

Berrybank Wind Farm

Round 3 Post Construction Noise Monitoring

S7598.1C3

September 2024

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CONTENTS

1 INTRODUCTION 4

2 WIND FARM DETAILS 5

3 TEST METHODOLOGY 7

4 NEARFIELD MEASUREMENTS.....10

4.1 Noise Measurements 10

4.2 Data Analysis 14

4.3 Analysis Procedure 15

4.4 Analysis Results 17

4.5 Tonality 18

5 ATTENDED OBSERVATIONS19

6 RESIDENTIAL LOGGING.....31

6.1 Data Analysis 33

6.2 Special Audible Characteristics 36

6.3 Residential Logging Results 36

6.4 Noise Monitoring Outcomes 48

7 CONCLUSION49

APPENDIX A : ACOUSTIC RELATED APPROVAL CONDITIONS50

Appendix A.1 : Golden Plains Shire Approval Conditions 50

Appendix A.2 : Corangamite Shire Approval Conditions 51

APPENDIX B : TURBINE COORDINATES53

APPENDIX C : CALIBRATION CERTIFICATES.....54

APPENDIX D : NOISE MONITORING EQUIPMENT PHOTOGRAPHS78

APPENDIX E : SITE WIND DATA DERIVATION98

APPENDIX F : CORRELATION GRAPHS119

1 INTRODUCTION

The Berrybank Wind Farm (the **Wind Farm**) is located approximately 50km southwest of Ballarat in Victoria and consists of a total of 69 wind turbine generators (**WTGs**) split across two stages.

The Wind Farm was approved on 4 February 2018 by the Minister for Planning in planning permits with reference “20092820 – A” and “20092821 – A” for the portions of the Wind Farm within the Golden Plains Shire and Corangamite Shire, respectively (collectively the **Approval**). Condition 19 of the Approval requires that compliance testing be conducted periodically from the time the first turbine begins operating until the final turbine is operational. The acoustic related provisions of the Approval have been reproduced in Appendix A.

This report has been prepared to fulfill Condition 19 and summarises the methodology and results of the post construction noise monitoring. The noise monitoring and subsequent analysis have been completed in accordance with the endorsed noise compliance test plan and Condition 19 of the Approval.

Noise monitoring was conducted at residences where possible, and where not possible at a proxy location. A proxy location is a location that has been used to represent the conditions at a residence where access was not available. Proxy locations were located either at another residence or an intermediate location. An intermediate location is a location positioned between the Wind Farm and a particular residence, being closer to the Wind Farm, and in the vicinity of the 45 dB(A) noise level contour. The levels measured at these locations are compared with the relevant criteria. To assist in the identification of noise and special audible characteristics from the Wind Farm, measurements were also taken at intermediate locations and in the nearfield close to a turbine.

The methodology and results of the post construction noise monitoring and analysis have been summarised in this report.

2 WIND FARM DETAILS

The Wind Farm consists of 69 WTGs manufactured by Vestas, the details of which can be seen in Table 1. The coordinates of the turbines can be seen in Appendix B. The layout of the Wind Farm and the noise monitoring locations can be seen in Figure 1.

Table 1: Wind Turbine Details

Detail	Turbine Model
Make	Vestas
Model	V136
Rotor Diameter	136m
Hub Height	112m
Blade Orientation	Upwind
Blade Configuration	Serrated
Turbine Regulation Method	Variable Blade Pitch
Operating Mode	Power Optimised (PO1)*
Maximum Rated Power Generating Capacity	4.2 MW
Cut-in Wind Speed (Hub Height)	3.0 m/s
Rated Power Wind Speed (Hub Height)	13.0 m/s
Cut-out Wind Speed (Hub Height)	25.0 m/s

* Sound management modes not utilised.

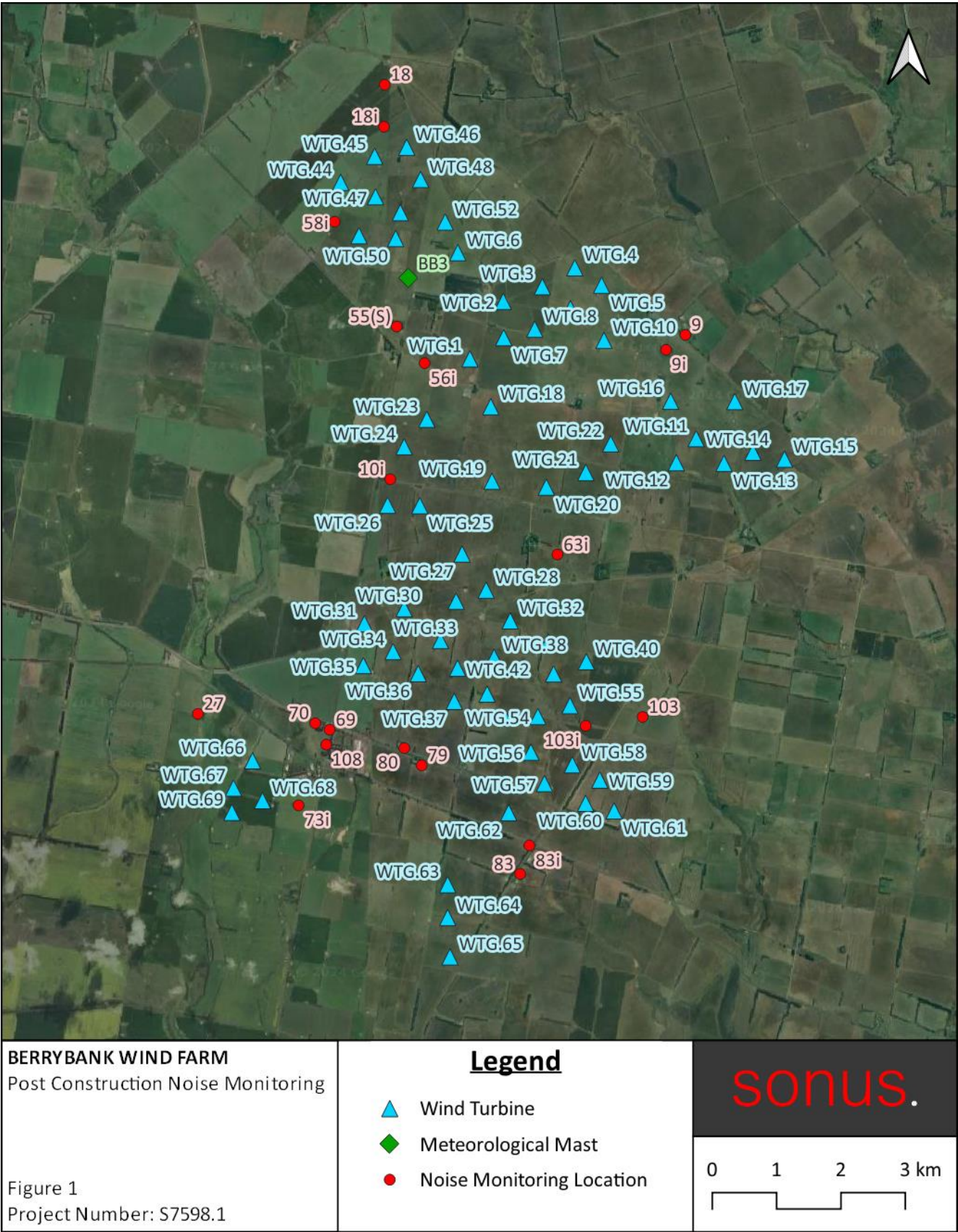


Figure 1: Wind Farm Layout and Noise Monitoring Locations

3 TEST METHODOLOGY

A Noise Compliance Test Plan (**NCTP**) was prepared by Marshall Day Acoustics (**MDA**) and summarised in the document titled “Berrybank Wind Farm Noise Compliance Test Plan”, with reference “Rp 001 R04 20180495” and dated 15 April 2019. The NCTP was then endorsed by the Minister for Planning on 17 April 2019. The NCTP outlines the procedures to be undertaken in order to measure and assess the noise from the Wind Farm in accordance with the Approval.

The NCTP provides a list of 17 preferred noise logging locations which can be seen in Table 2. Previous post construction noise monitoring was conducted by MDA on two occasions, once in 2021 and again in 2022/2023. This round of noise monitoring was conducted, as close as practical to the locations as the previous post construction noise monitoring. It is noted that permission was not granted to conduct the noise monitoring at all locations preferred by the NCTP, so a number of substitute locations were considered, which can also be seen in Table 2, consistent with the approach taken by MDA during the previous noise monitoring. The status of the noise monitoring, whether it was conducted or if Sonus was advised that access was refused, is also shown. One residence, receiver 58, is derelict, so the substitute location was used in this case.

Table 2: Preferred Noise Monitoring Locations

Receiver	Direction from Nearest Turbine	Distance from Nearest Turbine	Monitoring Status	Substitute Location	Direction from Nearest Turbine	Distance from Nearest Turbine	Monitoring Status
9	NNE	1150	Conducted	9(i)	N	776	Conducted
10	NW	1141	Refused	10(i)	N	402	Conducted
18	NNW	1071	Conducted	18(i)	NNE	480	Conducted
27	NW	1099	Conducted	-	-	-	-
56	W	1141	Refused	56(i)	W	717	Conducted
57	W	1298	Refused	55(S)	WNW	1246	Conducted
58	W	1149	Derelict	58(i)	WNW	429	Conducted
63	NE	1416	Refused	63(i)	S	1065	Conducted
69	SSW	1114	Conducted	-	-	-	-
70	SW	1171	Conducted	-	-	-	-
72 (108)*	E	1247	Conducted	-	-	-	-
73	ESE	1220	Refused	73(i)	E	576	Conducted
79	SSW	1093	Conducted	-	-	-	-
80	SW	1091	Conducted	-	-	-	-
83	E	1128	Conducted	83(i)	SSE	602	Conducted
102	SSE	1196	Refused	63	NE	1416	Refused
103	NNE	1159	Conducted	103(i)	SE	399	Conducted

* The coordinates for the dwelling identified as 72 in the NCTP was rectified during the background monitoring and subsequently identified as 108.

It is noted that the resident at receiver 102 refused access to place the noise monitoring in advance of deployment. Receiver 63 was chosen as an appropriate substitute location, as the predicted noise levels are similar. The resident at receiver 63 refused access while deploying the noise monitoring equipment. As such, the substitute location for receiver 63, receiver 63i, will form the basis of the assessment for both receiver 63 and receiver 102.

Noise limits have been previously calculated by MDA based on background noise monitoring and are summarised in the report titled “Round 2 Post-Construction Noise Monitoring”, with reference “Rp 003 20200683”, and dated 4 August 2023 (the **Round 2 Report**). The background noise levels have been reproduced in Table 3, with the criteria, where defined, reproduced in Table 4. It is noted that criteria are also provided for receiver 83i based on background noise levels measured at this location.

Table 3: Background Noise Levels

Receiver	Hub Height (112m) Wind Speed, m/s										
	3	4	5	6	7	8	9	10	11	12	13
Derived Background Noise Levels (L ₉₀), dB(A) – All-Time (Reduced)											
27	*	28	28	29	30	31	32	34	35	37	39
69	*	29	29	30	31	33	34	36	38	41	43
70	*	27	27	28	29	31	33	36	38	41	44
80	*	26	26	27	28	29	31	32	34	36	38
108	*	30	31	31	33	34	36	38	41	43	45
55(S)	*	28	28	28	29	31	33	35	37	40	42
9i	21	22	22	23	24	25	25	26	27	28	29
10i	26	27	27	28	29	29	30	31	32	33	34
18i	22	22	23	23	24	25	25	26	28	29	30
56i	24	25	26	26	27	28	29	30	31	32	34
58i	20	20	21	21	22	23	24	25	26	27	28
63i	21	22	23	24	24	25	26	26	27	28	29
73i	21	22	22	23	24	25	26	28	29	31	32
83i	29	30	32	33	35	36	38	39	41	42	43
103i	24	25	26	27	28	29	30	31	32	33	34
Derived Background Noise Levels (L ₉₀), dB(A) – Night-Time Period											
83i	27	28	30	31	33	34	36	38	39	40	41
103i	18	19	20	21	23	24	26	27	28	28	*

* The wind speed is outside the valid range of the regression analysis.

Table 4: Derived Noise Criteria

Receiver	Hub Height (112m) Wind Speed, m/s										
	3	4	5	6	7	8	9	10	11	12	13
27	40	40	40	40	40	40	40	40	40	42	44
57*	40	40	40	40	40	40	40	40	42	45	47
69	40	40	40	40	40	40	40	41	43	46	48
70	40	40	40	40	40	40	40	41	43	46	49
79**	40	40	40	40	40	40	40	40	40	41	43
80	40	40	40	40	40	40	40	40	40	41	43
83i	40	40	40	40	40	41	43	44	46	47	48
83i (Night)	40	40	40	40	40	40	41	43	44	45	46
108	40	40	40	40	40	40	41	43	46	48	50
* Based on representative background noise levels measured at receiver 55(S).											
** Based on representative background noise levels measured at receiver 80.											

The NCTP also required that attended observations were taken on a number of occasions while on site during the noise monitoring regime. This included all of the noise monitoring locations as well as in the vicinity of the closest turbine to each noise monitoring location. The purpose of the attended observations was to aid in determining whether there are any special audible characteristics (**SACs**) present in the noise of the Wind Farm.

Nearfield noise measurements close to a turbine were also conducted in accordance with the NCTP in order to determine the variation in sound power level of the turbine with wind speed and to assist in determining whether there are any SACs present.

4 NEARFIELD MEASUREMENTS

It is noted that the NCTP only requires nearfield noise testing to be conducted for the first turbine commissioned. Notwithstanding this, the NCTP notes that the noise measured in the nearfield should be used to assist in the identification of tonality in the noise output of the WTGs. The NCTP also notes that analysis of the noise level versus wind speed profile can be used to assist in determining whether the noise measured at the compliance locations is attributable to the Wind Farm. To this end, nearfield noise measurements were conducted in the vicinity of one turbine, WTG.19, for the purpose of analysing for tonality and determining the noise level versus wind speed profile. The measurements were conducted in accordance with International Standard *IEC 61400 11: 2012 Wind turbines – Part 11: Acoustic noise measurements techniques (IEC 61400)*.

An important consideration for nearfield noise testing is to minimise the influence of noise from turbines other than the turbine being tested. As the NCTP requires nearfield noise testing to be completed for the first turbine commissioned, this was not a consideration for the previous testing conducted by MDA at WTG.4. WTG.19 was therefore chosen as the location for these subsequent measurements as it allowed for the testing to be conducted at sufficient distance from other turbines to not influence the results.

Noise measurements at the nearfield location were conducted between 14 June 2024 and 13 August 2024. During this period, the turbine was periodically switched on and off on two occasions on 23 July 2024 and 2 August 2024. The data for these days were further analysed to determine the sound power level and the presence of any tonality.

4.1 Noise Measurements

A Rion NL-52 Class 1 sound level meter was placed at a location downwind from the tested turbine such that it would be within 15° of the downwind position for a sufficient period. Additional equipment was placed at a different bearing relative to the turbine to ensure that sufficient data were collected during the monitoring period. The locations where the measurement equipment was placed have been summarised in Table 5. The direction relative to the turbine corresponds to the degrees from north the measurement equipment was located when observed from the turbine. Sufficient data were obtained from the primary logger to complete the analysis and therefore the data collected by the backup logger were not used.

Table 5: Nearfield Test Locations

Location	Coordinates (UTM WGS84 54H)		Serial Number	Slant Distance (m)	Direction Relative to Turbine (°)
	Easting	Northing			
Primary	721029	5797364	00710427	204	194 (SSW)
Backup	721112	5797352	00710394	210	167 (SSE)

A secondary wind screen was used for each sound level meter and was positioned over the microphone on the measurement board. Figure 2 shows a typical example of the setup used to conduct the monitoring.

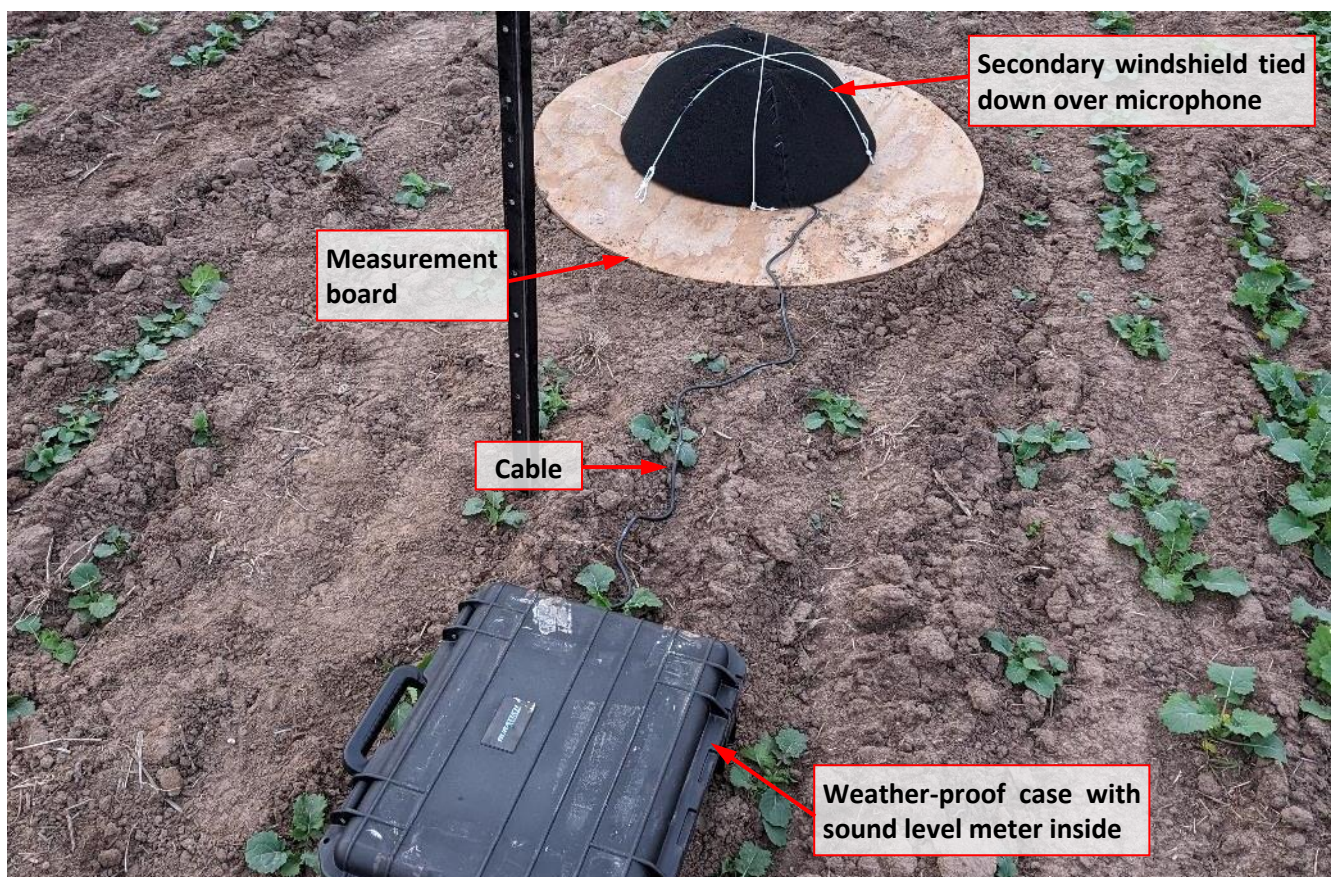


Figure 2: Microphone on the measurement board position with secondary screen.

The insertion loss of the secondary wind screen has been measured and is summarised in Table 6.

Table 6: Secondary Wind Screen Insertion Loss

Frequency 1/3-octave band (Hz)	20	25	31.5	40	50	63	80	100	125	160
Insertion loss (dB)	0.8	0.9	0.4	-0.2	0.4	0.0	-0.2	-0.1	0.1	0.0
Frequency 1/3-octave band (Hz)	200	250	315	400	500	630	800	1000	1250	1600
Insertion loss (dB)	-0.1	0.0	0.0	-0.1	0.2	0.3	0.4	0.1	0.1	0.5
Frequency 1/3-octave band (Hz)	2000	2500	3150	4000	5000	6300	8000	10000		
Insertion loss (dB)	0.1	0.3	0.3	0.3	0.4	0.5	0.6	0.6		

Figure 3 shows the location of the noise measurement equipment positioned in relation to WTG.19.



Figure 3: WTG.19 Primary Nearfield Monitoring Equipment

4.2 Data Analysis

The equivalent A-weighted sound pressure levels were measured continuously at the measurement positions during the measurement period. Each measurement was averaged over a period of 10 seconds.

During the measurement period, the turbines were switched 'off' on several occasions to allow for background noise measurements to be conducted.

Prior to analysis, the following data were discarded:

- measurements with intruding intermittent ambient noise or activity such as when apparatus was being set-up.
- measurements during start-up or shut-down of the turbines.
- measurements corresponding to non-downwind conditions.

Following data discard, the resultant number of sound pressure level data points in each wind speed bin (± 0.25 m/s wide centred at integer hub height wind speed), for the wind speed range required by the NCTP, that is between 6m/s and 10m/s (inclusive), as well as up to the wind speed of approximate rated power (13 m/s) are summarised in Table 7.

Table 7: Nearfield Valid Data Points

Wind Speed, V_{HH} (m/s)	WTG.19 ON	WTG.19 OFF
6	166	4
7	497	30
8	716	59
9	673	84
10	549	96
11	399	264
12	294	93
13	203	81

4.3 Analysis Procedure

The apparent sound power level at each integer wind speed has been derived using the procedure outlined in Section 9 of the IEC 61400 and summarised below.

1. All measured equivalent sound pressure levels at each 1/3 octave band between 20 Hz to 10 kHz are normalised to the measured overall equivalent sound pressure level. The 1/3 octave band levels between 20Hz and 10kHz are logarithmically summed and its difference with the measured overall level is arithmetically added to each 1/3 octave band levels.
2. The 1/3 octave band equivalent sound pressure levels are corrected for the influence of the secondary wind screen. The secondary wind screen insertion losses provided in Table 6 are arithmetically added to the 1/3 octave band levels. The resultant overall sound pressure level is obtained by logarithmically summing the corrected one third octave sound pressure levels.
3. The 1/3 octave band equivalent sound pressure levels are sorted into wind speed bins, each ± 0.25 m/s wide, centred at integer wind speeds. The turbine on and turbine off noise data are segregated into separate data sets.
4. The average 1/3 octave band equivalent sound pressure levels for each wind speed bin are determined logarithmically. The 1/3 octave band equivalent sound pressure levels at the bin centres are then calculated using linear interpolation between the bin average sound pressure level and wind speed values.
5. The background corrected wind turbine sound pressure levels are derived using the 1/3 octave band equivalent sound pressure levels (referenced to the bin centre) as follows:
 - “turbine off” sound levels are logarithmically subtracted from the “turbine on” sound levels where the “turbine off” level is at least 3 dB(A) below the “turbine on” 1/3 octave band equivalent sound pressure level.
 - In the case where the “turbine off” sound level is within 3 dB(A) of the 1/3 octave band “turbine on” sound pressure level, 3 dB(A) has been subtracted from the 1/3 octave band “turbine on” equivalent sound pressure level. These values have been noted as being affected by background noise.
 - Where the logarithmic sum of each 1/3 octave band sound pressure level for the “turbine on” noise levels is within 3 dB(A) of the logarithmic sum of each 1/3 octave band sound pressure level for the “turbine off” sound levels, the data have not been reported, in accordance with IEC 61400.
 - Where less than 10 “turbine off” sound level data points were available, the “turbine on” sound levels were used with no adjustment.

6. The background corrected wind turbine sound pressure levels at each 1/3 octave band are used to calculate the apparent sound power levels at each integer wind speed using Equation (26) in the IEC 61400. The slant distance for each measurement location is presented in Table 5.
7. The overall apparent sound power level at each integer wind speed is determined by logarithmically summing the 1/3 octave band apparent sound power levels.

The data points (overall equivalent sound pressure levels) included in the analysis are shown in Figure 4.

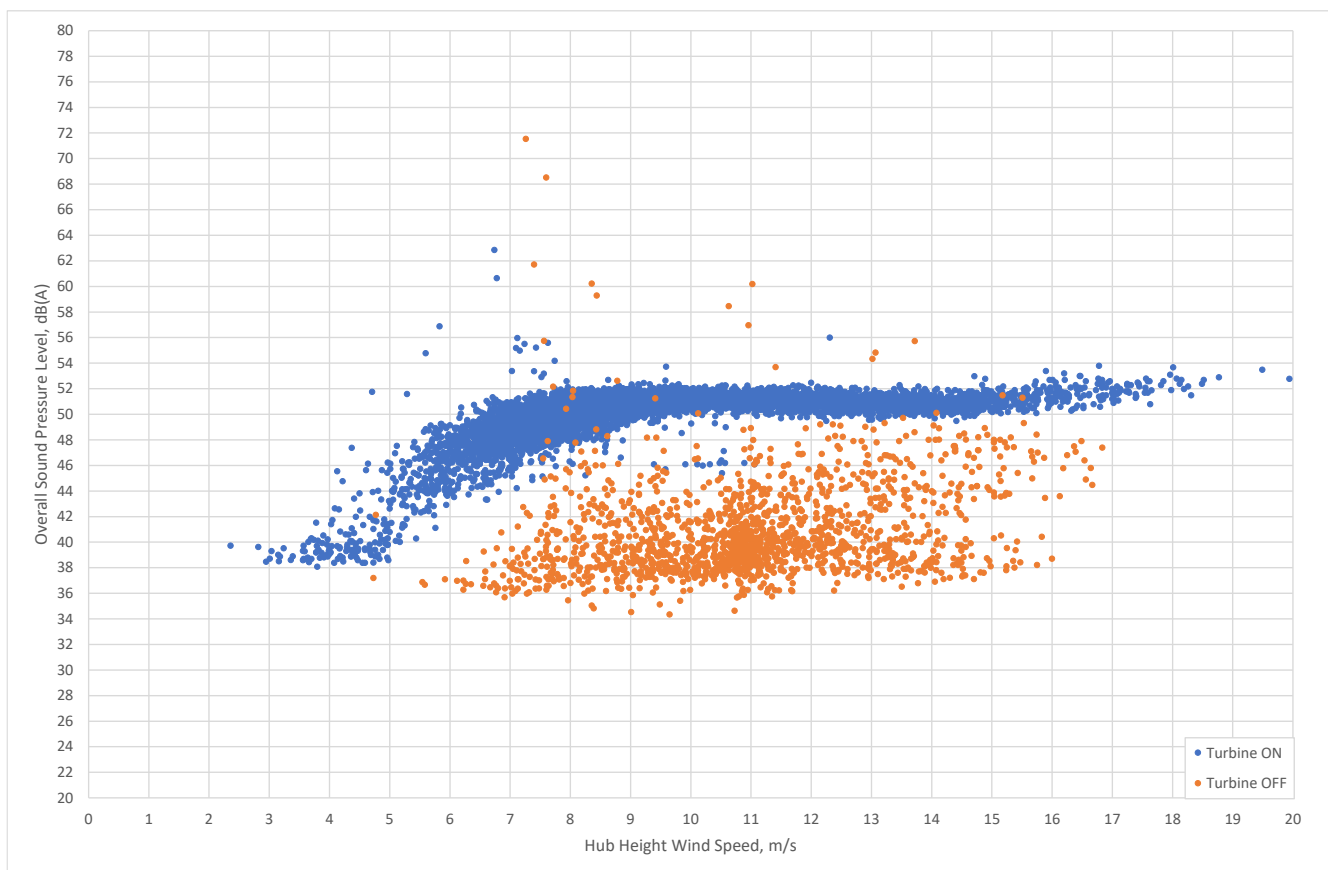


Figure 4: Nearfield Data Points

4.4 Analysis Results

The derived apparent sound power levels are summarised in Table 8.

Table 8: Derived Apparent Sound Power Levels

V _{HH} (m/s)	V ₁₀ (m/s)	L _{WA} [dB(A)]	Sound Power Level [dB(A)] at each 1/3 Octave Band (Hz)																											
			20	25	31.5	40	50	63	80	100	125	160	200	250	315	400	500	630	800	1000	1250	1600	2000	2500	3150	4000	5000	6300	8000	10000
6	4.1	98.0	59.1	63.2	66.3	69.1	72.9	75.8	78.9	84.4	79.8	81.9	85.1	86.4	87.3	86.6	87.2	88.1	87.5	87.7	87.2	86.6	84.7	82.1	79.8	76.4	71.1	63.5	[57.3]	[54.8]
7	4.8	99.9	60.3	64.8	68.2	71.2	74.4	77.8	80.7	84.0	83.3	85.3	86.6	88.4	89.4	88.4	88.9	89.6	89.0	89.4	89.8	88.5	87.0	84.3	82.3	78.7	74.7	69.5	65.8	60.3
8	5.5	100.6	61.4	66.0	69.4	71.2	76.1	78.9	[79.7]	83.2	84.0	[83.1]	87.6	89.8	90.6	89.6	89.8	90.4	90.0	90.1	90.7	89.0	86.9	84.3	81.1	[77.3]	#	#	#	#
9	6.2	101.7	62.4	67.1	70.5	73.4	77.3	80.2	82.5	83.9	84.8	84.6	88.3	90.4	91.2	90.5	90.9	91.5	91.2	91.4	91.7	90.5	88.7	85.9	83.0	[77.8]	#	#	#	#
10	6.9	101.9	62.5	67.1	70.5	73.5	77.4	80.3	82.7	83.7	84.6	85.2	88.3	90.4	91.2	90.7	91.3	92.0	91.7	91.9	91.6	90.7	89.0	86.1	83.4	78.0	#	[64.6]	[58.2]	#
11	7.6	101.8	62.3	67.1	70.5	73.5	77.3	80.1	82.5	83.5	84.1	84.9	88.1	90.3	90.9	90.5	91.2	92.2	91.8	91.9	91.2	90.4	88.8	85.9	81.4	#	#	#	#	#
12	8.2	101.6	62.5	67.4	70.9	73.9	77.6	80.3	82.6	83.3	83.7	84.4	87.3	89.6	90.2	89.9	90.7	92.0	91.8	92.0	91.2	90.6	88.8	86.0	83.2	79.2	#	#	#	#
13	8.9	101.0	61.6	67.0	70.4	73.5	77.3	79.9	82.1	82.5	83.0	83.4	86.2	88.6	89.1	88.9	89.8	91.4	91.3	91.8	91.1	90.4	88.5	84.9	81.6	[78.1]	#	#	#	#

- The background noise is higher than the total noise.
[] - The background noise is within 3 dB of the total noise.
V_{HH} - is the hub height (112m) wind speed.
V₁₀ - is the standardised wind speed, referenced at 10m above ground level.

4.5 Tonality

The nearfield measurements have been analysed for tonality in accordance with the procedure outlined in IEC 61400. Potential tones were identified at a range of frequencies. In accordance with the standard, a potential tone needs to have an audibility greater than -3 dB and be present in more than 20% of samples within a wind speed bin for it to be reported. As the potential tones were present for less than 20% of samples in each wind speed bin, no relevant tones are reported in accordance with the standard.

