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**Bluewater Wind Farm – Turbine T31
IEC 61400-11 Edition 2.1 Measurement Report**

Prepared for:

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Revision History

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1	Issued test report	February 6, 2015

This report in its entirety, including appendices contains 56 pages.

Statement Qualifications and Limitations

This report was prepared by Aercoustics Engineering Limited in accordance with International Standard IEC 61400-11 (Edition 2.0, released 2002 and amendment 1, released 2006-05), "Wind turbine generator systems – Part 11: Acoustic noise measurement techniques". This report is specific only to the Wind Turbine identified in this report.

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This Statement of Qualifications and Limitations is attached to and forms part of this report.

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1 Introduction

Aercoustics Engineering Limited (Aercoustics) was retained by Varna Wind LP (“Varna”) to conduct an acoustic measurement of turbine T31 at the Bluewater Wind Farm located in Bluewater, ON. The purpose of the measurement was to provide verification of the maximum noise emission of the turbine. The measurement was carried out in accordance with International Standard IEC 61400-11 (Edition 2.0, released 2002 and amendment 1, released 2006-05), “Wind turbine generator systems – Part 11: Acoustic noise measurement techniques”. This report is specific only to Turbine T31.

2 Wind Turbine Information

2.1 Wind turbine equipment specific information

Wind turbine specific equipment information for turbine T31 was provided by Varna Wind LP and is summarized in Tables 1 – 5.

Table 1 - Wind Turbine Details

Wind Turbine Details	
Manufacturer	GE
Model Number	1.X 100m
Turbine ID	T-31

Table 2 - Operating Details

Operating Details	
Vertical or Horizontal axis wind turbine	HAWT
Upwind or downwind rotor	Upwind
Hub height	82m
Horizontal distance from rotor centre to tower axis	
Diameter of rotor	100m
Tower type (lattice or tube)	Tube
Passive stall, active stall, or pitch controlled turbine	Pitch Controlled
Constant or variable speed	Variable
Power curve	See Figure B.01
Rotational speed at each integer standardised wind speed	See Figure B.02
Rated power output	1.6MW
Control software version	V04.07.02C build 2

Table 3 - Rotor Details

Rotor Details	
Rotor control devices	Electric
Presence of vortex generators, stall strips, serrated trailing edges	Vortex generators, Serrated trailing edge
Blade type	TPI
Serial number	D21907-101-03521-W860, D21907-101-03522-W860, D21907-101-03520-W860
Number of blades	3

Table 4 - Gearbox Details

Gearbox Details	
Manufacturer	Nanjing
Model number	FDMD
Serial number	FDMD-2063

Table 5 - Generator Details

Generator Details	
Manufacturer	GE
Model number	WTG-1304-072
Serial number	1-6-HEAD-30336-P

2.2 Wind Turbine Location

Turbine T31 is located in the municipality of Bluewater, approximately 540m East of Blind Line, and 1200m South of Kippen Road. The area surrounding T31 is flat and consists primarily of farmland.

A general layout of the area in which the turbine is located is provided in the site plan (Figure A.01).

3 Measurement Details

3.1 Measurement Equipment

3.1.1 Acoustic Measurement Equipment

A summary of acoustic equipment utilized by Aercoustics for the measurement of turbine T31 is summarized in Table 6.

Table 6 - Acoustic Measurement Equipment

Equipment	Manufacturer Name & Model	Serial Number
Acoustic Data acquisition system	LMS SCADA Mobile	5310922
Microphone	B&K 4189	2622169
Pre-amplifier	B&K 2671	2614900
Acoustic calibrator	B&K 4231	2513184

Calibration of the measurement setup was carried out before and after Aercoustics set of measurements.

3.1.2 Meteorological Equipment

Wind speed for Turbine ON was derived from the power curve (as per procedures outlined in IEC 61400-11). Wind direction for turbine ON measurements was utilized from the nacelle anemometer located at hub height (80m high) from turbine T31. Data for background measurements was obtained from a 10m high anemometer, which was placed as per guidelines outlined in IEC-61400-11.

The meteorological equipment is summarized in Table 7

Table 7 – Meteorological Measurement Equipment

Equipment	Manufacturer Name & Model	Serial Number
Anemometer	VAISALA WXT520	K242001
Serial to Analog Converter	NOKEVAL 7470	A165152

3.2 Measurement Setup

3.2.1 Microphone Placement

The measurement microphone was setup 130m from the base of the turbine in 'Position 1', (i.e. downwind of the turbine, as per IEC 61400-11) at an elevation of 0m relative to the base of T31. The microphone was placed in the centre of a circular, acoustically reflective board.

During the measurement period only data points for which the microphone was within 15 degrees of downwind from the turbine were used. The microphone position relative to downwind of the turbine was monitoring via the yaw angle output provided from the

turbine system (discussed further in Section 3.5). During placement of the microphone the turbine was parked and the reference yaw angle for that measurement logged.

There were no nearby reflecting surfaces (houses, barns etc.); as such the influence from reflecting surfaces was considered to be negligible.

Photos of the measurement setup are provided in Figure A.02, Appendix A.

3.2.2 Double Windscreen Setup

A double windscreen setup was not utilized.

3.3 Measurement Schedule

Table 8 provides a summary of the test date and times. Data was logged in 1 minute intervals for post-processing (as per the measurement standard).

Table 8 - Measurement Schedule Summary

Date	Test Type	Start Time	Finish time
December 3, 2014	Turbine ON	10:47 am	11:47 pm
	Background	11:54 am	12:55 pm
	Background	12:59 pm	1:15 pm
December 8, 2014	Background	1:48 pm	3:38 pm
	Background	3:42 pm	4:23 pm

3.4 Meteorological Conditions

Detailed meteorological data relevant to the measurement is provided in Appendix E.

As previously mentioned, wind speed for Turbine ON was derived from T31's power curve (as per the standard), while wind direction was provided by T31's nacelle anemometer (located at hub height). Background data was obtained from an anemometer located 10m above ground level near T31.

Temperature and pressure readings during the measurement period were provided by the 10m anemometer, located near turbine T31 for the duration of Aercoustics measurements.

3.5 Turbine operational information

Output data from the turbine (Power, yaw, RPM, pitch angle, and nacelle wind speed) were obtained as analog output signals that were simultaneously acquired with the acoustic and anemometer measurement data using Aercoustics data acquisition system.

4 Measurement Results

4.1 Deviations from IEC-61400-11 Edition 2.1

The sound power level of the turbine was calculated using a binned analysis, as outlined in Section 8.3 of IEC-61400-11. An energy average of all data points was used as opposed to a linear regression. This is considered a more accurate representation of the turbine sound power level.

For wind bins where the overall signal to noise was between 3 to 6 dB the overall sound pressure level for Turbine ON (background adjusted) was calculated off the measured overall sound pressure level for background (not capped at 1.3 dB). This is considered a more accurate evaluation of turbine emission on the day of the test.

4.2 Special Notes & Considerations

There were no other turbines in the immediate vicinity of T31.

4.3 Analysis Details

The following section outlines analysis of the measurement data acquired for T31. The data presented is exclusive of transient events such as vehicle traffic, wildlife, air traffic etc. The site has been assessed to have a roughness length of 0.05m, representative of farmland with some vegetation.

4.3.1 Double Windscreen Adjustment

As previously mentioned, no double wind screen was used, as such the measurement data did not require adjustment.

4.3.2 Wind Speed Correction

Method 1: “determination of the wind speed from the electric output and power curve” (as per IEC 61400-11) was used to adjust the measured turbine power output (provided by GE Energy) to standardized wind speed data (10m above grade) for Turbine ON.

For data points between 5% and 95% of the rated power, Aercoustics applied a linear regression using the nacelle wind speed and corrected wind speed at hub height determined from electrical power output (for points beyond 95% of rated power).

Background wind speed was derived utilizing data acquired with the 10m anemometer.

4.4 Type B uncertainties

Type B uncertainties were obtained through interpretation of information provided in Annex D of IEC-61400-11. A summary of Type B uncertainties is provided in Table 9, while detailed information (including data in 1/3 octave) is provided in Appendix C.

Table 9 - Summary of Type B uncertainties

Component	Turbine ON Uncertainty (dB)	Background Uncertainty (dB)	Apparent Sound Power Level Uncertainty (dB)
Calibration	0.2	0.2	0.2
Instrument	0.2	0.2	0.2
Board	0.3	0.3	0.3
Distance	0.1	-	0.1
Impedance	0.1	0.1	0.1
Turbulence	0.4	-	0.4
Wind speed measured	0.9	0.9	0.9
Wind speed derived	0.2	-	0.2
Direction	0.3	-	0.3
Background	-	-	(Turbine ON – Background)

4.5 Sound Pressure Level Measurements

Sound pressure level measurements are summarized in Table 10. Detailed 1/3 Octave band spectrum data, respective uncertainties, and analysis plots are provided in Appendix C. A copy of the unprocessed measurement data used for analysis is provided in Appendix E and includes meteorological and turbine operational data.

As the purpose of this measurement was to verify turbine noise emission, testing was conducted in conformity with IEC 61400-11 section 5, paragraph 5 and a minimum of three integer wind speed values and 8m/s have been reported.

Table 10 - Summary of Sound Pressure Level Measurements

	6 m/s	7 m/s	8 m/s	9 m/s	10 m/s
Turbine ON					
L_{eq} (dBA)	53.3	54.0	54.4	55.1	55.6
# of data points	7	16	8	16	7
Uncertainty (dB)	1.3	1.2	1.3	1.2	1.2
Background					
L_{eq} (dBA)	39.7	38.4	41.8	46.1	48.6
# of data points	28	4	5	18	25
Uncertainty (dB)	2.5	2.4	2.6	1.4	2.0
Resultant Levels					
Signal to Noise (dB)	13.6	15.7	12.7	9.0	7.1
Turbine ON, Background adjusted L_{eq} (dBA)	53.1	53.9	54.2	54.5	54.7

Values marked with *denote background level was 3 to 6 dB below Turbine ON level
 Values marked with ** denote background level was less than 3 dB below Turbine ON level and has not been reported (as per IEC 61400-11)

4.6 Sound Power Level of Turbine

The calculated sound power level of the turbine T31 (as per IEC 61400-11) is summarized in Table 11. Detailed analysis results are provided in Appendix C.

Table 11 - $L_{WA 10m, K}$ at each integer wind speed

	6 m/s	7 m/s	8 m/s	9 m/s	10 m/s
Apparent LWA, (dBA)	101.7	102.6	102.9	103.2	103.3
Uncertainty (dB)	1.3	1.2	1.3	1.4	1.6

Values marked with *denote background level was 3 to 6 dB below Turbine ON level
 Values marked with ** denote background level was less than 3 dB below Turbine ON level and has not been reported (as per IEC 61400-11)

4.7 Tonality Analysis

The tonality analysis for Turbine T31 is summarized in Table 12, while plots of narrow band spectra at each wind speed are provided in Appendix D.

Table 12 - Tonality Assessment Summary

Wind Speed (m/s)	Frequency (Hz)	Tonality, ΔL_{in} (dB)	Tonal audibility, ΔL_a (dB)	FFT's with tones	Total # of FFT's	Presence (%)
6	136*	-3.3	-1.3	4	12	33%
7	630	-5.2	-2.7	8	12	67%
9	626	-5.1	-2.7	11	12	92%

*Denotes masking noise is influenced by background

5 Closure

Measurements and analysis were carried on Turbine T31 of the Bluewater Wind Farm, located in the municipality of Bluewater as per International Standard IEC 61400-11 (Edition 2.0, released 2002 and amendment 1, released 2006-05) , “Wind turbine generator systems – Part 11: Acoustic noise measurement techniques”.

Should you have any questions or comments please do not hesitate to contact the authors of this report.

6 References

1. International Standard IEC 61400-11 (Edition 2.0, released 2002 and amendment 1, released 2006-05), “Wind turbine generator systems – Part 11: Acoustic noise measurement techniques”.

Appendix A Site Details





LEGEND

- Turbine (GE) (2013-08-15)
- Met Tower
- Transmission Poles (2014-01-28)
- Transmission Line
- Service Roads (2013-08-15)
- Collection Line (2013-08-15)
- Construction Disturbance Area
- Laydown Yard / Substation
- MES-JB
- Archaeological Sites to Avoid
- Watercourse
- Parcels
- Stage2 Scatter Area 20m Buffer
- Stage2 Scatter Areas
- Stage2 Survey Area
- Conservation Authority Regulations Limit
- Natural Features

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Figure Title

Site Plan

Figure A.01



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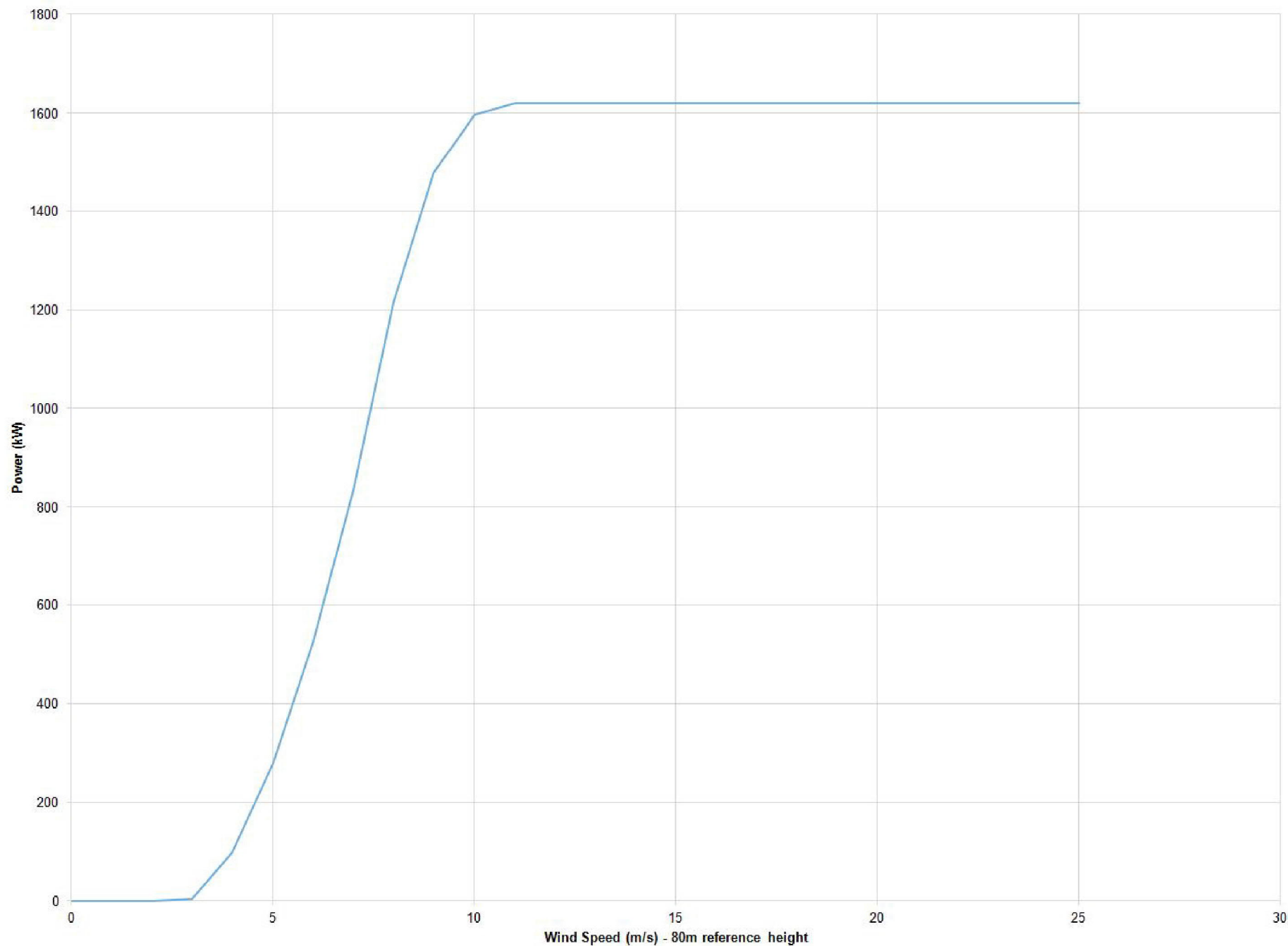
Figure Title

