28	30.7	31.9

APPENDIX 11.6

PREDICTED CUMULATIVE WINDFARM NOISE LEVELS AT NEARBY NOISE SENSITIVE LOCATIONS

Table A11.6.1: Predicted Cumulative Operational Noise at Noise Sensitive Locations within the Study area, Littleton Windfarm only.

Receptor ID	Description	10m standardised Windspeed m/s 10m/s
R1	Residential	39.1
R3	Residential	39.2
R14	Residential and Commercial	35.1
R49	Residential	35.1
R50	Residential	36.5
R61	Residential	35.3
R67	Residential	37.3
R68	Residential	37.3
R69	Residential	37.4
R97	Residential	35.8
R101	Residential and Commercial	36.4
R112	Residential and Commercial	37.6
R117	Residential	35.8
R119	Residential	37.3
R122	Residential	36.1
R134	Residential and Commercial	37.8
R154	Residential	34.9
R155	Residential	35
R156	Residential	35.4

Receptor ID	Description	10m standardised Windspeed m/s 10m/s
R157	Residential	36.4
R158	Residential	34.7
R166	Residential	35.1
R167	Residential	35.1
R168	Residential and Commercial	36.2
R175	Residential	34.8
R189	Residential	34.8
R193	Residential	32.6
R199	Residential and Commercial	36
R200	Residential	36
R201	Residential	36.1
R238	Residential	35.7
R239	Residential	38.2
R240	Residential	37.7
R241	Residential	35.8
R247	Residential	35.4
R248	Residential and Commercial	36.2
R284	Residential	30.3
R303	Residential and Commercial	32.7
R333	Residential	34.6

Receptor ID	Description	10m standardised Windspeed m/s 10m/s
R334	Residential	34.6
R335	Residential	36.7
R336	Residential and Commercial	36.9
R337	Residential	36.5
R338	Residential	36.5
R339	Residential	36.1
R340	Residential	35.6
R341	Residential	35.6