5 ATTENDED OBSERVATIONS

As per the NCTP, attended observations, summarised in Table 9, were made on a number of occasions while on site, including:

- During placement of the noise monitoring equipment.
- During an intermediate trip to check the noise monitoring equipment.
- During collection of the noise monitoring equipment.
- Additional observations were made at night at select locations downwind from the Wind Farm.
- Observations at approximately 200m from the turbine closest to each noise monitoring location were also conducted on one occasion.

Table 9: Attended Observation Records

Location	Date/Time	Wind Speed	Wind Direction	Measured Noise Level – Leq [L90]	Special Audible Characteristics			Notes
					Tonality	AM	Impulse	
R18	15/05/24 8:05am – 8:45am	5.3 m/s – 5.9 m/s	303° – 313°	45 dB(A) [32 dB(A)]	No	No	No	Turbines barely audible. Some noise from other direction, possibly from highway.
R55(S)	15/05/24 8:50am – 9:25am	6.5 m/s – 7.6 m/s	298° – 302°	37 dB(A) [30 dB(A)]	No	No	No	Turbines just audible, more so on opposite side of house. Downwind conditions. Occasional swish audible, however not a significant character of the noise.
R58i	15/05/24 9:35am – 10:05am	4.4 m/s – 5.1 m/s	291° – 300°	39 dB(A) [37 dB(A)]	Potential	No	No	Quite close to turbines. Turbines audible. Possible low frequency tone. Just audible when wind dies down
R10i	15/05/24 10:15am – 10:35am	4.4 m/s – 4.8 m/s	289° – 300°	39 dB(A) [34 dB(A)]	No	No	No	Turbines audible when background noise is low. Occasional swish noise heard. Some traffic and machine noise also audible.

Location	Date/Time	Wind Speed	Wind Direction	Measured Noise Level – Leq [L90]	Special Audible Characteristics			Notes
					Tonality	AM	Impulse	
R69	15/05/24 10:45am – 11:10am	5.4 m/s – 6.1 m/s	264° – 279°	54 dB(A) [36 dB(A)]	No	No	No	Wind farm inaudible. Noise from wind in trees, traffic on highway, and Telstra exchange (tonal).
R70	15/05/24 11:15am – 11:50am	5.8 m/s – 6.4 m/s	265° – 268°	57 dB(A) [42 dB(A)]	No	No	No	Wind farm inaudible. Noise from highway traffic, wind in trees, and train.
R27	15/05/24 12:15pm – 12:40pm	5.8 m/s – 6.1 m/s	259° – 273°	47 dB(A) [36 dB(A)]	No	No	No	Turbines inaudible. Little to no breeze. Noise from highway, local sources, windmill, birds, sheep, fence rattling.
R108	15/05/24 12:45pm – 1:15pm	4.7 m/s – 5.2 m/s	264° – 271°	46 dB(A) [36 dB(A)]	No	No	No	Turbines inaudible. Noise from wind in trees, birds, highway traffic.
R83	15/05/24 2:05pm – 2:35pm	5.4 m/s – 5.9 m/s	250° – 255°	43 dB(A) [34 dB(A)]	No	No	No	Turbines just audible. Other noise from train, wind in trees, and trucks. Can hear swish at times.
R83i	15/05/24 2:40pm – 3:05pm	5.5 m/s – 6.4 m/s	242° – 254°	43 dB(A) [37 dB(A)]	No	No	No	Turbines inaudible. Noise from wind, wind in trees, traffic. Occasional clunks heard from turbine (non-standard?).
R103i	15/05/24 3:10pm – 3:40pm	5.7 m/s – 6.2 m/s	238° – 252°	39 dB(A) [36 dB(A)]	Potential	No	No	Turbines audible most of time. Other noise from wind, traffic, insects. Potential tone observed on meter output at low frequency but inaudible.
R63i	15/05/24 3:55pm – 4:30pm	4.8 m/s – 5.4 m/s	235° – 242°	33 dB(A) [29 dB(A)]	No	No	No	Turbines just audible in still conditions. Noise from wind masks turbines. Some insect noise also present.
R79	15/05/24 4:45pm – 5:15pm	5.1 m/s – 5.8 m/s	203° – 222°	59 dB(A) [43 dB(A)]	No	No	No	Turbines inaudible. Noise from grading in adjacent paddock extremely dominant. Some noise from highway also audible.
R80	16/05/24 7:00am – 7:30am	2.3 m/s – 2.9 m/s	348° – 353°	55 dB(A) [32 dB(A)]	No	No	No	Turbines barely audible only when no other noises are present. Noise from highway traffic, birds, insects, nearby animals (dog, rooster)

Location	Date/Time	Wind Speed	Wind Direction	Measured Noise Level – Leq [L90]	Special Audible Characteristics			Notes
					Tonality	AM	Impulse	
R18i	16/05/24 7:55am – 8:30am	1.6 m/s – 1.9 m/s	339° – 347°	38 dB(A) [34 dB(A)]	Potential	No	No	Turbines just audible (not much wind). Other noise from birds, insects, and traffic. Can hear a drone from turbine when quiet. Also creaking (of blades?) occasionally.
R9	16/05/24 9:00am – 9:40am	2.4 m/s – 2.7 m/s	351° – 353°	33 dB(A) [26 dB(A)]	No	No	No	Turbines inaudible. Noise from birds, traffic, bees.
R56i	16/05/24 9:55am – 10:25am	1.0 m/s – 2.0 m/s	346° – 355°	47 dB(A) [26 dB(A)]	No	No	No	Very little wind, turbines barely moving. Turbines inaudible. Noise from insects, birds, traffic.
R73i	16/05/24 12:20pm – 12:45pm	0.9 m/s – 2.2 m/s	247° – 31°	69 dB(A) [28 dB(A)]	No	No	No	Very little wind, turbines barely spinning. Turbines inaudible. Noise from birds, traffic, fence setup.
R103	16/05/24 1:05pm – 1:25pm	1.3 m/s – 2.2 m/s	226° – 263°	31 dB(A) [27 dB(A)]	No	No	No	Little to no wind, turbines barely turning. Turbines inaudible. Noise from sheep, bees, birds, phone. Wind picked up a little after being on site for a while, but turbines still not audible.
R9i	16/05/24 1:50pm – 2:35pm	2.3 m/s – 3.0 m/s	243° – 292°	33 dB(A) [26 dB(A)]	No	No	No	Very little wind, most turbines not spinning. Turbines inaudible. Can hear traffic from distant road, insects, some noise from logger setup. While on site, wind picked up a bit. Location was downwind from some turbines (however not the closest ones) but the turbines were still only barely audible.
R18	13/06/24 8:35am – 9:05am	2.0 m/s – 3.0 m/s	262° – 270°	34 dB(A) [25 dB(A)]	No	No	No	Still morning with little wind. Turbines barely spinning. Wind farm inaudible. Noise from birds, highway traffic.

Location	Date/Time	Wind Speed	Wind Direction	Measured Noise Level – Leq [L90]	Special Audible Characteristics			Notes
					Tonality	AM	Impulse	
R18i	13/06/24 9:15am – 9:45am	2.2 m/s – 2.7 m/s	230° – 296°	39 dB(A) [32 dB(A)]	Potential	No	No	Light breeze, some close turbines spinning, barely audible. Noise mainly from traffic, birds, some dogs barking in distance. Possible low tone just audible in lulls between background noise sources.
R79	13/06/24 10:00am – 10:25am	1.4 m/s – 3.1 m/s	300° – 326°	51 dB(A) [33 dB(A)]	No	No	No	Wind farm inaudible. Noise from local activities, music, train, some power tools and hand tools. Mainly noise from traffic on highway, insects, birds.
R108	13/06/24 10:30am – 10:50am	2.0 m/s – 2.8 m/s	303° – 323°	47 dB(A) [26 dB(A)]	No	No	No	Little to no wind, turbines barely spinning. Turbines inaudible. Noise from traffic on highway and birds.
R69	13/06/24 10:55am – 11:15am	1.8 m/s – 2.0 m/s	286° – 303°	61 dB(A) [35 dB(A)]	No	No	No	Little to no wind, turbines barely spinning. Turbines inaudible. Noise from birds and highway traffic.
R70	13/06/24 11:20am – 11:40am	1.6 m/s – 1.6 m/s	284° – 289°	66 dB(A) [31 dB(A)]	No	No	No	Little to no wind, turbines barely spinning. Turbines inaudible. Noise from traffic on highway and birds.
R27	13/06/24 12:00pm – 12:30pm	1.5 m/s – 1.7 m/s	284° – 302°	32 dB(A) [23 dB(A)]	No	No	No	Little to no wind, turbines barely spinning. Turbines inaudible. Noise from traffic on highway, some birds and insects.
R83	13/06/24 1:35pm – 2:05pm	1.4 m/s – 2.8 m/s	260° – 273°	36 dB(A) [20 dB(A)]	No	No	No	Little to no wind, turbines barely spinning. Turbines inaudible. Noise from birds and insects. Possible local source of tonality (extremely quiet but present without turbine movement).
R83i	13/06/24 2:10pm – 2:40pm	1.1 m/s – 1.6 m/s	229° – 262°	26 dB(A) [20 dB(A)]	No	No	No	Little to no wind, turbines slowing to a stop. Turbines inaudible. Noise from birds, some distant traffic. Possible 200Hz tone from other industry not the wind farm.

Location	Date/Time	Wind Speed	Wind Direction	Measured Noise Level – Leq [L90]	Special Audible Characteristics			Notes
					Tonality	AM	Impulse	
R103i	13/06/24 2:50pm – 3:15pm	0.7 m/s – 1.2 m/s	236° – 256°	38 dB(A) [25 dB(A)]	Potential	No	No	Little to no wind, turbines barely moving/stopped. Turbines inaudible. Noise from plane, train, traffic on road, some insects, possibly birds. Low drone heard at 200Hz, possibly in startup of turbine.
R9	13/06/24 3:40pm – 4:15pm	1.3 m/s – 1.6 m/s	158° – 184°	39 dB(A) [22 dB(A)]	No	No	No	Little to no wind, most turbines not turning. Turbines inaudible. Noise from local sources (pump), birds, insects, dogs, some traffic.
Near R55(S)	13/06/24 10:00pm – 10:30pm	2.9 m/s – 3.3 m/s	85° – 89°	33 dB(A) [22 dB(A)] 26 dB(A) [22 dB(A)]	Potential	No	No	Light breeze blowing from turbines (location downwind). Turbines just audible. Can tell that nearest two turbines are spinning. Can hear low hum/drone, possibly from turbines. Other noise from dogs barking, cows, car engine ticking, some distant traffic. Other unknown noise source started at about 10:15pm and lasted for approximately 5 minutes. A second measurement was taken with less extraneous noise, only from dogs barking and the occasional engine tick or cow.

Location	Date/Time	Wind Speed	Wind Direction	Measured Noise Level – Leq [L90]	Special Audible Characteristics			Notes
					Tonality	AM	Impulse	
Near R69/R70	13/06/24 10:40pm – 11:10pm	3.3 m/s – 3.7 m/s	80° – 91°	28 dB(A) [20 dB(A)]	Potential	No	No	Light breeze to begin with, but died down during observation. Some turbines slowed/stopped as a result. Wind farm just audible to begin with but became inaudible. Low drone/hum audible. Other noise from insects, occasional bird, some engine ticks, some traffic. Measurement paused as truck went past until no longer audible. Other local noise in beginning of measurement most obvious in mid to high frequencies (1 kHz – 2 kHz), possibly from power pole. Very low noise levels observed. Similar in character to night observations near 55(S) with more influence from traffic.
R55(S)	14/06/24 9:45am – 10:15am	3.5 m/s – 3.8 m/s	58° – 66°	47 dB(A) [29 dB(A)]	No	No	No	Light breeze, turbines spinning. Turbines possibly just audible with no other noise sources present. Other noise from birds, cows, tractor starting and driving past, other traffic on road.
R58i	14/06/24 10:25am – 11:00am	3.0 m/s – 3.3 m/s	62° – 83°	35 dB(A) [32 dB(A)]	Potential	No	No	Bit of a breeze. Downwind from some turbines. Turbines audible. Other noise from birds and traffic/tractor in distance. Possible 80 Hz tone.
R10i	14/06/24 11:15am – 11:45am	5.2 m/s – 6.5 m/s	88° – 94°	37 dB(A) [35 dB(A)]	No	No	No	Breezy. Crosswind from the nearest turbines. Turbines audible. Other noise from birds, insects, wind in trees and occasional traffic. Drone/hum less obvious here, possibly masked by wind and regular operation.
R56i	14/06/24 11:50am – 12:20pm	6.1 m/s – 6.4 m/s	97° – 99°	35 dB(A) [33 dB(A)]	No	No	No	Light breeze. Turbines audible. Other noise from wind in trees/grass, occasional bird, wind on mic, occasional traffic.

Location	Date/Time	Wind Speed	Wind Direction	Measured Noise Level – Leq [L90]	Special Audible Characteristics			Notes
					Tonality	AM	Impulse	
R63i	14/06/24 12:35pm – 1:05pm	4.9 m/s – 6.0 m/s	92° – 107°	36 dB(A) [31 dB(A)]	No	No	No	Breezy. Turbines barely audible. Noise from wind and birds. Turbines more audible in lulls between gusts. Possibly some distant traffic noise.
R73i	14/06/24 1:15pm – 1:45pm	4.5 m/s – 4.7 m/s	94° – 112°	40 dB(A) [36 dB(A)]	No	No	No	Upwind of nearest turbines. Turbines audible. Other noise from sheep, traffic, wind. Can occasionally hear a blade swish, however it is not regular. Drone/hum audible when quiet but masked with other noise.
R103	14/06/24 1:55pm – 2:25pm	4.7 m/s – 5.2 m/s	109° – 118°	38 dB(A) [32 dB(A)]	No	No	No	Light breeze, crosswind from turbines. Turbines barely audible. Other noise from windmill rattling, train, wind in trees, sheep, birds. Bit of a low hum/drone.
R9i	14/06/24 2:45pm – 3:15pm	5.4 m/s – 5.5 m/s	106° – 110°	34 dB(A) [31 dB(A)]	No	No	No	Light winds. Upwind from closest turbine but downwind from some other turbines further away. Turbines audible. Possible drone audible, but often masked by wind and noise of normal turbine operation.
R80	14/06/24 4:55pm – 5:30pm	7.6 m/s – 8.4 m/s	105° – 110°	53 dB(A) [35 dB(A)]	No	No	No	Light breeze. Turbines inaudible. Noise from traffic on highway and other local sources including animals and power tools.
R80	10/07/24 7:00am – 7:30am	4.4m/s – 5.0 m/s	249° – 258°	61 dB(A) [30 dB(A)]	No	No	No	Turbines inaudible. Noise from animals (dog, rooster), highway traffic, grain store, train.
R18	10/07/24 7:40am – 8:05am	4.8m/s – 5.1 m/s	257° – 259°	49 dB(A) [33 dB(A)]	No	No	No	Turbines barely audible. Noise from birds, traffic. Some amount of low frequency energy showing on meter across multiple bands, so possibly not tonal.

Location	Date/Time	Wind Speed	Wind Direction	Measured Noise Level – Leq [L90]	Special Audible Characteristics			Notes
					Tonality	AM	Impulse	
R18i	10/07/24 8:10am – 8:40am	5.1 m/s – 5.6 m/s	256° – 259°	39 dB(A) [33 dB(A)]	Potential	No	No	Turbines audible. Other noise from birds, traffic, plane. Possible tone at 80 Hz. Occasional clunk noise.
WTG.45	10/07/24 8:45am – 9:00am	5.3 m/s – 5.4 m/s	261° – 264°	42 dB(A) [40 dB(A)]	Potential	No	No	Turbine clearly audible. Other noise from birds, car ticks. Low hum/drone audible. Potentially tonal at times.
WTG.46	10/07/24 9:00am – 9:15am	5.1 m/s – 5.4 m/s	269° – 279°	43 dB(A) [38 dB(A)]	Potential	No	No	Turbine clearly audible. Other noise from birds and occasional clunks. Low hum/drone, potentially tonal at 80 Hz.
WTG.49	10/07/24 9:20am – 9:35am	4.8m/s – 5.1 m/s	272° – 275°	45 dB(A) [41 dB(A)]	Potential	No	No	Turbine clearly audible. Other noise from birds, sheep, occasional clunks, cars. Potential tone at 80 Hz.
R55(S)	10/07/24 9:40am – 10:05am	5.1 m/s – 6.3 m/s	269° – 288°	41 dB(A) [32 dB(A)]	No	No	No	Turbines barely audible. Other noise from birds, livestock, dogs, traffic, wind in trees.
R58i	10/07/24 10:10am – 10:40am	4.8 m/s – 5.3 m/s	270° – 299°	40 dB(A) [37 dB(A)]	Potential	No	No	Turbines audible. Other noise from birds, wind, and occasional clunks. Potential tone at 80 Hz.
R56i	10/07/24 10:45am – 11:15am	5.0 m/s – 6.2 m/s	290° – 301°	38 dB(A) [32 dB(A)]	No	No	No	Turbines audible. Other noise from birds, traffic, wind in grass.
R10i	10/07/24 11:20am – 12:00pm	5.0 m/s – 6.1 m/s	282° – 300°	38 dB(A) [36 dB(A)]	No	No	No	Turbines audible. Other noise from insects and birds.
WTG.26	10/07/24 12:10pm – 12:20pm	5.2 m/s	303°	41 dB(A) [37 dB(A)]	No	No	No	Turbine clearly audible. Other noise from birds, occasional clunks, insects (?), wind noise, distant traffic, car ticks.
WTG.20	10/07/24 12:50pm – 1:00pm	4.8 m/s	307°	38 dB(A) [36 dB(A)]	Potential	No	No	Turbine clearly audible. Other noise from birds and occasional clunks. Potential tone at 80 Hz. Possible harmonic at 160 Hz?

Location	Date/Time	Wind Speed	Wind Direction	Measured Noise Level – Leq [L90]	Special Audible Characteristics			Notes
					Tonality	AM	Impulse	
WTG.35	10/07/24 1:20pm – 1:30pm	4.4 m/s	314°	42 dB(A) [37 dB(A)]	No	No	No	Turbine clearly audible. Other noise from birds, traffic, car ticks, occasional clunks, and wind noise. Less tonal at higher wind speeds.
WTG.37	10/07/24 1:40pm – 1:50pm	4.6 m/s	320°	41 dB(A) [37 dB(A)]	Potential	No	No	Turbine clearly audible. Other noise from car ticks, occasional clunks, wind noise, birds, distant traffic. Possible tone when wind dies down.
WTG.39	10/07/24 2:00pm – 2:10pm	4.3 m/s	324°	39 dB(A) [36 dB(A)]	Potential	No	No	Turbine clearly audible. Other noise from birds, insects, car ticks, occasional clunks, wind in trees/grass. Possible tone at 80 Hz, though energy also in adjacent bands at times.
R63i	10/07/24 2:20pm – 2:50pm	4.7 m/s – 4.9 m/s	311° – 312°	34 dB(A) [29 dB(A)]	Potential	No	No	Turbines barely audible, only when background noise is low. Other noise from birds, insects, wind noise, distant traffic (?). Possible tone when background noise is low, as per the meter though it was inaudible, otherwise it was masked.
R103	10/07/24 3:05pm – 3:30pm	4.1 m/s – 4.8 m/s	313° – 328°	43 dB(A) [33 dB(A)]	No	No	No	Turbines inaudible. Other noise from birds, insects, livestock, metal banging, distant traffic.
R103i	10/07/24 3:35pm – 4:05pm	4.6 m/s – 4.9 m/s	327° – 344°	35 dB(A) [31 dB(A)]	Potential	No	No	Turbines audible. Other noise from birds, occasional clunks, and metal banging.
WTG.55	10/07/24 4:10pm – 4:20pm	4.3 m/s	346°	36 dB(A) [34 dB(A)]	Potential	No	No	Turbine clearly audible. Other noise from birds and wind in trees. Possible tone at 80 Hz and possible harmonic at 160 Hz.
R9i	11/07/24 8:20am – 8:45am	18.6 m/s – 19.2 m/s	354° – 357°	59 dB(A) [44 dB(A)]	No	No	No	Very strong winds. Upwind from turbines. Turbines inaudible. Other noise from wind, wind in trees, car ticks, tripod whistling.
R9	11/07/24 8:50am – 9:10am	19.6 m/s – 20.3 m/s	359° – 3°	51 dB(A) [50 dB(A)]	No	No	No	Windy. Upwind from turbines. Turbines inaudible. Noise from wind, wind in trees, and birds.

Location	Date/Time	Wind Speed	Wind Direction	Measured Noise Level – Leq [L90]	Special Audible Characteristics			Notes
					Tonality	AM	Impulse	
WTG.16	11/07/24 9:20am – 9:30am	17.6 m/s	7°	56 dB(A) [52 dB(A)]	No	No	No	Very windy. Downwind from turbine. Turbine audible. Other noise from wind, car ticks and rattles, tripod whistling, wind in trees.
WTG.1	11/07/24 9:45am – 9:55am	12.1 m/s – 12.8 m/s	10° – 11°	56 dB(A) [50 dB(A)]	No	No	No	Very windy. Approximately 45° from downwind. Turbine audible. Other noise from wind in grass, car ticks and rattles, birds, wind, tripod whistling and rattling.
R83	11/07/24 10:10am – 10:50am	12.3 m/s – 15.9 m/s	10° – 12°	50 dB(A) [47 dB(A)]	No	No	No	Windy. Turbines generally audible, but possibly barely audible at times. Other noise from birds, wind in trees, and traffic.
R79	11/07/24 10:55am – 11:15am	14.3 m/s – 15.3 m/s	6° – 8°	64 dB(A) [60 dB(A)]	No	No	No	Very windy. Turbines inaudible. Other noise from wind in trees and highway traffic.
R83i	11/07/24 11:20am – 11:50am	12.8 m/s – 14.1 m/s	7°	65 dB(A) [60 dB(A)]	No	No	No	Very windy. Turbines maybe audible. Mainly noise from wind and wind in trees, as well as some noise from traffic.
WTG.62	11/07/24 11:55am – 12:05pm	13.1 m/s – 14.7 m/s	3° – 5°	61 dB(A) [52 dB(A)]	Potential	No	No	Very windy. Turbine audible (crosswind). Other noise from highway traffic and wind blowing things around. Potential tone at 160 Hz, though it is often masked. Some trucks passing by were tonal.
R73i	11/07/24 12:10pm – 12:40pm	13.7 m/s – 15.1 m/s	3° – 8°	62 dB(A) [53 dB(A)]	No	No	No	Very windy. Turbines barely audible. Other noise from wind, sheep, traffic, tractor feeding sheep (some distance away).
WTG.66	11/07/24 12:45pm – 1:00pm	16.0 m/s – 16.6 m/s	2° – 4°	68 dB(A) [60 dB(A)]	No	No	No	Extremely windy. Turbine barely audible over wind noise and wind in trees.
WTG.68	11/07/24 1:05pm – 1:15pm	14.7 m/s – 14.9 m/s	359° – 4°	63 dB(A) [52 dB(A)]	Potential	No	No	Very windy. Turbine audible. Noise from car rattles, windborne dust, and wind noise. Potential tone at 160 Hz, but typically masked.

Location	Date/Time	Wind Speed	Wind Direction	Measured Noise Level – Leq [L90]	Special Audible Characteristics			Notes
					Tonality	AM	Impulse	
R108	11/07/24 1:20pm – 1:40pm	14.8 m/s – 15.5 m/s	3°	62 dB(A) [58 dB(A)]	No	No	No	Windy. Turbines inaudible. Other noise from wind in trees and traffic on highway.
R69	11/07/24 1:45pm – 2:05pm	16.2 m/s – 18.6 m/s	353° – 359°	65 dB(A) [61 dB(A)]	No	No	No	Very windy. Turbines inaudible. Noise from wind in trees, traffic on highway, general clanking of things in the wind.
R70	11/07/24 2:05pm – 2:25pm	18.6 m/s – 18.9 m/s	353° – 359°	69 dB(A) [65 dB(A)]	No	No	No	Very windy. Turbines inaudible. Noise from wind in trees and highway traffic.
R27	11/07/24 2:35pm – 3:00pm	16.1 m/s – 18.4 m/s	357° – 359°	52 dB(A) [48 dB(A)]	No	No	No	Windy. Turbines inaudible. Noise from wind in trees, highway traffic, sheep, windmill creaking.

As per the NCTP, the periods where possible tonality was noted during the attended observations were further analysed in accordance with the International Standard *ISO 1996-2:2017 Acoustics – Description, measurement and assessment of environmental noise – Part 2: Determination of sound pressure levels (ISO 1996)* as well as the publicly available specification *ISO/PAS 20065 Acoustics – Objective method for assessing the audibility of tones in noise – Engineering Method (ISO/PAS 20065)* which is referenced by ISO 1996.

Based on this further analysis, tonality was confirmed to be present on a number of occasions for a frequency of 80 Hz. In addition, a single period of tonality was found at a frequency of 600 Hz from an observation in close proximity to WTG.55 While it is noted that the method detected tones at some other frequencies, upon further review, these were confirmed to be from sources other than the Wind Farm such as wind on the microphone and planes. As such, they were not be considered further.

6 RESIDENTIAL LOGGING

The A-weighted noise levels (L_{A90}) at each of the residential logging locations were measured continuously in 10-minute intervals between 15 May 2024 and 13 August 2024 (summarised in Table 10), which resulted in 8 weeks of data at each location. Table 10 shows the locations at which the noise monitoring equipment was placed. Due to equipment failures (power failure, memory card error), the noise monitoring period at receivers 10i and 83 were extended to ensure sufficient data was captured.

Table 10: Residential Monitoring Details

Monitoring Location	Location Type	Coordinates (UTM WGS84 54H)		Serial Number	Monitoring Period
		Easting	Northing		
9	Residential	724082	5799803	00240810	16/05/2024 – 11/07/2024
9i	Intermediate	723782	5799571	00710426	16/05/2024 – 11/07/2024
10i	Proxy	719495	5797558	00320648 00320657*	15/05/2024 – 13/08/2024
18	Residential	719407	5803691	00320654	15/05/2024 – 10/07/2024
18i	Intermediate	719397	5803038	00331170	16/05/2024 – 10/07/2024
27	Residential	716502	5793909	00331171	15/05/2024 – 11/07/2024
55(S)	Proxy	719596	5799932	00331168	15/05/2024 – 10/07/2024
56i	Proxy	720028	5799363	00220549	16/05/2024 – 10/07/2024
58i	Proxy	718630	5801562	00320657	15/05/2024 – 10/07/2024
63i	Proxy	722094	5796388	00331169	15/05/2024 – 10/07/2024
69	Residential	718552	5793662	00710391	15/05/2024 – 11/07/2024
70	Residential	718329	5793764	00710393	15/05/2024 – 11/07/2024
73i	Proxy	718069	5792486	00520898	16/05/2024 – 11/07/2024
79	Residential	719983	5793109	01130807	15/05/2024 – 11/07/2024
80	Residential	719713	5793378	00240808	16/05/2024 – 10/07/2024
83	Residential	721514	5791421	00220543	15/05/2024 – 13/08/2024
83i	Intermediate	721658	5791863	00598175	15/05/2024 – 11/07/2024
103	Residential	723418	5793861	00320656	16/05/2024 – 10/07/2024
103i	Intermediate	722532	5793724	00320646	15/05/2024 – 10/07/2024
108	Residential	718498	5793431	00320647	15/05/2024 – 11/07/2024

* Due to an equipment error, the noise logger at this location was replaced with an alternate unit.

At each of the monitoring locations, Rion NL-52, NL-52A, or NL-53, NATA calibrated, Class 1 sound level meters with a noise floor of less than 20 dB(A) were deployed. The serial numbers of the sound level meters are provided in Table 10 and the calibration certificates are provided in Appendix C. An example of an on-site setup can be seen in Figure 5.



Figure 5: Typical On-Site Noise Monitoring Setup

The sound level meters were calibrated before and after the background noise monitoring regime with a Class 1 Rion NC-75 calibrator (with serial number 34913547) and the microphones were fitted with Rion WS 15 all-weather wind shields.

At each of the residential logging locations, noise monitoring equipment was placed at the equivalent position to the background noise monitoring location, prior to construction of the Wind Farm. Photographs of the noise logging equipment at each residential logging location are provided in Appendix D.

In addition to the noise logging, local wind speed logging was conducted at two locations (receivers 70 and 83) using Rainwise wind data loggers. It is noted that local wind speed logging was also conducted at 55(S), however the data was corrupted and not useable. Local rainfall data were collected using Rainwise rain loggers at three locations (receivers 55(S), 70, and 83). The rainfall data and the measured wind speed at the microphone height were used to identify periods when data might have been adversely affected by weather. For locations where the local weather logging equipment was not deployed, data from the closest weather logger has been used in the analysis.

During the noise monitoring regime, wind speed and direction were monitored at a number of locations around the Wind Farm. The meteorological mast used for this purpose during the pre-construction noise monitoring, BB3, has since been decommissioned. To this end, a data set has been synthesised by GPG, before being provided to Sonus, based on wind speed and direction measurements taken at turbines WTG-15, WTG-31, and WTG-37. The data were analysed to provide a hub height (112m) data set in 10-minute intervals free from wake effects at the location of BB3. The process used for the analysis is summarised in the GPG document titled “Wind Data for Far Field Noise Test”, with reference “31205I00319”, and dated 1 December 2022. This document has been included as Appendix E. It is noted that this document was prepared for the previous round of noise monitoring. It is understood that the same process has been used for this round of noise monitoring.

6.1 Data Analysis

Data have been filtered out where it can be seen to be influenced by sources of noise other than the Wind Farm. This has been done for the following reasons:

- Where data are affected by local weather such as rain or high winds at the microphone location. Data is considered to be affected by weather where rain is detected in the 10-minute period or the period either side of the period in question, or where the local wind speed is greater than 5 m/s for more than 90% of a 10-minute period.
- Where data is exposed to a high level of extraneous noise, such as from domestic machinery, agricultural operations, or elevated noise from birds, frogs, or insects in accordance with the procedure outlined in the NCTP. A 10-minute period is considered to be adversely affected by extraneous noise where the highest A-weighted one-third octave band noise level is greater than 1 kHz, is greater than a level of 20 dB L_{A90} , and is within 5 dB of the broadband A-weighted noise level for the period in question.
- Where the hub height wind speed is below the cut-in wind speed of the turbine (3 m/s) or above the approximate wind speed of rated power (13 m/s), as detailed in the NCTP.