Site Photos

Figure A.02

Appendix B Turbine Information





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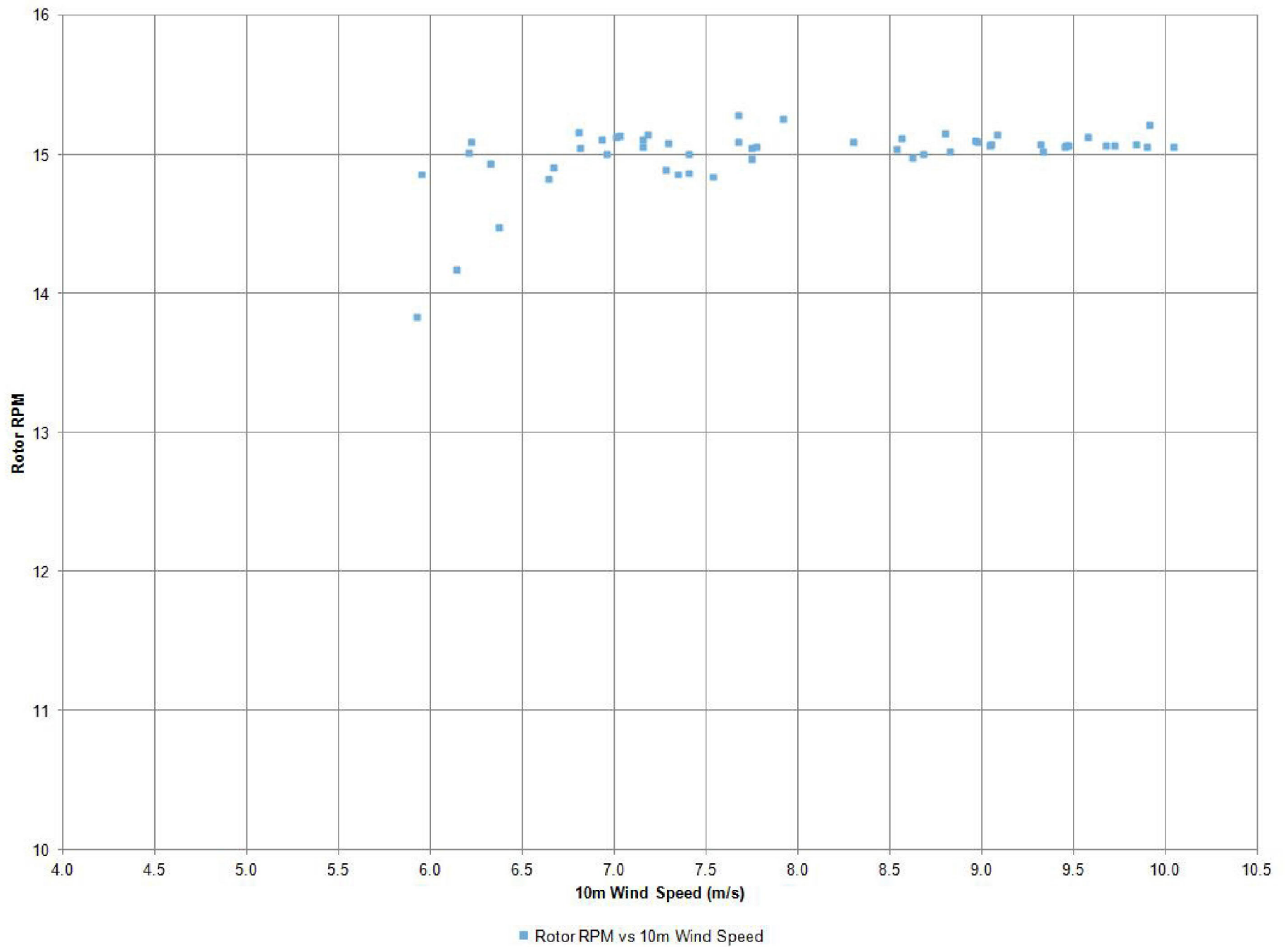
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Figure Title

Power Curve

Figure B.01



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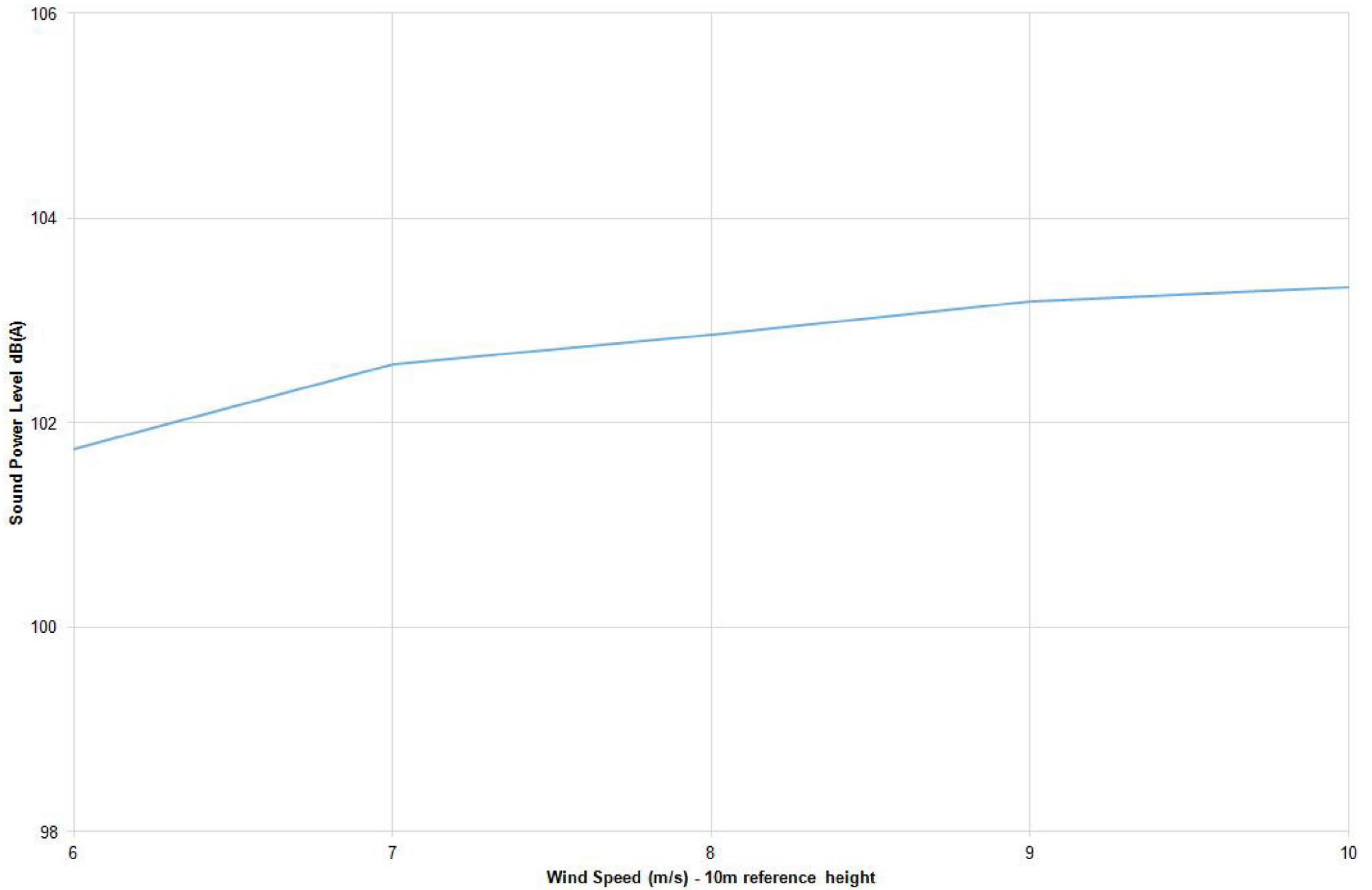
Rotor RPM vs. Wind Speed

Figure B.02

Appendix C

Apparent Sound Power Level





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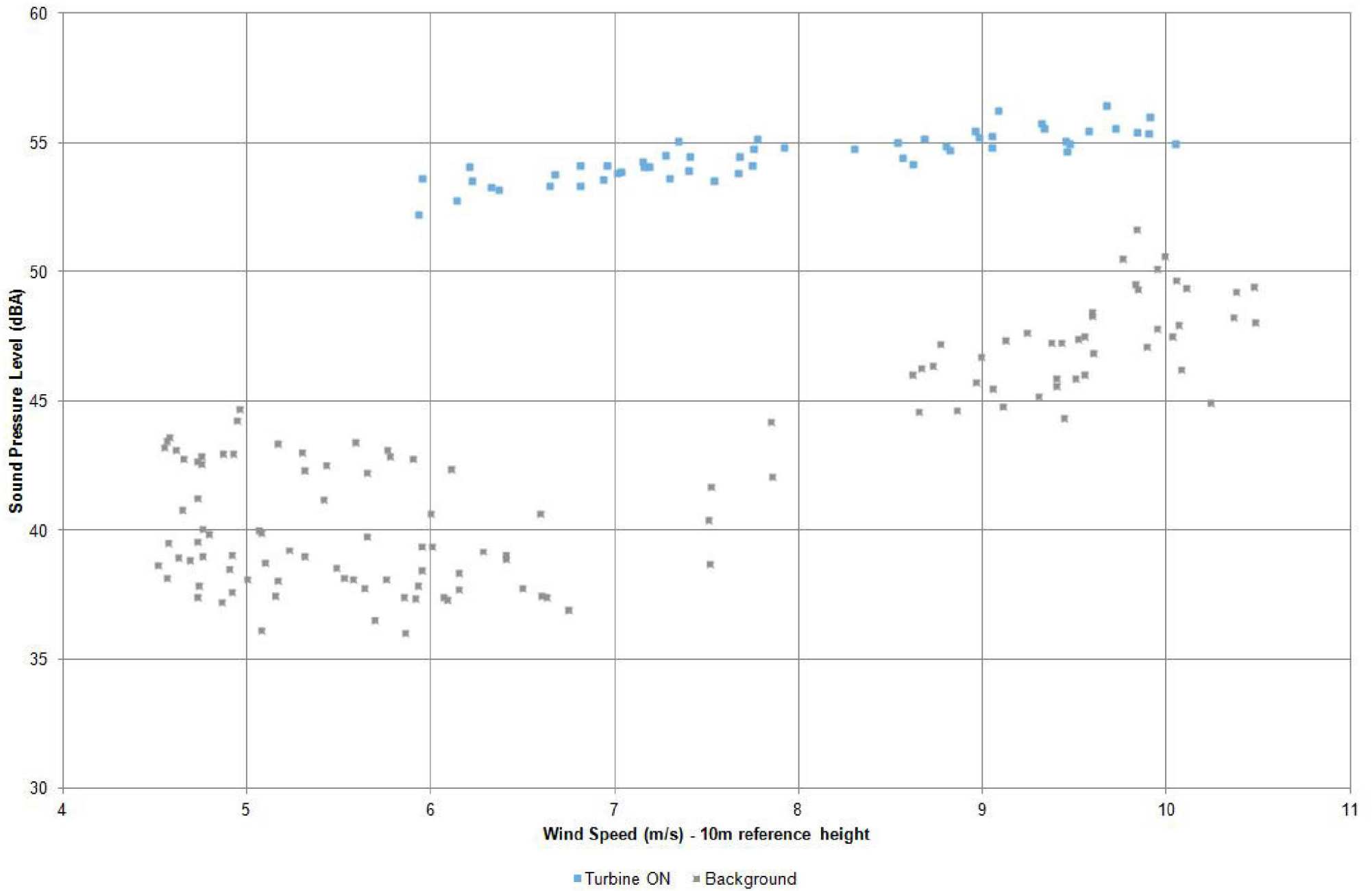
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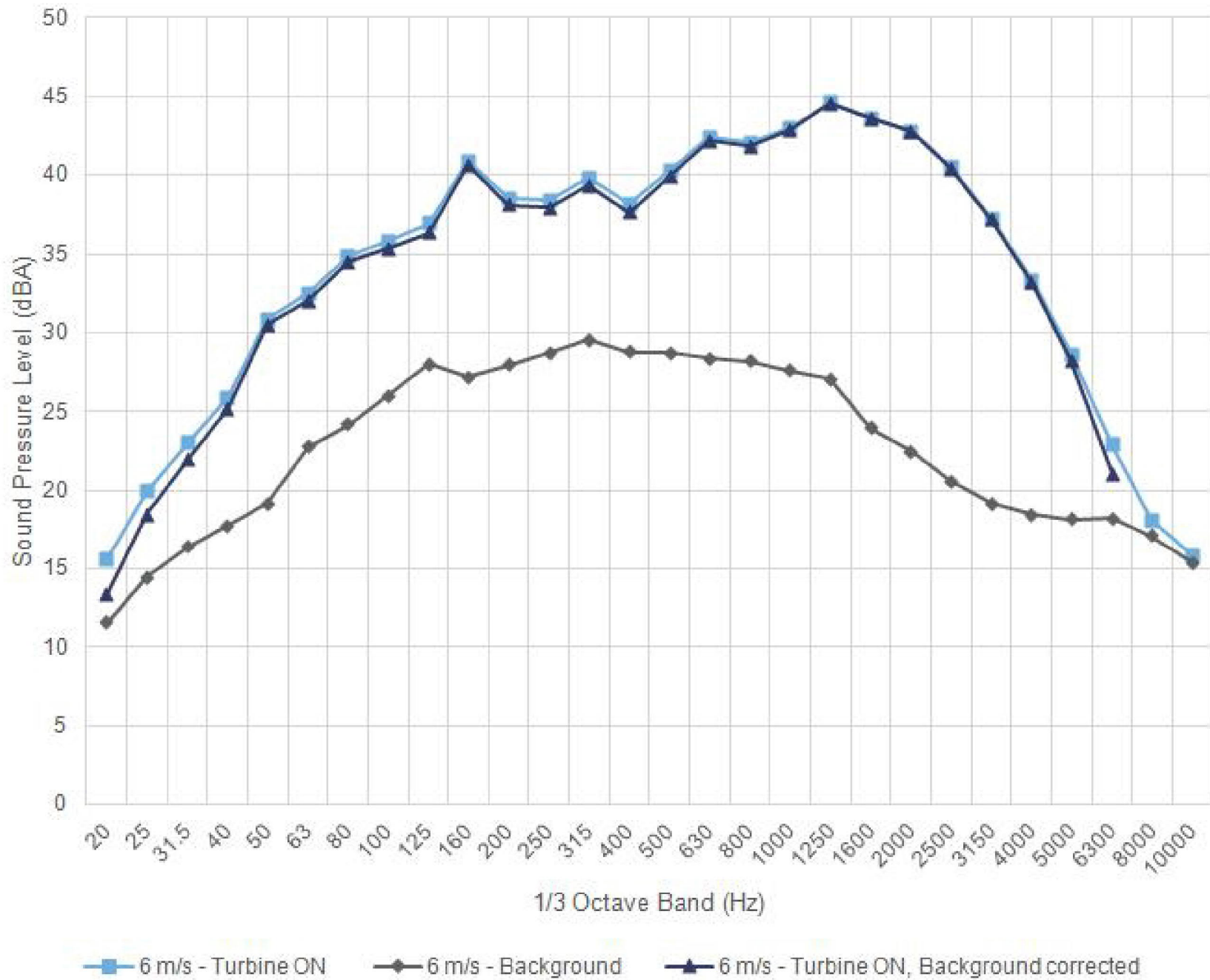
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Figure Title

Plot of sound power level at each integer wind speed

Figure C.01





■ 6 m/s - Turbine ON
 ◆ 6 m/s - Background
 ▲ 6 m/s - Turbine ON, Background corrected



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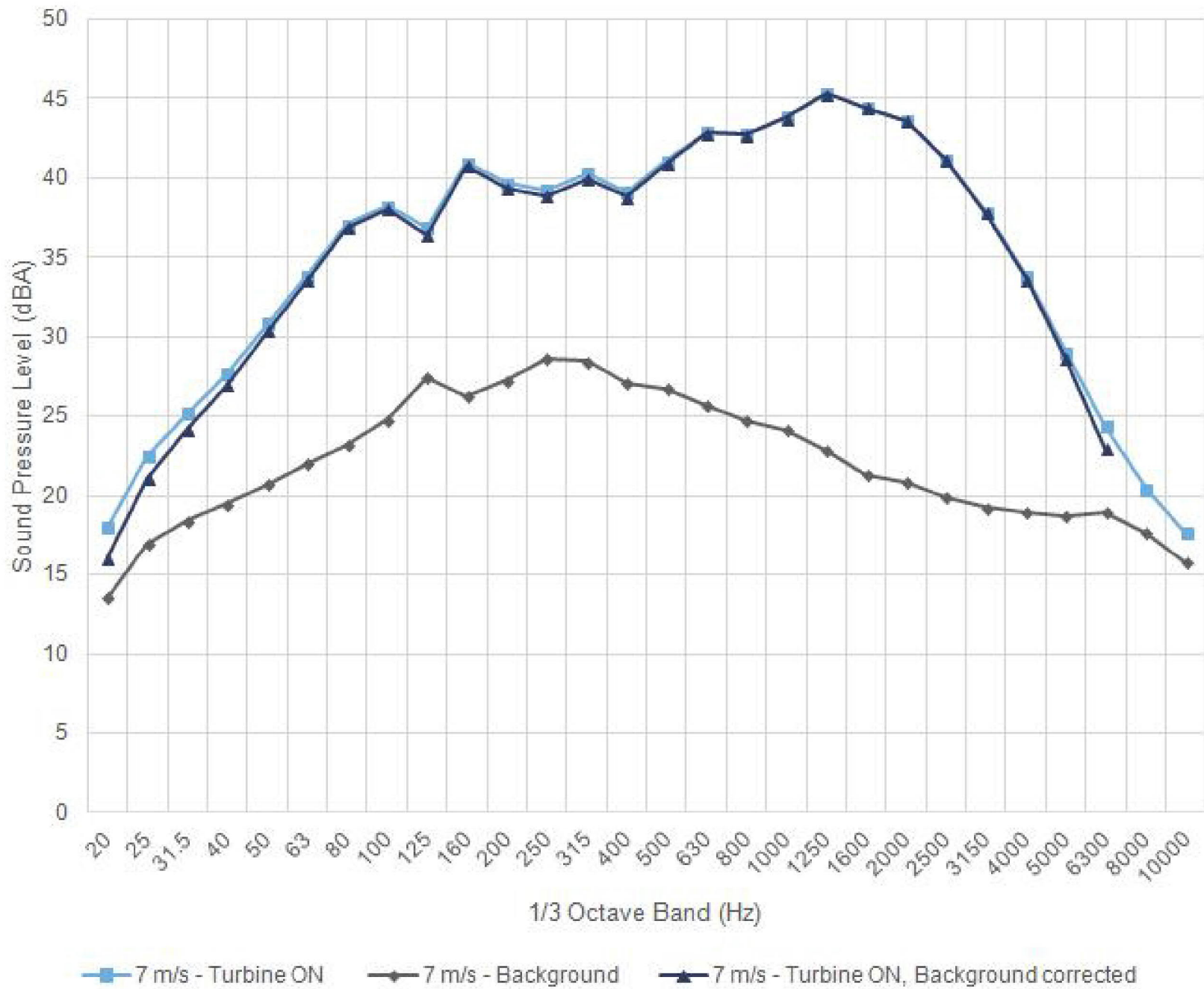
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Figure Title

