aercoustics

Aercoustics Engineering Ltd.
1004 Middlegate Road, Suite 1100
Mississauga, ON L4Y 0G1

Tel: 416-249-3361
Fax 416-249-3613
aercoustics.com

ASSESSMENT REPORT - **Project: 13228.00**

SOUTH KENT WIND LP
Acoustic Audit – Receptor Measurements

57 Talbot Street West
W Blenheim, Chatham-Kent Municipality
N0P 1A0

Prepared for:

South Kent Wind L.P.
55 Standish Court
Mississauga, Ontario
L5R 4B2

Prepared by:

A. Munro

Allan Munro, B.A.Sc.

Payam Ashtiani, B.A.Sc., P.Eng

10 January 2019; Rev2

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Executive Summary

Aercoustics Engineering Limited ("AEL") has been retained by South Kent Wind L.P. to complete the acoustic audit outlined in the Renewable Energy Approval ("REA") for the South Kent Wind Farm ("SKWF"). SKWF operates under REA #2871-8UKGPC, issued on June 15, 2012.

This report details the first measurement campaign of the SKWF immission audit. Noise measurements were conducted from October 4 to December 23, 2014 near receptors R3306, R3330, and R3344. Acoustic and weather data was logged simultaneously for the duration of the measurement campaign.

The audit was completed as per the methodology outlined in Part D of the "MOE Compliance Protocol for Wind Turbine Noise – Guideline for Acoustic Assessment and Measurement." Sample size requirements were met for both Turbine ON and Background.

The turbine-only noise contribution was compared to the Ministry of Environment Conservation and Parks sound level limits, and the facility was found to be in compliance.

1 Introduction

Aercoustics Engineering Limited ("AEL") has been retained by South Kent Wind L.P. to complete the required acoustic audit outlined in the Renewable Energy Approval ("REA") for the South Kent Wind Farm ("SKWF") [1]. SKWF operates under REA #2871-8UKGPC, issued on June 15, 2012.

The audit was completed as per the methodology outlined in Part D of the "MOE Compliance Protocol for Wind Turbine Noise – Guideline for Acoustic Assessment and Measurement," [2] to fulfil Section E, "Acoustic Audit – Immission" of the REA. This report outlines the methodology of the measurements, the results, and a comparison of the sound contribution of the turbines to the Ontario Ministry of Environment Conservation and Parks ("MECP") sound level limits.

2 Facility Description

The SKWF utilizes 124 Siemens SWT-101 wind turbines for power generation. These turbines have a nameplate capacity of 2.221MW, 2.126MW, 1.903MW, or 1.824MW depending on location. Each turbine has a hub height of 100 meters and a rotor diameter of 101 meters. Each turbine has its own transformer at the base of the tower that steps up the voltage and connects the turbine to its collection line. The power from all the turbines are collected at one of 2 substation transformers, where the voltage is stepped up again before connection to the Ontario power grid.

The facility operates 24 hours per day, 7 days per week.

3 Audit Details

The acoustic audit was conducted at three receptors – R3306, R3330, and R3344 – from October 4, 2014 to December 23, 2014. The following sections detail the test equipment, measurement methodology, measurement locations, and environmental conditions during the audit.

3.1 Test Equipment

The following list details the equipment, both acoustic and non-acoustic, that was used at each audit location for the measurement campaign.

- One (1) Type 1 sound level meter, with microphone and pre-amplifier that meet the MECP protocol specifications outlined in Part D, Section D2.1 - Acoustic Instrumentation.

- One (1) primary and one (1) secondary windscreen for the microphone. The 1/3 Octave band insertion loss of the secondary windscreen has been tested, and was accounted for in the data analysis.

- One (1) anemometer programmed to sample weather data every 0.5 seconds. The anemometer was located 10m above grade, as defined by Section D3.4. Performance specifications comply with Part D, Section D.2.2 of the MECP protocol.