- Where data is considered to be abnormal, such as during the setup and collection of the noise monitoring equipment.
- Where the Wind Farm is not operating in a normal manner, which is considered to be where any relevant turbines are not available to generate power or operate in a non-standard mode. A noise model of the Wind Farm has been produced to aid in determining when the Wind Farm is not operating normally. This was done using the ISO 9613-2¹ noise propagation model as implemented in the SoundPLANnoise noise modelling software and with the inputs recommended by the Institute of Acoustics². Turbines which are not operating normally are not considered to be relevant where the predicted noise levels (when operating) collectively result in a level 15 dB lower than the predicted noise level for the Wind Farm as a whole at that location. This will ensure that these turbines, if operating normally, would contribute 0.1dB or less to the overall noise level.
- Where the noise at the monitoring location can be seen to be from a source other than the Wind Farm with reference to measurements taken at an intermediate location. Noise at a monitoring location that is higher than the noise measured at an intermediate location during the same period is considered to be background noise affected in accordance with the NCTP and can be removed from further analysis.
- The time periods used for the background noise analysis were limited to exclude any potential impacts from construction activities. To remain consistent with this approach and enable a comparison with the criteria determined from this background noise data, data between 7:00am and 5:00pm has been removed from further analysis.
- The background noise monitoring conducted by MDA noted that there were distinct trends in the background noise data between the day and night periods at two locations, receivers 83i and 103i. It has been assumed that these trends would also have been identified at receivers 83 and 103 if background noise monitoring could have been conducted at these locations. The NCTP requires that where distinctive trends are identified, a subset of the data must be defined and analysed separately. This subset of data, as defined by MDA, includes all data between 10:00pm and 5:00am at receivers 83i and 103i, and has been extended to include data between the same times for receivers 83 and 103. The NCTP requires that a separate analysis be completed for these subsets in addition to the analysis of the main set of data. The data has therefore been further filtered to only include points within this subset for additional analysis.

¹ ISO 9613-2:1996 "Acoustics — Attenuation of sound during propagation outdoors — Part 2: General method of calculation"

² A Good Practice Guide to the Application of ETSU-R-97 for the Assessment and Rating of Wind Turbine Noise, May 2013

The NCTP notes that in order to determine the contribution of noise from the Wind Farm in isolation, the background noise levels should be subtracted from the measured noise levels. This, however, is only valid where the same data filtering procedures have been used for the background and compliance monitoring regimes. Where additional data filtering has occurred, such as using measurements taken at an intermediate location, the subtraction of background noise is no longer valid. It is noted that not subtracting the background noise levels represents a conservative approach, as the measured noise levels will contain noise from sources other than the Wind Farm. Background noise levels have not been subtracted from the measured noise levels at any location as part of this analysis.

Following the data removal process, the remaining noise data were correlated with the hub height referenced wind speed data for each residential logging location. Table 11 provides the number of valid data points for each period following the filtering of data.

Table 11: Valid Data Points

Receiver	Collected Data Points	Valid Data Points Full Period	Valid Data Points Night Period
9	8060	3031	-
10i	7831	2865	-
18	8059	3303	-
27	8220	3210	-
55(S)	8070	3075	-
56i	7925	3040	-
58i	8068	3652	-
63i	8052	3146	-
69	8226	3389	-
70	8225	3352	-
73i	8064	3502	-
79	8125	3456	-
80	7918	3309	-
83	8784	3773	1858
103	7932	3302	1614
108	8211	3389	-

6.2 Special Audible Characteristics

Based on the results of the attended observations and nearfield testing, it has been confirmed that there is the potential for tonality to be present in the noise profile of the turbine. As such, a further assessment of tonality at the residential logging locations has been undertaken in accordance with ISO 1996 and ISO/PAS 20065. Consideration has been given to the frequencies at which tones were identified based on the attended observations and nearfield noise testing.

Where an audible tone was identified at a residential logging location in a specific 10-minute period, a penalty was applied to the noise level for that period based on the tonal audibility. The penalty ranges from 1 dB to 6 dB in accordance with table J.1 of ISO 1996.

6.3 Residential Logging Results

The operational noise data collected at each residential logging location, following data removal and addition of SAC penalties, were correlated with the wind speed at the synthesised meteorological mast for a hub height of 112m for each 10-minute period.

A least squares regression analysis of the data was undertaken to find the line of best fit for the correlations to determine the measured noise level. The results of the analysis have been summarised in the following tables. It is noted that all results have been rounded to the nearest integer, as is common industry practice, which can result in the appearance that there is an error. All calculations were conducted on the pre-rounded values. The data and regression curves used for the analysis are shown on the figures in Appendix F.

For each 10-minute period where a tone was identified in the frequencies of interest, a penalty was added to the measured noise level for that period. A regression analysis was then performed on the dataset with penalties applied to determine the post construction noise level. In order to quantify the impact of the SAC penalty, a regression analysis was also completed for the dataset without penalties applied. The SAC penalty is then reported as the difference between the levels from these two regression analyses at each integer wind speed. Figure 6 shows an example of the application of SAC penalties and how this effects the measured noise level.



Figure 6: Example of Application of Penalty for SACs

The NCTP notes that data measured at an intermediate location may be used to inform an assessment of the Wind Farm at the compliance monitoring locations. One method for doing this is through extrapolation, where data measured at an intermediate location is extrapolated to the compliance location in accordance with ISO 1996. ISO 1996 provides two methods for extrapolation, using either calculations or measurements. Where calculations are to be used, as has been done here, a suitable calculation methodology must be chosen. ISO 1996 notes that one such methodology is ISO 9613. Noise predictions have therefore been conducted using ISO 9613 and the noise model noted in Section 6.1. The difference in predicted noise level between the intermediate location and the compliance location is defined as the propagation correction. The NCTP notes that an uncertainty margin of ± 1 dB must also be included. 1 dB has therefore been added to the calculated value for propagation. It is noted that this is a conservative approach, as the noise will be reduced by a lesser amount between the intermediate and compliance locations.

6.3.1 Receiver 9

Receiver 9 is a residential location where background noise monitoring was not previously conducted. It has therefore been assessed against the baseline noise criteria of 40 dB(A) at all wind speeds. The results of the analysis can be seen in Table 12. The results indicate that the relevant criteria are achieved at this receiver.

Table 12: Receiver 9 Compliance Analysis

Acoustic Descriptor, [dB(A)]	Hub Height (112m) Wind Speed, m/s										
	3	4	5	6	7	8	9	10	11	12	13
Measured Noise Level, L_{A90}	18	21	24	26	29	30	32	33	34	35	35
SAC Penalty	4	3	2	1	1	-	-	-	-	0	1
Noise Level with Penalty, L_{A90}	22	24	26	28	29	30	32	33	34	35	37
Noise Level Criteria, L_{Aeq}	40	40	40	40	40	40	40	40	40	40	40
Compliance	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

6.3.2 Receiver 10i

Receiver 10i is a proxy location for receiver 10. Background noise monitoring was previously conducted at receiver 10i. It has been assessed against the baseline noise criteria of 40 dB(A) at all wind speeds. Consideration has also been given to the difference in propagation between the proxy and residential locations. The results of the analysis can be seen in Table 13. The results indicate that the relevant criteria are achieved at this receiver.

Table 13: Receiver 10i Compliance Analysis

Acoustic Descriptor, [dB(A)]	Hub Height (112m) Wind Speed, m/s										
	3	4	5	6	7	8	9	10	11	12	13
Measured Noise Level, L_{A90}	26	30	33	35	37	39	41	42	43	45	45
SAC Penalty	5	4	3	2	1	0	-	-	-	-	1
Propagation Correction	-6	-6	-6	-6	-6	-6	-6	-6	-6	-6	-6
Corrected Noise Level with Penalty, L_{A90}	25	28	29	31	32	34	35	36	37	38	39
Noise Level Criteria, L_{Aeq}	40	40	40	40	40	40	40	40	40	40	40
Compliance	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

6.3.3 Receiver 18

Receiver 18 is a residential location. Background noise monitoring was previously conducted at a proxy location receiver 18i. It has been assessed against the baseline noise criteria of 40 dB(A) at all wind speeds. The results of the analysis can be seen in Table 14. The results indicate that the relevant criteria are achieved at this receiver.

Table 14: Receiver 18 Compliance Analysis

Acoustic Descriptor, [dB(A)]	Hub Height (112m) Wind Speed, m/s										
	3	4	5	6	7	8	9	10	11	12	13
Measured Noise Level, L_{A90}	22	24	26	28	29	31	32	34	34	35	35
SAC Penalty	4	3	3	2	1	0	-	-	-	0	1
Noise Level with Penalty, L_{A90}	26	27	28	29	30	31	32	34	34	35	36
Noise Level Criteria, L_{Aeq}	40	40	40	40	40	40	40	40	40	40	40
Compliance	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

6.3.4 Receiver 27

Receiver 27 is a residential location where background noise monitoring was previously conducted. It has been assessed against criteria determined based on the background noise monitoring. The results of the analysis can be seen in Table 15. The results indicate that the relevant criteria are achieved at this receiver.

Table 15: Receiver 27 Compliance Analysis

Acoustic Descriptor, [dB(A)]	Hub Height (112m) Wind Speed, m/s										
	3	4	5	6	7	8	9	10	11	12	13
Measured Noise Level, L_{A90}	21	24	26	28	29	30	31	32	34	35	37
SAC Penalty	5	4	3	2	1	0	-	-	-	0	1
Noise Level with Penalty, L_{A90}	26	28	29	30	30	31	31	32	34	35	38
Noise Level Criteria, L_{Aeq}	40	40	40	40	40	40	40	40	40	42	44
Compliance	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

6.3.5 Receiver 55(S)

Receiver 55(S) is a proxy location for receiver 57. Background noise monitoring was previously conducted at receiver 55(S). It has been assessed against criteria determined based on the background noise monitoring at this location. The results of the analysis can be seen in Table 16. The results indicate that the relevant criteria are achieved at this receiver.

Table 16: Receiver 55(S) Compliance Analysis

Acoustic Descriptor, [dB(A)]	Hub Height (112m) Wind Speed, m/s										
	3	4	5	6	7	8	9	10	11	12	13
Measured Noise Level, L_{A90}	20	22	25	27	29	31	34	36	38	39	41
SAC Penalty	4	4	3	2	1	0	-	-	-	0	1
Noise Level with Penalty, L_{A90}	25	26	27	29	30	31	34	36	38	40	43
Noise Level Criteria, L_{Aeq}	40	40	40	40	40	40	40	40	42	45	47
Compliance	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

6.3.6 Receiver 56i

Receiver 56i is a proxy location for receiver 56. Background noise monitoring was previously conducted at receiver 56i. It has been assessed against the baseline noise criteria of 40 dB(A) at all wind speeds. The results of the analysis can be seen in Table 17. The results indicate that the relevant criteria are achieved at this receiver.

Table 17: Receiver 56i Compliance Analysis

Acoustic Descriptor, [dB(A)]	Hub Height (112m) Wind Speed, m/s										
	3	4	5	6	7	8	9	10	11	12	13
Measured Noise Level, L_{A90}	21	24	27	29	32	33	35	36	37	38	39
SAC Penalty	5	4	3	2	1	0	-	-	-	0	2
Noise Level with Penalty, L_{A90}	26	28	30	31	33	34	35	36	37	38	40
Noise Level Criteria, L_{Aeq}	40	40	40	40	40	40	40	40	40	40	40
Compliance	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

6.3.7 Receiver 58i

Receiver 58i is a proxy location for receiver 58. Background noise monitoring was previously conducted at receiver 58i. It has been assessed against the baseline noise criteria of 40 dB(A) at all wind speeds. Consideration has also been given to the difference in propagation between the proxy and residential locations. The results of the analysis can be seen in Table 18. The results indicate that the relevant criteria are achieved at this receiver.

Table 18: Receiver 58i Compliance Analysis

Acoustic Descriptor, [dB(A)]	Hub Height (112m) Wind Speed, m/s										
	3	4	5	6	7	8	9	10	11	12	13
Measured Noise Level, L_{A90}	25	29	31	34	36	38	39	41	41	42	42
SAC Penalty	4	4	3	2	1	0	-	-	-	0	2
Propagation Correction	-6	-6	-6	-6	-6	-6	-6	-6	-6	-6	-6
Corrected Noise Level with Penalty, L_{A90}	23	26	28	30	31	32	33	34	35	36	38
Noise Level Criteria, L_{Aeq}	40	40	40	40	40	40	40	40	40	40	40
Compliance	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

6.3.8 Receiver 63i

Receiver 63i is a proxy location for receivers 63 and 102. Background noise monitoring was previously conducted at receiver 63i. It has been assessed against the baseline noise criteria of 40 dB(A) at all wind speeds. The results of the analysis can be seen in Table 19. The results indicate that the relevant criteria are achieved at this receiver.

Table 19: Receiver 63i Compliance Analysis

Acoustic Descriptor, [dB(A)]	Hub Height (112m) Wind Speed, m/s										
	3	4	5	6	7	8	9	10	11	12	13
Measured Noise Level, L_{A90}	20	23	26	28	30	32	33	34	35	36	37
SAC Penalty	5	3	2	1	0	-	-	-	-	0	1
Noise Level with Penalty, L_{A90}	24	26	28	29	31	32	33	34	35	37	38
Noise Level Criteria, L_{Aeq}	40	40	40	40	40	40	40	40	40	40	40
Compliance	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

6.3.9 Receiver 69

Receiver 69 is a residential location where background noise monitoring was previously conducted. It has been assessed against criteria determined based on the background noise monitoring. The results of the analysis can be seen in Table 20. The results indicate that the relevant criteria are achieved at this receiver.

Table 20: Receiver 69 Compliance Analysis

Acoustic Descriptor, [dB(A)]	Hub Height (112m) Wind Speed, m/s										
	3	4	5	6	7	8	9	10	11	12	13
Measured Noise Level, L_{A90}	25	26	28	29	31	33	34	36	38	40	41
SAC Penalty	3	2	1	1	0	0	-	-	-	0	1
Noise Level with Penalty, L_{A90}	27	28	29	30	32	33	34	36	38	40	42
Noise Level Criteria, L_{Aeq}	40	40	40	40	40	40	40	41	43	46	48
Compliance	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

6.3.10 Receiver 70

Receiver 70 is a residential location where background noise monitoring was previously conducted. It has been assessed against criteria determined based on the background noise monitoring. The results of the analysis can be seen in Table 21. The results indicate that the relevant criteria are achieved at this receiver.

Table 21: Receiver 70 Compliance Analysis

Acoustic Descriptor, [dB(A)]	Hub Height (112m) Wind Speed, m/s										
	3	4	5	6	7	8	9	10	11	12	13
Measured Noise Level, L_{A90}	21	24	26	28	30	32	35	37	38	40	42
SAC Penalty	3	2	2	1	1	0	-	-	-	0	1
Noise Level with Penalty, L_{A90}	24	26	28	29	31	33	35	37	38	41	43
Noise Level Criteria, L_{Aeq}	40	40	40	40	40	40	40	41	43	46	49
Compliance	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

6.3.11 Receiver 73i

Receiver 73i is a proxy location for receiver 73. Background noise monitoring was previously conducted at receiver 73i. It has been assessed against the baseline noise criteria of 40 dB(A) at all wind speeds. The results of the analysis can be seen in Table 22. The results indicate that the relevant criteria are achieved at this receiver.

Table 22: Receiver 73i Compliance Analysis

Acoustic Descriptor, [dB(A)]	Hub Height (112m) Wind Speed, m/s										
	3	4	5	6	7	8	9	10	11	12	13
Measured Noise Level, L_{A90}	23	27	30	32	34	35	36	36	37	37	38
SAC Penalty	6	4	3	2	1	0	-	-	-	0	1
Noise Level with Penalty, L_{A90}	29	31	33	34	35	35	36	36	37	38	39
Noise Level Criteria, L_{Aeq}	40	40	40	40	40	40	40	40	40	40	40
Compliance	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

6.3.12 Receiver 79

Receiver 79 is a residential location where background noise monitoring was not previously conducted. Background noise monitoring was previously conducted at receiver 80 from which criteria were determined. The results of the analysis can be seen in Table 23. The results indicate that the relevant criteria are achieved at this receiver.

Table 23: Receiver 79 Compliance Analysis

Acoustic Descriptor, [dB(A)]	Hub Height (112m) Wind Speed, m/s										
	3	4	5	6	7	8	9	10	11	12	13
Measured Noise Level, L_{A90}	24	25	27	29	30	32	34	36	37	39	41
SAC Penalty	3	2	2	1	0	0	-	-	-	0	1
Noise Level with Penalty, L_{A90}	27	28	29	30	31	32	34	36	37	39	41
Noise Level Criteria, L_{Aeq}	40	40	40	40	40	40	40	40	40	41	43
Compliance	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

6.3.13 Receiver 80

Receiver 80 is a residential location where background noise monitoring was previously conducted. It has been assessed against criteria determined based on the background noise monitoring. The results of the analysis can be seen in Table 24. The results indicate that the relevant criteria are achieved at this receiver.

Table 24: Receiver 80 Compliance Analysis

Acoustic Descriptor, [dB(A)]	Hub Height (112m) Wind Speed, m/s										
	3	4	5	6	7	8	9	10	11	12	13
Measured Noise Level, L_{A90}	24	26	27	29	31	32	34	36	38	39	40
SAC Penalty	2	2	1	1	0	0	-	-	-	0	0
Noise Level with Penalty, L_{A90}	27	27	28	29	31	32	34	36	38	39	40
Noise Level Criteria, L_{Aeq}	40	40	40	40	40	40	40	40	40	41	43
Compliance	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

6.3.14 Receiver 83

Receiver 83 is a residential location where background noise monitoring was not previously conducted. Background noise monitoring was conducted at receiver 83i, which was a proxy location during the background noise monitoring regime. Based on the background noise levels measured at 83i it was determined that there were obvious trends between the day and night periods. Therefore, an additional analysis of the night period (determined based on the background noise monitoring to be between 10:00pm and 5:00am) is required as per the NCTP. The results of the analysis can be seen in Table 25 for the full period and Table 26 for the night period.

Table 25: Receiver 83 Compliance Analysis

Acoustic Descriptor, [dB(A)]	Hub Height (112m) Wind Speed, m/s										
	3	4	5	6	7	8	9	10	11	12	13
Measured Noise Level, L_{A90}	23	25	27	29	31	33	35	37	39	40	42
SAC Penalty	6	4	3	1	1	0	-	-	-	0	0
Noise Level with Penalty, L_{A90}	29	29	30	31	32	33	35	37	39	40	42
Noise Level Criteria, $L_{Aeq}^{[3]}$	40	40	40	40	40	40	40	40	40	40	40
Compliance	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	-

^[3] These are the lowest criteria which could apply, as no background noise monitoring was conducted at this location. Based on the background noise levels measured at receiver 83i and the increase in noise at high wind speeds, it is likely that the criteria at high wind speeds would have been significantly higher if background noise monitoring was conducted.

Table 26: Receiver 83 Night Period Compliance Analysis

Acoustic Descriptor, [dB(A)]	Hub Height (112m) Wind Speed, m/s										
	3	4	5	6	7	8	9	10	11	12	13
Measured Noise Level, L_{A90}	22	24	27	29	31	33	35	37	38	40	42
SAC Penalty	6	4	2	1	0	-	-	-	-	0	0
Noise Level with Penalty, L_{A90}	28	28	29	30	31	33	35	37	38	40	42
Noise Level Criteria, $L_{Aeq}^{[3]}$	40	40	40	40	40	40	40	40	40	40	40
Compliance	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	-

The NCTP notes that where the influence of background noise precludes a definitive assessment of compliance, a supplementary assessment shall be undertaken. As background noise monitoring was not conducted at this location, reference has been made to the noise level versus wind speed profile to determine whether the measured noise is influenced by background noise. The profile determined from the nearfield testing indicates that the noise level emitted by the wind turbines does not increase above a wind speed of 10 m/s, and only increases by 2 dB(A) between 7 m/s and 10 m/s. As the noise level at the receiver location continues to increase significantly above these wind speeds, it can be determined that the measured noise is heavily influenced by background noise. Figure 7 shows the expected noise level based on the noise level versus wind speed profile.

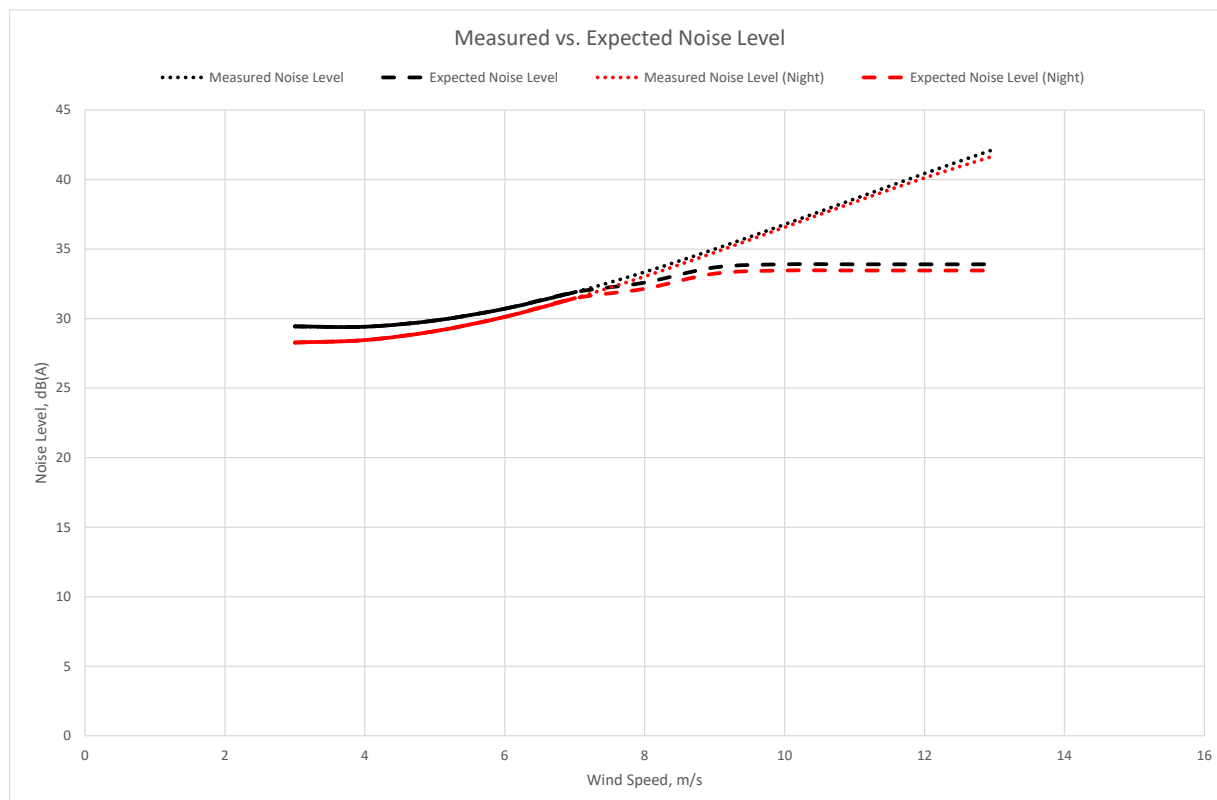


Figure 7: Receiver 83 Measured vs. Expected Noise Level

The figure above shows that if the measured noise levels followed the profile expected from the noise emitted by the Wind Farm only, without any influence from background noise, the noise at the receiver will easily comply with the relevant criteria.

As background noise monitoring was conducted at the intermediate location, receiver 83i, consideration has also been given to compliance at this location if the residence were to be located here at a position closer to the Wind Farm. Additional analysis has therefore been conducted at receiver 83i and compared to criteria determined based on the measured background noise levels. The results of this analysis can be seen in Table 27 for the full period and Table 28 for the night period.

Table 27: Receiver 83i Compliance Analysis

Acoustic Descriptor, [dB(A)]	Hub Height (112m) Wind Speed, m/s										
	3	4	5	6	7	8	9	10	11	12	13
Measured Noise Level, L_{A90}	23	27	29	32	34	36	38	39	41	44	46
SAC Penalty	5	4	3	2	1	0	-	-	-	0	1
Noise Level with Penalty, L_{A90}	29	30	32	33	35	36	38	39	41	44	47
Noise Level Criteria, L_{Aeq}	40	40	40	40	40	41	43	44	46	47	48
Compliance	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

Table 28: Receiver 83i Night Period Compliance Analysis

Acoustic Descriptor, [dB(A)]	Hub Height (112m) Wind Speed, m/s										
	3	4	5	6	7	8	9	10	11	12	13
Measured Noise Level, L_{A90}	22	26	29	31	34	36	37	39	41	43	45
SAC Penalty	6	4	3	1	1	-	-	-	-	0	1
Noise Level with Penalty, L_{A90}	28	30	31	33	34	36	37	39	41	43	46
Noise Level Criteria, L_{Aeq}	40	40	40	40	40	40	41	43	44	45	46
Compliance	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

Given the above analysis, the Wind Farm will comply at receiver 83i if it were considered to be a sensitive receiver. This provides a further indication of compliance at receiver 83.

The difficulty at this location is due to the lack of background noise measurements at the residential location. The background noise levels at the intermediate location are generally higher than the post construction noise levels measured at the residential location. Consideration should therefore be given to the source of the high background noise, which is the large trees along the road close to these two locations. Due to the proximity of the noise monitoring equipment to these trees, this is the likely source of the elevated background noise levels experienced at high wind speeds at these locations and the reason why the measured noise levels are higher than expected for wind turbine noise.

6.3.15 Receiver 103

Receiver 103 is a residential location where background noise monitoring was not previously conducted. Background noise monitoring was conducted receiver 103i, which was a proxy location during the background noise monitoring regime. It has been assessed against the baseline noise criteria of 40 dB(A) at all wind speeds. Based on the background noise levels measured at 103i it was determined that there were obvious trends between the day and night periods. Therefore, an additional analysis of the night period (determined based on the background noise monitoring to be between 10:00pm and 5:00am) is required as per the NCTP. The results of the analysis can be seen in Table 29 for the full period and Table 30 for the night period. The results indicate that the relevant criteria are achieved at this receiver for both time periods.

Table 29: Receiver 103 Compliance Analysis

Acoustic Descriptor, [dB(A)]	Hub Height (112m) Wind Speed, m/s										
	3	4	5	6	7	8	9	10	11	12	13
Measured Noise Level, L_{A90}	21	24	26	28	30	32	33	35	36	38	39
SAC Penalty	5	4	3	2	1	0	-	-	-	0	1
Noise Level with Penalty, L_{A90}	26	27	29	30	31	32	33	35	36	38	40
Noise Level Criteria, L_{Aeq}	40	40	40	40	40	40	40	40	40	40	40
Compliance	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

Table 30: Receiver 103 Night Period Compliance Analysis

Acoustic Descriptor, [dB(A)]	Hub Height (112m) Wind Speed, m/s										
	3	4	5	6	7	8	9	10	11	12	13
Measured Noise Level, L_{A90}	20	23	26	28	30	32	33	35	36	37	38
SAC Penalty	5	4	3	2	1	0	-	-	-	0	1
Noise Level with Penalty, L_{A90}	25	27	28	30	31	32	33	35	36	37	39
Noise Level Criteria, L_{Aeq}	40	40	40	40	40	40	40	40	40	40	40
Compliance	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

6.3.16 Receiver 108

Receiver 108 is a residential location where background noise monitoring was previously conducted. It has been assessed against criteria determined based on the background noise monitoring. The results of the analysis can be seen in Table 31. The results indicate that the relevant criteria are achieved at this receiver.

Table 31: Receiver 108 Compliance Analysis

Acoustic Descriptor, [dB(A)]	Hub Height (112m) Wind Speed, m/s										
	3	4	5	6	7	8	9	10	11	12	13
Measured Noise Level, L_{A90}	21	23	25	27	29	31	33	35	38	40	42
SAC Penalty	4	3	2	1	1	0	-	-	-	0	1
Noise Level with Penalty, L_{A90}	25	26	27	28	30	31	33	35	38	40	43
Noise Level Criteria, L_{Aeq}	40	40	40	40	40	40	41	43	46	48	50
Compliance	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

6.4 Noise Monitoring Outcomes

From the above tables, it can be seen that, with the exception of receiver 83, the noise criteria were achieved at all residential logging locations for all assessment periods. At receiver 83, the difficulty is due to the lack of background noise monitoring for this residence. The nearfield noise monitoring shows that there is no increase in noise emissions at high wind speeds, therefore an increase in noise level at these wind speeds cannot be associated with the Wind Farm and must therefore be related to background noise. The background noise levels at high wind speeds, which is associated with wind in trees, is therefore higher than the base noise criteria. As such, it can be determined that the Wind Farm is in compliance with the Approval conditions.

If further analysis is required for receiver 83, it is recommended that on/off testing be conducted, where subsequent measurements are taken with and without the Wind Farm operating.

7 CONCLUSION

Post construction noise monitoring was completed for the Berrybank Wind Farm for the purpose of determining compliance with the Approval conditions. The monitoring was conducted in accordance with the procedures described in the Noise Compliance Test Plan and Condition 19 of the Approval. The results of the post construction noise monitoring were assessed against criteria determined in accordance with the New Zealand Standard and previous background noise measurements conducted by Marshall Day Acoustics.

This assessment also considered the potential impacts of special audible characteristics including tonality, amplitude modulation, and impulsiveness. It was found that amplitude modulation and impulsiveness were not a character of the wind turbine, however tonality was found to be present and has been penalised in accordance with the relevant standards.

For receiver 83, high noise levels were recorded at high wind speeds. As no background noise monitoring was conducted, the increase in noise at these wind speeds could not be directly identified as being emitted from the Wind Farm or from other sources (wind in trees in particular). An analysis of noise emissions from turbines demonstrated that the increase in noise at the residence at higher wind speeds was not associated with the Wind Farm.

Based on the assessment, the results of the post construction noise monitoring indicate that the Wind Farm complied with the Approval conditions at all assessment locations.

APPENDIX A: ACOUSTIC RELATED APPROVAL CONDITIONS

Appendix A.1: Golden Plains Shire Approval Conditions

NOISE STANDARD

17. Except as provided below in this condition, the operation of the wind energy facility must comply with New Zealand Standard 6808:2010 '*Acoustics - Wind farm noise*' at any noise sensitive location that existed at 3 April 2017, to the satisfaction of the Minister for Planning.

The limits specified under this condition do not apply if an agreement has been entered into with the relevant landowner waiving the limits. Evidence of the agreement must be provided to the satisfaction of the Minister for Planning upon request, and be in a form that applies to the land for the life of the wind energy facility.

NOISE COMPLIANCE ASSESSMENT

19. Before the development starts a noise compliance testing plan must be prepared by a suitably qualified acoustics expert to the satisfaction of the Minister for Planning.

When approved, the noise compliance testing plan will be endorsed by the Minister for Planning and will then form part of this permit.

The noise testing must be carried out in accordance with the noise compliance testing plan to the satisfaction of the Minister for Planning.

The noise compliance testing plan must include:

- a) a determination of the noise limits to be applied during construction using the methodology prescribed in the EPA Noise Control Guidelines - publication 1254 released October 2008;
- b) a program of compliance testing to be implemented during the construction of the wind energy facility that:
 - (i) Is designed by a suitably qualified acoustic expert, and
 - (ii) Utilises the methodology prescribed in *State Environment Protection Policy (Control of Noise from Commerce, Industry and Trade) No N-1*, to demonstrate compliance with the limits determined in (a) above;
- c) a procedure for a near field compliance test of the first turbine commissioned at the wind energy facility; and
- d) a procedure for a final compliance test of the wind energy facility after the commissioning of the last turbine, such testing to:

- (i) consider compliance of the operational wind energy facility as a whole with the noise limits set under condition 17;
- (ii) be carried out according to the method described in NZS6808:2010 '*Acoustics – Wind farm noise*'; and
- (iii) be submitted to the responsible authority within 6 months of the first turbine operating. Further post-construction acoustic compliance reports prepared in accordance with this condition must be submitted to the responsible authority annually from the date of the first report being submitted until the final turbine is operating.