Plot of sound pressure spectrum in 1/3 Octave at 6 m/s

Figure C.03



■ 7 m/s - Turbine ON
 ◆ 7 m/s - Background
 ▲ 7 m/s - Turbine ON, Background corrected



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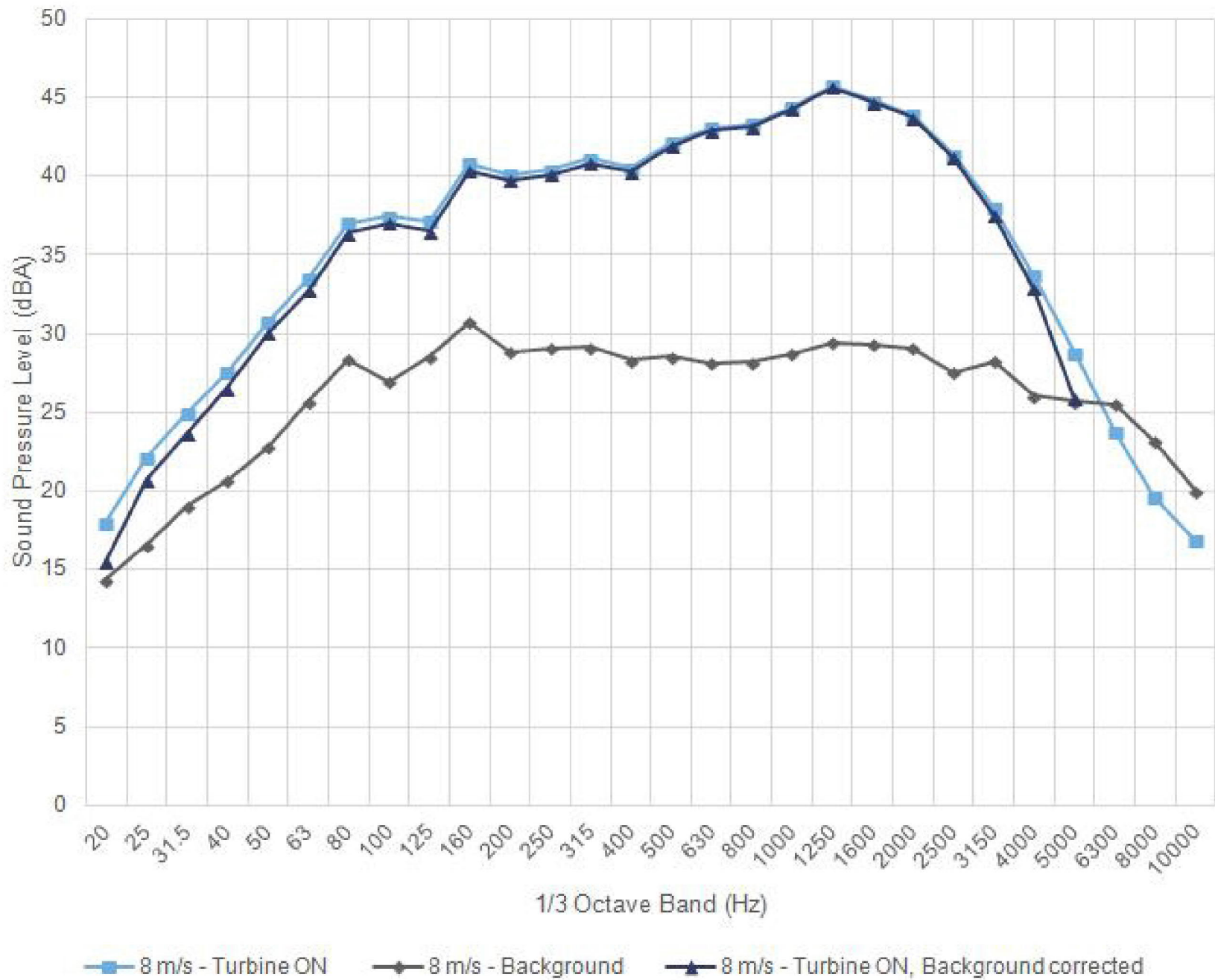
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Figure Title

Plot of sound pressure spectrum in 1/3 Octave at 7 m/s

Figure C.04



■ 8 m/s - Turbine ON
 ◆ 8 m/s - Background
 ▲ 8 m/s - Turbine ON, Background corrected



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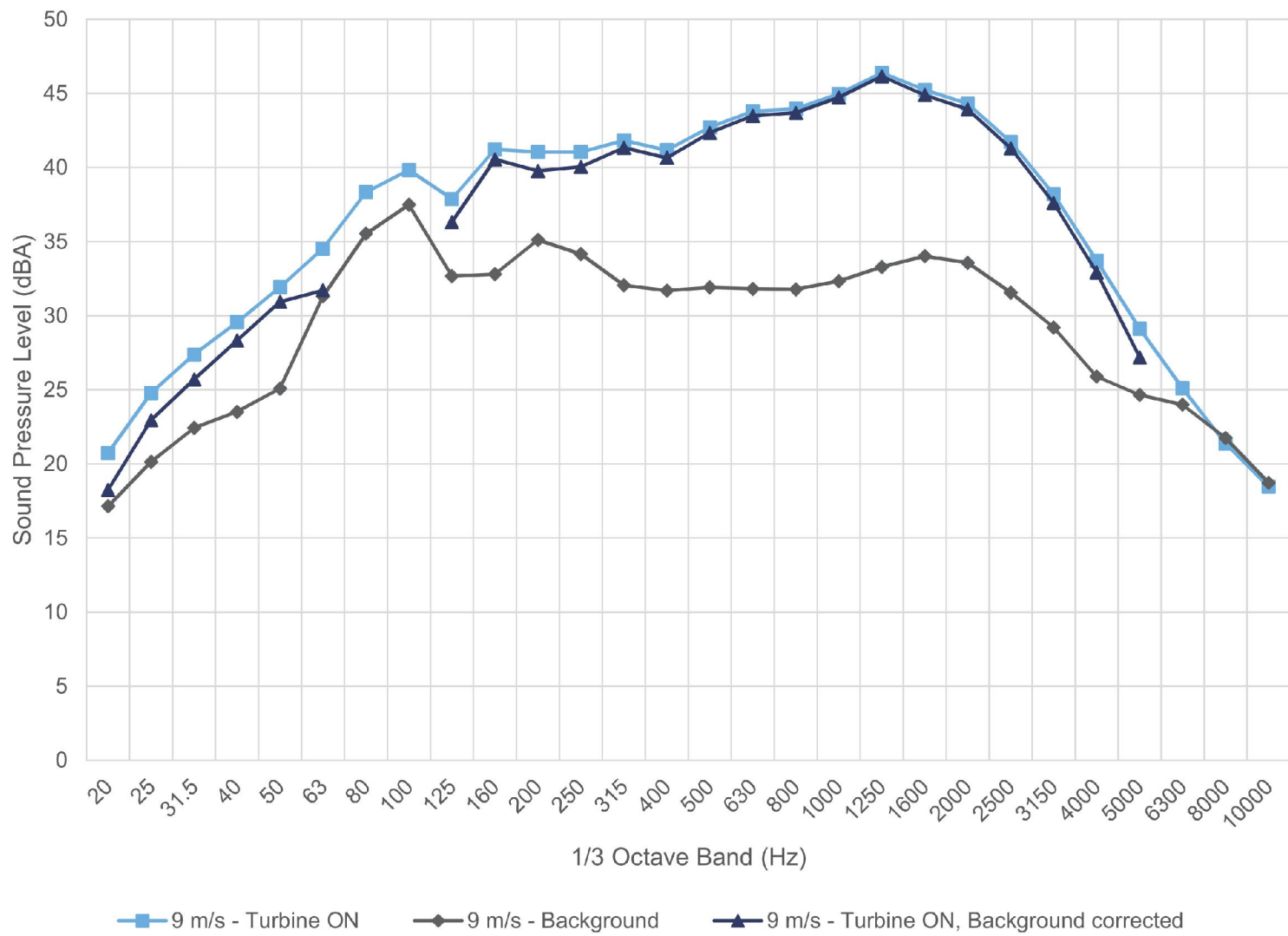
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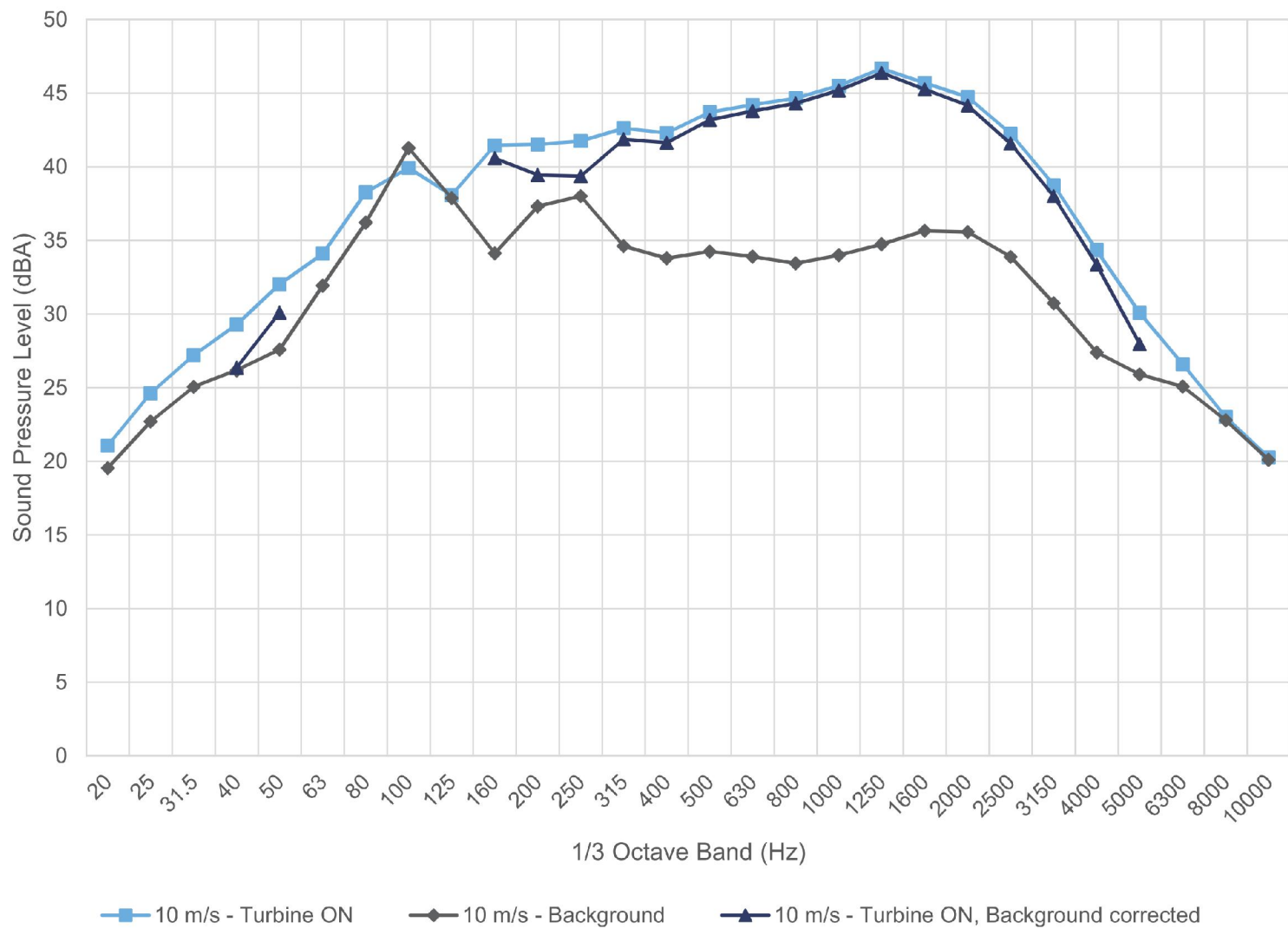
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Figure Title

Plot of sound pressure spectrum in 1/3 Octave at 8 m/s

Figure C.05





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Figure Title

Plot of sound pressure spectrum in 1/3 Octave at 10m/s

Figure C.07

Table C.01 Sound Pressure Spectrum in 1/3 Octave Band 6-10m/s

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Wind Speed	Description	Sound Pressure Level per 1/3 Octave Band (Hz), dBA																											
		20	25	32	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 m/s	Turbine on	16	20	23	26	31	32	35	36	37	41	39	38	40	38	40	42	42	43	45	44	43	40	37	33	29	23	18	16
	Background	12	14	16	18	19	23	24	26	28	27	28	29	30	29	29	28	28	28	27	24	22	21	19	18	18	18	17	15
	Turbine ON (background corrected)	13*	19*	22	25	31	32	34	35	36	41	38	38	39	38	40	42	42	43	45	44	43	40	37	33	28	21*	**	**
7 m/s	Turbine on	18	23	25	28	31	34	37	38	37	41	40	39	40	39	41	43	43	44	45	44	44	41	38	34	29	24	20	18
	Background	14	17	18	19	21	22	23	25	27	26	27	29	28	27	27	26	25	24	23	21	21	20	19	19	19	19	18	16
	Turbine ON (background corrected)	16*	21*	24	27	30	34	37	38	36	41	39	39	40	39	41	43	43	44	45	44	44	41	38	34	29	23*	**	**
8 m/s	Turbine on	18	22	25	28	31	34	37	37	37	41	40	40	41	41	42	43	43	44	46	45	44	41	38	34	29	24	20	17
	Background	14	17	19	21	23	26	28	27	29	31	29	29	29	28	29	28	28	29	29	29	29	28	28	26	26	26	23	20
	Turbine ON (background corrected)	16*	21*	24*	27	30	33	36	37	36	40	40	40	41	40	42	43	43	44	46	45	44	41	37	33	26*	**	**	**
9 m/s	Turbine on	21	25	27	30	32	35	38	40	38	41	41	41	42	41	43	44	44	45	46	45	44	42	38	34	29	25	21	18
	Background	17	20	22	24	25	31	36	37	33	33	35	34	32	32	32	32	32	33	34	34	32	29	26	25	24	22	19	
	Turbine ON (background corrected)	18*	23*	26*	28	31	32*	**	**	36*	41	40*	40	41	41	42	43	44	45	46	45	44	41	38	33	27*	**	**	**
10 m/s	Turbine on	21	25	27	29	32	34	38	40	38	41	42	42	43	42	44	44	45	46	47	46	45	42	39	34	30	27	23	20
	Background	20	23	25	26	28	32	36	41	38	34	37	38	35	34	34	34	33	34	35	36	36	34	31	27	26	25	23	20
	Turbine ON (background corrected)	**	**	**	26*	30*	**	**	**	**	41	39*	39*	42	42	43	44	44	45	46	45	44	42	38	33	28*	**	**	**

Values with * denote background is greater than 3 dB, but less than 6 dB from Turbine ON.
 Values with ** denote background was less than 3 dB from Turbine ON.

Table C.02 1/3 Octave Band measurement uncertainties - Turbine ON

Project: Bluewater Wind Energy Centre - Turbine T31 - IEC 61400-11 Measurement
 Report ID: 14331.01.T31.RP1

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 Created on: 1/13/2015

Standard Measurement Uncertainty (Type A Uncertainty)

Wind Speed	Description	1/3 Octave Band (Hz), dB																											
		20	25	32	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
6m/s	Type A uncertainties	1.5	1.9	1.7	1.1	2.7	0.8	0.8	0.7	1.3	0.9	0.7	0.6	0.8	0.6	0.5	0.8	0.7	0.7	0.7	0.7	0.7	0.7	0.6	0.6	0.5	0.6	0.9	0.8
7m/s	Type A uncertainties	1.8	1.6	1.7	1.3	1.1	1.0	1.2	1.6	0.8	0.6	0.9	0.9	0.7	1.0	0.8	0.4	0.5	0.4	0.2	0.3	0.3	0.3	0.4	0.5	1.0	2.2	2.9	2.7
8m/s	Type A uncertainties	1.7	1.8	1.8	1.6	1.7	1.0	1.6	1.3	1.1	0.8	1.2	1.6	1.3	1.6	1.0	0.6	0.5	0.5	0.3	0.4	0.4	0.3	0.3	0.4	0.6	1.0	1.6	1.5
9m/s	Type A uncertainties	1.9	1.7	1.7	1.2	1.0	1.0	0.6	1.3	0.7	0.5	0.8	1.3	1.2	1.5	1.0	0.7	0.6	0.5	0.4	0.4	0.3	0.4	0.4	0.4	0.8	1.7	2.4	2.3
10m/s	Type A uncertainties	1.9	1.7	1.7	1.2	1.1	0.6	0.5	1.3	0.7	0.9	0.8	1.2	1.4	1.5	1.0	0.6	0.5	0.4	0.3	0.3	0.4	0.5	0.6	0.8	1.3	2.5	3.5	3.7

Type B measurement uncertainty	
calibration	0.2 dB
instrument	0.2 dB
board	0.3 dB
distance	0.1 dB
impedance	0.1 dB
turbulence	0.4 dB
wind speed measured	0.9 dB
wind speed derived	0.2 dB
direction	0.3 dB
Total - Wind speed measured	1.1 dB
Total - Wind speed derived	0.7 dB

Overall Uncertainty (Type A & B Uncertainties combined)