The final compliance testing report provided to the Minister for Planning must include a summary of the results in terms that are aimed at a lay person, and must be accompanied by a report by an environmental auditor appointed under the Environment Protection Act 1970, containing the auditor's opinion on the methodology of the compliance testing.

If the proponent considers that a suitable auditor cannot be engaged, the proponent may seek the written consent of the Minister for Planning to obtain an independent peer review of the results of the noise compliance testing instead.

Compliance test results must be publicly available.

Appendix A.2: Corangamite Shire Approval Conditions

NOISE STANDARD

17. Except as provided below in this condition, the operation of the wind energy facility must comply with New Zealand Standard 6808:2010 '*Acoustics - Wind farm noise*' at any noise sensitive location that existed at 3 April 2017, to the satisfaction of the Minister for Planning.

The limits specified under this condition do not apply if an agreement has been entered into with the relevant landowner waiving the limits. Evidence of the agreement must be provided to the satisfaction of the Minister for Planning upon request, and be in a form that applies to the land for the life of the wind energy facility.

NOISE COMPLIANCE ASSESSMENT

19. Before the development starts a noise compliance testing plan must be prepared by a suitably qualified acoustics expert to the satisfaction of the Minister for Planning.

When approved, the noise compliance testing plan will be endorsed by the Minister for Planning and will then form part of this permit.

The noise testing must be carried out in accordance with the noise compliance testing plan to the satisfaction of the Minister for Planning.

The noise compliance testing plan must include:

- a) a determination of the noise limits to be applied during construction using the methodology prescribed in the EPA Noise Control Guidelines - publication 1254 released October 2008;
- b) a program of compliance testing to be implemented during the construction of the wind energy facility that:
 - (i) Is designed by a suitably qualified acoustic expert; and
 - (ii) Utilises the methodology prescribed in *State Environment Protection Policy (Control of Noise from Commerce, Industry and Trade) No N-1*, to demonstrate compliance with the limits determined in (a) above.
- c) a procedure for a near field compliance test of the first turbine commissioned at the wind energy facility; and
- d) a procedure for a final compliance test of the wind energy facility after the commissioning of the last turbine, with such testing to:
 - (i) consider compliance of the operational wind energy facility as a whole with the noise limits set under condition 17;
 - (ii) be carried out according to the method described in New Zealand Standard 6808:2010 '*Acoustics – Wind farm noise*'; and
 - (iii) be submitted to the responsible authority within 6 months of the first turbine operating. Further post-construction acoustic compliance reports prepared in accordance with this condition must be submitted to the responsible authority annually from the date of the first report being submitted until the final turbine is operating.

The final compliance testing report provided to the Minister for Planning must include a summary of the results in terms that are aimed at a lay person, and must be accompanied by a report by an environmental auditor appointed under the Environment Protection Act 1970, containing the auditor's opinion on the methodology of the compliance testing.

If the proponent considers that a suitable auditor cannot be engaged, the proponent may seek the written consent of the Minister for Planning to obtain an independent peer review of the results of the noise compliance testing instead.

Compliance test results must be publicly available.

APPENDIX B: TURBINE COORDINATES

Turbine	Coordinates (UTM WGS84 54H)		Turbine	Coordinates (UTM WGS84 54H)	
	Easting	Northing		Easting	Northing
WTG.1	720733	5799429	WTG.36	719929	5794535
WTG.2	721251	5800323	WTG.37	720489	5794103
WTG.3	721859	5800552	WTG.38	721109	5794788
WTG.4	722364	5800847	WTG.39	721955	5795028
WTG.5	722780	5800575	WTG.40	722543	5794720
WTG.6	720545	5801081	WTG.41	722034	5794531
WTG.7	721258	5799760	WTG.42	720541	5794620
WTG.8	721740	5799891	WTG.43	721000	5794218
WTG.9	722296	5800211	WTG.44	718723	5802176
WTG.10	722817	5799718	WTG.45	719252	5802580
WTG.11	724250	5798189	WTG.46	719751	5802721
WTG.12	723942	5797816	WTG.47	719266	5801952
WTG.13	724683	5797804	WTG.48	719967	5802221
WTG.14	725133	5797978	WTG.49	719008	5801346
WTG.15	725624	5797870	WTG.50	719580	5801302
WTG.16	723854	5798772	WTG.51	719652	5801705
WTG.17	724851	5798766	WTG.52	720348	5801559
WTG.18	721057	5798686	WTG.53	721277	5793851
WTG.19	721076	5797527	WTG.54	721790	5793869
WTG.20	721921	5797435	WTG.55	722289	5794039
WTG.21	722535	5797663	WTG.56	721681	5793316
WTG.22	722922	5798109	WTG.57	721893	5792827
WTG.23	720062	5798490	WTG.58	722325	5793119
WTG.24	719710	5798063	WTG.59	722753	5792881
WTG.25	719954	5797147	WTG.60	722532	5792519
WTG.26	719453	5797154	WTG.61	722975	5792402
WTG.27	720611	5796396	WTG.62	721336	5792374
WTG.28	720985	5795834	WTG.63	720387	5791255
WTG.29	720518	5795662	WTG.64	720387	5790743
WTG.30	719710	5795545	WTG.65	720424	5790132
WTG.31	719092	5795312	WTG.66	717354	5793181
WTG.32	721359	5795356	WTG.67	717057	5792757
WTG.33	720275	5795050	WTG.68	717508	5792561
WTG.34	719538	5794878	WTG.69	717031	5792379
WTG.35	719076	5794661			

APPENDIX C: CALIBRATION CERTIFICATES

CERTIFICATE OF CALIBRATION

CERTIFICATE No: **C37473**

EQUIPMENT TESTED : Sound Level Calibrator

Manufacturer: Rion
Type No: NC-75 **Serial No:** 34913547
Class: 1
Owner: Sonus Pty Ltd
17 Ruthven Ave
Adelaide SA 5000

Tests Performed: Measured Output Pressure level, Frequency & Distortion
Comments: See Details and Class Tolerance overleaf.

CONDITION OF TEST:

Ambient Pressure	1014 hPa ± 1 hPa	Date of Receipt :	18/09/2023
Temperature	23 °C $\pm 1^\circ$ C	Date of Calibration :	22/09/2023
Relative Humidity	41 % $\pm 5\%$	Date of Issue :	25/09/2023

Acu-Vib Test AVP02 (Calibrators)
Procedure: Test Method: AS IEC 60942 - 2017

CHECKED BY:  **AUTHORISED SIGNATURE:** 

Accredited for compliance with ISO/IEC 17025 - Calibration
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Page 1 of 2 Calibration Certificate
AVCERT02.1 Rev.2.0 14.04.2021

CERTIFICATE OF CALIBRATION

CERTIFICATE No: **SLM33787**

EQUIPMENT TESTED: Sound Level Meter

Manufacturer: Rion
Type No: NL-52
Mic. Type: UC-59
Pre-Amp. Type: NH-25

Serial No: 00220543
Serial No: 03377
Serial No: 10543

Owner: Sonus Pty Ltd
17 Ruthven Ave
Adelaide SA 5000

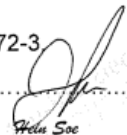
Tests Performed: IEC 61672-3:2013

Comments: All Tests passed for Class 1. (See overleaf for details)

CONDITIONS OF TEST:

Ambient Pressure	1005 hPa ± 1 hPa	Date of Receipt :	19/09/2022
Temperature	24 $^{\circ}\text{C} \pm 1^{\circ}\text{C}$	Date of Calibration :	20/09/2022
Relative Humidity	40 % $\pm 5\%$	Date of Issue :	21/09/2022

Acu-Vib Test Procedure: AVP10 (SLM) based on IEC 61672-3

CHECKED BY:  AUTHORISED SIGNATURE: 

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CERTIFICATE OF CALIBRATION

CERTIFICATE NO: **SLM36127A**

EQUIPMENT TESTED: Sound Level Meter

Manufacturer: Rion

Type No: NL-52 **Serial No:** 00220549

Mic. Type: UC-59 **Serial No:** 14803

Pre-Amp. Type: NH-25 **Serial No:** 87465

Owner: Sonus Pty Ltd
17 Ruthven Ave
Adelaide SA 5000

Tests Performed: IEC 61672-3:2013

Comments: All Tests passed for Class 1. (See overleaf for details)
Equipment owner has advised that the internal components have been replaced previously and does not match outer serial number markings. Serial number indicated on internal meter display is found to be **00220583**

CONDITIONS OF TEST:

Ambient Pressure	1010 hPa ± 1 hPa	Date of Receipt :	11/05/2023
Temperature	21 $^{\circ}\text{C} \pm 1^{\circ}\text{C}$	Date of Calibration :	17/05/2023
Relative Humidity	51 % $\pm 5\%$	Date of Issue :	30/04/2024

Acu-Vib Test Procedure: AVP10 (SLM) based on IEC 61672-3.

CHECKED BY: *[Signature]* **AUTHORISED SIGNATURE:** *[Signature]*
Bruce Meldrum

Accredited for compliance with ISO/IEC 17025 - Calibration
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Page 1 of 2 Calibration Certificate
AVCERT10.2 Rev.2.0 14/04/2021

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CERTIFICATE OF CALIBRATION

CERTIFICATE No: **SLM35180**

EQUIPMENT TESTED: Sound Level Meter

Manufacturer:	Rion	Serial No:	00320646
Type No:	NL-52	Serial No:	03400
Mic. Type:	UC-59	Serial No:	10659
Pre-Amp. Type:	NH-25		

Owner: Sonus Pty Ltd
17 Ruthven Ave
Adelaide SA 5000

Tests Performed: IEC 61672-3:2013

Comments: All Tests passed for Class 1. (See overleaf for details)

CONDITIONS OF TEST:

Ambient Pressure	1004 hPa ± 1 hPa	Date of Receipt :	14/02/2023
Temperature	22 $^{\circ}\text{C} \pm 1^{\circ}\text{C}$	Date of Calibration :	20/02/2023
Relative Humidity	46 % $\pm 5\%$	Date of Issue :	20/02/2023

Acu-Vib Test Procedure: AVP10 (SLM) based on IEC 61672-3.

CHECKED BY:

AUTHORISED SIGNATURE:

Jack Kielt

Accredited for compliance with ISO/IEC 17025 - Calibration
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Page 1 of 2 Calibration Certificate
AVCERT10.2 Rev.2.0 14/04/2021

CERTIFICATE OF CALIBRATION

CERTIFICATE NO: **SLM33788**

EQUIPMENT TESTED: Sound Level Meter

Manufacturer: Rion
Type No: NL-52
Mic. Type: UC-59
Pre-Amp. Type: NH-25

Serial No: 00320648
Serial No: 03397
Serial No: 10656

Owner: Sonus Pty Ltd
17 Ruthven Ave
Adelaide SA 5000

Tests Performed: IEC 61672-3:2013

Comments: All Tests passed for Class 1. (See overleaf for details)

CONDITIONS OF TEST:

Ambient Pressure	1005 hPa ± 1 hPa	Date of Receipt :	19/09/2022
Temperature	24 °C $\pm 1^\circ$ C	Date of Calibration :	20/09/2022
Relative Humidity	40 % $\pm 5\%$	Date of Issue :	21/09/2022

Acu-Vib Test Procedure: AVP10 (SLM) based on IEC 61672-3.

CHECKED BY: **AUTHORISED SIGNATURE:**

Helen Sae

Accredited for compliance with ISO/IEC 17025 - Calibration

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CERTIFICATE OF CALIBRATION

CERTIFICATE NO: **SLM39486A**

EQUIPMENT TESTED: Sound Level Meter

Manufacturer: Rion
Type No: NL-52
Mic. Type: UC-59
Pre-Amp. Type: NH-25

Serial No: 00320649
Serial No: 03401
Serial No: 54465

Owner: Sonus Pty Ltd
17 Ruthven Ave
Adelaide SA 5000

Tests Performed: IEC 61672-3:2013

All Tests passed for Class 1. (See overleaf for details)

Comments: Equipment owner has advised that the internal components have been replaced previously and does not match outer serial number markings. Serial number indicated on internal meter display is found to be **00320647**

CONDITIONS OF TEST:

Ambient Pressure	1000 hPa ± 1 hPa	Date of Receipt :	12/04/2024
Temperature	23 °C ± 1 °C	Date of Calibration :	18/04/2024
Relative Humidity	51 % ± 5 %	Date of Issue :	30/04/2024

Acu-Vib Test Procedure: AVP10 (SLM) based on IEC 61672-3.

CHECKED BY: *[Signature]*

AUTHORISED

SIGNATURE: *[Signature]*

Bruce Meldrum

Accredited for compliance with ISO/IEC 17025 - Calibration
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CERTIFICATE OF CALIBRATION

CERTIFICATE No: **SLM50117**

EQUIPMENT TESTED: Sound Level Meter

Manufacturer:	Rion	Serial No:	00320652
Type No:	NL-25	Serial No:	07470
Mic. Type:	UC-59	Serial No:	87468
Pre-Amp. Type:	NH-25		

Owner: Sonus Pty Ltd
17 Ruthven Ave
Adelaide SA 5000

Tests Performed: IEC 61672-3:2013

Comments: All Tests passed for Class 1. (See overleaf for details)

CONDITIONS OF TEST:

Ambient Pressure	998 hPa ± 1 hPa	Date of Receipt :	31/05/2024
Temperature	24 $^{\circ}\text{C} \pm 1^{\circ}\text{C}$	Date of Calibration :	11/06/2024
Relative Humidity	51 % $\pm 5\%$	Date of Issue :	11/06/2024

Acu-Vib Test Procedure: AVP10 (SLM) based on IEC 61672-3

CHECKED BY:

AUTHORISED

SIGNATURE:

Hein Soc

Accredited for compliance with ISO/IEC 17025 - Calibration
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The uncertainties quoted are calculated in accordance with the methods of the ISO Guide to the Uncertainty of Measurement and quoted at a coverage factor of 2 with a confidence interval of approximately 95%.


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CERTIFICATE OF CALIBRATION

CERTIFICATE No: **SLM35179**

EQUIPMENT TESTED: Sound Level Meter

Manufacturer:	Rion	Serial No:	00320654
Type No:	NL-52	Serial No:	03403
Mic. Type:	UC-59	Serial No:	10662
Pre-Amp. Type:	NH-25		

Owner: Sonus Pty Ltd
17 Ruthven Ave
Adelaide SA 5000

Tests Performed: IEC 61672-3:2013

Comments: All Tests passed for Class 1. (See overleaf for details)

CONDITIONS OF TEST:

Ambient Pressure	1005 hPa ± 1 hPa	Date of Receipt :	14/02/2023
Temperature	24 °C ± 1 ° C	Date of Calibration :	20/02/2023
Relative Humidity	49 % ± 5 %	Date of Issue :	20/02/2023

Acu-Vib Test Procedure: AVP10 (SLM) based on IEC 61672-3.

CHECKED BY: AUTHORISED SIGNATURE:
Jack Kiet

Accredited for compliance with ISO/IEC 17025 - Calibration
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The uncertainties quoted are calculated in accordance with the methods of the ISO Guide to the Uncertainty of Measurement and quoted at a coverage factor of 2 with a confidence interval of approximately 95%.



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CERTIFICATE OF CALIBRATION

CERTIFICATE No: **SLM35167**

EQUIPMENT TESTED: Sound Level Meter

Manufacturer:	Rion	Serial No:	00320656
Type No:	NL-52	Serial No:	04575
Mic. Type:	UC-59	Serial No:	10664
Pre-Amp. Type:	NH-25		

Owner: Sonus Pty Ltd
17 Ruthven Ave
Adelaide SA 5000

Tests Performed: IEC 61672-3:2013

Comments: All Tests passed for Class 1. (See overleaf for details)

CONDITIONS OF TEST:

Ambient Pressure	1006 hPa ± 1 hPa	Date of Receipt :	14/02/2023
Temperature	23 $^{\circ}\text{C} \pm 1^{\circ}\text{C}$	Date of Calibration :	20/02/2023
Relative Humidity	59 % $\pm 5\%$	Date of Issue :	20/02/2023

Acu-Vib Test Procedure: AVP10 (SLM) based on IEC 61672-3

CHECKED BY: AUTHORISED SIGNATURE:
Jack Kielt

Accredited for compliance with ISO/IEC 17025 - Calibration
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CERTIFICATE OF CALIBRATION

CERTIFICATE NO: **SLM33789**

EQUIPMENT TESTED: Sound Level Meter

Manufacturer: Rion
Type No: NL-52
Mic. Type: UC-59
Pre-Amp. Type: NH-25

Serial No: 00320657
Serial No: 03435
Serial No: 10665

Owner: Sonus Pty Ltd
17 Ruthven Ave
Adelaide SA 5000

Tests Performed: IEC 61672-3:2013

Comments: All Tests passed for Class 1. (See overleaf for details)

CONDITIONS OF TEST:

Ambient Pressure	1005 hPa ± 1 hPa	Date of Receipt :	19/09/2022
Temperature	24 $^{\circ}\text{C} \pm 1^{\circ}\text{C}$	Date of Calibration :	20/09/2022
Relative Humidity	41 % $\pm 5\%$	Date of Issue :	21/09/2022

Acu-Vib Test Procedure: AVP10 (SLM) based on IEC 61672-3.

CHECKED BY: AUTHORISED SIGNATURE:

Alan Soc

Accredited for compliance with ISO/IEC 17025 - Calibration

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CERTIFICATE OF CALIBRATION

CERTIFICATE No: **SLM39484**

EQUIPMENT TESTED: Sound Level Meter

Manufacturer: Rion
Type No: NL-52
Mic. Type: UC-59
Pre-Amp. Type: NH-25

Serial No: 00520898
Serial No: 21148
Serial No: 11745

Owner: Sonus Pty Ltd
17 Ruthven Ave
Adelaide SA 5000

Tests Performed: IEC 61672-3:2013

Comments: All Tests passed for Class 1. (See overleaf for details)

CONDITIONS OF TEST:

Ambient Pressure	1002 hPa ± 1 hPa	Date of Receipt :	12/04/2024
Temperature	24 $^{\circ}\text{C} \pm 1^{\circ}\text{C}$	Date of Calibration :	18/04/2024
Relative Humidity	61 % $\pm 5\%$	Date of Issue :	18/04/2024

Acu-Vib Test Procedure: AVP10 (SLM) based on IEC 61672-3

CHECKED BY: *[Signature]*

AUTHORISED

SIGNATURE: *[Signature]*
High Soc

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CERTIFICATE OF CALIBRATION

CERTIFICATE No: **SLM36131**

EQUIPMENT TESTED: Sound Level Meter

Manufacturer: Rion

Type No: NL-52 **Serial No:** 00598175

Mic. Type: UC-59 **Serial No:** 15519

Pre-Amp. Type: NH-25 **Serial No:** 98387

Owner: Sonus Pty Ltd
17 Ruthven Ave
Adelaide SA 5000

Tests Performed: IEC 61672-3:2013

Comments: All Tests passed for Class 1. (See overleaf for details)

CONDITIONS OF TEST:

Ambient Pressure	1010 hPa ± 1 hPa	Date of Receipt :	11/05/2023
Temperature	22 $^{\circ}\text{C} \pm 1^{\circ}\text{C}$	Date of Calibration :	17/05/2023
Relative Humidity	50 % $\pm 5\%$	Date of Issue :	17/05/2023

Acu-Vib Test Procedure: AVP10 (SLM) based on IEC 61672-3.

CHECKED BY: *IKB* **AUTHORISED SIGNATURE:** *Hein/Soc*

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Page 1 of 2 Calibration Certificate
AVCERT10.2 Rev.2.0 14/04/2021

CERTIFICATE OF CALIBRATION

CERTIFICATE No: **SLM37467**

EQUIPMENT TESTED: Sound Level Meter

Manufacturer: Rion

Type No: NL-52

Mic. Type: UC-59

Pre-Amp. Type: NH-25

Serial No: 00710391

Serial No: 19669

Serial No: 11344

Owner: Sonus Pty Ltd
17 Ruthven Ave
Adelaide SA 5000

Tests Performed: IEC 61672-3:2013

Comments: All Tests passed for Class 1. (See overleaf for details)

CONDITIONS OF TEST:

Ambient Pressure 1005 hPa ± 1 hPa

Temperature 25 $^{\circ}\text{C} \pm 1^{\circ}\text{C}$

Relative Humidity 36 % $\pm 5\%$

Date of Receipt : 18/09/2023

Date of Calibration : 22/09/2023

Date of Issue : 25/09/2023

Acu-Vib Test Procedure: AVP10 (SLM) based on IEC 61672-3.

CHECKED BY:

AUTHORISED SIGNATURE:

Alan Sae

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Page 1 of 2 Calibration Certificate
AVCERT10.2 Rev.2.0 14/04/2021

CERTIFICATE OF CALIBRATION

CERTIFICATE No: **SLM37470**

EQUIPMENT TESTED: Sound Level Meter

Manufacturer: Rion

Type No: NL-52

Mic. Type: UC-59

Pre-Amp. Type: NH-25

Serial No: 00710393

Serial No: 19671

Serial No: 10936

Owner: Sonus Pty Ltd
17 Ruthven Ave
Adelaide SA 5000

Tests Performed: IEC 61672-3:2013

Comments: All Tests passed for Class 1. (See overleaf for details)

CONDITIONS OF TEST:

Ambient Pressure 1015 hPa ± 1 hPa

Temperature 23 $^{\circ}\text{C} \pm 1^{\circ}\text{C}$

Relative Humidity 40 % $\pm 5\%$

Date of Receipt : 18/09/2023

Date of Calibration : 22/09/2023

Date of Issue : 25/09/2023

Acu-Vib Test Procedure: AVP10 (SLM) based on IEC 61672-3.

CHECKED BY:

AUTHORISED SIGNATURE:

Heidi Soc

Accredited for compliance with ISO/IEC 17025 - Calibration

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Page 1 of 2 Calibration Certificate
AVCERT10.2 Rev.2.0 14/04/2021

CERTIFICATE OF CALIBRATION

CERTIFICATE No: **SLM37472**

EQUIPMENT TESTED: Sound Level Meter

Manufacturer: Rion

Type No: NL-52

Mic. Type: UC-59

Pre-Amp. Type: NH-25

Serial No: 00710394

Serial No: 19672

Serial No: 10937

Owner: Sonus Pty Ltd
17 Ruthven Ave
Adelaide SA 5000

Tests Performed: IEC 61672-3:2013

Comments: All Tests passed for Class 1. (See overleaf for details)

CONDITIONS OF TEST:

Ambient Pressure 1015 hPa ± 1 hPa

Temperature 23 $^{\circ}\text{C} \pm 1^{\circ}\text{C}$

Relative Humidity 40 % $\pm 5\%$

Date of Receipt : 18/09/2023

Date of Calibration : 22/09/2023

Date of Issue : 25/09/2023

Acu-Vib Test Procedure: AVP10 (SLM) based on IEC 61672-3.

CHECKED BY: 

AUTHORISED SIGNATURE: 

Helen Soc

Accredited for compliance with ISO/IEC 17025 - Calibration

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Page 1 of 2 Calibration Certificate
AVCERT10.2 Rev.2.0 14/04/2021

CERTIFICATE OF CALIBRATION

CERTIFICATE NO: **SLM39482**

EQUIPMENT TESTED: Sound Level Meter

Manufacturer: Rion
Type No: NL-52
Mic. Type: UC-59
Pre-Amp. Type: NH-25

Serial No: 00710426
Serial No: 19481
Serial No: 10969

Owner: Sonus Pty Ltd
17 Ruthven Ave
Adelaide SA 5000

Tests Performed: IEC 61672-3:2013

Comments: All Tests passed for Class 1. (See overleaf for details)

CONDITIONS OF TEST:

Ambient Pressure	1004 hPa ± 1 hPa	Date of Receipt :	12/04/2024
Temperature	23 °C $\pm 1^\circ$ C	Date of Calibration :	18/04/2024
Relative Humidity	61 % $\pm 5\%$	Date of Issue :	18/04/2024

Acu-Vib Test Procedure: AVP10 (SLM) based on IEC 61672-3.

CHECKED BY: *KB*

AUTHORISED

SIGNATURE: *Hugh Soc*

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CERTIFICATE OF CALIBRATION
CERTIFICATE No: **SLM37471**

EQUIPMENT TESTED: Sound Level Meter

Manufacturer: Rion
Type No: NL-52
Mic. Type: UC-59
Pre-Amp. Type: NH-25

Serial No: 00710427
Serial No: 19622
Serial No: 10970

Owner: Sonus Pty Ltd
17 Ruthven Ave
Adelaide SA 5000

Tests Performed: IEC 61672-3:2013

Comments: All Tests passed for Class 1. (See overleaf for details)

CONDITIONS OF TEST:

Ambient Pressure	1015 hPa ± 1 hPa	Date of Receipt :	18/09/2023
Temperature	23 $^{\circ}\text{C} \pm 1^{\circ}\text{C}$	Date of Calibration :	22/09/2023
Relative Humidity	41 % $\pm 5\%$	Date of Issue :	25/09/2023

Acu-Vib Test Procedure: AVP10 (SLM) based on IEC 61672-3.

CHECKED BY: **AUTHORISED SIGNATURE:**
Hein Sae

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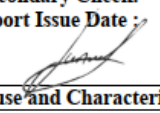
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Sound Level Meter
IEC 61672-3:2013
Calibration Certificate
Calibration Number C23359

Client Details		Sonus Pty Ltd 17 Ruthven Ave Adelaide SA 5000	
Equipment Tested/ Model Number :		NL-52AEX	
Instrument Serial Number :		00331168	
Microphone Serial Number :		23071	
Pre-amplifier Serial Number :		22643	
Firmware Version :		2.0	
Pre-Test Atmospheric Conditions		Post-Test Atmospheric Conditions	
Ambient Temperature : 22.1°C		Ambient Temperature : 22.4°C	
Relative Humidity : 52.6%		Relative Humidity : 52.2%	
Barometric Pressure : 101.7kPa		Barometric Pressure : 101.8kPa	
Calibration Technician : Ken Williams		Secondary Check: Megan Williams	
Calibration Date : 6 Jun 2023		Report Issue Date : 6 Jun 2023	
Approved Signatory :		 Juan Agüero	
Clause and Characteristic Tested	Result	Clause and Characteristic Tested	Result
12: Acoustical Sig. tests of a frequency weighting	Pass	17: Level linearity incl. the level range control	N/A
13: Electrical Sig. tests of frequency weightings	Pass	18: Toneburst response	Pass
14: Frequency and time weightings at 1 kHz	Pass	19: C Weighted Peak Sound Level	Pass
15: Long Term Stability	Pass	20: Overload Indication	Pass
16: Level linearity on the reference level range	Pass	21: High Level Stability	Pass

The sound level meter submitted for testing has successfully completed the class 1 periodic tests of IEC 61672-3:2013, for the environmental conditions under which the tests were performed.

However, no general statement or conclusion can be made about conformance of the sound level meter to the full requirements of IEC 61672-1:2013 because evidence was not publicly available, from an independent testing organisation responsible for pattern approvals, to demonstrate that the model of sound level meter fully conformed to the requirements in IEC 61672-1:2013 and because the periodic tests of IEC 61672-3:2013 cover only a limited subset of the specifications in IEC 61672-1:2013.

Uncertainties of Measurement -			
Acoustic Tests		Environmental Conditions	
125Hz:	±0.13dB	Temperature	±0.1°C
1kHz:	±0.13dB	Relative Humidity	±1.9%
8kHz:	±0.14dB	Barometric Pressure	±0.014kPa
Electrical Tests	±0.13dB		

All uncertainties are derived at the 95% confidence level with a coverage factor of 2.



This calibration certificate is to be read in conjunction with the calibration test report.

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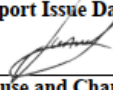
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Sound Level Meter
IEC 61672-3:2013
Calibration Certificate
Calibration Number C23357

Client Details		Sonus Pty Ltd 17 Ruthven Ave Adelaide SA 5000	
Equipment Tested/ Model Number :		NL-52AEX	
Instrument Serial Number :		00331169	
Microphone Serial Number :		23072	
Pre-amplifier Serial Number :		22644	
Firmware Version :		2.0	
Pre-Test Atmospheric Conditions		Post-Test Atmospheric Conditions	
Ambient Temperature : 22.6°C		Ambient Temperature : 22.3°C	
Relative Humidity : 52.2%		Relative Humidity : 52.7%	
Barometric Pressure : 101.8kPa		Barometric Pressure : 101.9kPa	
Calibration Technician : Ken Williams		Secondary Check: Megan Williams	
Calibration Date : 6 Jun 2023		Report Issue Date : 6 Jun 2023	
Approved Signatory :		 Juan Agüero	
Clause and Characteristic Tested	Result	Clause and Characteristic Tested	Result
12: Acoustical Sig. tests of a frequency weighting	Pass	17: Level linearity incl. the level range control	N/A
13: Electrical Sig. tests of frequency weightings	Pass	18: Toneburst response	Pass
14: Frequency and time weightings at 1 kHz	Pass	19: C Weighted Peak Sound Level	Pass
15: Long Term Stability	Pass	20: Overload Indication	Pass
16: Level linearity on the reference level range	Pass	21: High Level Stability	Pass

The sound level meter submitted for testing has successfully completed the class 1 periodic tests of IEC 61672-3:2013, for the environmental conditions under which the tests were performed.

However, no general statement or conclusion can be made about conformance of the sound level meter to the full requirements of IEC 61672-1:2013 because evidence was not publicly available, from an independent testing organisation responsible for pattern approvals, to demonstrate that the model of sound level meter fully conformed to the requirements in IEC 61672-1:2013 and because the periodic tests of IEC 61672-3:2013 cover only a limited subset of the specifications in IEC 61672-1:2013.

Uncertainties of Measurement -			
Acoustic Tests		Environmental Conditions	
125Hz:	±0.13dB	Temperature	±0.1°C
1kHz:	±0.13dB	Relative Humidity	±1.9%
8kHz:	±0.14dB	Barometric Pressure	±0.014kPa
Electrical Tests	±0.13dB		

All uncertainties are derived at the 95% confidence level with a coverage factor of 2.



This calibration certificate is to be read in conjunction with the calibration test report.

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Sound Level Meter
IEC 61672-3:2013
Calibration Certificate
Calibration Number C23358

Client Details	Sonus Pty Ltd 17 Ruthven Ave Adelaide SA 5000
Equipment Tested/ Model Number :	NL-52AEX
Instrument Serial Number :	00331170
Microphone Serial Number :	23074
Pre-amplifier Serial Number :	22645
Firmware Version :	1.1
Pre-Test Atmospheric Conditions	Post-Test Atmospheric Conditions
Ambient Temperature : 22.5°C	Ambient Temperature : 51.5°C
Relative Humidity : 52.4%	Relative Humidity : 23.6%
Barometric Pressure : 101.8kPa	Barometric Pressure : 101.8kPa
Calibration Technician : Shaheen Boaz	Secondary Check: Dhanush Bonu
Calibration Date : 6 Jun 2023	Report Issue Date : 7 Jun 2023
Approved Signatory :	Ken Williams

Clause and Characteristic Tested	Result	Clause and Characteristic Tested	Result
12: Acoustical Sig. tests of a frequency weighting	Pass	17: Level linearity incl. the level range control	N/A
13: Electrical Sig. tests of frequency weightings	Pass	18: Toneburst response	Pass
14: Frequency and time weightings at 1 kHz	Pass	19: C Weighted Peak Sound Level	Pass
15: Long Term Stability	Pass	20: Overload Indication	Pass
16: Level linearity on the reference level range	Pass	21: High Level Stability	Pass

The sound level meter submitted for testing has successfully completed the class 1 periodic tests of IEC 61672-3:2013, for the environmental conditions under which the tests were performed.

However, no general statement or conclusion can be made about conformance of the sound level meter to the full requirements of IEC 61672-1:2013 because evidence was not publicly available, from an independent testing organisation responsible for pattern approvals, to demonstrate that the model of sound level meter fully conformed to the requirements in IEC 61672-1:2013 and because the periodic tests of IEC 61672-3:2013 cover only a limited subset of the specifications in IEC 61672-1:2013.

Uncertainties of Measurement -			
Acoustic Tests		Environmental Conditions	
125Hz:	±0.13dB	Temperature	±0.1°C
1kHz:	±0.13dB	Relative Humidity	±1.9%
8kHz:	±0.14dB	Barometric Pressure	±0.014kPa
Electrical Tests	±0.13dB		

All uncertainties are derived at the 95% confidence level with a coverage factor of 2.



This calibration certificate is to be read in conjunction with the calibration test report.

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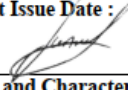
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Sound Level Meter
IEC 61672-3:2013
Calibration Certificate
Calibration Number C23356

Client Details Sonus Pty Ltd 17 Ruthven Ave Adelaide SA 5000	
Equipment Tested/ Model Number : NL-52AEX Instrument Serial Number : 00331171 Microphone Serial Number : 23075 Pre-amplifier Serial Number : 22646 Firmware Version : 2.0	
Pre-Test Atmospheric Conditions Ambient Temperature : 22.4°C Relative Humidity : 52.7% Barometric Pressure : 101.8kPa	Post-Test Atmospheric Conditions Ambient Temperature : 22.6°C Relative Humidity : 52.3% Barometric Pressure : 101.83kPa
Calibration Technician : Ken Williams Calibration Date : 6 Jun 2023	Secondary Check: Megan Williams Report Issue Date : 6 Jun 2023
Approved Signatory :	
 Juan Aguero	
Clause and Characteristic Tested 12: Acoustical Sig. tests of a frequency weighting <i>Pass</i> 13: Electrical Sig. tests of frequency weightings <i>Pass</i> 14: Frequency and time weightings at 1 kHz <i>Pass</i> 15: Long Term Stability <i>Pass</i> 16: Level linearity on the reference level range <i>Pass</i>	Clause and Characteristic Tested 17: Level linearity incl. the level range control <i>N/A</i> 18: Toneburst response <i>Pass</i> 19: C Weighted Peak Sound Level <i>Pass</i> 20: Overload Indication <i>Pass</i> 21: High Level Stability <i>Pass</i>

The sound level meter submitted for testing has successfully completed the class 1 periodic tests of IEC 61672-3:2013, for the environmental conditions under which the tests were performed.

However, no general statement or conclusion can be made about conformance of the sound level meter to the full requirements of IEC 61672-1:2013 because evidence was not publicly available, from an independent testing organisation responsible for pattern approvals, to demonstrate that the model of sound level meter fully conformed to the requirements in IEC 61672-1:2013 and because the periodic tests of IEC 61672-3:2013 cover only a limited subset of the specifications in IEC 61672-1:2013.

Uncertainties of Measurement -			
Acoustic Tests		Environmental Conditions	
125Hz:	±0.13dB	Temperature	±0.1°C
1kHz:	±0.13dB	Relative Humidity	±1.9%
8kHz:	±0.14dB	Barometric Pressure	±0.014kPa
Electrical Tests	±0.13dB		

All uncertainties are derived at the 95% confidence level with a coverage factor of 2.



This calibration certificate is to be read in conjunction with the calibration test report.

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3-20-41 Higashimotomachi Kokubunji Tokyo 185-8533
Phone:042(359)7888, Facsimile:042(359)7442

Certificate of Calibration

Name : Class 1 Sound Level Meter
Model : NL-53 **S/No.** : 00240808
Date of Calibration : March, 04, 2024

We hereby certify that the above product was tested and calibrated according to the prescribed Rion procedures, and that it fulfills specification requirements.

The measuring equipment and reference devices used for testing and calibrating this unit are managed under the Rion traceability system and are traceable according to official Japanese standards and official standards of countries belonging to the International Committee of Weights and Measures.

RION CO., LTD.

A handwritten signature in black ink, appearing to read 'J. Kawamura'.

Manager, Quality Control Department



3-20-41 Higashimotomachi Kokubunji Tokyo 185-8533
Phone:042(359)7888, Facsimile:042(359)7442

Certificate of Calibration

Name : Class 1 Sound Level Meter
Model : NL-53 **S/No.** : 00240810
Date of Calibration : March, 04, 2024

We hereby certify that the above product was tested and calibrated according to the prescribed Rion procedures, and that it fulfills specification requirements.

The measuring equipment and reference devices used for testing and calibrating this unit are managed under the Rion traceability system and are traceable according to official Japanese standards and official standards of countries belonging to the International Committee of Weights and Measures.

RION CO., LTD.

A handwritten signature in black ink, appearing to read 'J. Kawamura'.

Manager, Quality Control Department



3-20-41 Higashimotomachi Kokubunji Tokyo 185-8533
Phone:042(359)7888, Facsimile:042(359)7442

Certificate of Calibration

Name : Class 1 Sound Level Meter
Model : NL-53 **S/No.** : 01130807
Date of Calibration : March, 04, 2024

We hereby certify that the above product was tested and calibrated according to the prescribed Rion procedures, and that it fulfills specification requirements.
The measuring equipment and reference devices used for testing and calibrating this unit are managed under the Rion traceability system and are traceable according to official Japanese standards and official standards of countries belonging to the International Committee of Weights and Measures.

RION CO., LTD.

A handwritten signature in black ink, appearing to read 'J. Kawamura'.

Manager, Quality Control Department

APPENDIX D: NOISE MONITORING EQUIPMENT PHOTOGRAPHS

Figure 8: Location 9 Noise Monitoring Equipment Photographs



Figure 9: Location 9i Noise Monitoring Equipment Photographs



Figure 10: Location 10i Noise Monitoring Equipment Photographs



Figure 11: Location 18 Noise Monitoring Equipment Photographs



Figure 12: Location 18i Noise Monitoring Equipment Photographs



Figure 13: Location 27 Noise Monitoring Equipment Photographs



Figure 14: Location 55(S) Noise Monitoring Equipment Photographs

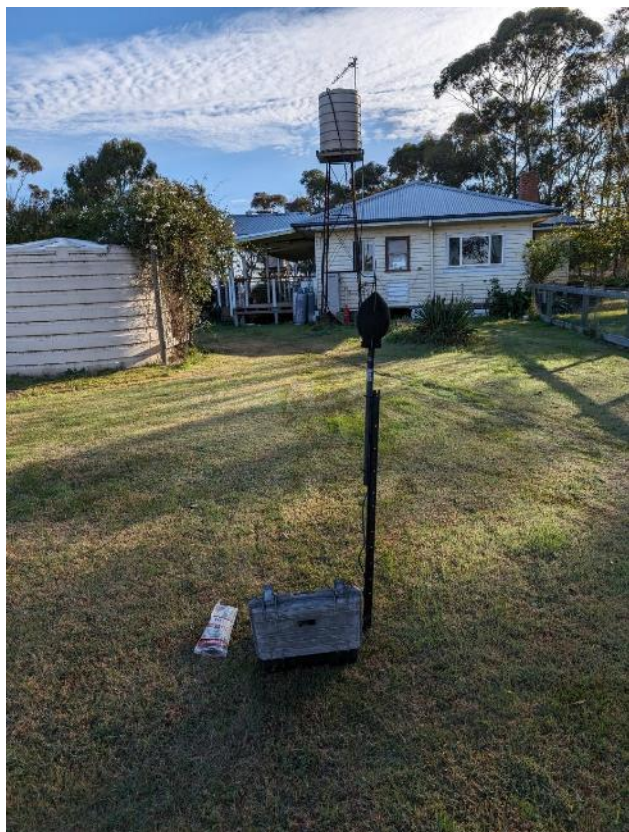


Figure 15: Location 56i Noise Monitoring Equipment Photographs



Figure 16: Location 58i Noise Monitoring Equipment Photographs



Figure 17: Location 63i Noise Monitoring Equipment Photographs

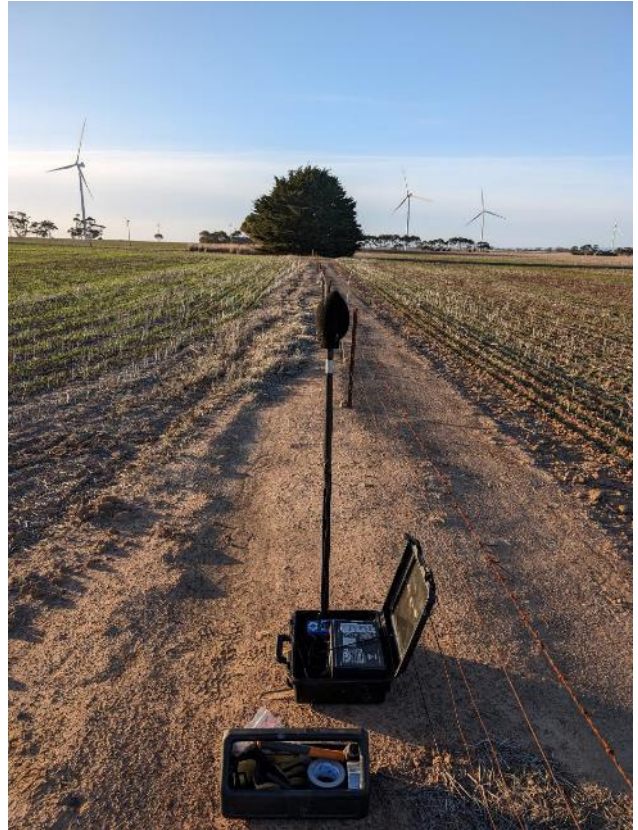


Figure 18: Location 69 Noise Monitoring Equipment Photographs

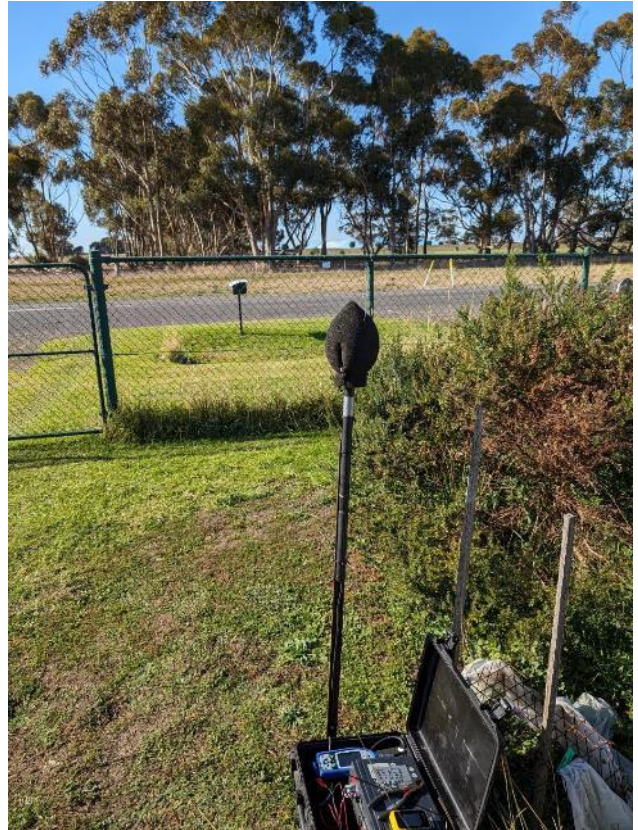


Figure 19: Location 70 Noise Monitoring Equipment Photographs

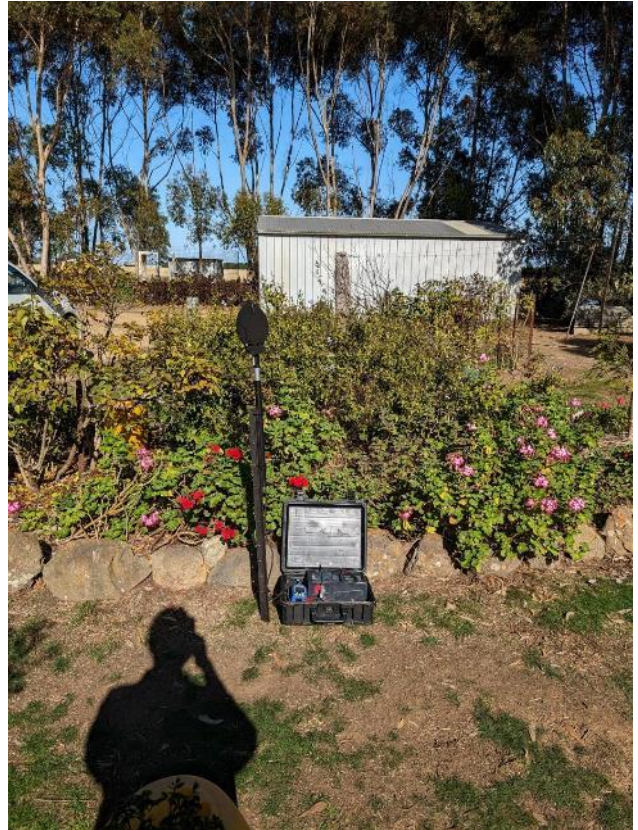


Figure 20: Location 73i Noise Monitoring Equipment Photographs



Figure 21: Location 79 Noise Monitoring Equipment Photographs



Figure 22: Location 80 Noise Monitoring Equipment Photographs



Figure 23: Location 83 Noise Monitoring Equipment Photographs



Figure 24: Location 83i Noise Monitoring Equipment Photographs



Figure 25: Location 103 Noise Monitoring Equipment Photographs



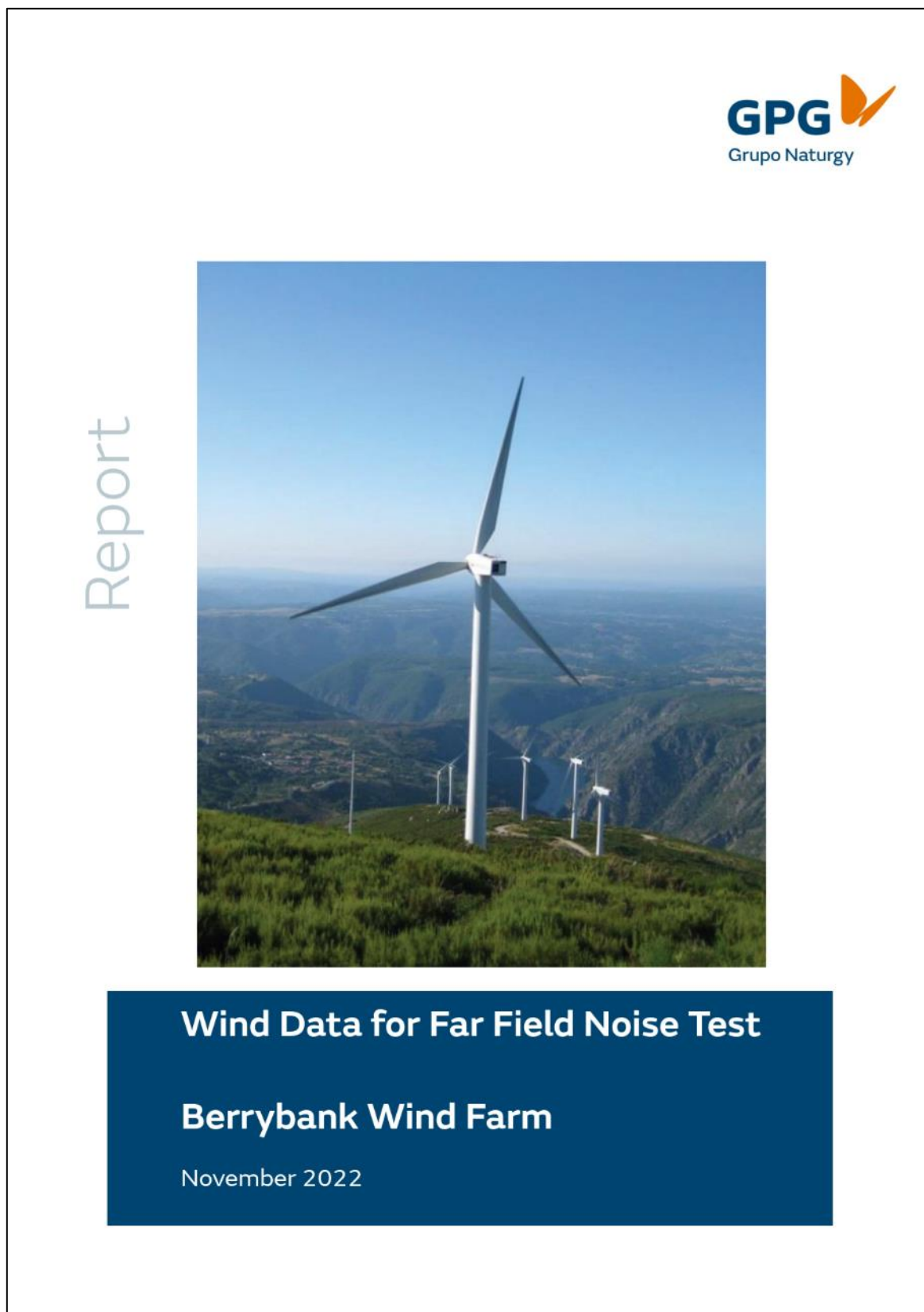
Figure 26: Location 103i Noise Monitoring Equipment Photographs



Figure 27: Location 108 Noise Monitoring Equipment Photographs



APPENDIX E: SITE WIND DATA DERIVATION





Summary

1. Aim 4

2. Site description 4

3. Methodology..... 9

 3.1. Selection of the wind turbine generators representative of BB3 meteorological stations wind data 9

 3.2. Synthesised data set11

Annex I. Wake losses (WAsP simulation) 13

Annex II. Wind speed (WAsP simulation)..... 16

Annex III. Correction Factor 19

Tables

Table 1. Location of the wind turbines of Berrybank 1 wind farm 7

Table 2. Location of the wind turbines of Berrybank 2 wind farm 8

Table 3. Wake losses [%] from turbines WTG-15.3, WTG-31.6 and WTG-37.7 10

Table 4. Correction factor for the Wind Speed from turbines WTG-15.3, WTG-31.6 and WTG-37.7 12

Table 5. Wake losses simulated with WAsP..... 15

Table 6. Wind Speed simulated with WAsP..... 18

Table 7. Correction of the Wind Speed simulated with WAsP. Multiplier applied to the synthesised dataset. 21

Figures

Figure 1. Location of the wind farm site in the state of Victoria..... 5

Figure 2. Location of the wind farm site..... 5

Figure 3. Location of the wind turbines 6

Figure 4. Location of the chosen wind turbines WTG-15.3, WTG-31.6 and WTG-37.7, in the Berrybank WF 11



List of Acronyms

AGD94: Geocentric Datum Of Australia 1994.
AGL: Above Ground Level.
ASL: Above Sea Level.
CF: Correction Factor.
BB1WF: Berrybank 1 Wind Farm.
BB2WF: Berrybank 2 Wind Farm.
BB3: Berrybank 3 Meteorological Station.
DTU: Technical University of Denmark.
HH: Hub Height.
UTM: Universal Transverse Mercator.
WAsP: Wind Atlas and Application Program.
WTG: Wind Turbine Generator.



1. Aim

The purpose of this report is to provide the necessary wind data to MARSHALL DAY ACOUSTICS to perform the Far Field Test according to the Noise and Vibration MP for Berrybank 1 Wind Farm.

The previous rounds of testing were done using the wind data from BB3 met mast, but it was decommissioned in December 2020.

Berrybank 1 Wind Farm commercial operations commenced in July 2021. The Wind Farm has 43 turbines and each one has an anemometer and a windvane that record its wind speed and direction respectively. Since BB3 meteorological mast data is not available, wind data from the turbines that best represent BB3 will be used to estimate its wind data.

To the north and south of the Berrybank 1 wind farm is the Berrybank 2 wind farm, with 26 wind turbines. This wind farm has been recently constructed and has been in operation since November 2022.

The main objectives of this report are:

- Decide which wind turbine generators from BB1WF should be selected to represent the wind resource in BB3 meteorological mast. The wind data needs to be wake-free for all directions.
- Provide a data set (wind speed and direction) at BB3 with adjusted measurement data from the selected wind turbines.

2. Site description

Berrybank 1 y 2 Wind Farms site is located in South-Western Victoria approximately 14km east of Lismore and 16km west of Cressy. It is approximately 130km west of Melbourne within the Victorian district known as the Western Plains, located within the Corangamite and Golden Plains Local Government Areas.

This wind farm has been designed to contain 43 turbines in Stage 1 and 26 wind turbines in Stage 2. There are 4 meteorological masts situated in different positions of the site: BB2, BB3, BB4 and BB5.

A map with the site location of Berrybank 1 & 2 wind farm is shown below.



Figure 1. Location of the wind farm site in the state of Victoria



Figure 2. Location of the wind farm site

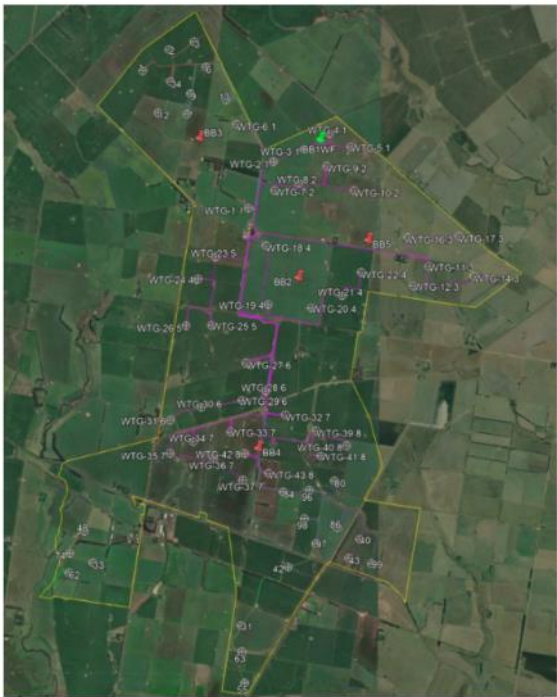


Figure 3. Location of the wind turbines

The site locations of the wind turbines are as follows:

Berrybank 1 Wind Farm		
Datum AGD94		
Zone 54		
43 Wind Turbine Locations		
WTG	X UTM	Y UTM
WTG-1.1	720,733	5,799,429
WTG-2.1	721,251	5,800,323
WTG-3.1	721,859	5,800,552
WTG-4.1	722,364	5,800,847
WTG-5.1	722,780	5,800,575
WTG-6.1	720,545	5,801,081
WTG-7.2	721,258	5,799,760
WTG-8.2	721,740	5,799,891
WTG-9.2	722,296	5,800,211
WTG-10.2	722,817	5,799,718
WTG-11.3	724,250	5,798,189



Berrybank 1 Wind Farm		
Datum AGD94		
Zone 54		
43 Wind Turbine Locations		
WTG	X UTM	Y UTM
WTG-12.3	723,942	5,797,816
WTG-13.3	724,683	5,797,804
WTG-14.3	725,133	5,797,978
WTG-15.3	725,624	5,797,870
WTG-16.3	723,854	5,798,772
WTG-17.3	724,851	5,798,766
WTG-18.4	721,057	5,798,686
WTG-19.4	721,076	5,797,527
WTG-20.4	721,921	5,797,435
WTG-21.4	722,535	5,797,663
WTG-22.4	722,922	5,798,109
WTG-23.5	720062	5,798,490
WTG-24.4	719,710	5,798,063
WTG-25.5	719,954	5,797,147
WTG-26.5	719,453	5,797,155
WTG-27.6	720,611	5,796,396
WTG-28.6	720,985	5,795,834
WTG-29.6	720,518	5,795,662
WTG-30.6	719,710	5,795,545
WTG-31.6	719092	5,795,312
WTG-32.7	721,359	5,795,356
WTG-33.7	720,275	5,795,050
WTG-34.7	719,538	5,794,878
WTG-35.7	719,076	5,794,661
WTG-36.7	719,929	5,794,535
WTG-37.7	720489	5,794,103
WTG-38.8	721,109	5,794,788
WTG-39.8	721,955	5,795,028
WTG-40.8	722543	5,794,720
WTG-41.8	722,034	5,794,531
WTG-42.8	720,541	5,794,620
WTG-43.8	721,000	5,794,218

Table 1. Location of the wind turbines of Berrybank 1 wind farm



Berrybank 2 Wind Farm		
Datum AGD94		
Zone 54		
26 Wind Turbine Locations		
WTG	X UTM	Y UTM
1	718,723	5,802,176
2	719,252	5,802,580
3	719,751	5,802,721
6	719,967	5,802,221
7	719,58	5,801,302
9	719,652	5,801,705
12	719,008	5,801,346
13	720,348	5,801,559
34	719,266	5,801,952
31	720,387	5,791,255
33	717,508	5,792,561
40	722,753	5,792,881
42	721,336	5,792,374
43	722,532	5,792,519
48	717,354	5,793,181
55	720,424	5,790,132
62	717,031	5,792,379
63	720,387	5,790,743
74	717,057	5,792,757
80	722,289	5,794,039
84	721,277	5,793,851
86	722,325	5,793,119
96	721,79	5,793,869
97	721,893	5,792,827
98	721,681	5,793,316
99	722,975	5,792,402

Table 2. Location of the wind turbines of Berrybank 2 wind farm

The location of the BB3 meteorological mast is UTM (719,773 m; 5,800,689 m), Datum AGD94, Zone 54.



3. Methodology

In order to obtain the adjusted wind data set that would have occurred at BB3 meteorological station location if the wind farms (Berrybank 1 and 2) were not present, the following methodology will be applied:

3.1. Selection of the wind turbine generators representative of BB3 meteorological stations wind data

The selection of the turbines used to represent wind data at BB3 meteorological mast location, has been done using WAsP software, developed by DTU Denmark Technical University. This software is used for the surface extrapolation of the wind resource at a site. Based on the wind resource recorded by the BB3 meteorological mast (from June 2010 until January 2020), WAsP simulates the wind speed and energy production at all wind turbine positions of both Berrybank stage 1 and 2 wind farms.

The WAsP simulation estimates the wake loss and wind speed of each turbine and wind rose sector from the BB1WF and BB2WF.

The wake effect of a turbine quantifies the decrease in energy production of the wind farm, which results from the changes in wind speed caused by the impact of the turbines on each other.

The selection of the WTG locations that best represent the wind speed and direction from BB3 has been done choosing the direction sectors that are wake free and close to BB3 meteorological mast.

The table in Annex I shows the wake losses in each turbine from BB1WF according to the different sectors from the direction wind rose.

The following WTG have been chosen to cover all wind direction so that no sector is wake affected:

- WTG-15.3 will be used to cover from sector 1 to sector 9.
- WTG-31.6 will be used to cover from sector 12 to sector 16.
- WTG-37.7 will be used to cover from sector 10 to sector 11.

The next table shows the wake losses results for Wind Turbine Generators 15.3, 31.6 and 37.7:



Sector	Direction [°]		Wake losses [%]		
	From	To	WTG-15.3	WTG-31.6	WTG-37.7
Sector 1 (0°)	348.75	11.25	0.00%	2.61%	19.35%
Sector 2 (22,5°)	11.25	33.75	0.00%	10.27%	15.16%
Sector 3 (45°)	33.75	56.25	0.00%	13.11%	28.34%
Sector 4 (67,5°)	56.25	78.75	0.00%	41.73%	38.43%
Sector 5 (90°)	78.75	101.25	0.00%	15.84%	26.55%
Sector 6 (112,5°)	101.25	123.75	0.00%	20.82%	23.71%
Sector 7 (135°)	123.75	146.25	0.00%	46.82%	11.08%
Sector 8 (157,5°)	146.25	168.75	0.00%	5.70%	7.99%
Sector 9 (180°)	168.75	191.25	0.00%	33.21%	6.85%
Sector 10 (202,5°)	191.25	213.75	2.42%	4.66%	0.00%
Sector 11 (225°)	213.75	236.25	5.75%	4.35%	0.00%
Sector 12 (247,5°)	236.25	258.75	5.08%	0.00%	5.34%
Sector 13 (270°)	258.75	281.25	26.49%	0.00%	0.00%
Sector 14 (292,5°)	281.25	303.75	21.14%	0.00%	10.07%
Sector 15 (315°)	303.75	326.25	9.03%	0.00%	17.07%
Sector 16 (337,5°)	326.25	348.75	0.28%	0.00%	8.07%

Table 3. Wake losses [%] from turbines WTG-15.3, WTG-31.6 and WTG-37.7

The location of these three chosen turbines on the Berrybank Wind Farm is shown in the following figure:

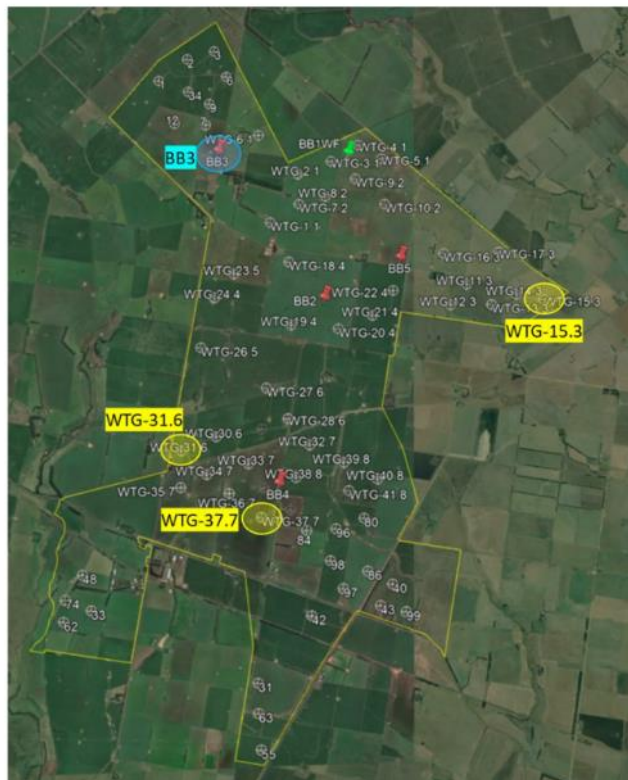


Figure 4. Location of the chosen wind turbines WTG-15.3, WTG-31.6 and WTG-37.7, in the Berrybank WF

3.2. Synthesised data set

For the current Noise Test, as BB3 is already decommissioned, BB1WF turbines wind data will be used to estimate data for BB3. The period of data available goes from 06/09/2022 until 05/11/2022.