Wind Speed	Description	1/3 Octave Band (Hz), dB																											
		20	25	32	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
6m/s	Type A & B uncertainties combined	1.9	2.2	2.0	1.6	2.9	1.4	1.4	1.3	1.7	1.4	1.3	1.3	1.4	1.3	1.2	1.4	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.2	1.3	1.5	1.4	
7m/s	Type A & B uncertainties combined	2.1	2.0	2.0	1.7	1.6	1.5	1.7	2.0	1.4	1.3	1.4	1.5	1.3	1.5	1.4	1.2	1.2	1.2	1.1	1.2	1.2	1.2	1.2	1.2	1.5	2.4	3.1	2.9
8m/s	Type A & B uncertainties combined	2.0	2.1	2.1	2.0	2.0	1.5	2.0	1.7	1.6	1.4	1.6	2.0	1.7	2.0	1.5	1.3	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.3	1.5	2.0	1.8
9m/s	Type A & B uncertainties combined	2.2	2.0	2.0	1.7	1.5	1.5	1.3	1.7	1.3	1.2	1.3	1.7	1.7	1.8	1.5	1.3	1.3	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.3	2.0	2.6	2.6
10m/s	Type A & B uncertainties combined	2.2	2.0	2.0	1.6	1.6	1.3	1.2	1.8	1.3	1.4	1.4	1.6	1.8	1.9	1.5	1.3	1.2	1.2	1.2	1.2	1.2	1.2	1.3	1.4	1.7	2.7	3.7	3.9

Table C.03 1/3 Octave Band measurement uncertainties - Background

Project: Bluewater Wind Energy Centre - Turbine T31 - IEC 61400-11 Measurement

Report ID: 14331.01.T31.RP1

Standard Measurement Uncertainty (Type A Uncertainty)

Wind Speed	Description	1/3 Octave Band (Hz), dB																											
		20	25	32	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 m/s	Type A uncertainties	4.7	4.7	4.1	3.5	2.6	2.3	2.5	2.5	2.1	2.3	2.2	1.7	1.6	2.1	2.1	3.0	3.6	4.0	4.3	4.4	3.9	3.1	2.3	1.9	1.6	1.6	1.4	1.2
7 m/s	Type A uncertainties	2.6	3.1	2.6	2.1	2.2	1.7	1.7	2.2	1.9	2.0	2.2	2.2	2.1	1.4	1.6	1.7	1.6	1.5	1.6	1.8	1.8	1.8	1.9	1.8	1.5	1.6	1.3	1.2
8 m/s	Type A uncertainties	5.1	5.0	4.8	4.7	4.0	3.0	3.5	2.3	1.5	2.1	0.9	1.0	1.3	1.3	1.3	1.9	2.9	3.8	4.5	6.9	7.2	6.8	8.0	6.4	6.3	6.0	5.0	3.9
9 m/s	Type A uncertainties	3.5	3.2	3.3	2.9	2.3	2.1	0.8	2.7	2.6	0.9	1.2	2.2	1.3	1.0	1.1	0.9	0.9	0.8	0.8	1.0	1.0	1.9	2.4	3.2	3.6	3.4	2.8	
10 m/s	Type A uncertainties	2.4	2.3	2.5	2.4	2.1	2.5	0.7	2.0	3.7	1.0	1.3	2.4	1.7	1.3	1.6	1.5	1.5	1.4	1.4	1.4	1.7	2.1	2.2	2.4	3.0	3.3	3.4	3.2

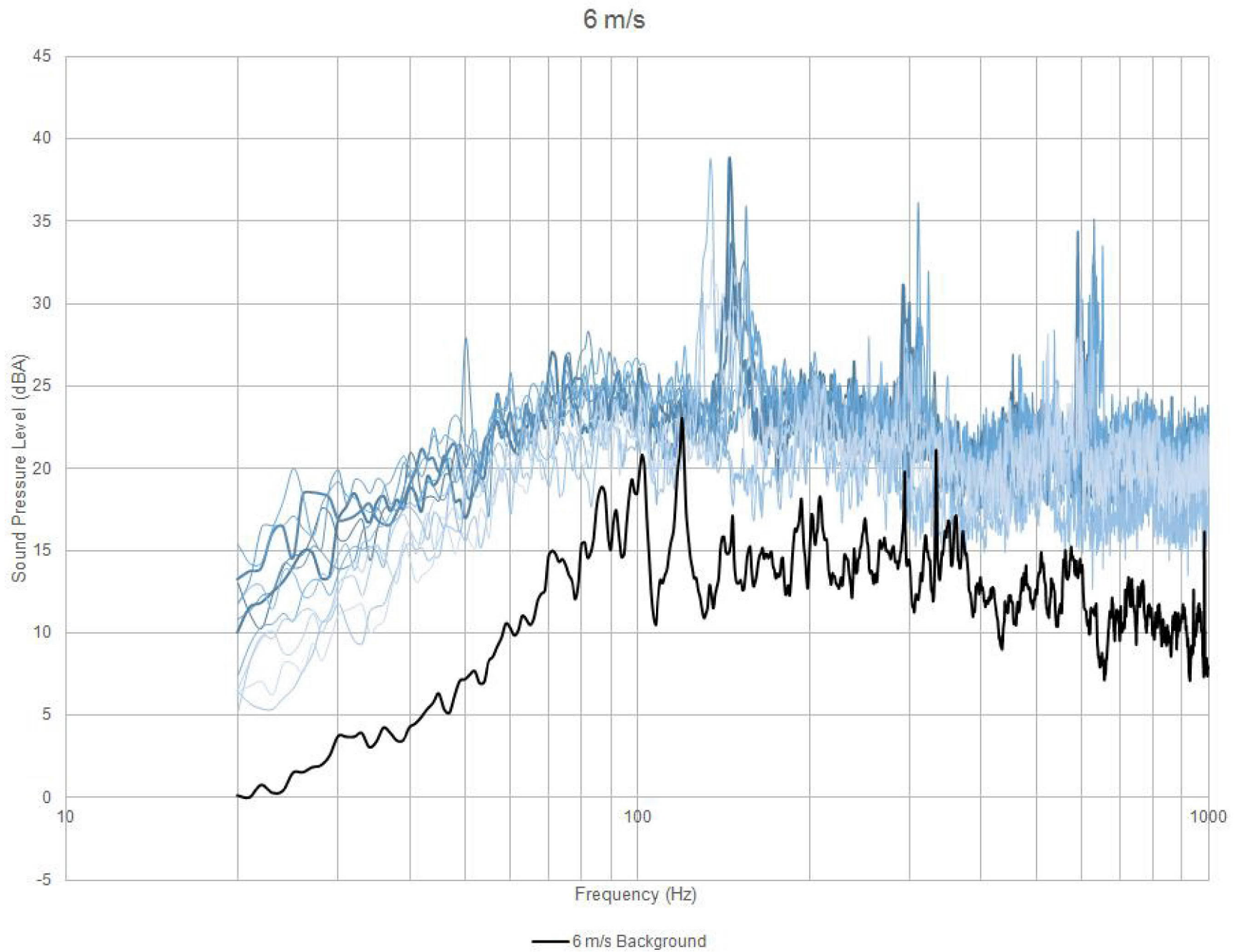
Type B measurement uncertainty	
calibration	0.2 dB
instrument	0.2 dB
board	0.3 dB
impedance	0.1 dB
wind speed measured	0.9 dB
Total	1.0 dB

Overall Uncertainty (Type A & B Uncertainties combined)

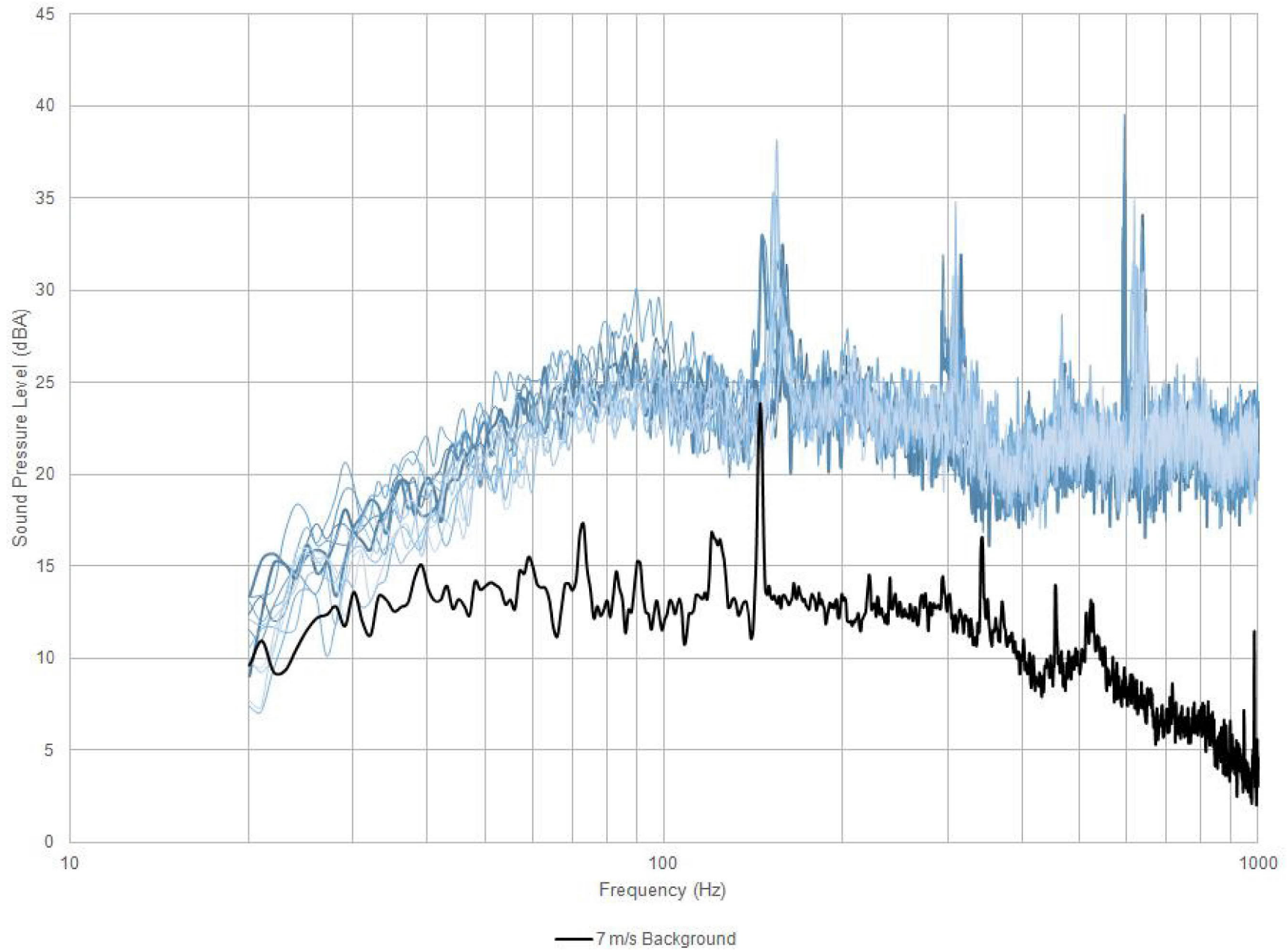
Wind Speed	Description	1/3 Octave Band (Hz), dB																											
		20	25	32	40	50	63	80	100	125	160	200	250	315	400	500	630	800	1000	1250	1600	2000	2500	3150	4000	5000	6300	8000	10000
6 m/s	Type A & B uncertainties combined	4.9	4.8	4.3	3.7	2.8	2.6	2.7	2.7	2.4	2.5	2.4	2.0	1.9	2.4	2.3	3.1	3.7	4.1	4.4	4.5	4.0	3.2	2.5	2.1	1.9	1.8	1.7	1.5
7 m/s	Type A & B uncertainties combined	2.8	3.2	2.8	2.3	2.4	2.0	2.0	2.4	2.1	2.2	2.5	2.5	2.3	1.7	1.9	2.0	1.9	1.8	1.9	2.1	2.0	2.0	2.1	2.1	1.8	1.9	1.6	1.5
8 m/s	Type A & B uncertainties combined	5.2	5.1	4.9	4.8	4.1	3.1	3.6	2.5	1.8	2.3	1.4	1.4	1.6	1.7	1.7	2.1	3.0	4.0	4.6	6.9	7.2	6.8	8.0	6.5	6.3	6.1	5.1	4.0
9 m/s	Type A & B uncertainties combined	3.6	3.4	3.4	3.1	2.5	2.3	1.3	2.9	2.8	1.3	1.5	2.5	1.6	1.4	1.5	1.3	1.3	1.3	1.3	1.3	1.4	1.4	2.2	2.6	3.3	3.7	3.5	3.0
10 m/s	Type A & B uncertainties combined	2.6	2.5	2.7	2.6	2.3	2.7	1.2	2.3	3.8	1.4	1.6	2.6	2.0	1.7	1.9	1.8	1.8	1.7	1.7	1.8	2.0	2.3	2.4	2.6	3.1	3.5	3.5	3.4

Appendix D Tonality Assessment





7 m/s



14331.01.T31.RP1

Scale: NTS
Drawn by: VS
Reviewed by: RJ
Date: Jan 13, 2015
Revision: 1

Project Name

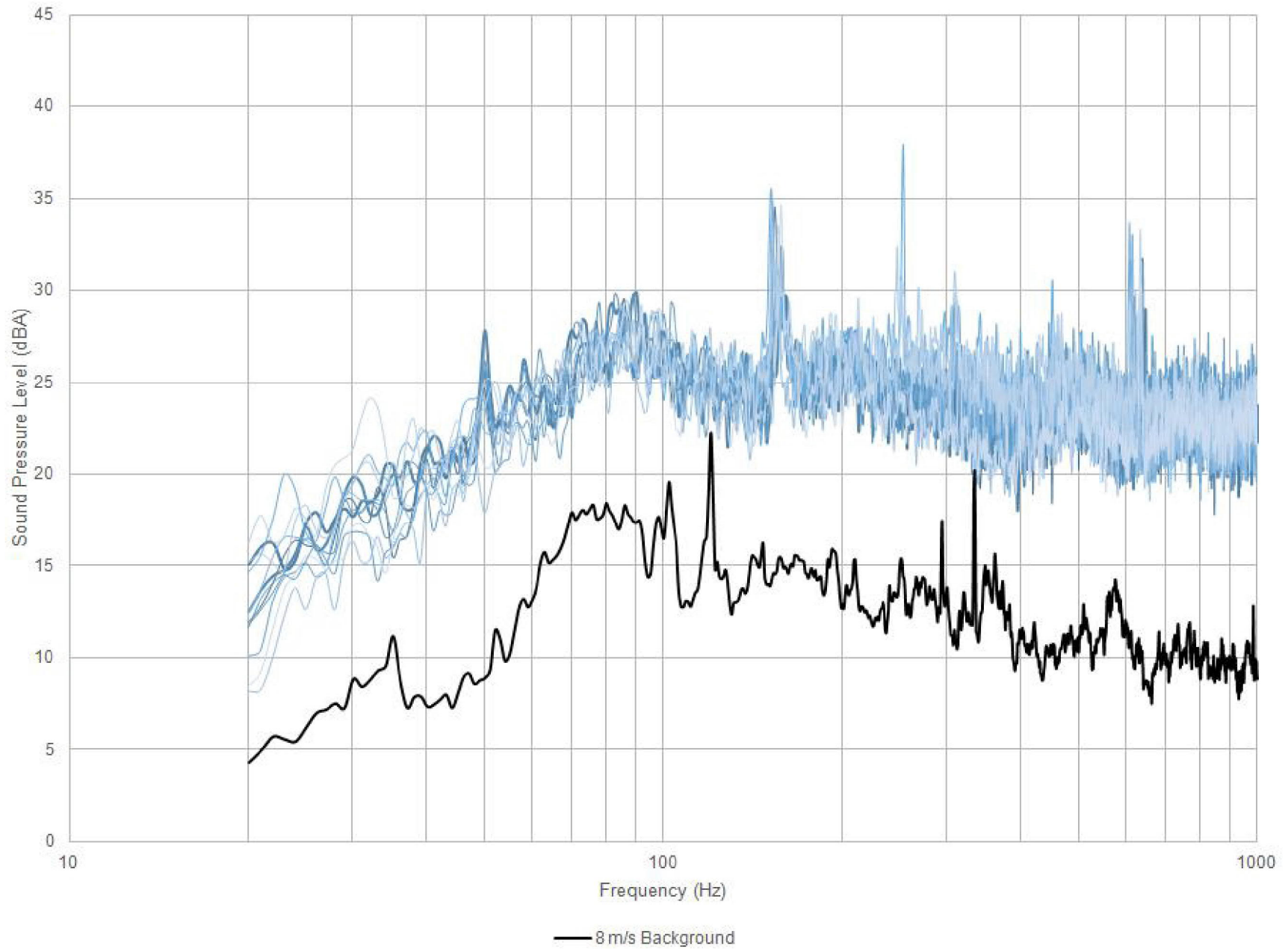
Bluewater Wind Energy Centre - Turbine T31 - IEC61400-11 Edition 2.1