The windvane from WTG-15.3 will be used to for the wind direction of the wind farm.

The wind speed dataset from the turbines selected for each sector needs to be corrected in order to neutralise the wake effect.

The correction factor will be calculated as follows:



- With WAsP software entering the data from BB3 mast, the wind speed at the selected wind turbines, WTG-15.3, WTG-31.6, and WTG-37.7 is obtained for each sector of the wind rose. The results are shown in the table below.
- The wind speed distribution in each of the BB3 met station sectors is also available in the WAsP simulation. The results are shown in the table below.
- The correction factor will be calculated using the differences between the wind speed from BB3 met mast and the one from the turbine chosen for each sector. The wind speed and correction factor from all the turbines of BB1WF is shown in Annex II and III.
- Therefore, to correct the wind speed at the turbine location to BB3 met mast location, the wind speed needs to be multiplied by the following correction factors (CF):

Sector	Direction [°]		Wind speed [m/s]				Correction factor Wind Speed (CF)		
	From	To	BB3 mast	WTG-15.3	WTG-31.6	WTG-37.7	WTG-15.3	WTG-31.6	WTG-37.7
Sector 1 (0°)	348.75	11.25	10.61	10.54	10.59	10.58	1.0066	1.0019	1.0028
Sector 2 (22,5°)	11.25	33.75	7.77	7.75	7.66	7.71	1.0026	1.0144	1.0078
Sector 3 (45°)	33.75	56.25	5.34	5.26	5.27	5.31	1.0152	1.0133	1.0056
Sector 4 (67,5°)	56.25	78.75	5.98	5.95	5.94	5.96	1.0050	1.0067	1.0034
Sector 5 (90°)	78.75	101.25	7.66	7.53	7.61	7.64	1.0173	1.0066	1.0026
Sector 6 (112,5°)	101.25	123.75	7.67	7.53	7.65	7.66	1.0186	1.0026	1.0013
Sector 7 (135°)	123.75	146.25	6.06	5.97	6.09	6.09	1.0151	0.9951	0.9951
Sector 8 (157,5°)	146.25	168.75	5.77	5.70	5.77	5.78	1.0123	1.0000	0.9983
Sector 9 (180°)	168.75	191.25	5.99	5.95	5.98	5.99	1.0067	1.0017	1.0000
Sector 10 (202,5°)	191.25	213.75	6.67	6.63	6.65	6.65	1.0060	1.0030	1.0030
Sector 11 (225°)	213.75	236.25	7.36	7.28	7.32	7.34	1.0110	1.0055	1.0027
Sector 12 (247,5°)	236.25	258.75	7.69	7.61	7.64	7.67	1.0105	1.0065	1.0026
Sector 13 (270°)	258.75	281.25	8.34	8.19	8.28	8.31	1.0183	1.0072	1.0036
Sector 14 (292,5°)	281.25	303.75	8.87	8.69	8.83	8.85	1.0207	1.0045	1.0023
Sector 15 (315°)	303.75	326.25	9.52	9.36	9.51	9.51	1.0171	1.0011	1.0011
Sector 16 (337,5°)	326.25	348.75	10.37	10.25	10.37	10.35	1.0117	1.0000	1.0019

Table 4. Correction factor for the Wind Speed from turbines WTG-15.3, WTG-31.6 and WTG-37.7

The generation of the synthesised dataset of wind speed and direction has been obtained from the data recorded by the wind turbines by applying the correction factor obtained in each sector.

The corrected wind data is wake-free for all directions that occurred during the noise survey, including the directions when these turbines would be wake affected.

The final result is to provide the synthesised wind speed and direction dataset that goes from 25/05/2021 to 24/11/2022 that represent the wind resource at BB3 meteorological station (file Synthesized dataset in BB3 at 112m_20210525-20221124.txt).



Annex I. Wake losses (WAsP simulation)



- Wake losses (%) simulated with WAsP with BB3 wind data from June 2010 until January 2020.

Wake losses [%] (Simulated with BB3 wind data June 2010 - January 2020)																
Wind Turbine Generator BB1WF	Sector 1 (0°)	Sector 2 (22,5°)	Sector 3 (45°)	Sector 4 (67,5°)	Sector 5 (90°)	Sector 6 (112,5°)	Sector 7 (135°)	Sector 8 (157,5°)	Sector 9 (180°)	Sector 10 (202,5°)	Sector 11 (225°)	Sector 12 (247,5°)	Sector 13 (270°)	Sector 14 (292,5°)	Sector 15 (315°)	Sector 16 (337,5°)
WTG-1.1	3.14%	8.42%	29.33%	37.49%	6.28%	8.79%	8.33%	34.61%	15.62%	14.33%	9.27%	0.00%	0.00%	0.00%	2.97%	6.02%
WTG-2.1	0.00%	0.00%	0.35%	42.71%	18.65%	14.00%	33.07%	11.41%	45.89%	18.53%	4.76%	0.00%	0.00%	4.12%	13.40%	2.40%
WTG-3.1	0.00%	0.00%	14.72%	28.58%	18.38%	11.50%	39.86%	9.09%	25.64%	23.25%	15.23%	19.01%	1.46%	11.68%	4.47%	0.00%
WTG-4.1	0.00%	0.00%	0.00%	0.00%	0.00%	20.26%	29.92%	22.06%	32.86%	19.68%	20.63%	21.06%	4.83%	8.77%	1.14%	0.00%
WTG-5.1	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	10.70%	13.44%	28.75%	9.41%	22.70%	16.15%	14.20%	19.16%	11.24%	0.00%
WTG-6.1	1.18%	0.00%	0.00%	0.00%	5.65%	15.44%	25.86%	18.28%	17.06%	5.46%	0.00%	0.00%	6.18%	13.21%	9.98%	20.53%
WTG-7.2	13.55%	4.78%	21.33%	45.58%	19.35%	8.50%	9.56%	11.29%	20.23%	13.56%	16.77%	12.76%	0.00%	0.77%	6.05%	7.99%
WTG-8.2	6.60%	15.24%	24.25%	30.71%	9.54%	12.22%	8.91%	9.91%	12.95%	15.46%	8.92%	24.74%	8.89%	3.79%	19.72%	0.49%
WTG-9.2	9.66%	5.65%	27.33%	14.69%	0.00%	3.43%	34.14%	8.77%	12.36%	9.31%	14.20%	22.57%	7.99%	13.30%	15.52%	0.00%
WTG-10.2	8.00%	0.00%	0.00%	0.00%	0.00%	5.12%	18.71%	5.40%	16.64%	10.90%	6.81%	6.02%	10.89%	10.26%	18.98%	5.49%
WTG-11.3	0.00%	0.00%	26.61%	0.55%	10.10%	20.26%	34.09%	0.29%	0.63%	15.58%	28.54%	9.68%	9.02%	4.26%	13.06%	6.43%
WTG-12.3	6.33%	8.70%	47.29%	4.70%	32.07%	0.78%	0.00%	0.00%	0.91%	9.09%	7.80%	6.08%	10.15%	9.81%	6.25%	4.48%
WTG-13.3	4.17%	5.32%	3.39%	45.40%	18.56%	0.00%	0.00%	0.00%	0.00%	5.38%	7.08%	4.70%	19.95%	7.04%	22.63%	0.59%
WTG-14.3	0.53%	0.00%	0.00%	0.00%	19.23%	21.31%	0.00%	0.00%	0.00%	3.63%	7.62%	28.07%	15.64%	12.68%	5.91%	8.78%
WTG-15.3	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	2.42%	5.75%	5.08%	26.49%	21.14%	9.03%	0.28%
WTG-16.3	0.00%	0.00%	0.00%	0.00%	17.04%	8.45%	26.09%	20.60%	19.61%	8.03%	14.63%	7.88%	4.19%	6.43%	10.26%	1.89%
WTG-17.3	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	14.69%	27.71%	13.98%	11.22%	23.88%	8.82%	12.12%	7.77%	3.49%	0.00%
WTG-18.4	5.88%	13.98%	12.19%	5.42%	7.91%	10.22%	10.43%	12.40%	25.61%	10.76%	6.65%	10.66%	5.00%	0.00%	1.44%	12.48%
WTG-19.4	8.57%	7.86%	4.17%	12.18%	25.24%	3.84%	0.00%	15.65%	20.21%	20.20%	5.03%	9.85%	1.75%	5.41%	5.06%	3.79%
WTG-20.4	4.60%	4.95%	9.60%	41.48%	7.06%	0.00%	0.00%	4.29%	16.19%	15.06%	12.65%	2.11%	13.73%	6.20%	3.32%	6.32%
WTG-21.4	4.86%	5.41%	40.24%	13.13%	13.93%	0.00%	0.00%	0.00%	12.34%	12.40%	11.11%	20.36%	8.79%	4.35%	5.51%	5.46%
WTG-22.4	4.58%	0.00%	10.80%	14.45%	18.72%	11.55%	0.00%	0.00%	6.76%	14.35%	29.13%	10.53%	3.62%	5.53%	6.75%	4.50%
WTG-23.5	4.06%	6.49%	26.17%	14.24%	14.90%	7.93%	12.71%	18.35%	22.34%	17.38%	22.21%	0.00%	0.00%	0.00%	0.00%	2.67%
WTG-24.4	3.85%	10.92%	43.69%	14.10%	9.47%	10.13%	4.74%	33.64%	20.58%	15.72%	0.00%	0.00%	0.00%	0.00%	0.00%	1.06%



Wake losses [%] (Simulated with BB3 wind data June 2010 - January 2020)																
Wind Turbine Generator BB1WF	Sector 1 (0°)	Sector 2 (22,5°)	Sector 3 (45°)	Sector 4 (67,5°)	Sector 5 (90°)	Sector 6 (112,5°)	Sector 7 (135°)	Sector 8 (157,5°)	Sector 9 (180°)	Sector 10 (202,5°)	Sector 11 (225°)	Sector 12 (247,5°)	Sector 13 (270°)	Sector 14 (292,5°)	Sector 15 (315°)	Sector 16 (337,5°)
WTG-25.5	7.62%	8.87%	10.59%	20.06%	6.46%	0.00%	26.08%	24.22%	18.65%	11.59%	0.93%	1.74%	22.58%	2.56%	0.00%	5.90%
WTG-26.5	4.23%	17.53%	13.30%	10.58%	38.57%	8.74%	21.39%	22.77%	17.70%	6.80%	0.00%	0.00%	0.00%	0.00%	0.00%	0.07%
WTG-27.6	3.91%	13.48%	12.41%	11.23%	0.00%	0.00%	28.84%	36.98%	32.25%	15.93%	14.90%	1.56%	0.00%	3.18%	9.95%	4.79%
WTG-28.6	5.65%	7.10%	13.85%	5.66%	0.00%	2.30%	39.81%	29.64%	25.16%	14.21%	18.38%	29.74%	5.68%	0.00%	11.79%	8.99%
WTG-29.6	10.05%	10.74%	14.13%	44.94%	6.71%	23.80%	20.01%	28.96%	27.00%	31.85%	11.52%	10.47%	9.99%	0.00%	2.24%	5.99%
WTG-30.6	6.83%	7.88%	21.31%	18.88%	22.53%	14.36%	40.12%	22.83%	21.06%	22.65%	10.00%	18.72%	1.31%	0.00%	0.00%	1.15%
WTG-31.6	2.61%	10.27%	13.11%	41.73%	15.84%	20.82%	46.82%	5.70%	33.21%	4.66%	4.35%	0.00%	0.00%	0.00%	0.00%	0.00%
WTG-32.7	4.46%	8.48%	9.35%	2.57%	0.00%	25.41%	25.71%	23.62%	17.89%	35.12%	15.06%	15.57%	8.43%	10.99%	17.04%	8.15%
WTG-33.7	5.36%	25.88%	23.38%	16.33%	14.06%	21.67%	38.78%	43.38%	11.89%	14.98%	14.84%	16.06%	9.67%	5.82%	11.47%	3.19%
WTG-34.7	7.34%	19.06%	21.77%	28.36%	24.08%	25.11%	45.55%	5.02%	2.08%	0.00%	9.36%	23.59%	0.77%	1.06%	15.34%	0.39%
WTG-35.7	12.87%	11.14%	27.05%	52.43%	25.95%	20.84%	5.37%	5.51%	0.00%	0.89%	8.12%	0.00%	0.00%	0.00%	0.00%	0.16%
WTG-36.7	6.22%	21.36%	28.76%	27.78%	30.56%	25.32%	26.56%	3.62%	5.39%	0.00%	3.10%	2.97%	8.53%	8.67%	23.30%	4.46%
WTG-37.7	19.35%	15.16%	28.34%	38.43%	26.55%	23.71%	11.08%	7.99%	6.85%	0.00%	0.00%	5.34%	0.00%	10.07%	17.07%	8.07%
WTG-38.8	7.58%	25.45%	10.08%	20.13%	15.55%	16.65%	19.33%	27.80%	34.55%	17.62%	13.98%	21.87%	14.42%	14.43%	4.98%	8.51%
WTG-39.8	4.05%	5.73%	9.56%	0.00%	0.00%	21.56%	6.56%	35.69%	43.02%	14.69%	11.14%	19.36%	11.49%	16.95%	10.86%	3.80%
WTG-40.8	3.71%	5.10%	5.15%	0.00%	0.00%	0.00%	0.00%	2.55%	17.11%	28.79%	13.54%	29.31%	13.61%	21.73%	7.53%	4.09%
WTG-41.8	12.95%	5.19%	7.21%	40.85%	4.64%	0.00%	8.54%	46.33%	16.37%	30.56%	11.36%	13.55%	12.70%	13.28%	13.51%	10.68%
WTG-42.8	10.00%	11.62%	21.61%	37.32%	19.13%	13.45%	46.97%	7.18%	38.13%	10.01%	1.14%	10.33%	18.23%	10.02%	12.27%	12.93%
WTG-43.8	11.91%	20.47%	18.37%	22.84%	10.05%	18.73%	44.19%	29.27%	8.36%	1.99%	0.00%	17.42%	13.13%	13.67%	20.29%	6.28%

Table 5. Wake losses simulated with WAsP



Annex II. Wind speed (WAsP simulation)



- Wind speed at hub height 112 m (m/s) simulated with WAsP with BB3 wind data from June 2010 until January 2020.

Wind Speed (Simulated with BB3 wind data June 2010 - January 2020)																
Wind Turbine Generator BB1WF	Sector 1 (0°)	Sector 2 (22,5°)	Sector 3 (45°)	Sector 4 (67,5°)	Sector 5 (90°)	Sector 6 (112,5°)	Sector 7 (135°)	Sector 8 (157,5°)	Sector 9 (180°)	Sector 10 (202,5°)	Sector 11 (225°)	Sector 12 (247,5°)	Sector 13 (270°)	Sector 14 (292,5°)	Sector 15 (315°)	Sector 16 (337,5°)
WTG-1.1	10.60	7.81	5.36	5.99	7.67	7.67	6.05	5.76	5.98	6.66	7.36	7.71	8.35	8.87	9.51	10.36
WTG-2.1	10.59	7.79	5.33	5.97	7.63	7.63	6.04	5.75	5.98	6.66	7.34	7.68	8.31	8.82	9.48	10.34
WTG-3.1	10.60	7.78	5.30	5.97	7.60	7.61	6.02	5.74	5.99	6.66	7.34	7.66	8.27	8.79	9.45	10.33
WTG-4.1	10.59	7.72	5.27	5.94	7.59	7.61	6.03	5.74	5.98	6.65	7.31	7.63	8.26	8.79	9.46	10.33
WTG-5.1	10.65	7.69	5.25	5.92	7.58	7.62	6.06	5.78	6.01	6.68	7.32	7.62	8.24	8.78	9.48	10.39
WTG-6.1	10.64	7.80	5.35	6.00	7.68	7.68	6.07	5.78	6.01	6.69	7.38	7.71	8.35	8.88	9.54	10.40
WTG-7.2	10.59	7.74	5.32	5.97	7.64	7.66	6.05	5.76	5.98	6.65	7.33	7.67	8.32	8.85	9.51	10.36
WTG-8.2	10.62	7.67	5.24	5.92	7.60	7.65	6.06	5.78	6.00	6.65	7.30	7.62	8.26	8.82	9.52	10.40
WTG-9.2	10.62	7.68	5.25	5.93	7.60	7.65	6.06	5.78	6.00	6.66	7.31	7.63	8.27	8.82	9.52	10.39
WTG-10.2	10.61	7.67	5.24	5.92	7.58	7.63	6.05	5.77	6.00	6.65	7.30	7.62	8.25	8.80	9.49	10.38
WTG-11.3	10.55	7.74	5.28	5.94	7.57	7.58	6.00	5.72	5.96	6.63	7.30	7.63	8.24	8.76	9.41	10.29
WTG-12.3	10.56	7.67	5.25	5.91	7.56	7.59	6.01	5.73	5.96	6.62	7.28	7.61	8.23	8.76	9.43	10.31
WTG-13.3	10.55	7.73	5.26	5.94	7.55	7.56	5.99	5.72	5.96	6.63	7.29	7.61	8.21	8.73	9.39	10.28
WTG-14.3	10.56	7.75	5.27	5.95	7.55	7.56	5.99	5.72	5.96	6.64	7.29	7.62	8.22	8.73	9.39	10.28
WTG-15.3	10.54	7.75	5.26	5.95	7.53	7.53	5.97	5.70	5.95	6.63	7.28	7.61	8.19	8.69	9.36	10.25
WTG-16.3	10.65	7.70	5.26	5.94	7.61	7.65	6.07	5.79	6.02	6.68	7.33	7.64	8.27	8.82	9.51	10.41
WTG-17.3	10.60	7.77	5.26	5.97	7.55	7.56	5.99	5.73	5.98	6.66	7.32	7.62	8.21	8.72	9.40	10.31
WTG-18.4	10.59	7.79	5.37	6.00	7.69	7.68	6.06	5.76	5.97	6.65	7.35	7.71	8.37	8.89	9.53	10.36
WTG-19.4	10.58	7.76	5.35	5.98	7.67	7.68	6.06	5.76	5.97	6.64	7.34	7.70	8.35	8.88	9.53	10.35
WTG-20.4	10.56	7.63	5.30	5.95	7.66	7.71	6.09	5.78	5.97	6.61	7.29	7.66	8.33	8.91	9.58	10.39
WTG-21.4	10.56	7.63	5.21	5.89	7.55	7.60	6.03	5.75	5.97	6.61	7.26	7.58	8.21	8.76	9.46	10.34
WTG-22.4	10.62	7.68	5.26	5.94	7.61	7.64	6.05	5.77	6.00	6.66	7.32	7.64	8.27	8.82	9.50	10.38
WTG-23.5	10.54	7.64	5.31	5.95	7.66	7.68	6.06	5.76	5.95	6.61	7.29	7.66	8.33	8.89	9.54	10.35
WTG-24.4	10.53	7.62	5.27	5.93	7.62	7.65	6.06	5.75	5.94	6.60	7.27	7.62	8.28	8.84	9.51	10.33



Wind Speed (Simulated with BB3 wind data June 2010 - January 2020)																
Wind Turbine Generator BB1WF	Sector 1 (0°)	Sector 2 (22,5°)	Sector 3 (45°)	Sector 4 (67,5°)	Sector 5 (90°)	Sector 6 (112,5°)	Sector 7 (135°)	Sector 8 (157,5°)	Sector 9 (180°)	Sector 10 (202,5°)	Sector 11 (225°)	Sector 12 (247,5°)	Sector 13 (270°)	Sector 14 (292,5°)	Sector 15 (315°)	Sector 16 (337,5°)
WTG-25.5	10.60	7.69	5.28	5.95	7.62	7.65	6.07	5.77	5.98	6.65	7.32	7.65	8.29	8.83	9.51	10.37
WTG-26.5	10.62	7.70	5.29	5.96	7.63	7.66	6.09	5.78	5.99	6.66	7.34	7.66	8.30	8.85	9.53	10.39
WTG-27.6	10.57	7.66	5.30	5.95	7.64	7.67	6.07	5.77	5.97	6.62	7.31	7.65	8.31	8.86	9.52	10.36
WTG-28.6	10.54	7.65	5.31	5.95	7.65	7.67	6.07	5.76	5.95	6.61	7.30	7.66	8.32	8.88	9.53	10.34
WTG-29.6	10.55	7.69	5.32	5.96	7.65	7.67	6.08	5.76	5.96	6.62	7.32	7.67	8.32	8.87	9.52	10.34
WTG-30.6	10.57	7.71	5.31	5.96	7.64	7.65	6.07	5.76	5.97	6.64	7.33	7.66	8.31	8.85	9.50	10.34
WTG-31.6	10.59	7.66	5.27	5.94	7.61	7.65	6.09	5.77	5.98	6.65	7.32	7.64	8.28	8.83	9.51	10.37
WTG-32.7	10.54	7.65	5.30	5.94	7.63	7.65	6.06	5.76	5.95	6.61	7.29	7.65	8.30	8.85	9.51	10.33
WTG-33.7	10.56	7.72	5.33	5.97	7.66	7.67	6.08	5.76	5.96	6.63	7.33	7.69	8.33	8.87	9.52	10.34
WTG-34.7	10.55	7.69	5.30	5.94	7.62	7.64	6.07	5.75	5.96	6.63	7.32	7.65	8.29	8.83	9.49	10.33
WTG-35.7	10.60	7.75	5.30	5.95	7.62	7.63	6.08	5.76	5.99	6.67	7.35	7.66	8.29	8.82	9.48	10.35
WTG-36.7	10.56	7.71	5.32	5.96	7.65	7.66	6.09	5.76	5.97	6.64	7.33	7.68	8.32	8.86	9.51	10.34
WTG-37.7	10.58	7.71	5.31	5.96	7.64	7.66	6.09	5.78	5.99	6.65	7.34	7.67	8.31	8.85	9.51	10.35
WTG-38.8	10.55	7.67	5.31	5.96	7.65	7.67	6.09	5.77	5.96	6.62	7.31	7.66	8.32	8.87	9.53	10.35
WTG-39.8	10.56	7.65	5.26	5.92	7.59	7.62	6.05	5.77	5.97	6.62	7.29	7.62	8.26	8.80	9.48	10.34
WTG-40.8	10.57	7.69	5.27	5.93	7.58	7.60	6.02	5.77	5.98	6.63	7.30	7.62	8.25	8.78	9.45	10.32
WTG-41.8	10.58	7.67	5.25	5.92	7.57	7.60	6.04	5.77	5.98	6.64	7.30	7.61	8.24	8.77	9.45	10.33
WTG-42.8	10.56	7.73	5.33	5.96	7.65	7.66	6.07	5.77	5.97	6.63	7.33	7.67	8.32	8.85	9.50	10.34
WTG-43.8	10.57	7.65	5.30	5.95	7.65	7.68	6.09	5.79	5.98	6.63	7.32	7.66	8.32	8.88	9.54	10.36
BB3	10.61	7.77	5.34	5.98	7.66	7.67	6.06	5.77	5.99	6.67	7.36	7.69	8.34	8.87	9.52	10.37

Table 6. Wind Speed simulated with WASP



Annex III. Correction Factor



- Correction Factor for Wind Speed, simulated with WASP with BB3 wind data from June 2010 until January 2020.

Correction Factor for Wind Speed (Simulated with BB3 wind data June 2010 - January 2020)																
Wind Turbine Generator BB1WF	Sector 1 (0°)	Sector 2 (22,5°)	Sector 3 (45°)	Sector 4 (67,5°)	Sector 5 (90°)	Sector 6 (112,5°)	Sector 7 (135°)	Sector 8 (157,5°)	Sector 9 (180°)	Sector 10 (202,5°)	Sector 11 (225°)	Sector 12 (247,5°)	Sector 13 (270°)	Sector 14 (292,5°)	Sector 15 (315°)	Sector 16 (337,5°)
WTG-1.1	1.0009	0.9949	0.9963	0.9983	0.9987	1.0000	1.0017	1.0017	1.0017	1.0015	1.0000	0.9974	0.9988	1.0000	1.0011	1.0010
WTG-2.1	1.0019	0.9974	1.0019	1.0017	1.0039	1.0052	1.0033	1.0035	1.0017	1.0015	1.0027	1.0013	1.0036	1.0057	1.0042	1.0029
WTG-3.1	1.0009	0.9987	1.0075	1.0017	1.0079	1.0079	1.0066	1.0052	1.0000	1.0015	1.0027	1.0039	1.0085	1.0091	1.0074	1.0039
WTG-4.1	1.0019	1.0065	1.0133	1.0067	1.0092	1.0079	1.0050	1.0052	1.0017	1.0030	1.0068	1.0079	1.0097	1.0091	1.0063	1.0039
WTG-5.1	0.9962	1.0104	1.0171	1.0101	1.0106	1.0066	1.0000	0.9983	0.9967	0.9985	1.0055	1.0092	1.0121	1.0103	1.0042	0.9981
WTG-6.1	0.9972	0.9962	0.9981	0.9967	0.9974	0.9987	0.9984	0.9983	0.9967	0.9970	0.9973	0.9974	0.9988	0.9989	0.9979	0.9971
WTG-7.2	1.0019	1.0039	1.0038	1.0017	1.0026	1.0013	1.0017	1.0017	1.0030	1.0041	1.0026	1.0024	1.0023	1.0011	1.0010	1.0010
WTG-8.2	0.9991	1.0130	1.0191	1.0101	1.0079	1.0026	1.0000	0.9983	0.9983	1.0030	1.0082	1.0092	1.0097	1.0057	1.0000	0.9971
WTG-9.2	0.9991	1.0117	1.0171	1.0084	1.0079	1.0026	1.0000	0.9983	0.9983	1.0015	1.0068	1.0079	1.0085	1.0057	1.0000	0.9981
WTG-10.2	1.0000	1.0130	1.0191	1.0101	1.0106	1.0052	1.0017	1.0000	0.9983	1.0030	1.0082	1.0092	1.0109	1.0080	1.0032	0.9990
WTG-11.3	1.0057	1.0039	1.0114	1.0067	1.0119	1.0119	1.0100	1.0087	1.0050	1.0060	1.0082	1.0079	1.0121	1.0126	1.0117	1.0078
WTG-12.3	1.0047	1.0130	1.0171	1.0118	1.0132	1.0105	1.0083	1.0070	1.0050	1.0076	1.0110	1.0105	1.0134	1.0126	1.0095	1.0058
WTG-13.3	1.0057	1.0052	1.0152	1.0067	1.0146	1.0146	1.0117	1.0087	1.0050	1.0060	1.0096	1.0105	1.0158	1.0160	1.0138	1.0088
WTG-14.3	1.0047	1.0026	1.0133	1.0050	1.0146	1.0146	1.0117	1.0087	1.0050	1.0045	1.0096	1.0092	1.0146	1.0160	1.0138	1.0088
WTG-15.3	1.0066	1.0026	1.0152	1.0050	1.0173	1.0186	1.0151	1.0123	1.0067	1.0060	1.0110	1.0105	1.0183	1.0207	1.0171	1.0117
WTG-16.3	0.9962	1.0091	1.0152	1.0067	1.0066	1.0026	0.9984	0.9965	0.9950	0.9985	1.0041	1.0065	1.0085	1.0057	1.0011	0.9962
WTG-17.3	1.0009	1.0000	1.0152	1.0017	1.0146	1.0146	1.0117	1.0070	1.0017	1.0015	1.0055	1.0092	1.0158	1.0172	1.0128	1.0058
WTG-18.4	1.0019	0.9974	0.9944	0.9967	0.9961	0.9987	1.0000	1.0017	1.0034	1.0030	1.0014	0.9974	0.9964	0.9978	0.9990	1.0010
WTG-19.4	1.0028	1.0013	0.9981	1.0000	0.9987	0.9987	1.0000	1.0017	1.0034	1.0045	1.0027	0.9987	0.9988	0.9989	0.9990	1.0019
WTG-20.4	1.0047	1.0183	1.0075	1.0050	1.0000	0.9948	0.9951	0.9983	1.0034	1.0091	1.0096	1.0039	1.0012	0.9955	0.9937	0.9981
WTG-21.4	1.0047	1.0183	1.0250	1.0153	1.0146	1.0092	1.0050	1.0035	1.0034	1.0091	1.0138	1.0145	1.0158	1.0126	1.0063	1.0029
WTG-22.4	0.9991	1.0117	1.0152	1.0067	1.0066	1.0039	1.0017	1.0000	0.9983	1.0015	1.0055	1.0065	1.0085	1.0057	1.0021	0.9990
WTG-23.5	1.0066	1.0170	1.0056	1.0050	1.0000	0.9987	1.0000	1.0017	1.0067	1.0091	1.0096	1.0039	1.0012	0.9978	0.9979	1.0019
WTG-24.4	1.0076	1.0197	1.0133	1.0084	1.0052	1.0026	1.0000	1.0035	1.0084	1.0106	1.0124	1.0092	1.0072	1.0034	1.0011	1.0039



Correction Factor for Wind Speed (Simulated with BB3 wind data June 2010 - January 2020)																
Wind Turbine Generator BB1WF	Sector 1 (0°)	Sector 2 (22,5°)	Sector 3 (45°)	Sector 4 (67,5°)	Sector 5 (90°)	Sector 6 (112,5°)	Sector 7 (135°)	Sector 8 (157,5°)	Sector 9 (180°)	Sector 10 (202,5°)	Sector 11 (225°)	Sector 12 (247,5°)	Sector 13 (270°)	Sector 14 (292,5°)	Sector 15 (315°)	Sector 16 (337,5°)
WTG-25.5	1.0009	1.0104	1.0114	1.0050	1.0052	1.0026	0.9984	1.0000	1.0017	1.0030	1.0055	1.0052	1.0060	1.0045	1.0011	1.0000
WTG-26.5	0.9991	1.0091	1.0095	1.0034	1.0039	1.0013	0.9951	0.9983	1.0000	1.0015	1.0027	1.0039	1.0048	1.0023	0.9990	0.9981
WTG-27.6	1.0038	1.0144	1.0075	1.0050	1.0026	1.0000	0.9984	1.0000	1.0034	1.0076	1.0068	1.0052	1.0036	1.0011	1.0000	1.0010
WTG-28.6	1.0066	1.0157	1.0056	1.0050	1.0013	1.0000	0.9984	1.0017	1.0067	1.0091	1.0082	1.0039	1.0024	0.9989	0.9990	1.0029
WTG-29.6	1.0057	1.0104	1.0038	1.0034	1.0013	1.0000	0.9967	1.0017	1.0050	1.0076	1.0055	1.0026	1.0024	1.0000	1.0000	1.0029
WTG-30.6	1.0038	1.0078	1.0056	1.0034	1.0026	1.0026	0.9984	1.0017	1.0034	1.0045	1.0041	1.0039	1.0036	1.0023	1.0021	1.0029
WTG-31.6	1.0019	1.0144	1.0133	1.0067	1.0066	1.0026	0.9951	1.0000	1.0017	1.0030	1.0055	1.0065	1.0072	1.0045	1.0011	1.0000
WTG-32.7	1.0066	1.0157	1.0075	1.0067	1.0039	1.0026	1.0000	1.0017	1.0067	1.0091	1.0096	1.0052	1.0048	1.0023	1.0011	1.0039
WTG-33.7	1.0047	1.0065	1.0019	1.0017	1.0000	1.0000	0.9967	1.0017	1.0050	1.0060	1.0041	1.0000	1.0012	1.0000	1.0000	1.0029
WTG-34.7	1.0057	1.0104	1.0075	1.0067	1.0052	1.0039	0.9984	1.0035	1.0050	1.0060	1.0055	1.0052	1.0060	1.0045	1.0032	1.0039
WTG-35.7	1.0009	1.0026	1.0075	1.0050	1.0052	1.0052	0.9967	1.0017	1.0000	1.0000	1.0014	1.0039	1.0060	1.0057	1.0042	1.0019
WTG-36.7	1.0047	1.0078	1.0038	1.0034	1.0013	1.0013	0.9951	1.0017	1.0034	1.0045	1.0041	1.0013	1.0024	1.0011	1.0011	1.0029
WTG-37.7	1.0028	1.0078	1.0056	1.0034	1.0026	1.0013	0.9951	0.9983	1.0000	1.0030	1.0027	1.0026	1.0036	1.0023	1.0011	1.0019
WTG-38.8	1.0057	1.0130	1.0056	1.0034	1.0013	1.0000	0.9951	1.0000	1.0050	1.0076	1.0068	1.0039	1.0024	1.0000	0.9990	1.0019
WTG-39.8	1.0047	1.0157	1.0152	1.0101	1.0092	1.0066	1.0017	1.0000	1.0034	1.0076	1.0096	1.0092	1.0097	1.0080	1.0042	1.0029
WTG-40.8	1.0038	1.0104	1.0133	1.0084	1.0106	1.0092	1.0066	1.0000	1.0017	1.0060	1.0082	1.0092	1.0109	1.0103	1.0074	1.0048
WTG-41.8	1.0028	1.0130	1.0171	1.0101	1.0119	1.0092	1.0033	1.0000	1.0017	1.0045	1.0082	1.0105	1.0121	1.0114	1.0074	1.0039
WTG-42.8	1.0047	1.0052	1.0019	1.0034	1.0013	1.0013	0.9984	1.0000	1.0034	1.0060	1.0041	1.0026	1.0024	1.0023	1.0021	1.0029
WTG-43.8	1.0038	1.0157	1.0075	1.0050	1.0013	0.9987	0.9951	0.9965	1.0017	1.0060	1.0055	1.0039	1.0024	0.9989	0.9979	1.0010

Table 7. Correction of the Wind Speed simulated with WAsP. Multiplier applied to the synthesised dataset.

APPENDIX F: CORRELATION GRAPHS

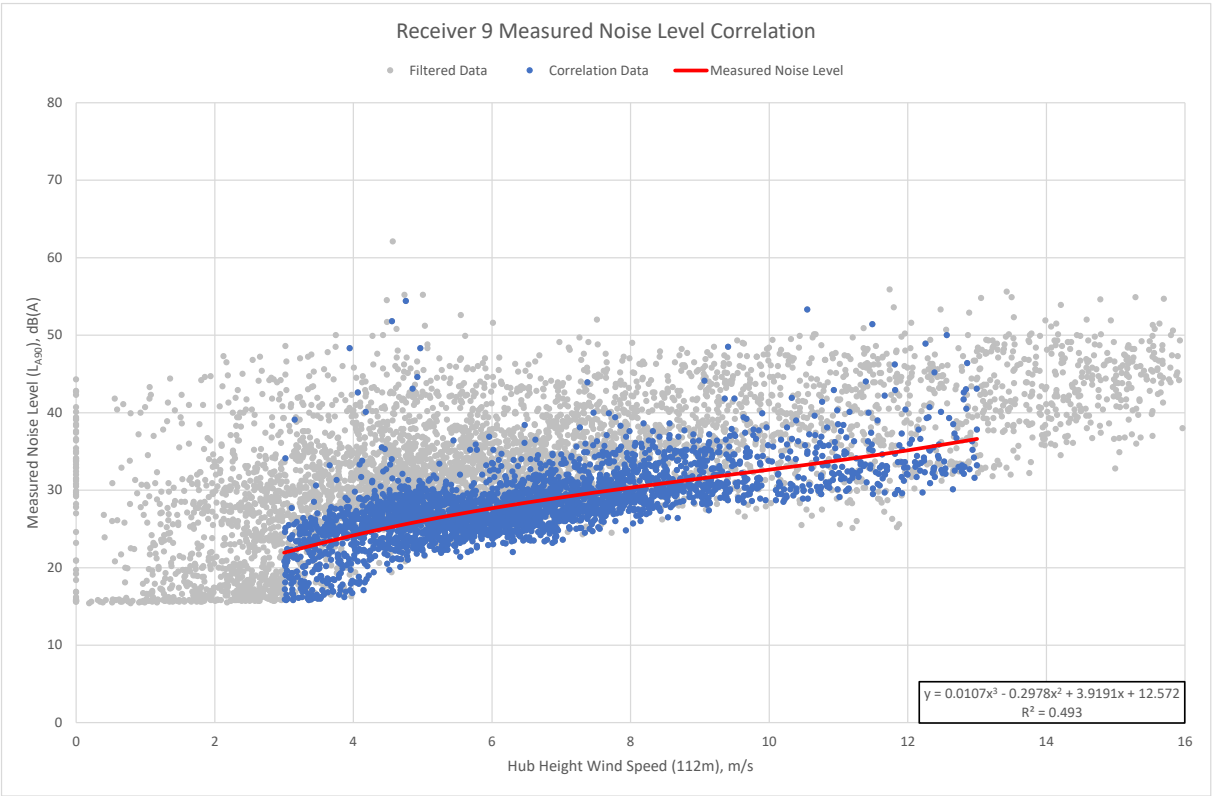


Figure 28: Receiver 9 Measured Noise Level

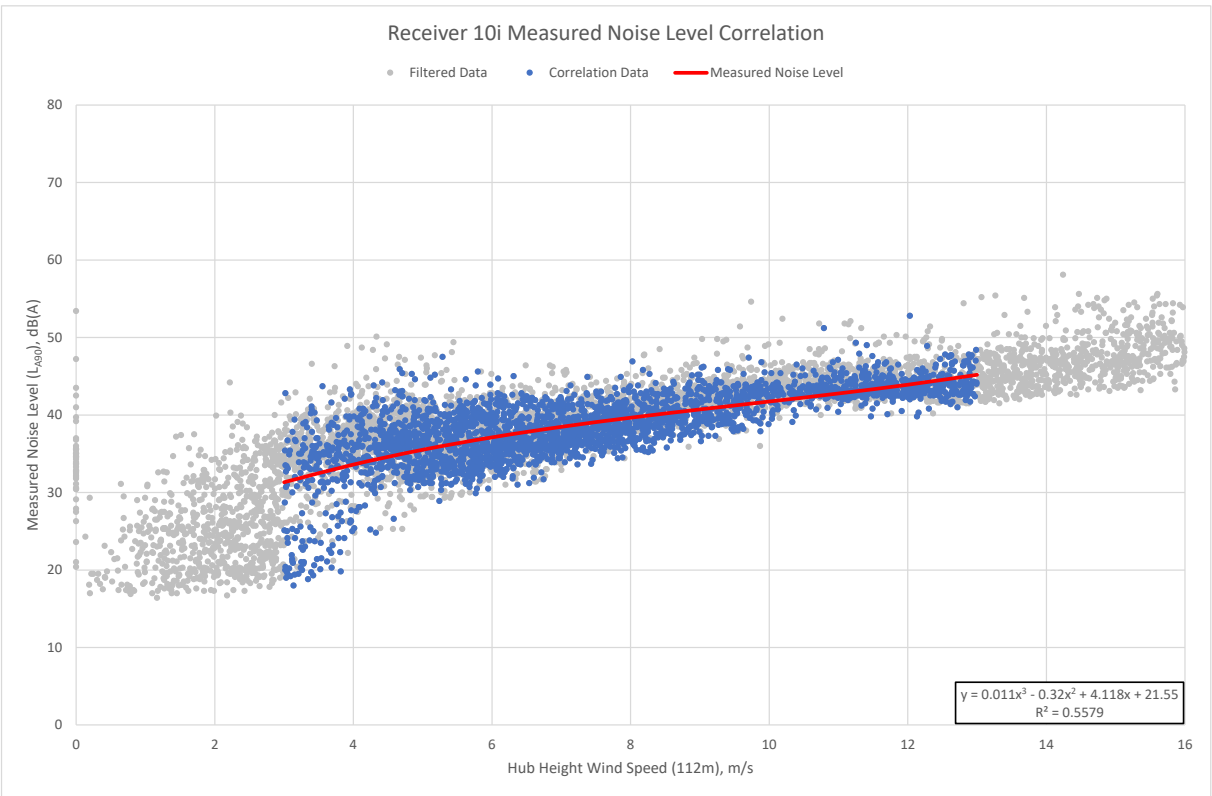


Figure 29: Receiver 10i Measured Noise Level

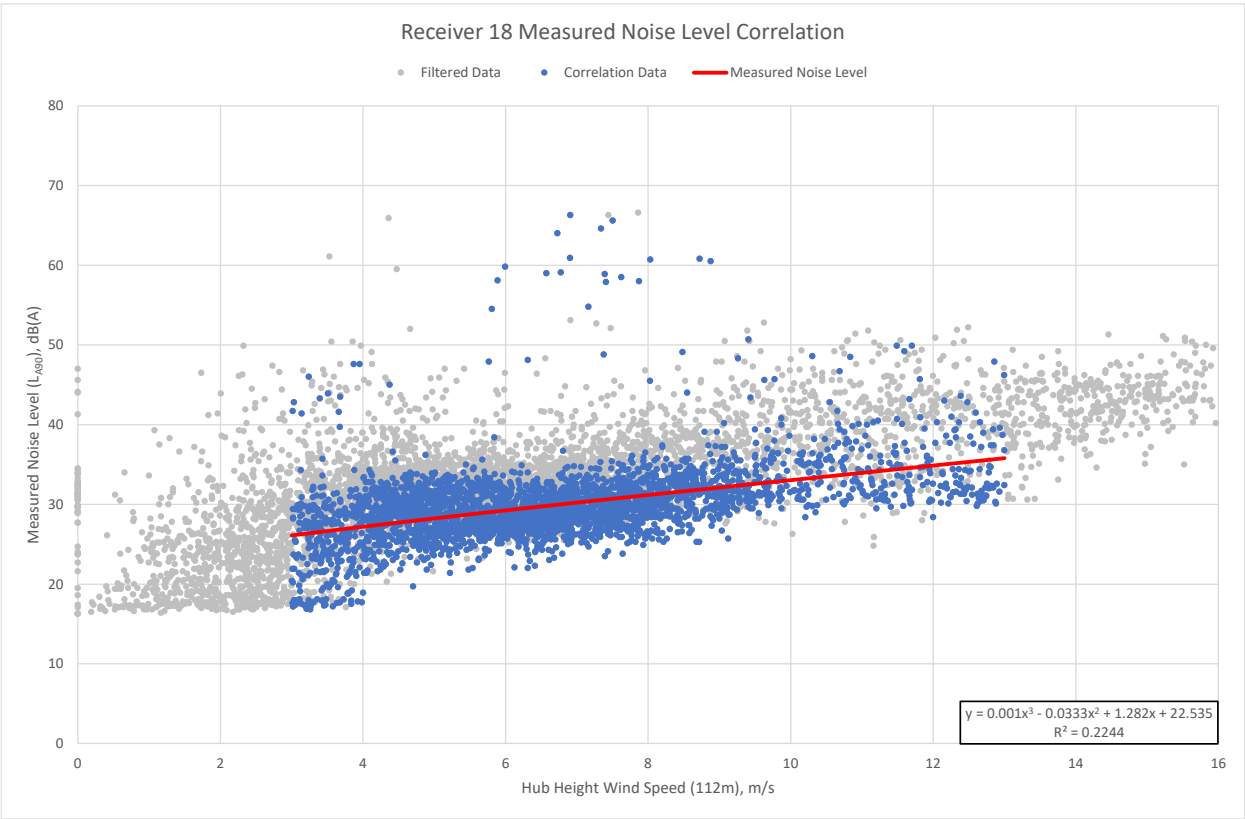


Figure 30: Receiver 18 Measured Noise Level

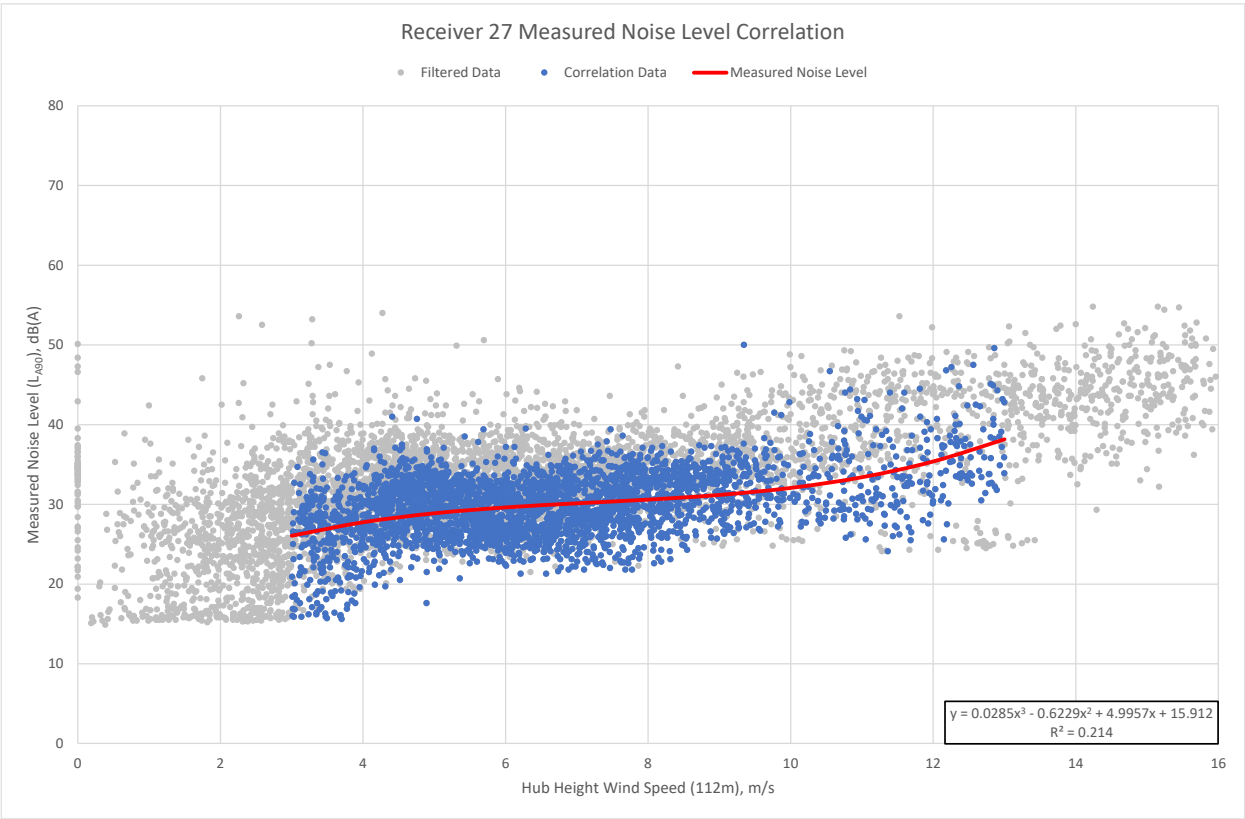


Figure 31: Receiver 27 Measured Noise Level

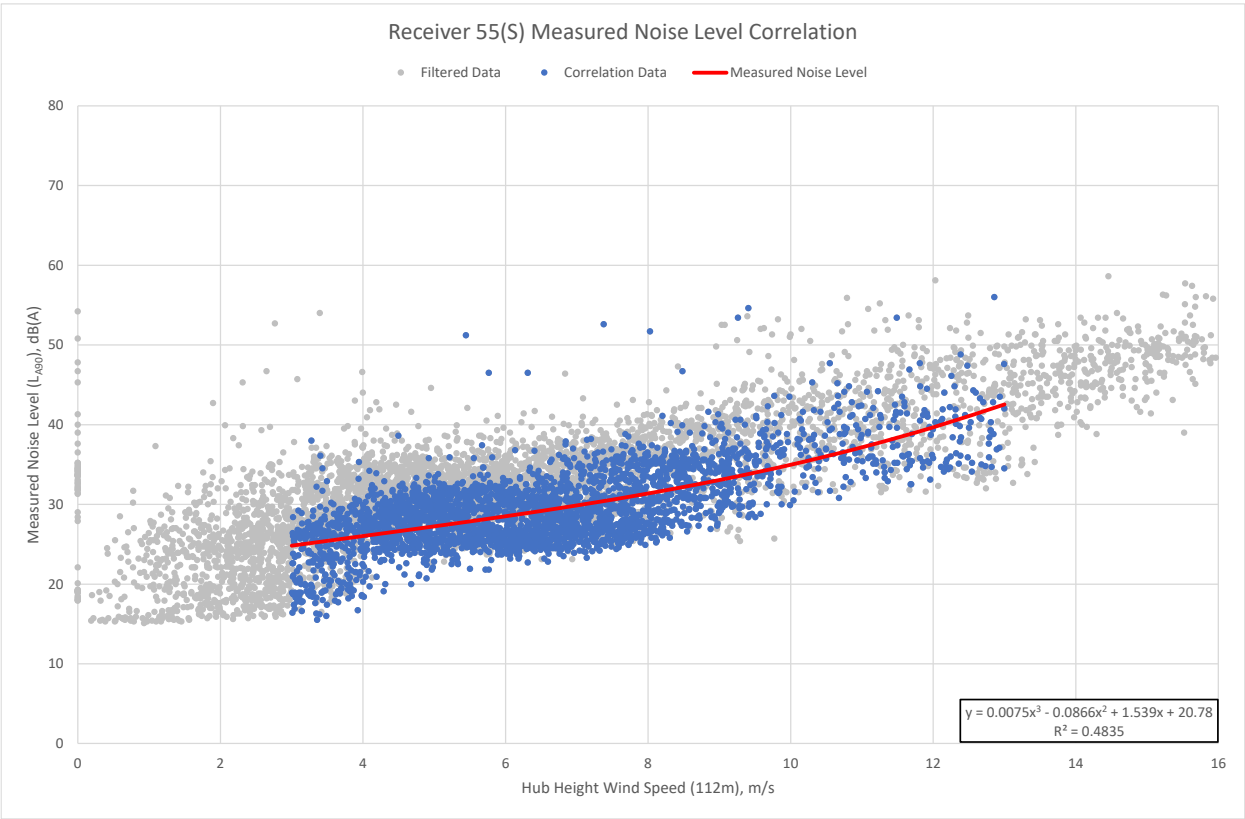


Figure 32: Receiver 55(S) Measured Noise Level

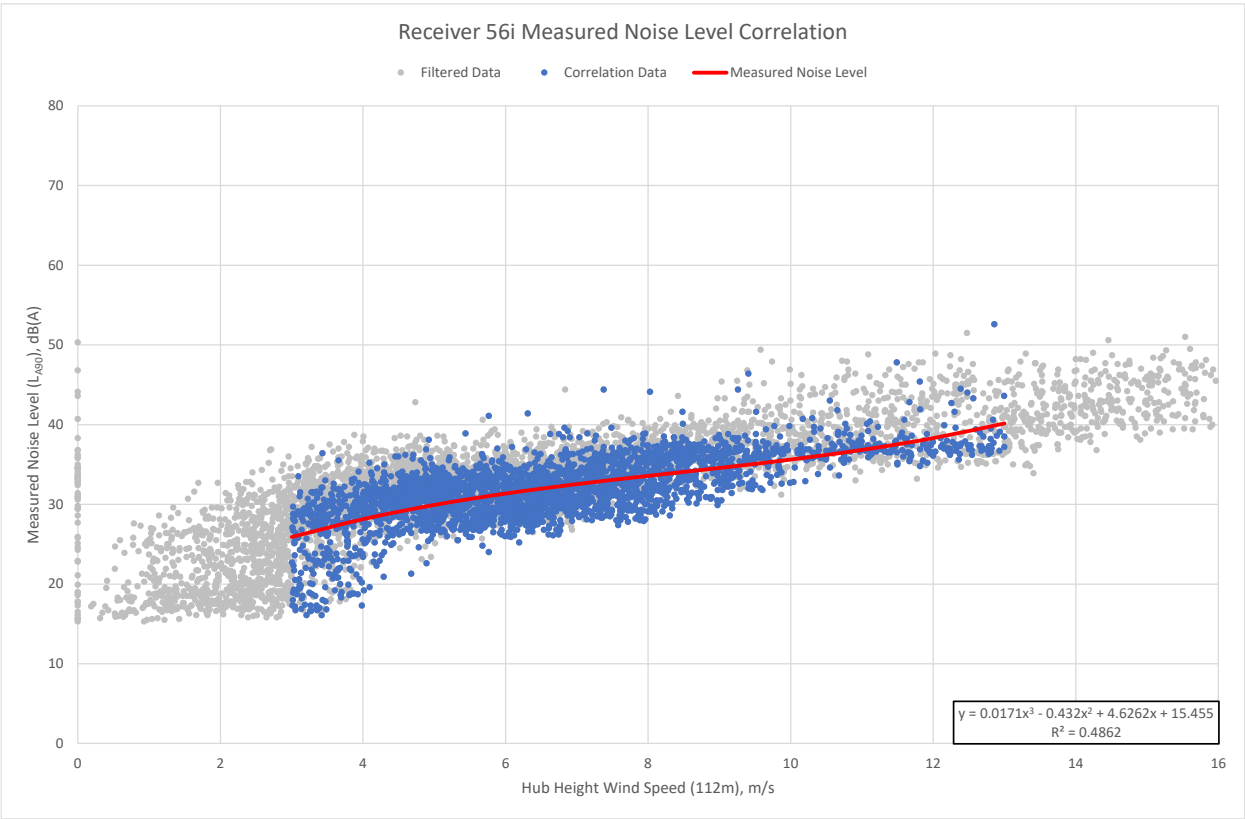


Figure 33: Receiver 56i Measured Noise Level

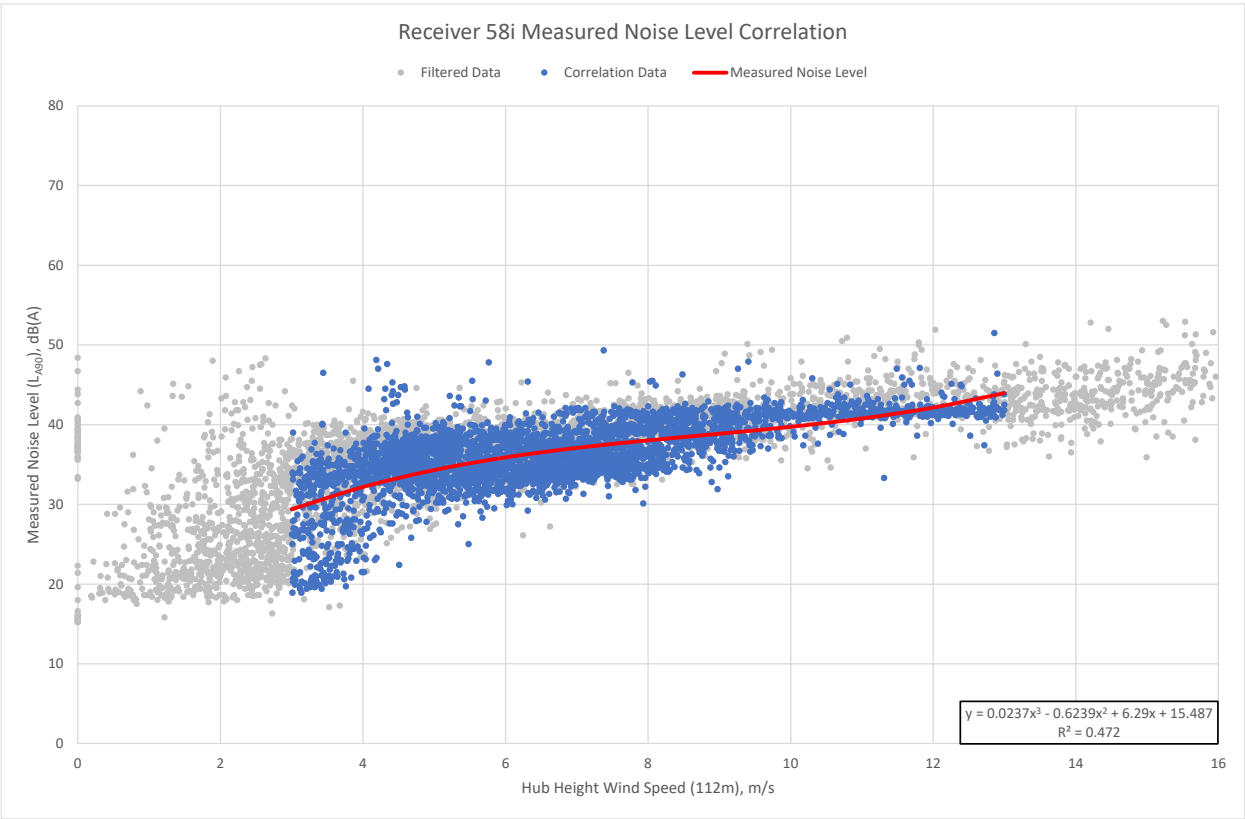


Figure 34: Receiver 58i Measured Noise Level

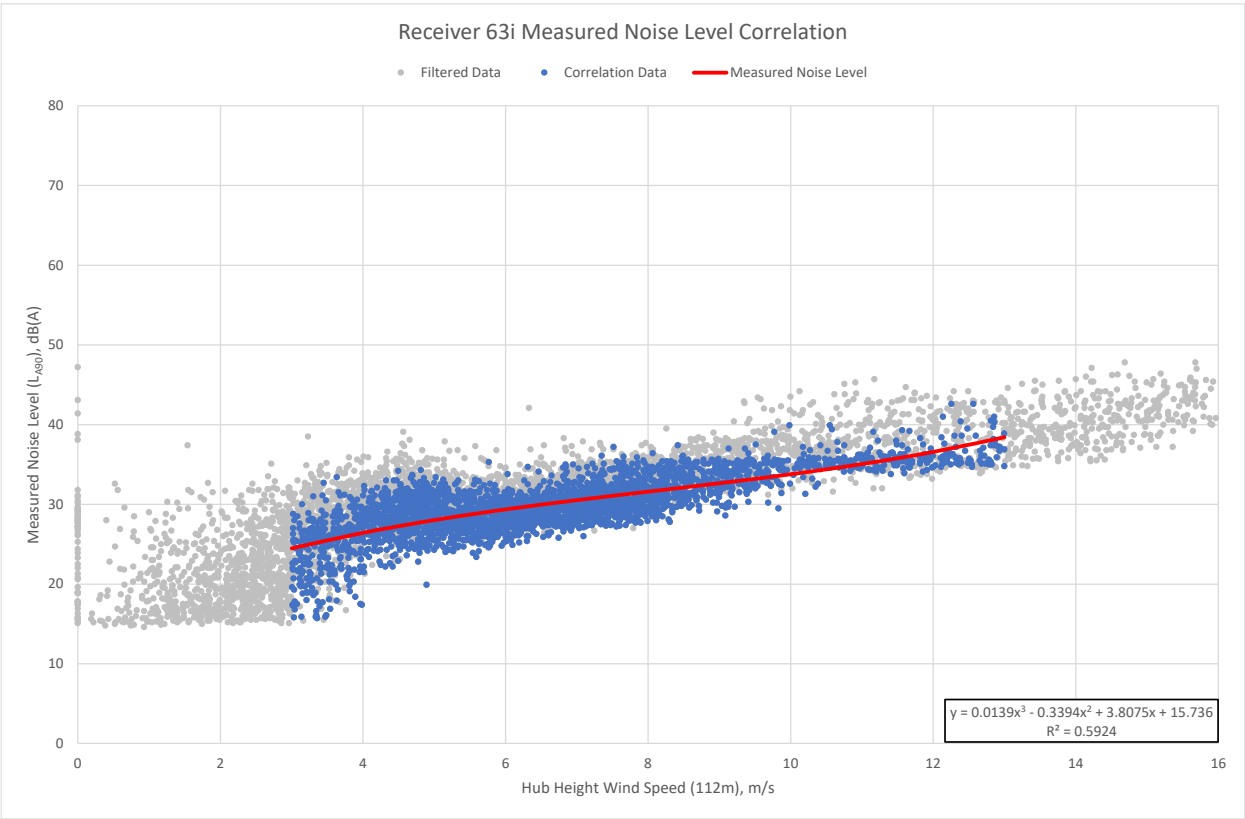


Figure 35: Receiver 63i Measured Noise Level

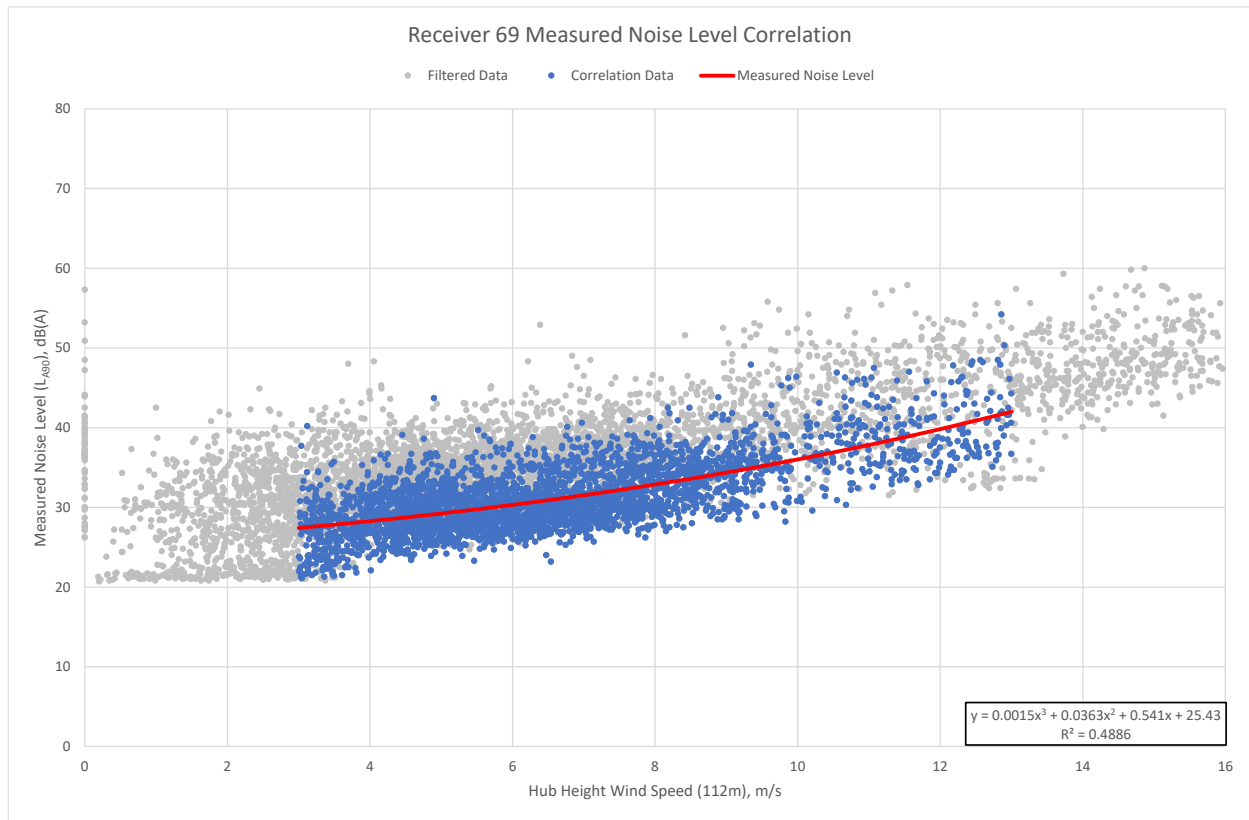


Figure 36: Receiver 69 Measured Noise Level