Figure Title

Plot of narrow band spectra – Turbine ON vs. Background at 7 m/s

Figure D.02

8 m/s



14331.01.T31.RP1

Scale: NTS
Drawn by: VS
Reviewed by: RJ
Date: Jan 13, 2015
Revision: 1

Project Name

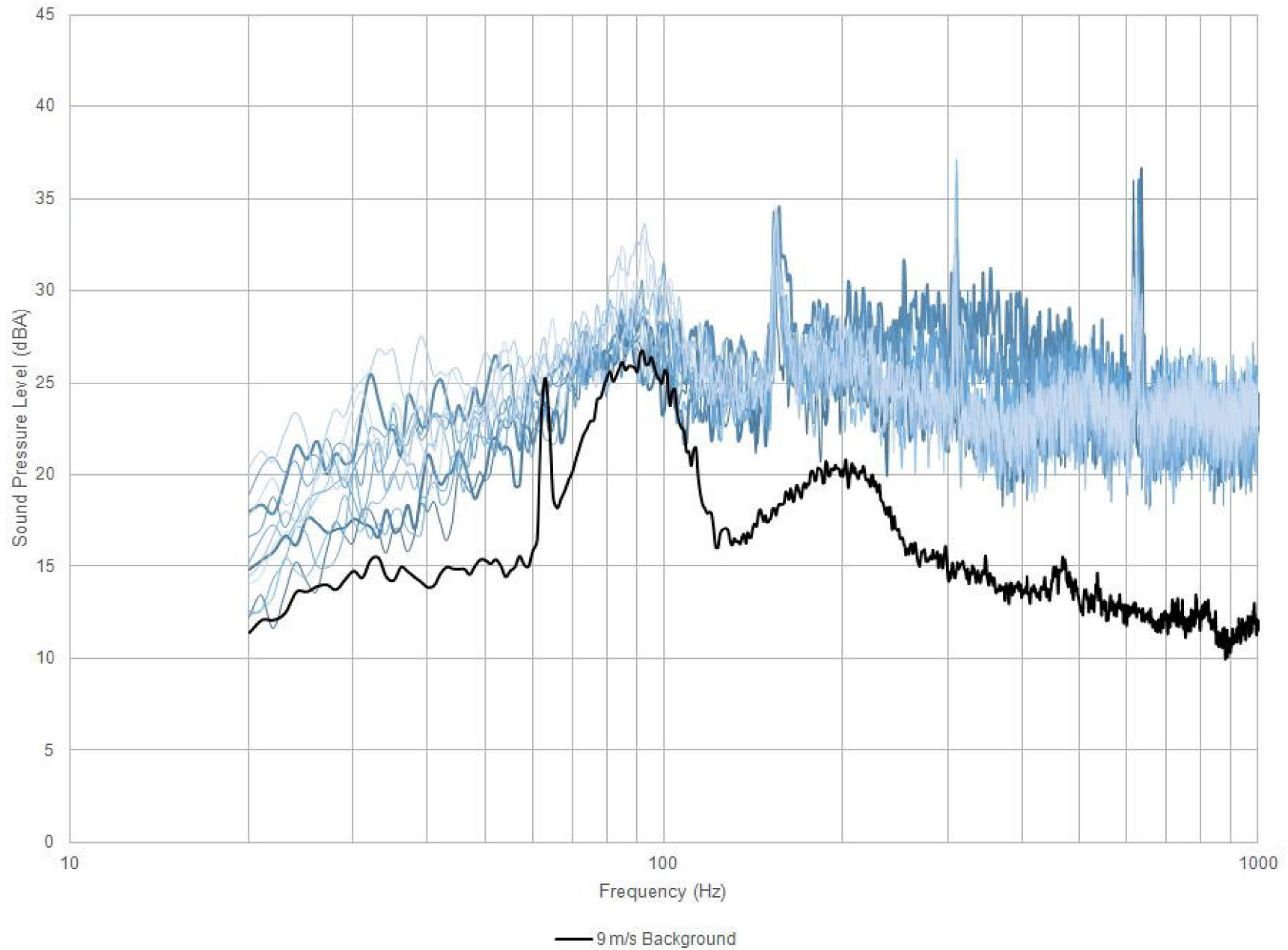
Bluewater Wind Energy Centre - Turbine T31 - IEC61400-11 Edition 2.1

Figure Title

Plot of narrow band spectra – Turbine ON vs. Background at 8 m/s

Figure D.03

9 m/s



14331.01.T31.RP1

Scale: NTS
Drawn by: VS
Reviewed by: RJ
Date: Jan 13, 2015
Revision: 1

Project Name

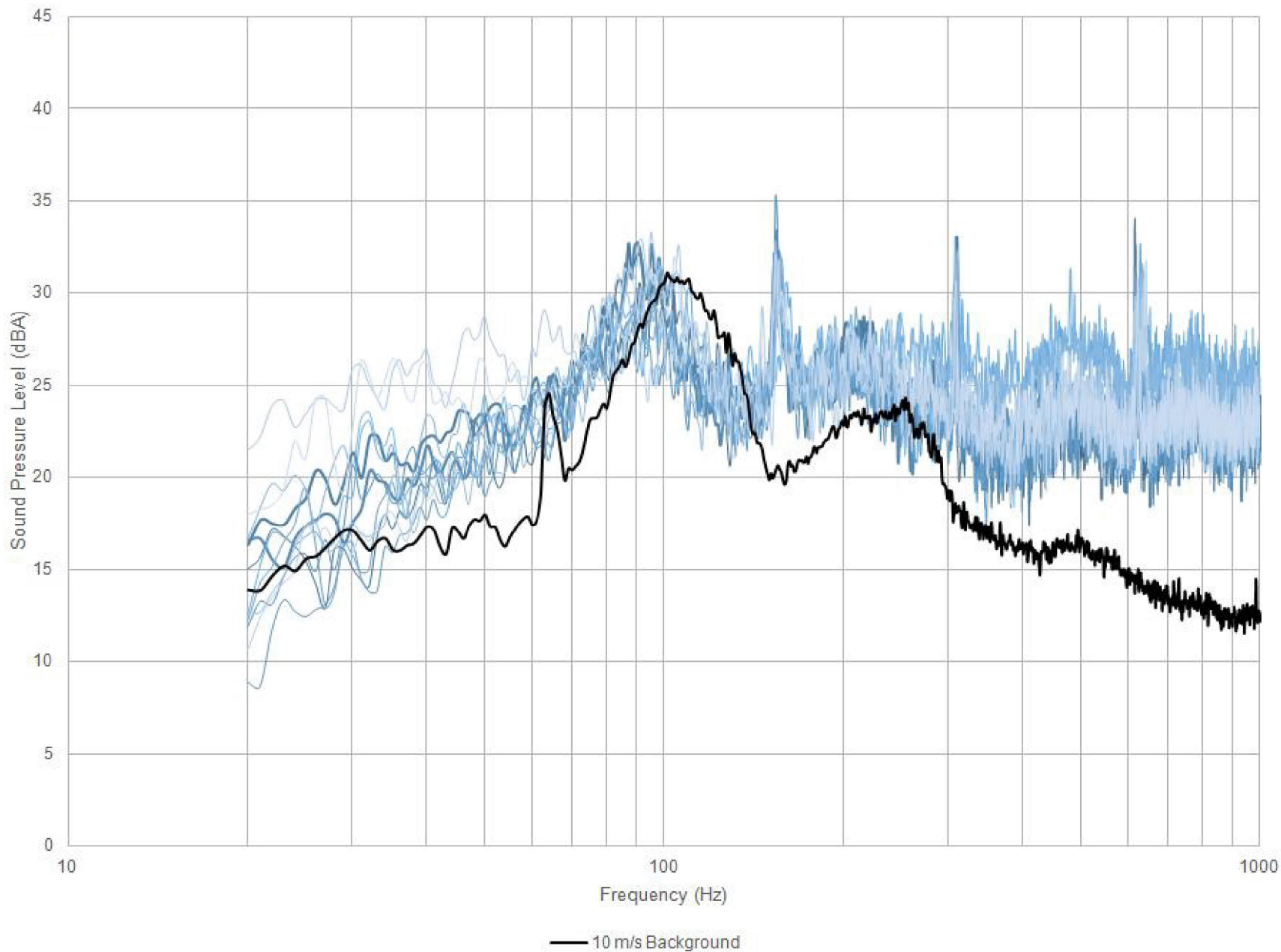
Bluewater Wind Energy Centre - Turbine T31 - IEC61400-11 Edition 2.1

Figure Title

Plot of narrow band spectra – Turbine ON vs. Background at 9 m/s

Figure D.04

10 m/s



14331.01.T31.RP1

Scale: NTS
Drawn by: VS
Reviewed by: RJ
Date: Jan 13, 2015
Revision: 1

Project Name

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Figure Title

Plot of narrow band spectra – Turbine ON vs. Background at 10 m/s

Figure D.05

Table D.01 Tonality Assessment Table - 6 m/s

Project: Bluewater Wind Energy Centre - Turbine T31 - IEC 61400-11 Measurement
 Report ID: 14331.01.T31.RP1

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Description	Data Points												Average	
	1	2	3	4	5	6	7	8	9	10	11	12		
Centre frequency (Hz)	130*	134*	135	145										136
Energy average of all masking lines (dB)	20.8	21.5	22.1	23.7										
Background (dB)	15.8	15.7	15.7	15.6										15.7
Background adjusted criterion level (dB)	19.1	20.1	21.0	23.0										
Masking level (dB)	37.4	38.4	39.3	41.3										
Tone level (dB)	34.1	42.4	40.8	41.8										
Determination of tonality (dB)	-3.3	4.0	1.5	0.5	-18.3	-18.3	-18.3	-18.3	-18.3	-18.3	-18.3	-18.3	-18.3	-3.3
Frequency dependent audibility criterion (dB)														-2.0
Tonal Audibility (dB)														-1.3

*Denotes masking noise is influenced by background

Table D.02 Tonality Assessment Table - 7 m/s

Project: Bluewater Wind Energy Centre - Turbine T31 - IEC 61400-11 Measurement
 Report ID: 14331.01.T31.RP1

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 Created on: 1/13/2015

Description	Data Points												Average
	1	2	3	4	5	6	7	8	9	10	11	12	
Centre frequency (Hz)	617	620	625	628	637	637	638	639					630
Energy average of all masking lines (dB)	21.8	21.7	22.1	22.5	21.9	22.8	21.1	21.7					
Background (dB)	8.0	8.0	7.9	7.8	7.6	7.6	7.6	7.6					7.8
Background adjusted criterion level (dB)	21.7	21.5	21.9	22.3	21.8	22.7	20.9	21.5					
Masking level (dB)	40.9	40.8	41.2	41.6	41.0	42.0	40.2	40.8					
Tone level (dB)	38.1	38.3	38.7	33.6	34.1	37.1	38.0	38.8					
Determination of tonality (dB)	-2.8	-2.5	-2.4	-7.9	-7.0	-4.8	-2.1	-2.0	-19.3	-19.3	-19.3	-19.3	-5.2
Frequency dependent audibility criterion (dB)													-2.4
Tonal Audibility (dB)													-2.7

Table D.03 Tonality Assessment Table - 9 m/s

Project: Bluewater Wind Energy Centre - Turbine T31 - IEC 61400-11 Measurement
 Report ID: 14331.01.T31.RP1

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 Created on: 1/13/2015

Description	Data Points												Average
	1	2	3	4	5	6	7	8	9	10	11	12	
Centre frequency (Hz)	618	620	624	624	625	628	629	629	629	629	635		626
Energy average of all masking lines (dB)	22.2	22.5	21.9	22.8	23.3	23.7	24.1	25.2	24.7	22.2	23.1		
Background (dB)	12.4	12.4	12.4	12.4	12.4	12.4	12.4	12.4	12.4	12.4	12.4		12.4
Background adjusted criterion level (dB)	21.7	22.1	21.4	22.4	22.9	23.3	23.8	24.9	24.4	21.7	22.8		
Masking level (dB)	41.0	41.3	40.7	41.6	42.2	42.6	43.0	44.2	43.7	41.0	42.0		
Tone level (dB)	38.8	31.8	35.3	33.8	37.5	38.2	30.5	37.9	36.5	36.6	41.8		
Determination of tonality (dB)	-2.1	-9.5	-5.4	-7.9	-4.7	-4.4	-12.6	-6.3	-7.2	-4.4	-0.3	-19.3	-5.1
Frequency dependent audibility criterion (dB)													-2.4
Tonal Audibility (dB)													-2.7

Appendix E Measurement Data



Table E.01 Measurement data - Turbine ON

Project: Bluewater Wind Energy Centre - Turbine T31 - IEC 61400-11 Measurement
 Report ID: 14331.01.T31.RP1

***Blank data denotes values that were omitted in the analysis due to yaw angle or an extraneous event during recording

Data Point #	Standardized Wind Speed (m/s)	Turbine Power Output (kW)	Reference Yaw Angle (°)	Yaw Angle (°)	Pitch Angle (°)	Rotor RPM	Nacelle Anemometer Wind Speed (m/s)	10m Anemometer Wind Speed (m/s)	Air Temperature (-C)	Pressure (kPa)	Relative Humidity (%)	Wind Shear
1	9.7	1624	239	239	10.2	15.1	11.5	8.8	1	98.4	78	0.21
2	7.8	1632	239	239	7.8	15.0	9.5	7.2	1	98.4	78	0.19
3	9.6	1624	239	239	11.0	15.1	11.3	7.8	1	98.4	79	0.26
4	9.0	1629	239	239	9.5	15.1	10.8	7.6	1	98.4	78	0.24
5	9.1	1628	239	239	9.4	15.1	10.8	8.1	1	98.4	78	0.21
6	9.3	1625	239	239	9.7	15.0	11.1	7.8	1	98.4	78	0.25
7	7.8	1627	239	239	8.9	15.1	9.5	7.9	1	98.4	78	0.15
8	9.0	1629	239	239	9.7	15.1	10.7	8.5	1	98.4	77	0.19
9	9.5	1628	239	239	9.7	15.1	11.2	9.6	1	98.4	77	0.15
10	8.3	1629	239	239	9.1	15.1	10.1	7.8	1	98.4	76	0.19
11	7.4	1626	239	239	8.6	15.0	9.2	7.9	1	98.4	77	0.13
12	9.1	1626	239	239	11.0	15.1	10.8	9.3	1	98.4	76	0.15
13	10.6	1628	239	239	10.4	15.1	12.3	11.0	1	98.4	76	0.14
14	9.7	1626	239	239	11.1	15.1	11.4	9.6	1	98.4	75	0.16
15	7.3	1622	239	239	7.3	14.9	9.1	8.9	1	98.4	76	0.07
16	7.9	1636	239	239	8.5	15.3	9.7	8.8	1	98.4	76	0.11
17	9.9	1625	239	239	10.4	15.1	11.7	10.2	1	98.4	76	0.15
18	7.3	1626	239	242	7.3	14.9	9.1	8.2	1	98.4	75	0.10
19	9.9	1635	239	242	10.9	15.2	11.7	10.3	1	98.4	75	0.14
20	8.8	1627	239	242	9.1	15.0	10.6	10.6	1	98.4	75	0.07
21	7.7	1628	239	242	6.8	15.0	9.5	9.8	1	98.5	74	0.04
22	7.4	1623	239	242	5.7	14.9	9.2	7.5	1	98.5	75	0.16
23	6.8	1631	239	247	5.9	15.2	8.6	7.9	1	98.5	75	0.09
24	7.2	1623	239	253	7.7	15.1	9.0	6.5	1	98.5	76	0.21
25	6.7	1624	239	253	5.6	14.9	8.4	6.4	1	98.5	76	0.18
26	6.2	1633	239	253	4.9	15.1	8.0	7.4	1	98.4	76	0.08
27	5.9	1626	239	253	3.4	14.9	7.7	6.8	1	98.4	76	0.10
28	6.2	1612	239	253	4.4	15.0	8.0	6.8	1	98.4	75	0.11
29	7.7	1634	239	237	6.4	15.3	9.4	8.1	1	98.4	75	0.14
30	7.5	1616	239	243	5.9	14.8	9.3	8.1	1	98.4	74	0.13
31	6.6	1614	239	248	3.0	14.8	8.4	6.2	1	98.4	74	0.19
32	6.1	1361	239	248	0.7	14.2	7.8	6.8	1	98.4	74	0.11
33	5.9	1283	239	248	1.0	13.8	7.8	7.1	1	98.4	74	0.07
34	7.0	1607	239	248	1.9	15.1	8.8	6.6	1	98.4	74	0.19
35	6.4	1444	239	248	1.8	14.5	8.1	6.6	1	98.4	74	0.15
36	7.7	1618	239	248	7.9	15.1	9.4	7.8	1	98.4	74	0.15
37	6.8	1630	239	248	6.0	15.1	8.6	8.0	1	98.4	74	0.08
38	7.3	1627	239	248	6.3	15.1	9.1	7.6	1	98.4	74	0.14
39	6.3	1623	239	248	5.0	14.9	8.1	7.6	1	98.4	74	0.07
40	6.9	1629	239	248	5.2	15.1	8.7	8.0	1	98.4	74	0.09
41	7.0	1631	239	248	6.8	15.1	8.8	7.6	1	98.4	74	0.12
42	8.6	1622	239	248	8.7	15.1	10.3	9.1	1	98.4	74	0.13
43	7.2	1628	239	248	8.1	15.1	8.9	9.4	1	98.4	74	0.03
44	7.0	1625	239	248	7.8	15.0	8.7	8.2	1	98.4	74	0.08
45	7.2	1633	239	248	7.7	15.1	8.9	8.4	1	98.4	74	0.08
46	9.0	1624	239	248	11.2	15.1	10.7	10.1	1	98.4	73	0.10

Table E.01 Measurement data - Turbine ON

Project: Bluewater Wind Energy Centre - Turbine T31 - IEC 61400-11 Measurement
 Report ID: 14331.01.T31.RP1

***Blank data denotes values that were omitted in the analysis due to yaw angle or an extraneous event during recording

Data Point #	Standardized Wind Speed (m/s)	Sound Pressure Level per 1/3 Octave Band (Hz), dBA																		Total (dBA)										
		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
47	9.3	23	26	29	31	33	35	40	42	39	41	41	41	42	41	43	44	45	46	47	46	45	42	39	34	30	25	21	18	55.7
48	8.7	21	26	29	30	32	34	39	40	38	42	41	40	41	40	42	44	44	45	47	45	45	42	38	34	29	24	20	17	55.1
49	8.5	22	27	29	30	33	35	39	41	38	41	41	41	41	40	42	44	44	45	46	45	44	42	38	34	29	25	20	18	55.0
50	8.8	21	25	28	30	32	35	39	40	38	41	41	40	40	40	42	44	44	45	46	45	44	42	38	34	29	24	20	17	54.8
51	11.8	22	26	29	31	33	35	39	43	41	41	42	43	43	43	45	45	46	47	48	47	46	43	40	36	32	29	26	23	56.7
52	11.3	19	23	26	29	31	34	39	41	39	41	42	42	43	43	45	45	46	47	48	47	46	43	40	35	30	26	22	19	56.5
53	11.0	19	23	25	28	31	34	39	41	39	41	42	42	43	42	44	45	45	46	47	46	45	43	39	35	30	25	20	17	56.1
54	10.0	19	23	26	28	31	33	39	41	37	41	41	40	41	40	42	43	44	45	46	45	44	42	38	33	28	24	20	17	54.9
55	8.6	20	23	26	28	31	34	38	40	37	41	40	39	41	39	41	42	43	44	46	45	44	41	37	33	28	24	20	18	54.2
56	10.7	22	26	29	32	33	36	39	42	39	41	41	41	42	42	44	45	46	46	47	47	46	43	40	35	31	27	23	20	56.2
57	11.1	24	28	31	32	33	35	39	44	40	41	42	43	43	43	45	45	46	47	48	47	46	43	40	35	31	28	24	21	56.7
58	9.8	20	24	26	28	31	33	38	41	37	41	41	41	42	41	43	44	45	46	47	46	45	42	39	34	29	25	21	18	55.4
59	9.5	23	26	28	31	33	34	39	41	38	41	41	40	41	40	42	44	44	45	46	45	44	42	38	34	30	28	26	23	55.0
60	9.5	18	22	24	28	30	33	37	38	36	40	40	39	41	40	42	44	44	45	46	45	44	42	38	33	29	24	20	18	54.7

Table E.01 Measurement data - Turbine ON

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***Blank data denotes values that were omitted in the analysis due to yaw angle or an extraneous event during recording

Data Point #	Standardized Wind Speed (m/s)	Turbine Power Output (kW)	Reference Yaw Angle (°)	Yaw Angle (°)	Pitch Angle (°)	Rotor RPM	Nacelle Anemometer Wind Speed (m/s)	10m Anemometer Wind Speed (m/s)	Air Temperature (°C)	Pressure (kPa)	Relative Humidity (%)	Wind Shear
47	9.3	1627	239	248	11.7	15.1	11.1	10.0	1	98.4	72	0.12
48	8.7	1627	239	248	10.3	15.0	10.4	9.5	1	98.4	72	0.11
49	8.5	1626	239	248	10.0	15.0	10.3	10.2	1	98.4	72	0.07
50	8.8	1630	239	248	9.8	15.2	10.6	9.0	1	98.4	71	0.15
51	11.8	1627	239	248	12.5	15.1	13.5	10.6	1	98.4	71	0.21
52	11.3	1627	239	248	12.6	15.1	13.1	10.6	1	98.4	70	0.19
53	11.0	1626	239	248	12.1	15.0	12.7	9.1	1	98.4	69	0.25
54	10.0	1628	239	248	10.9	15.1	11.8	9.5	1	98.4	70	0.18
55	8.6	1628	239	248	8.3	15.0	10.4	8.5	1	98.4	70	0.17
56	10.7	1628	239	248	12.6	15.2	12.4	9.9	1	98.4	71	0.19
57	11.1	1626	239	248	12.8	15.0	12.8	11.0	1	98.4	71	0.16
58	9.8	1628	239	248	11.6	15.1	11.6	10.1	1	98.4	70	0.15
59	9.5	1629	239	248	11.0	15.1	11.2	9.3	1	98.4	69	0.17
60	9.5	1628	239	248	9.8	15.1	11.2	10.4	1	98.4	70	0.12

Table E.02 Measurement data - Background

Project: Bluewater Wind Energy Centre - Turbine T31

Report ID: 14331.01.T31.RP1

***Blank data denotes values that were omitted in the analysis due to an extraneous event during recording

Data Point #	Standardized Wind Speed (m/s)	Sound Pressure Level per 1/3 Octave Band (Hz), dBA																Total (dBA)												
		20	25	32	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
1	9.4	11	13	16	20	24	29	34	33	28	31	33	30	30	31	31	32	32	33	33	33	31	27	23	22	21	19	16	44.3	
2	9.1	15	18	21	22	23	31	35	34	29	32	34	31	31	30	31	31	32	33	33	33	31	28	23	21	20	18	16	44.8	
3	9.1	19	22	24	25	26	32	36	35	30	33	35	32	32	31	32	31	32	33	33	33	31	28	24	23	22	20	17	45.4	
4	9.0	19	22	24	25	26	31	36	36	30	33	35	33	32	32	32	32	32	33	34	34	31	28	24	22	21	19	16	45.7	
5	9.3	9	15	17	18	20	31	34	38	34	31	34	34	31	30	30	30	30	31	32	33	32	30	27	22	19	19	17	15	45.2
6	8.9	18	21	23	25	26	31	35	33	30	32	34	31	31	31	31	31	31	32	33	32	30	28	24	23	22	20	18	44.6	
7	9.0	13	15	18	19	21	29	35	37	29	32	35	33	31	32	33	32	34	34	35	36	36	34	32	29	28	28	25	22	46.7
8	8.6	14	18	19	22	23	27	35	37	32	32	35	33	31	31	31	32	31	32	33	34	34	32	31	29	28	28	25	22	46.0
9	8.7	17	19	21	21	23	28	34	32	29	31	33	30	30	30	29	30	30	32	32	33	33	31	33	29	28	28	26	22	44.6
10	7.9	12	15	17	18	21	27	30	26	27	29	29	28	27	27	28	29	30	32	33	34	34	33	34	31	31	31	28	24	44.2
11	7.5	11	13	16	18	25	28	31	30	28	29	30	29	28	27	28	29	30	30	30	29	27	26	24	24	24	22	19	41.6	
12	10.2	13	17	20	21	29	30	34	37	31	31	34	33	31	31	31	30	31	32	33	32	30	27	25	24	24	22	19	44.9	
13	9.4	17	18	22	23	24	29	35	35	31	33	34	34	32	31	32	32	31	32	33	34	33	31	29	28	28	28	26	23	45.6
14	9.9	20	23	26	27	27	30	36	39	34	34	36	36	34	33	33	33	33	33	33	34	34	32	29	26	26	25	23	21	47.1
15	9.6	19	21	23	25	26	28	37	40	35	34	37	36	34	33	33	33	32	33	34	35	34	32	29	27	26	25	22	20	47.5
16	10.1	21	24	27	28	30	37	43	39	34	38	39	35	34	35	35	34	35	35	36	36	34	31	27	25	24	21	19	49.3	
17	10.0	16	20	21	22	24	27	35	41	37	33	37	37	33	33	33	32	32	33	33	35	35	33	30	26	23	22	19	16	47.5
18	11.2	22	25	27	29	30	30	36	43	41	35	39	40	35	34	35	34	34	34	35	36	37	35	32	29	28	27	25	22	49.8
19	10.1	18	21	23	24	26	29	37	41	36	34	37	37	34	33	33	33	32	33	34	35	35	33	31	28	28	27	25	22	47.9
20	9.6	19	22	24	26	26	28	37	41	37	34	37	38	34	34	34	34	34	34	35	36	35	34	31	28	26	25	23	20	48.3
21	9.4	19	22	23	24	25	28	36	40	35	34	37	37	33	32	33	32	32	32	33	34	34	32	30	27	26	26	23	20	47.2
22	12.2	23	26	29	32	32	33	37	44	42	36	39	42	37	36	37	37	36	37	37	38	38	37	36	34	34	34	33	30	51.7
23	10.8	22	25	28	29	30	31	36	45	41	35	40	41	37	36	36	36	35	36	36	37	38	37	33	30	29	28	26	23	50.9
24	11.2	24	28	29	31	32	32	36	44	42	36	40	42	38	36	37	37	36	36	37	38	38	37	34	30	28	27	25	23	51.6
25	10.8	23	27	29	31	31	32	37	44	42	36	39	41	37	36	36	36	35	36	36	37	38	37	33	30	28	26	23	20	51.1
26	9.8	21	25	27	28	30	31	37	43	38	35	39	39	35	35	35	35	34	34	35	36	36	35	31	28	26	24	21	18	49.5
27	9.6	15	19	20	23	25	27	36	38	33	33	35	35	32	31	32	32	31	32	33	34	33	31	27	23	21	20	18	16	46.0
28	10.5	20	23	25	26	27	29	36	42	40	34	38	39	36	35	35	35	35	35	36	36	36	35	31	28	25	24	22	19	49.4
29	10.0	17	21	22	23	25	28	36	41	37	34	37	37	34	33	33	33	32	33	34	35	35	33	29	26	24	22	20	17	47.7
30	9.8	20	23	26	27	29	32	37	42	36	34	38	38	34	34	34	34	34	35	36	37	37	36	34	32	31	31	28	25	49.3
31	10.5	19	22	24	25	27	33	36	41	37	34	37	38	34	33	34	33	33	34	34	35	35	33	30	27	25	25	22	19	48.1
32	9.6	19	23	23	25	26	33	37	38	32	34	36	35	33	33	34	33	32	33	34	34	34	31	28	24	22	21	19	17	46.8
33	10.1	18	21	23	23	24	34	36	38	33	33	36	34	32	32	33	32	31	32	33	33	33	30	27	23	21	19	17	15	46.2
34	8.8	19	23	26	27	27	34	37	39	34	34	36	35	33	33	33	33	33	33	34	34	34	32	29	25	24	23	21	18	47.2
35	9.5	15	19	23	22	24	34	35	37	32	32	35	34	32	31	32	31	31	32	33	34	33	30	27	23	21	20	18	16	45.8
36	9.1	13	16	18	19	22	33	36	40	36	33	36	37	33	32	33	32	32	32	33	34	34	32	29	24	22	21	19	16	47.3
37	9.5	19	21	22	24	25	34	37	40	34	34	37	36	33	33	33	33	32	33	34	35	34	32	29	25	23	22	20	18	47.3
38	10.8	21	25	28	29	30	34	36	43	39	35	39	40	36	35	36	36	35	35	36	37	37	36	33	30	28	27	25	22	50.1
39	9.8	19	23	24	25	27	34	36	43	41	34	38	40	36	35	36	36	35	36	37	38	38	36	33	29	26	25	22	19	50.4
40	11.8	20	23	24	26	26	33	34	44	46	37	39	43	40	36	37	37	36	37	38	39	39	39	36	32	32	31	29	27	52.5
41	10.6	22	25	26	27	28	34	36	44	41	35	39	41	37	36	36	36	35	35	36	37	38	36	32	28	25	24	21	18	50.6

Table E.02 Measurement data - Background

Project: Bluewater Wind Energy Centre - Turbine T31

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Data Point #	Standardized Wind Speed (m/s)	Rotor RPM	Nacelle Anemometer Wind Speed (m/s)	10m Anemometer Wind Speed (m/s)	Air Temperature (°C)	Pressure (kPa)	Relative Humidity (%)
1	9.4	0.8	9.8	9.4	1	1.0	71
2	9.1	0.7	8.3	9.1	1	1.0	71
3	9.1	0.6	6.6	9.1	1	1.0	72
4	9.0	0.7	8.6	9.0	1	1.0	71
5	9.3	0.7	8.0	9.3	1	1.0	71
6	8.9	0.6	7.8	8.9	1	1.0	70
7	9.0	0.6	7.8	9.0	1	1.0	71
8	8.6	0.6	7.7	8.6	1	1.0	71
9	8.7	0.6	7.1	8.7	1	1.0	71
10	7.9	0.4	6.2	7.9	1	1.0	72
11	7.5	0.6	7.4	7.5	1	1.0	73
12	10.2	0.6	8.8	10.2	1	1.0	72
13	9.4	0.6	8.4	9.4	1	1.0	72
14	9.9	0.6	8.3	9.9	1	1.0	72
15	9.6	0.6	9.3	9.6	1	1.0	72
16	10.1	0.7	10.0	10.1	1	1.0	71
17	10.0	0.6	10.0	10.0	1	1.0	71
18	11.2	0.8	9.1	11.2	1	1.0	71
19	10.1	0.7	8.7	10.1	1	1.0	72
20	9.6	0.7	9.3	9.6	1	1.0	72
21	9.4	0.7	8.0	9.4	1	1.0	72
22	12.2	0.8	11.1	12.2	1	1.0	71
23	10.8	0.8	9.9	10.8	1	1.0	70
24	11.2	0.8	9.9	11.2	1	1.0	71
25	10.8	0.7	9.4	10.8	1	1.0	71
26	9.8	0.6	8.0	9.8	1	1.0	71
27	9.6	0.7	8.4	9.6	1	1.0	72
28	10.5	0.7	7.7	10.5	1	1.0	71
29	10.0	0.7	7.9	10.0	1	1.0	71
30	9.8	0.8	8.1	9.8	1	1.0	71
31	10.5	0.7	7.7	10.5	1	1.0	71
32	9.6	0.6	7.8	9.6	1	1.0	71
33	10.1	0.6	7.6	10.1	1	1.0	72
34	8.8	0.6	8.2	8.8	1	1.0	72
35	9.5	0.7	9.9	9.5	1	1.0	72
36	9.1	0.7	7.3	9.1	1	1.0	72
37	9.5	0.6	8.2	9.5	1	1.0	72
38	10.8	0.7	8.4	10.8	1	1.0	71
39	9.8	0.7	10.6	9.8	1	1.0	71
40	11.8	0.9	9.2	11.8	1	1.0	70
41	10.6	0.6	8.5	10.6	1	1.0	70

Table E.02 Measurement data - Background

Project: Bluewater Wind Energy Centre - Turbine T31

Report ID: 14331.01.T31.RP1

***Blank data denotes values that were omitted in the analysis due to an extraneous event during recording

Data Point #	Standardized Wind Speed (m/s)	Sound Pressure Level per 1/3 Octave Band (Hz), dBA																				Total (dBA)								
		20	25	32	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
42	10.6	21	25	27	28	29	34	37	43	37	34	38	38	35	35	35	35	37	38	39	38	36	34	31	31	30	27	24	50.0	
43																														
44	8.7	19	22	24	24	26	33	35	38	35	33	35	35	33	32	32	32	31	32	33	33	31	28	24	22	20	18	16	46.3	
45	10.4	21	23	26	28	29	34	35	41	40	34	37	40	36	34	35	34	34	34	35	36	36	34	31	26	23	22	19	16	49.2
46	11.0	23	27	29	30	30	34	35	45	46	37	40	44	40	38	38	38	37	38	39	40	40	39	37	33	32	32	31	28	53.1
47	10.0	20	23	26	26	28	33	36	43	43	36	38	40	37	35	36	35	35	35	36	37	38	37	33	30	28	27	24	21	50.6
48	10.1	18	21	23	25	26	32	36	42	39	35	38	39	35	35	36	35	35	36	37	38	38	36	32	27	24	22	20	17	49.6
49	10.4	19	22	25	25	26	33	36	41	37	34	37	38	34	34	34	33	33	34	34	35	35	33	29	25	23	21	19	16	48.2
50	10.9	21	24	26	28	29	33	36	42	38	35	38	39	35	34	35	34	34	34	35	36	36	34	31	27	24	23	20	17	49.1
51	9.4	20	22	25	26	27	32	37	40	34	34	36	35	34	33	33	33	32	33	34	35	34	32	29	25	23	22	19	17	47.2
52	9.4	13	16	18	19	22	32	35	37	33	33	35	35	32	32	32	32	32	32	33	34	33	30	27	22	20	18	17	15	45.9
53	9.8	24	27	31	31	32	35	37	44	43	36	39	42	38	36	37	36	36	36	37	38	38	37	35	32	32	30	28	25	51.6
54	10.7	23	25	28	29	29	34	37	43	39	35	39	40	35	35	36	35	34	35	36	36	37	35	31	28	25	24	21	18	49.7
55	10.5	21	24	26	27	29	34	37	41	34	34	37	37	34	33	34	34	33	34	34	35	35	33	29	26	24	22	20	17	48.0
56	9.6	21	25	27	29	30	34	37	41	34	34	37	37	34	34	34	34	34	34	35	36	36	34	31	27	25	24	21	18	48.4
57	9.2	18	21	23	24	27	32	36	41	34	33	37	36	34	33	33	33	33	34	35	35	35	33	29	25	23	22	19	16	47.6
58	8.7	19	22	24	26	27	33	36	36	33	34	35	34	33	32	32	33	32	33	34	34	33	31	27	24	22	21	19	16	46.2
59	10.8	17	20	23	24	25	32	36	40	37	33	36	37	34	33	34	33	33	34	35	35	35	33	29	25	22	21	19	16	47.6
60																														
61																														
62	4.0	4	8	10	17	16	24	26	30	29	28	30	30	31	31	31	32	32	32	32	29	27	23	19	17	16	16	15	14	42.2
63	4.9	7	10	12	16	18	24	26	30	29	29	31	31	32	32	32	33	33	32	33	29	27	24	20	18	17	17	16	14	42.9
64	3.5	11	14	15	19	18	24	27	30	29	29	30	30	32	32	31	32	32	32	32	29	27	24	21	18	18	17	15	14	42.6
65	4.1	4	7	9	17	15	23	26	29	29	29	30	30	32	32	32	32	32	32	32	29	27	23	20	17	16	16	15	14	42.5
66	5.3	5	10	11	18	16	23	26	29	28	28	29	30	32	31	31	32	32	32	32	29	27	23	20	17	16	16	15	14	42.3
67	3.7	3	6	9	17	16	24	26	29	30	29	30	31	32	31	31	32	32	32	32	29	27	23	20	17	16	16	15	14	42.5
68	4.0	-1	3	8	17	17	26	27	30	30	30	33	33	33	32	31	32	32	32	32	28	26	23	19	17	16	15	15	13	43.0
69	2.9	0	5	9	18	16	24	26	29	29	31	31	31	32	31	31	32	32	32	32	28	26	23	19	17	16	16	15	14	42.6
70	4.9	7	8	11	18	17	23	26	29	30	29	30	32	32	32	32	33	33	32	33	29	27	24	20	18	17	17	16	14	42.9
71	4.6	6	10	12	19	17	23	27	29	29	29	30	31	32	32	32	33	33	33	34	31	29	25	21	19	18	18	17	15	43.4
72	6.1	6	8	11	18	16	24	26	30	29	29	30	31	31	31	31	32	32	32	31	28	26	23	19	17	17	17	16	14	42.3
73	6.2	35	38	39	43	52	59	61	60	66	69	72	74	76	79	81	83	83	83	82	79	81	82	79	77	76	78	82	81	92.8
74	5.0	14	19	18	21	24	29	30	31	30	30	31	34	35	34	34	35	35	34	33	30	28	25	21	20	19	19	17	16	44.7
75	3.9	9	11	13	15	17	24	26	29	28	29	30	31	32	32	31	32	32	32	31	28	26	23	20	18	17	17	16	14	42.4
76	3.4	6	8	10	14	16	24	26	30	30	31	32	33	33	33	32	33	32	32	32	29	27	23	20	17	16	15	14	43.4	
77	3.8	5	8	11	13	17	23	27	29	29	30	31	32	32	32	32	32	32	32	32	29	27	24	20	17	17	16	16	14	42.9
78	5.2	10	13	14	16	18	24	27	30	31	30	31	32	33	33	32	32	32	32	32	29	27	24	21	19	18	18	17	15	43.3
79	3.9	15	17	19	20	21	24	27	30	29	31	31	32	33	32	32	33	33	32	33	29	27	25	22	20	19	20	18	16	43.4
80	4.6	12	14	16	18	20	23	27	29	29	30	31	32	33	32	33	33	33	33	33	29	27	24	21	19	18	18	17	15	43.2
81	4.8	8	10	12	15	17	21	27	30	29	29	30	31	32	32	31	32	32	32	33	29	27	24	21	18	17	17	16	14	42.8
82	3.6	9	12	14	15	17	21	26	29	28	29	30	30	31	31	31	32	32	32	32	29	27	24	20	18	17	17	16	14	42.3