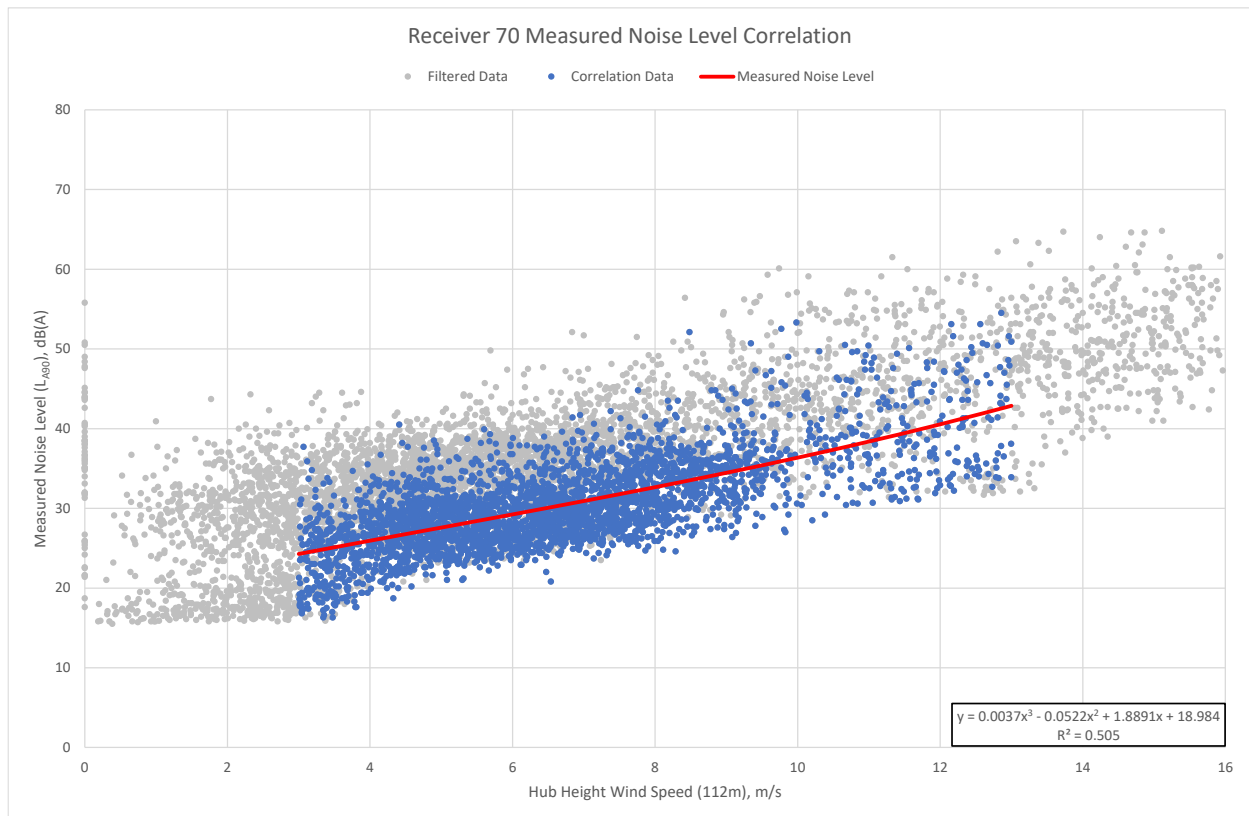


Figure 37: Receiver 70 Measured Noise Level

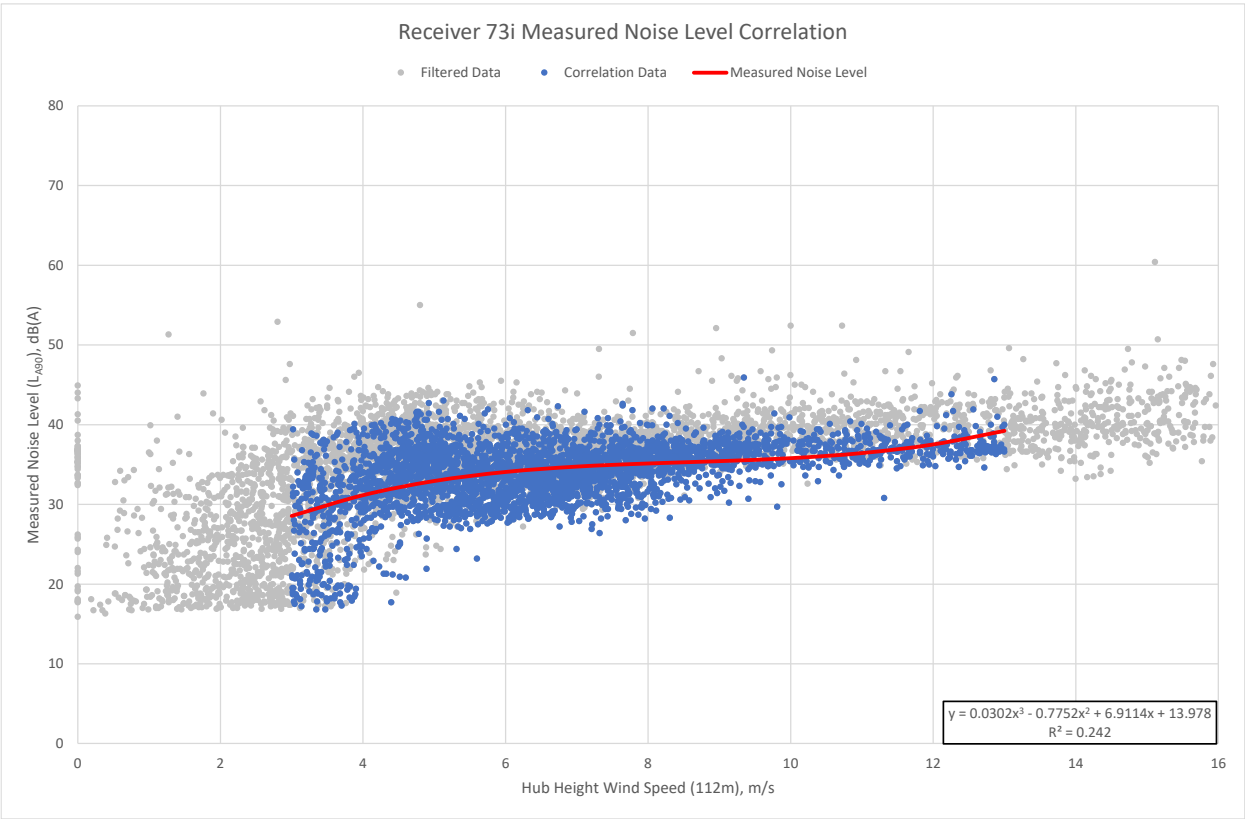


Figure 38: Receiver 73i Measured Noise Level

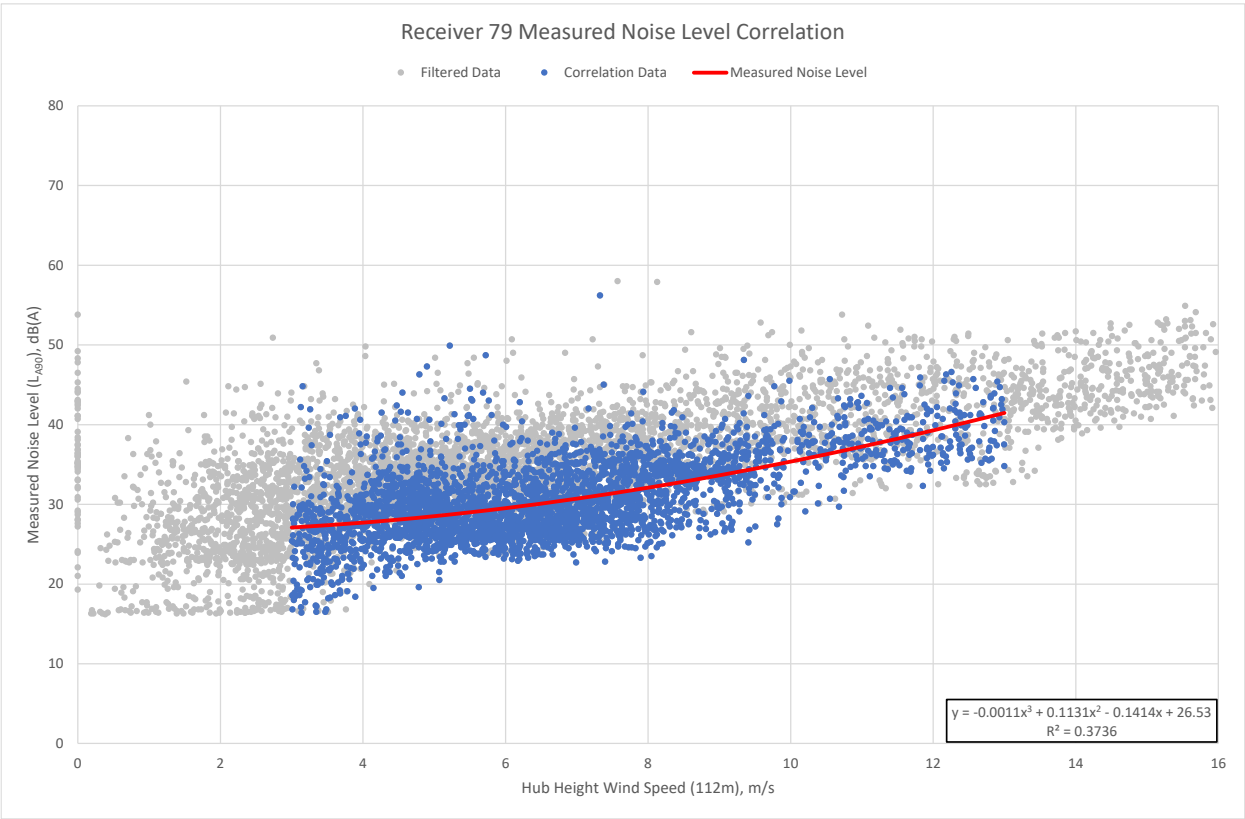


Figure 39: Receiver 79 Measured Noise Level

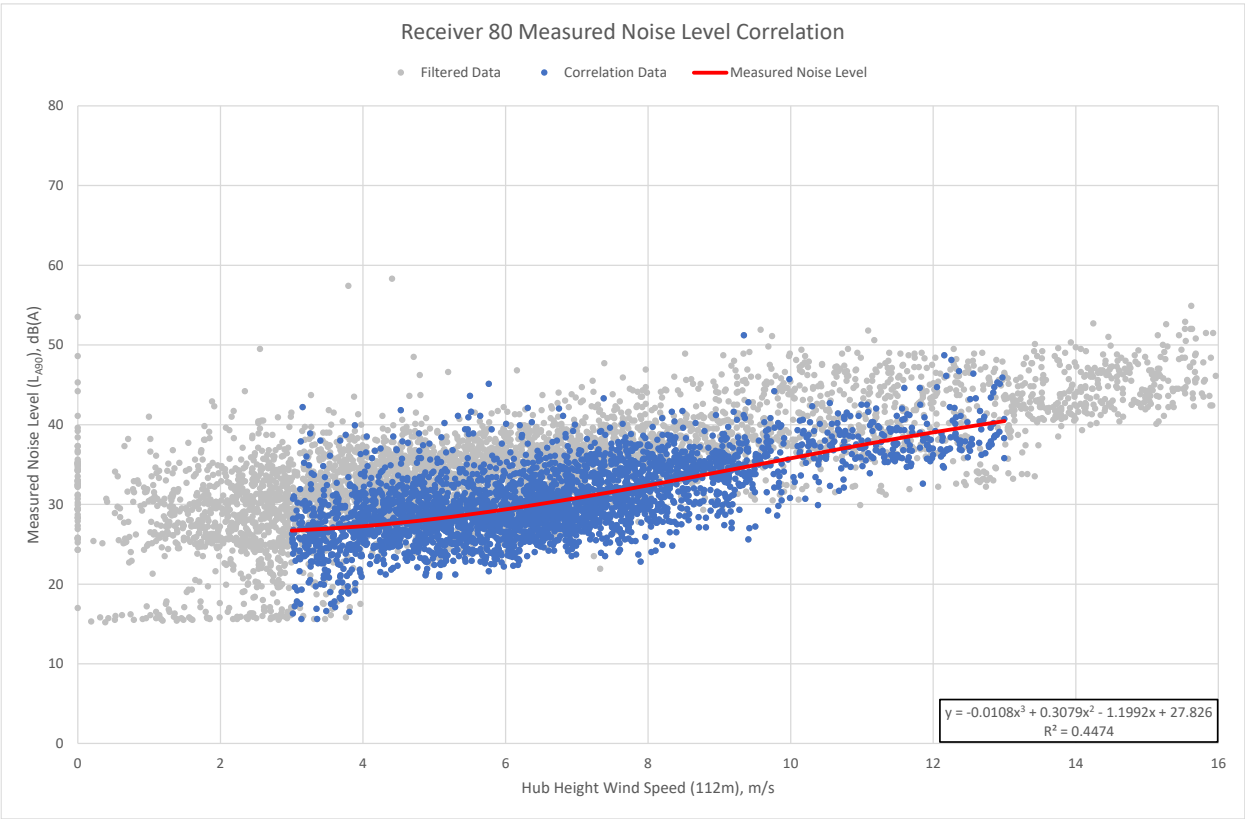


Figure 40: Receiver 80 Measured Noise Level

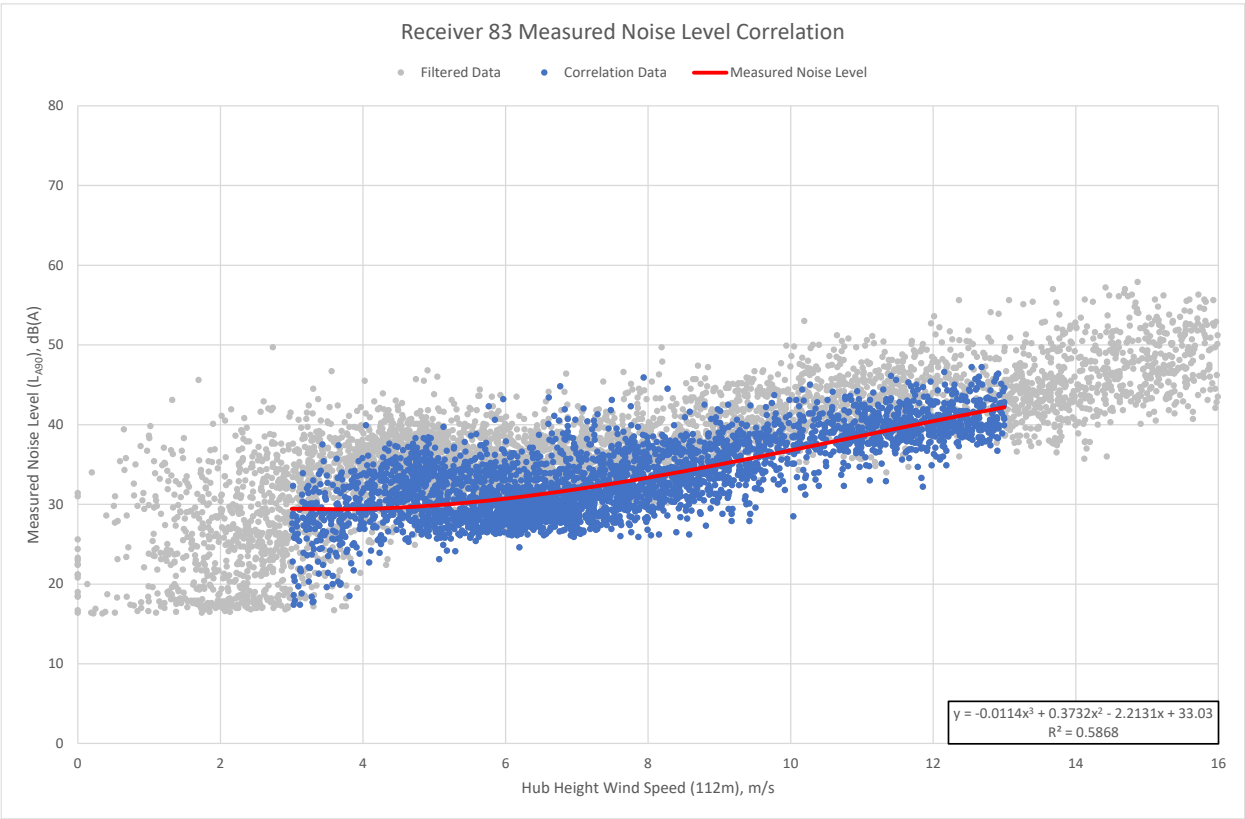


Figure 41: Receiver 83 Measured Noise Level

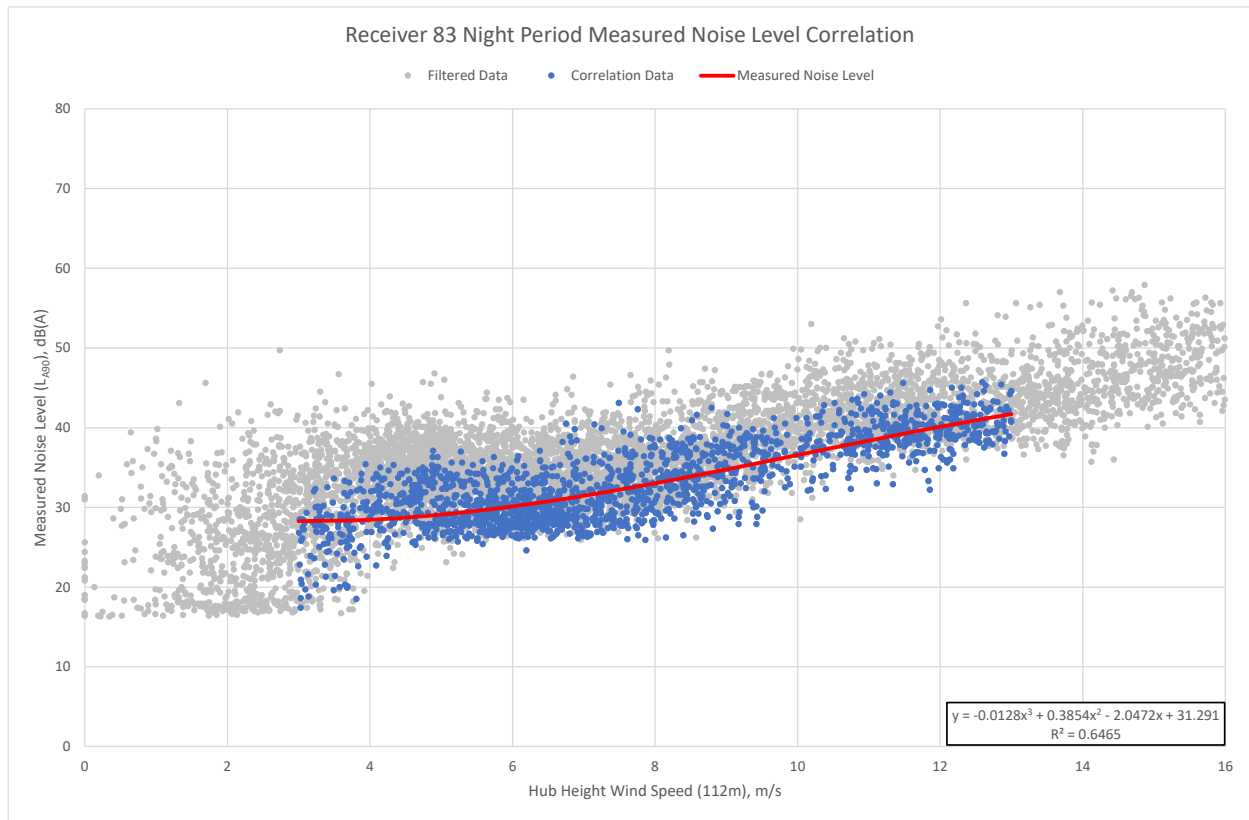


Figure 42: Receiver 83 Night Period Measured Noise Level

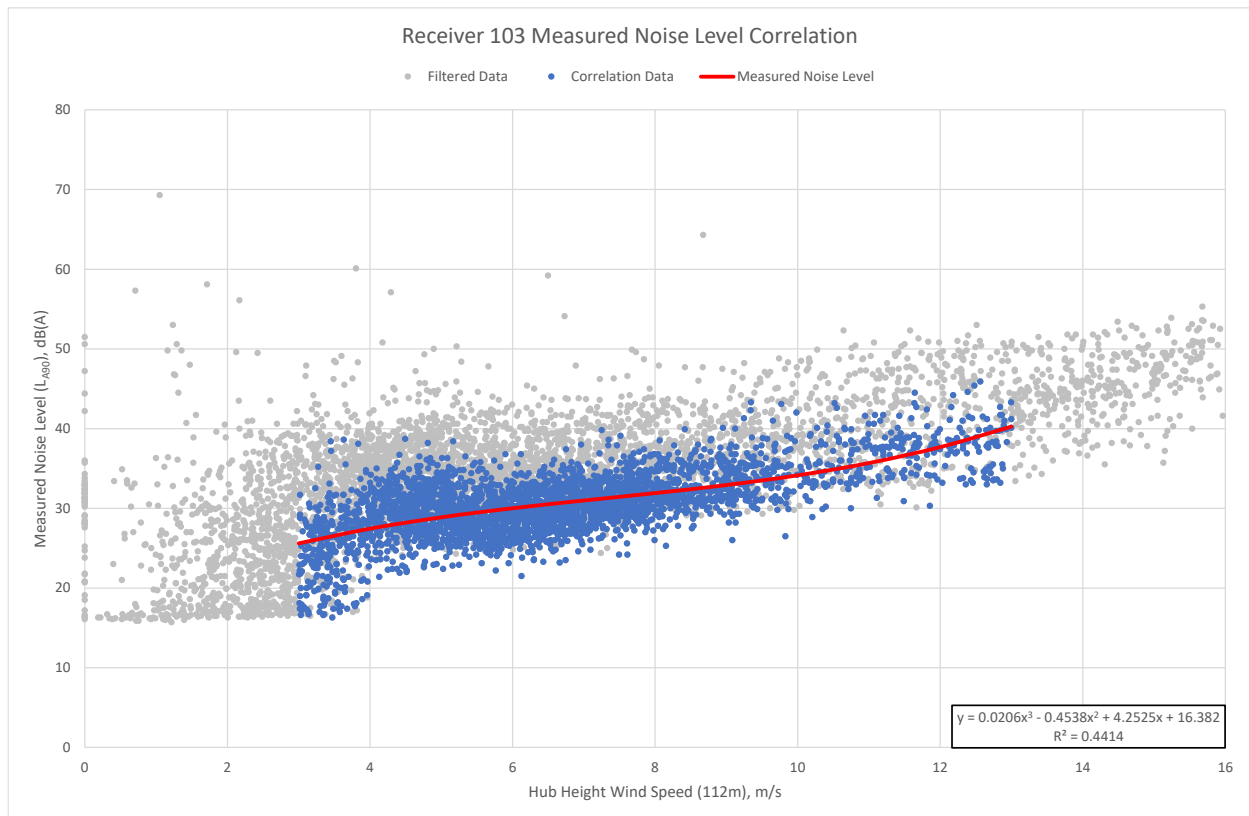


Figure 43: Receiver 103 Measured Noise Level

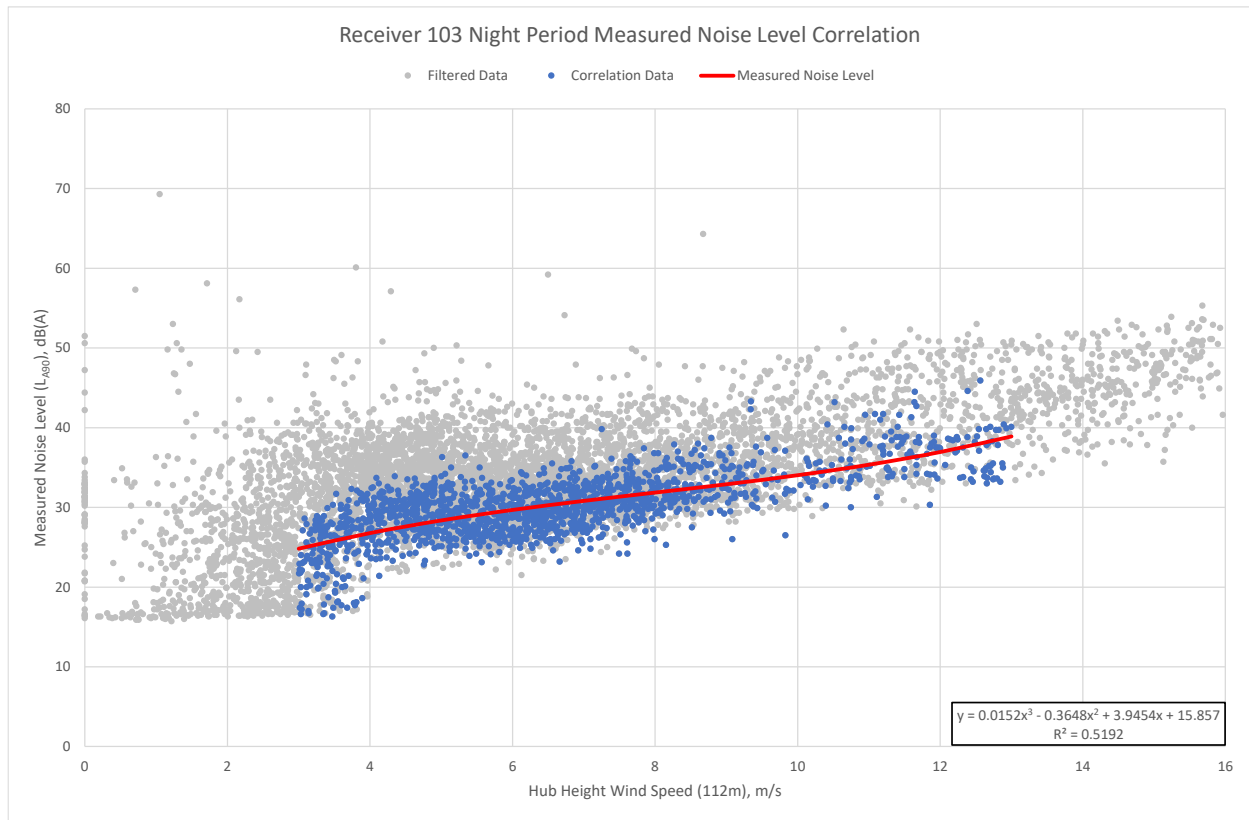


Figure 44: Receiver 103 Night Period Measured Noise Level

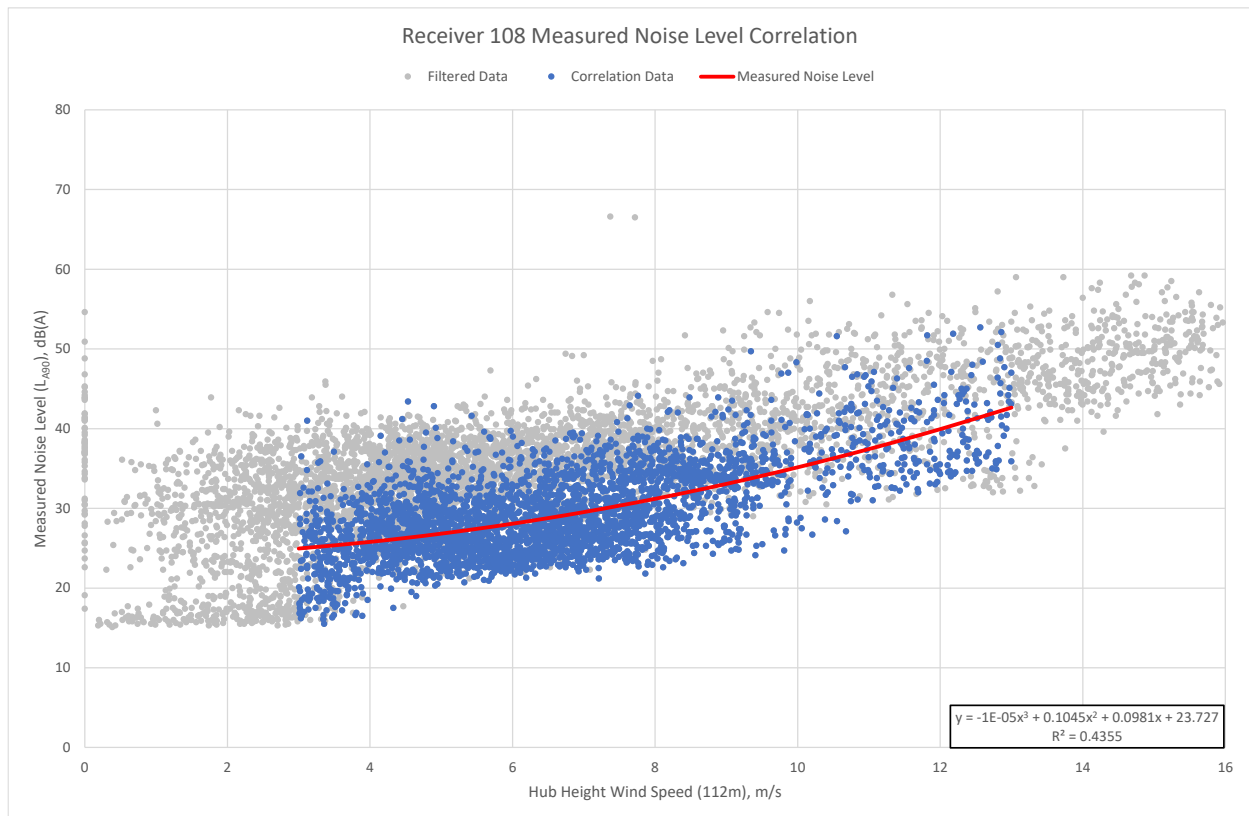


Figure 45: Receiver 108 Measured Noise Level