Table E.02 Measurement data - Background

Project: Bluewater Wind Energy Centre - Turbine T31

Report ID: 14331.01.T31.RP1

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Data Point #	Standardized Wind Speed (m/s)	Rotor RPM	Nacelle Anemometer Wind Speed (m/s)	10m Anemometer Wind Speed (m/s)	Air Temperature (°C)	Pressure (kPa)	Relative Humidity (%)
42	10.6	0.6	8.7	10.6	1	1.0	70
43		0.7	9.4	11.0	1	1.0	70
44	8.7	0.6	9.0	8.7	1	1.0	71
45	10.4	0.8	10.7	10.4	1	1.0	71
46	11.0	0.6	9.6	11.0	1	1.0	70
47	10.0	0.8	10.0	10.0	1	1.0	69
48	10.1	0.7	8.5	10.1	1	1.0	69
49	10.4	0.7	9.1	10.4	1	1.0	69
50	10.9	0.8	8.1	10.9	1	1.0	68
51	9.4	0.6	8.5	9.4	1	1.0	68
52	9.4	0.7	9.9	9.4	1	1.0	69
53	9.8	0.8	9.5	9.8	1	1.0	69
54	10.7	0.6	6.9	10.7	1	1.0	68
55	10.5	0.6	7.7	10.5	1	1.0	67
56	9.6	0.6	9.4	9.6	1	1.0	67
57	9.2	0.7	8.8	9.2	1	1.0	68
58	8.7	0.7	8.4	8.7	1	1.0	69
59	10.8	0.7	9.9	10.8	1	1.0	69
60		0.7	9.3	9.9	1	1.0	68
61		0.5	6.5	2.9	3	99.0	42
62	4.0	0.4	5.6	4.0	3	99.0	42
63	4.9	0.5	7.3	4.9	3	99.0	42
64	3.5	0.4	6.7	3.5	3	99.0	42
65	4.1	0.5	5.6	4.1	3	99.0	42
66	5.3	0.3	5.1	5.3	3	99.0	42
67	3.7	0.3	6.4	3.7	3	99.0	42
68	4.0	0.4	5.3	4.0	3	99.0	42
69	2.9	0.3	5.2	2.9	3	99.0	42
70	4.9	0.4	7.9	4.9	3	99.0	42
71	4.6	0.5	6.8	4.6	3	99.0	42
72	6.1	0.6	5.5	6.1	3	99.0	42
73	6.2	0.6	7.3	6.2	3	99.0	41
74	5.0	0.6	7.3	5.0	3	99.0	42
75	3.9	0.3	5.4	3.9	3	99.0	42
76	3.4	0.3	5.7	3.4	3	99.0	42
77	3.8	0.4	7.0	3.8	4	99.0	42
78	5.2	0.5	6.4	5.2	4	99.0	42
79	3.9	0.3	5.2	3.9	4	99.0	42
80	4.6	0.4	6.4	4.6	4	99.0	42
81	4.8	0.4	7.0	4.8	4	99.0	42
82	3.6	0.3	5.0	3.6	4	99.0	42

Table E.02 Measurement data - Background

Project: Bluewater Wind Energy Centre - Turbine T31

Report ID: 14331.01.T31.RP1

***Blank data denotes values that were omitted in the analysis due to an extraneous event during recording

Data Point #	Standardized Wind Speed (m/s)	Sound Pressure Level per 1/3 Octave Band (Hz), dBA																		Total (dBA)										
		20	25	32	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
83	3.9	4	8	10	14	17	21	27	29	32	30	32	32	33	32	32	32	32	33	33	28	26	23	19	17	16	16	15	14	43.2
84	4.6	7	10	13	15	17	22	27	29	31	29	30	31	33	32	32	32	33	33	33	29	27	24	20	17	17	17	15	14	43.1
85	4.0	15	17	19	20	21	24	27	30	29	30	30	31	32	32	32	33	33	33	33	29	28	25	23	21	20	20	18	17	43.3
86	3.6	15	18	20	22	24	25	28	30	29	30	30	31	32	32	32	33	33	33	33	29	28	25	23	21	20	20	18	16	43.4
87	2.8	1	6	9	12	15	21	26	29	28	29	30	31	32	32	31	32	32	33	33	29	27	24	20	17	16	16	15	14	42.7
88	4.1	1	4	8	11	15	20	26	29	28	29	30	31	32	32	31	32	32	32	32	28	26	23	19	17	16	16	15	14	42.3
89	4.4	3	6	10	12	16	21	26	29	29	29	30	31	32	31	31	32	32	32	33	29	27	24	20	17	17	16	15	14	42.6
90	4.4	5	8	11	13	16	21	27	30	30	33	40	41	37	32	32	32	32	32	32	29	27	24	21	18	17	17	16	14	46.4
91	4.0	1	6	10	14	16	22	27	30	30	31	34	37	36	33	32	32	32	32	32	29	27	24	20	18	17	16	15	14	44.5
92	3.6	4	8	10	13	17	22	26	29	29	30	31	32	33	33	31	32	32	32	32	29	27	23	20	17	16	16	15	14	42.7
93	5.6	12	15	17	19	20	25	28	30	30	30	33	32	33	32	32	32	32	32	32	29	27	25	22	20	19	19	18	16	43.4
94	3.7	15	17	21	20	21	23	27	30	29	30	30	31	33	32	32	32	33	33	32	29	27	24	21	20	19	19	18	16	43.2
95	3.6	6	8	12	14	18	23	27	30	29	29	30	31	33	32	32	32	32	32	32	29	27	24	20	18	17	17	16	14	42.8
96	4.7	10	14	15	16	18	22	27	30	29	29	30	31	32	32	32	32	32	32	32	29	27	23	20	18	17	17	16	15	42.7
97	4.4	5	8	11	14	17	21	26	30	30	30	30	32	32	32	32	32	32	32	32	29	27	23	20	17	17	17	16	14	42.6
98	3.9	6	9	12	14	16	21	27	30	30	29	30	31	32	31	32	32	32	32	32	29	27	24	20	18	17	17	16	14	42.5
99	4.4	5	9	11	13	16	21	26	29	30	28	29	30	31	31	31	32	32	32	32	29	27	24	21	18	17	17	16	14	42.4
100	3.9	8	10	11	14	16	21	26	29	29	29	29	31	31	32	32	33	33	33	33	30	28	24	21	18	17	17	16	14	42.7
101	3.5	6	10	12	14	16	21	27	29	30	30	30	31	32	32	32	32	32	32	32	29	27	24	20	17	17	16	15	14	42.8
102	4.4	1	5	9	12	15	21	30	30	30	29	30	31	31	31	32	33	33	33	33	29	27	24	20	17	16	16	15	14	42.9
103	4.6	13	16	19	19	21	26	30	30	30	30	31	32	32	32	33	33	33	33	33	30	28	25	23	22	20	20	19	17	43.6
104	3.5	5	8	11	13	17	28	27	30	31	29	30	32	32	32	32	33	33	33	33	29	27	24	20	17	17	16	15	14	43.2
105	4.4	12	13	16	17	22	31	27	30	29	29	30	32	32	32	33	33	33	33	33	29	28	24	21	19	18	18	17	15	43.5
106	3.8	8	11	12	14	20	24	26	29	30	29	31	32	32	32	32	33	32	32	32	29	27	24	20	18	17	17	16	14	43.0
107	3.7	-1	4	9	12	16	21	26	29	29	28	30	30	32	31	31	32	32	32	32	28	26	23	19	17	16	16	15	14	42.1
108	3.0	7	10	12	13	18	22	27	29	30	29	31	31	32	32	32	33	33	33	33	29	27	24	20	17	17	16	15	14	42.9
109	3.6	2	5	9	12	15	21	26	29	29	27	30	30	31	31	31	32	32	32	32	28	26	23	19	17	16	16	15	14	42.2
110	2.9	-1	4	8	11	16	21	26	29	30	28	30	31	32	31	32	32	33	33	33	29	27	23	20	17	16	16	15	14	42.7
111	3.0	10	13	15	17	19	22	27	29	30	30	31	32	32	32	32	32	33	33	32	29	27	24	20	18	17	17	16	15	43.1
112	4.1	0	4	8	11	16	21	26	29	30	29	31	30	32	32	32	32	33	33	33	29	27	24	20	17	16	16	15	14	42.8
113	3.6	1	5	8	12	16	21	27	29	30	29	31	31	32	32	32	32	32	32	32	28	26	23	19	17	16	16	15	14	42.8
114	3.0	6	8	11	13	16	21	26	29	29	29	30	30	32	31	32	32	33	32	32	28	26	23	19	17	16	16	15	14	42.5
115	3.8	-1	5	8	12	16	21	26	29	30	29	30	30	32	31	31	31	32	32	32	28	26	23	19	17	16	16	15	14	42.3
116	5.8	4	7	10	13	16	21	26	29	31	28	31	31	32	32	32	33	33	33	30	28	24	20	17	16	16	15	14	43.1	
117	5.7	9	12	13	15	17	21	26	29	29	28	30	30	31	31	31	32	32	32	32	28	26	23	20	18	17	17	16	15	42.2
118	5.9	8	12	13	15	18	22	27	29	29	28	30	30	32	31	32	32	33	33	32	29	27	23	20	18	17	17	16	15	42.7
119	4.8	14	16	18	19	20	23	24	25	27	27	29	29	30	29	29	29	29	29	29	28	24	22	21	19	19	18	19	17	40.0
120	6.2	10	12	14	15	17	20	22	25	27	26	26	28	28	27	26	25	24	23	24	19	19	18	17	17	17	18	17	15	37.7
121	4.2	10	12	14	15	18	22	23	24	28	26	27	29	29	28	27	25	24	23	24	20	19	19	18	18	18	18	17	15	38.0
122	4.4	8	10	12	13	17	19	21	23	26	25	26	26	27	26	26	24	23	23	23	18	17	17	16	16	17	17	16	14	36.5
123	5.7	8	9	12	14	16	19	21	22	25	25	25	26	27	26	26	24	23	22	23	18	17	17	17	17	17	17	16	15	36.5

Table E.02 Measurement data - Background

Project: Bluewater Wind Energy Centre - Turbine T31

Report ID: 14331.01.T31.RP1

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Data Point #	Standardized Wind Speed (m/s)	Rotor RPM	Nacelle Anemometer Wind Speed (m/s)	10m Anemometer Wind Speed (m/s)	Air Temperature (°C)	Pressure (kPa)	Relative Humidity (%)
83	3.9	0.3	4.4	3.9	4	99.0	42
84	4.6	0.5	7.7	4.6	4	99.0	42
85	4.0	0.5	5.9	4.0	4	99.0	42
86	3.6	0.3	5.3	3.6	4	99.0	42
87	2.8	0.5	5.0	2.8	4	99.0	42
88	4.1	0.5	5.8	4.1	4	98.9	42
89	4.4	0.5	5.4	4.4	4	98.9	42
90	4.4	0.5	5.9	4.4	4	99.0	43
91	4.0	0.5	6.5	4.0	4	99.0	43
92	3.6	0.5	5.5	3.6	4	99.0	43
93	5.6	0.4	6.4	5.6	4	98.9	43
94	3.7	0.4	5.9	3.7	4	98.9	43
95	3.6	0.3	6.1	3.6	4	99.0	43
96	4.7	0.5	6.2	4.7	4	99.0	43
97	4.4	0.5	5.3	4.4	4	99.0	43
98	3.9	0.5	5.9	3.9	4	98.9	43
99	4.4	0.5	6.1	4.4	4	98.9	43
100	3.9	0.5	5.9	3.9	4	98.9	43
101	3.5	0.5	5.8	3.5	4	98.9	43
102	4.4	0.4	6.8	4.4	4	98.9	43
103	4.6	0.6	6.8	4.6	4	98.9	43
104	3.5	0.4	5.9	3.5	4	98.9	43
105	4.4	0.6	6.7	4.4	4	98.9	43
106	3.8	0.5	6.9	3.8	4	98.9	42
107	3.7	0.4	6.0	3.7	4	98.9	43
108	3.0	0.6	6.4	3.0	4	98.9	43
109	3.6	0.4	5.5	3.6	4	98.9	42
110	2.9	0.4	6.1	2.9	4	98.9	42
111	3.0	0.2	5.7	3.0	4	98.9	43
112	4.1	0.5	5.2	4.1	4	98.9	42
113	3.6	0.4	5.4	3.6	4	98.9	42
114	3.0	0.3	5.9	3.0	4	98.9	42
115	3.8	0.5	5.7	3.8	4	98.9	42
116	5.8	0.6	6.2	5.8	4	98.9	41
117	5.7	0.5	6.6	5.7	4	98.9	40
118	5.9	0.4	7.0	5.9	4	98.9	39
119	4.8	0.5	6.6	4.8	4	98.9	39
120	6.2	0.4	5.0	6.2	4	98.9	39
121	4.2	0.4	6.0	4.2	4	98.9	38
122	4.4	0.4	6.5	4.4	4	98.9	39
123	5.7	0.6	6.1	5.7	4	98.9	38

Table E.02 Measurement data - Background

Project: Bluewater Wind Energy Centre - Turbine T31

Report ID: 14331.01.T31.RP1

***Blank data denotes values that were omitted in the analysis due to an extraneous event during recording

Data Point #	Standardized Wind Speed (m/s)	Sound Pressure Level per 1/3 Octave Band (Hz), dBA																	Total (dBA)											
		20	25	32	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
124	5.6	10	13	15	16	17	20	22	23	26	26	27	28	29	27	28	26	24	23	23	19	19	18	17	18	18	18	17	15	37.7
125	4.6	10	12	15	15	18	20	22	23	26	27	27	28	29	28	29	26	25	23	23	19	19	18	17	17	17	17	16	15	38.1
126	4.1	7	11	13	15	16	20	21	24	28	26	27	28	29	28	28	27	24	23	24	18	18	17	17	17	17	16	15	38.0	
127	4.5	12	14	16	17	18	20	23	24	28	27	28	29	30	28	28	26	25	24	25	19	18	18	17	17	17	16	15	38.6	
128	5.5	10	14	16	18	20	21	23	24	28	26	26	27	28	27	27	26	25	24	24	21	20	20	19	19	18	18	17	15	38.1
129	3.8	13	16	17	18	20	23	25	27	29	30	29	29	29	27	27	26	25	25	26	21	21	20	19	19	18	19	17	15	39.3
130	7.5	6	9	11	14	16	21	22	24	27	29	30	30	30	28	27	25	23	23	23	19	18	17	16	16	17	17	16	14	38.6
131	6.0	13	16	18	19	19	26	23	26	27	28	28	30	31	29	28	26	25	24	24	21	20	19	19	19	19	19	18	16	39.4
132	5.9	10	12	14	15	17	21	22	24	27	26	27	28	28	26	27	25	23	23	22	19	18	18	17	17	17	18	17	15	37.4
133																														
134																														
135	3.9	2	5	9	12	15	20	23	24	26	27	27	28	28	27	26	24	23	22	22	17	16	16	15	16	16	16	15	14	37.3
136	4.0	10	13	14	14	17	22	26	25	26	27	26	27	27	27	26	25	24	23	23	19	18	18	17	17	17	17	16	15	37.6
137	4.3	13	15	18	18	20	21	25	24	26	27	27	28	29	29	29	27	26	25	25	21	21	20	19	19	19	19	18	16	38.9
138	4.9	8	10	13	14	17	20	23	24	26	29	27	27	27	27	26	24	24	23	22	18	18	17	17	17	17	16	14	37.5	
139	7.9	18	21	23	26	26	27	28	28	29	32	29	30	30	30	31	30	30	29	28	27	26	26	25	24	23	23	21	19	42.0
140	7.5	15	17	19	19	21	23	26	25	30	33	27	29	29	29	29	28	26	25	24	22	22	21	20	20	20	20	19	17	40.4
141	5.8	18	21	24	25	25	28	30	27	34	34	29	31	31	31	31	30	30	29	28	26	26	25	24	23	22	22	21	19	42.8
142	5.4	18	22	24	24	26	28	27	28	35	33	29	30	31	30	30	30	29	28	27	25	25	24	24	23	22	22	20	18	42.5
143	5.3	21	23	25	27	26	28	28	28	32	30	30	31	32	32	32	31	31	30	29	27	26	26	25	24	23	23	21	19	43.0
144	5.4	18	22	23	23	23	25	25	26	30	29	30	30	30	30	31	30	29	28	27	25	24	24	23	22	21	21	20	18	41.1
145																														
146																														
147	6.4	12	15	15	16	19	20	23	25	30	28	27	29	30	29	27	26	25	24	23	20	19	19	18	18	18	18	17	15	38.8
148	4.9	11	14	16	17	19	21	23	25	27	26	27	28	29	28	28	27	26	25	24	21	20	19	18	18	18	18	17	15	38.4
149	4.1	7	9	12	14	17	20	22	24	29	27	28	30	32	30	28	26	28	25	22	19	18	17	17	17	17	16	14	39.4	
150	4.8	12	14	15	17	18	21	23	25	28	27	27	30	33	31	29	27	27	25	24	20	20	19	18	18	18	17	15	39.8	
151	4.4	9	11	13	15	17	20	22	25	29	28	29	30	32	29	28	27	27	24	22	19	18	17	17	17	17	17	15	39.4	
152	6.0	9	13	15	16	18	20	23	25	26	26	27	29	31	28	28	26	25	23	23	19	19	18	17	17	17	17	16	15	38.4
153	6.1	7	9	11	14	16	19	22	24	26	26	26	27	29	27	27	24	23	22	22	18	18	17	17	17	17	16	15	37.3	
154	6.6	12	15	17	18	20	22	23	25	25	26	27	28	26	26	25	24	23	23	22	20	20	19	18	18	18	17	15	37.4	
155	6.0	17	20	22	22	23	24	26	27	27	29	30	31	30	29	29	28	28	27	27	24	24	23	23	22	21	21	20	18	40.6
156	6.4	16	18	19	21	22	23	24	25	27	26	28	28	29	28	29	27	26	25	24	22	22	21	20	20	19	19	18	16	39.0
157	6.5	9	12	14	16	18	20	22	24	26	26	27	28	28	28	26	24	23	22	19	19	18	17	17	17	18	18	17	15	37.7
158	4.3	16	18	20	21	21	22	24	25	26	27	27	29	29	28	29	27	27	26	25	24	24	23	22	21	21	21	20	18	39.3
159	3.6	15	18	19	20	22	22	24	26	26	26	27	29	29	28	28	27	26	25	24	22	22	21	20	19	19	19	18	16	38.8
160	3.6	5	8	10	13	15	19	22	25	24	26	26	27	27	26	26	24	23	22	21	18	18	17	16	16	17	17	16	15	36.8
161	4.7	13	16	17	17	20	21	22	24	26	25	26	28	27	26	26	25	24	23	21	20	20	19	19	19	19	19	18	16	37.4
162	5.1	3	6	9	12	16	18	21	23	26	25	25	27	28	25	24	22	21	22	19	17	17	16	16	16	16	15	14	36.1	
163	6.8	12	13	14	16	17	20	21	23	25	25	25	26	27	25	27	26	28	29	29	30	27	19	17	17	17	16	15	39.0	
164	6.9	15	17	18	20	20	22	23	24	25	25	26	27	28	27	32	35	37	40	43	41	35	28	22	22	20	19	18	16	47.8

Table E.02 Measurement data - Background

Project: Bluewater Wind Energy Centre - Turbine T31

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Data Point #	Standardized Wind Speed (m/s)	Rotor RPM	Nacelle Anemometer Wind Speed (m/s)	10m Anemometer Wind Speed (m/s)	Air Temperature (°C)	Pressure (kPa)	Relative Humidity (%)
124	5.6	0.4	5.0	5.6	4	98.9	38
125	4.6	0.5	6.7	4.6	4	98.9	38
126	4.1	0.5	7.0	4.1	4	98.9	38
127	4.5	0.4	6.3	4.5	4	98.9	38
128	5.5	0.5	6.5	5.5	4	98.9	37
129	3.8	0.5	6.6	3.8	4	98.9	38
130	7.5	0.6	7.4	7.5	4	98.9	37
131	6.0	0.6	7.2	6.0	4	98.9	37
132	5.9	0.4	5.9	5.9	4	98.9	37
133		0.5	6.3	5.2	4	98.9	37
134		0.4	6.2	4.3	4	98.9	37
135	3.9	0.5	5.3	3.9	4	98.9	37
136	4.0	0.5	7.6	4.0	4	98.9	37
137	4.3	0.5	6.1	4.3	4	98.9	37
138	4.9	0.3	5.2	4.9	4	98.9	37
139	7.9	0.6	8.0	7.9	4	98.9	37
140	7.5	0.7	7.4	7.5	4	98.9	37
141	5.8	0.6	7.2	5.8	4	98.9	37
142	5.4	0.7	8.6	5.4	4	98.9	37
143	5.3	0.5	7.2	5.3	4	98.9	37
144	5.4	0.5	7.4	5.4	4	98.9	37
145		0.6	6.4	4.6	4	98.9	38
146		0.5	6.0	5.9	4	98.9	37
147	6.4	0.4	6.1	6.4	4	98.9	37
148	4.9	0.6	7.0	4.9	4	98.9	37
149	4.1	0.4	6.1	4.1	4	98.9	37
150	4.8	0.5	6.2	4.8	4	98.9	38
151	4.4	0.5	6.2	4.4	4	98.9	38
152	6.0	0.5	6.6	6.0	4	98.9	38
153	6.1	0.5	7.4	6.1	4	98.9	38
154	6.6	0.5	6.6	6.6	4	98.9	38
155	6.0	0.6	6.7	6.0	4	98.9	38
156	6.4	0.6	7.7	6.4	4	98.9	38
157	6.5	0.5	7.9	6.5	4	98.9	38
158	4.3	0.6	6.8	4.3	4	98.9	38
159	3.6	0.6	6.8	3.6	4	98.9	39
160	3.6	0.6	8.4	3.6	4	98.9	39
161	4.7	0.4	6.8	4.7	4	98.9	38
162	5.1	0.5	6.2	5.1	4	98.9	38
163	6.8	0.6	6.4	6.8	4	98.9	38
164	6.9	0.5	7.1	6.9	4	98.9	38

Table E.02 Measurement data - Background

Project: Bluewater Wind Energy Centre - Turbine T31

Report ID: 14331.01.T31.RP1

***Blank data denotes values that were omitted in the analysis due to an extraneous event during recording

Data Point #	Standardized Wind Speed (m/s)	Sound Pressure Level per 1/3 Octave Band (Hz), dBA																	Total (dBA)											
		20	25	32	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
165	5.0	14	17	18	19	21	21	22	23	26	25	26	27	28	27	26	26	25	23	22	22	21	21	20	20	20	19	17	38.1	
166	6.7	11	14	16	17	18	19	21	22	28	25	26	27	27	26	25	24	23	23	21	20	19	19	18	17	17	18	17	15	36.9
167	6.0	16	19	20	21	21	22	24	25	27	26	27	28	28	28	28	27	25	24	23	23	22	21	21	20	20	18	39.3		
168	4.7	9	11	13	15	16	20	21	23	26	27	29	28	28	27	25	25	24	21	19	18	17	17	17	17	16	15	37.8		
169	5.9	13	15	16	17	20	23	24	27	26	26	26	28	28	26	27	25	25	24	22	20	19	18	17	17	17	17	15	37.8	
170	5.7	5	8	13	15	22	24	21	24	27	25	27	29	30	31	30	29	29	28	26	22	19	17	17	17	17	16	14	39.7	
171	4.9	5	8	11	14	16	22	20	22	27	25	27	27	27	26	25	24	23	21	18	17	16	16	16	16	16	14	37.2		
172	6.6	17	20	22	22	23	23	25	27	29	29	30	31	31	29	29	28	27	26	25	24	23	22	22	21	21	21	19	17	40.6
173	4.3	19	22	24	25	26	27	28	30	31	31	31	32	31	30	30	30	29	28	27	26	25	24	23	22	22	22	20	18	42.2
174	5.5	14	16	17	19	19	21	24	26	27	26	26	28	28	28	27	27	26	25	23	21	21	20	19	19	19	20	18	16	38.5
175	6.9	17	20	22	22	23	23	25	26	29	26	27	29	30	29	29	28	27	25	24	23	23	22	22	21	21	20	18	40.2	
176	5.8	22	26	29	30	30	31	31	31	31	30	31	32	32	33	33	34	33	33	32	30	29	28	28	27	25	25	23	21	44.9
177	6.2	13	16	17	18	20	24	22	24	28	25	26	27	27	27	26	26	26	25	23	21	20	19	19	19	19	18	16	38.3	
178	5.3	14	16	18	18	21	24	23	24	27	26	27	28	29	30	29	28	27	25	24	22	21	20	19	19	19	19	17	16	39.0
179	4.7	14	16	18	19	21	23	23	24	27	26	27	32	30	30	29	27	27	25	23	22	21	21	20	19	19	20	18	16	39.5
180	6.6	12	15	17	19	19	23	22	23	26	25	26	27	27	26	26	25	24	24	22	21	20	19	19	18	18	17	15	37.4	
181	5.6	9	12	14	16	17	20	21	22	26	25	26	27	28	28	28	28	29	26	23	20	19	18	17	17	18	18	17	15	38.1
182	6.3	8	12	13	15	18	26	23	23	27	24	25	27	28	29	29	30	30	28	26	23	20	18	17	17	17	16	15	39.1	
183	4.5	8	12	14	15	19	26	23	24	26	25	27	28	30	31	31	30	30	27	25	23	20	18	18	17	18	18	17	15	39.9
184	5.1	8	10	14	15	18	22	25	26	27	26	26	27	29	28	28	28	29	27	23	20	18	17	17	17	17	16	15	38.7	
185	6.1	11	11	14	15	17	22	23	24	26	25	26	27	29	26	25	25	24	23	21	21	19	19	18	18	18	18	17	15	37.3
186	5.1	16	19	21	22	23	26	25	26	27	27	28	30	29	28	28	28	27	26	25	24	23	23	22	21	21	21	19	17	39.9
187	3.9	19	21	23	24	24	31	27	27	29	27	29	30	30	31	31	31	31	29	28	27	25	24	23	22	21	20	18	41.9	
188	4.6	15	18	18	20	21	23	24	25	27	25	27	28	28	28	29	30	29	28	26	24	22	21	20	19	19	19	18	16	39.5
189	4.3	9	13	14	16	21	27	22	22	26	24	25	26	26	26	27	26	25	24	22	20	19	18	17	17	17	16	15	37.3	
190	4.7	16	18	21	24	28	29	25	25	27	27	29	29	29	30	30	30	29	28	26	24	23	22	22	21	20	20	19	17	40.8
191	5.1	14	16	19	20	24	22	23	24	26	26	28	29	29	30	31	30	30	27	26	23	20	19	19	19	19	18	16	40.0	
192	3.5	12	15	17	19	27	24	23	24	28	26	27	29	29	29	29	28	27	25	24	22	20	19	18	18	18	18	16	39.2	
193	3.7	8	13	14	17	29	25	24	26	29	26	26	28	28	27	28	28	27	25	24	21	19	18	17	17	17	17	15	39.1	
194	4.7	19	23	24	25	26	31	28	28	30	28	29	31	31	31	32	32	31	30	29	27	26	25	24	24	24	23	22	19	42.6
195	4.8	18	21	23	23	25	27	26	27	30	29	30	31	32	32	33	32	31	30	28	27	25	24	23	22	21	20	18	42.5	
196	4.7	15	18	19	20	21	25	23	23	27	26	27	28	29	28	29	28	27	25	23	21	20	20	19	19	19	19	18	16	38.8
197	4.9	12	14	16	17	20	23	22	24	27	28	27	29	29	29	28	28	27	25	24	22	20	19	18	18	18	18	17	15	39.0
198	5.2	0	5	10	13	17	20	23	27	30	28	29	31	30	28	27	26	25	24	21	18	16	15	15	16	16	16	15	14	39.2
199	4.0	11	14	16	17	18	21	23	25	28	26	27	28	28	27	27	28	27	26	24	21	20	18	18	18	18	18	17	15	38.5
200	4.7	17	20	21	23	23	26	25	26	29	28	30	31	31	30	30	30	29	28	27	25	23	22	22	21	20	20	19	17	41.2
201	4.8	14	16	18	19	21	24	22	25	28	26	27	28	29	28	28	28	27	25	24	22	21	20	19	19	19	19	18	16	39.0
202	4.0	9	10	12	15	16	19	21	24	28	27	28	29	28	26	26	25	24	22	20	19	18	17	17	17	17	16	15	37.7	
203	4.3	8	11	13	15	16	19	23	23	27	33	28	28	28	27	26	25	24	23	20	19	18	17	17	17	17	16	15	38.5	
204	4.9	10	14	15	16	18	21	25	31	40	38	29	35	33	27	27	26	26	24	22	20	19	18	18	18	18	18	17	15	44.2
205	5.8	2	6	9	11	15	23	23	28	30	26	29	27	28	26	26	25	25	23	21	18	16	16	16	16	16	15	14	38.0	

Table E.02 Measurement data - Background

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Data Point #	Standardized Wind Speed (m/s)	Rotor RPM	Nacelle Anemometer Wind Speed (m/s)	10m Anemometer Wind Speed (m/s)	Air Temperature (°C)	Pressure (kPa)	Relative Humidity (%)
165	5.0	0.4	5.3	5.0	4	98.9	38
166	6.7	0.7	7.2	6.7	4	98.9	38
167	6.0	0.4	6.8	6.0	4	98.9	38
168	4.7	0.4	5.9	4.7	4	98.9	37
169	5.9	0.6	6.7	5.9	4	98.9	37
170	5.7	0.6	6.5	5.7	4	98.9	38
171	4.9	0.6	7.2	4.9	4	98.9	38
172	6.6	0.5	8.3	6.6	4	98.9	38
173	4.3	0.6	7.3	4.3	4	98.9	38
174	5.5	0.6	6.1	5.5	4	98.9	38
175	6.9	0.8	10.1	6.9	4	98.9	38
176	5.8	0.5	9.8	5.8	4	98.9	38
177	6.2	0.6	8.2	6.2	4	98.9	38
178	5.3	0.5	8.3	5.3	4	98.9	38
179	4.7	0.5	7.1	4.7	4	98.9	38
180	6.6	0.6	8.6	6.6	4	98.9	38
181	5.6	0.5	6.8	5.6	4	98.9	38
182	6.3	0.5	7.4	6.3	4	98.9	38
183	4.5	0.4	5.9	4.5	4	98.9	38
184	5.1	0.5	6.3	5.1	4	98.9	38
185	6.1	0.5	7.2	6.1	4	98.9	38
186	5.1	0.4	7.4	5.1	4	98.9	38
187	3.9	0.5	7.4	3.9	4	98.9	39
188	4.6	0.5	6.1	4.6	4	98.9	39
189	4.3	0.5	7.0	4.3	4	98.9	39
190	4.7	0.5	7.2	4.7	4	98.9	39
191	5.1	0.5	6.9	5.1	4	98.9	39
192	3.5	0.5	7.3	3.5	4	98.9	39
193	3.7	0.4	5.7	3.7	4	98.9	39
194	4.7	0.4	7.9	4.7	4	98.9	39
195	4.8	0.4	7.3	4.8	4	98.9	39
196	4.7	0.4	6.7	4.7	4	98.9	39
197	4.9	0.5	7.1	4.9	4	98.9	39
198	5.2	0.4	6.0	5.2	4	98.9	39
199	4.0	0.5	7.6	4.0	4	98.9	39
200	4.7	0.5	6.9	4.7	4	98.9	39
201	4.8	0.6	7.0	4.8	4	98.9	39
202	4.0	0.4	7.5	4.0	4	1.0	39
203	4.3	0.5	7.3	4.3	4	1.0	39
204	4.9	0.4	5.8	4.9	4	1.0	39
205	5.8	0.5	6.2	5.8	4	1.0	39

Table E.02 Measurement data - Background

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***Blank data denotes values that were omitted in the analysis due to an extraneous event during recording

Data Point #	Standardized Wind Speed (m/s)	Sound Pressure Level per 1/3 Octave Band (Hz), dBA																	Total (dBA)												
		20	25	32	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	
206	3.9	1	5	8	11	15	24	21	22	30	25	30	28	28	26	26	25	25	23	20	18	16	15	15	16	16	16	16	15	14	38.1
207	4.1	5	8	10	12	17	23	20	21	29	24	26	27	28	25	26	26	26	25	22	19	17	16	16	16	16	16	17	16	14	37.4
208	4.2	5	6	9	11	16	22	19	22	27	25	26	28	28	26	26	26	25	24	22	19	17	16	16	16	16	16	16	14	37.1	
209	5.9	4	7	11	12	15	21	20	22	23	23	24	25	28	24	25	25	26	24	21	18	17	16	16	16	16	16	16	14	36.0	
210	5.2	9	12	13	14	19	19	20	22	24	24	25	27	28	26	27	27	26	25	23	20	19	18	18	18	18	18	17	15	37.4	
211	4.3	6	9	11	13	16	22	20	22	25	24	25	27	28	27	31	27	27	25	22	20	18	18	17	17	17	17	16	15	37.9	

Table E.02 Measurement data - Background

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Data Point #	Standardized Wind Speed (m/s)	Rotor RPM	Nacelle Anemometer Wind Speed (m/s)	10m Anemometer Wind Speed (m/s)	Air Temperature (°C)	Pressure (kPa)	Relative Humidity (%)
206	3.9	0.3	6.0	3.9	4	1.0	39
207	4.1	0.4	5.5	4.1	4	1.0	40
208	4.2	0.4	7.1	4.2	4	1.0	40
209	5.9	0.5	6.7	5.9	3	1.0	40
210	5.2	0.4	6.4	5.2	3	1.0	40
211	4.3	0.6	8.0	4.3	3	1.0	40

End of Report