The following table lists the specific model and serial numbers for the equipment used during the measurement campaign.

Table 1 Equipment Details

Location	Equipment	Serial Number
SKW R3306	B&K 2250 Sound Level Meter	3004480
	B&K 4189 Microphone	2888671
	B&K ZC 0032 Pre-amplifier	20262
	Vaisala WXT 520	K0630016
SKW R3330	B&K 2250 Sound Level Meter	3004431
	B&K 4189 Microphone	2888684
	B&K ZC 0032 Pre-amplifier	20151
	Vaisala WXT 520	K0550007
SKW R3344	B&K 2250 Sound Level Meter	3004506
	B&K 4189 Microphone	2888374
	B&K ZC 0032 Pre-amplifier	20083
	Vaisala WXT 520	J3040014

The sound level meter, microphone, and pre-amplifier were calibrated successfully before and after the measurement campaign using a type 4231 Brüel & Kjær acoustic calibrator with serial number 2513130.

3.2 Measurement Methodology

For the duration of the measurement campaign, acoustic and anemometer data was logged simultaneously in one-minute intervals. The measurement equipment was setup to log one minute equivalent sound levels (L_{eq}) in broadband and 1/3 octave bands between 20-20,000 Hz. The microphone was placed at a measurement height of 4.5m above grade, at least 5 meters away from any large reflecting surfaces, in direct line of sight to the nearest turbines, and as far away as practically possible from trees or other foliage. Measurement data was filtered into integer wind bins from 3 to 10 m/s. Each bin ranged from 0.5m/s below to 0.5m/s above each respective wind bin (i.e. 5 m/s data represents data between 4.5m/s and 5.5m/s).

A one-minute measurement interval was considered valid if:

- The interval occurred between 10pm – 5am
- No precipitation was detected within an hour before or after the interval

- For R3306 and R3330 the maximum measured wind speed at 10m was no more than 2m/s higher than the recorded average for that interval.
- For R3344 the maximum measured wind speed at 10m was no more than 2.3m/s higher than the recorded average for that interval. (see Section 3.2.1)
- The temperature was above -10˚C
- Either all nearby turbines were on (for turbine ON measurements), or all nearby turbines were off (for ambient measurements)
- The measured L_{eq} was no more than 10 dB greater than the L90 value

These filters were designed to obtain measurement data of the wind farm when it is fully operational, as well as reduce the amount of contamination from transient ambient noise sources such as vehicle passbys and dog barks. These filters also are based on equipment operating limitations, and the filters prescribed in the Part D of the Protocol to eliminate noise from precipitation, as well as noise on the microphone from gusty periods where the reliability of the data is reduced.

It should be noted that although the MECP Protocol calls for data points to be excluded if the minimum wind speed at 10m is more than 2m/s less than the recorded average, this limitation was not employed on this data-set. The effect on the dataset of removing the minimum wind speed filter has been assessed at a number of locations and found to be insignificant; this study is provided in Appendix D.

3.2.1 Modified Wind Gusting Filter for R3344

In the case of R3344 the maximum measured wind speed at 10m was adjusted to no more than 2.3m/s higher than the recorded average for that interval, +0.3m/s above the standard gusting filter of 2m/s as per the 2011 Compliance Protocol. The modified filter was applied to satisfy the data count requirements. The standard deviations in each wind bin using the modified gusting filter was the same for 7 of 10 wind bins when compared to the standard 2m/s gusting filter. In 3 of 10 wind bins the standard deviation varied by 0.1 dB. Please refer to Appendix D for more details. Due to the negligible changes in standard deviation; the modified gusting filter used for R3344 allows for the minimum data count requirements to be satisfied without a change in data quality from wind gusts.

3.3 **Sample size requirements**

In order to account for the dependence on wind speed of wind turbine noise and ambient noise, the measurement data is sorted into integer wind speed bins according to the measured wind speed. As per Section D3.8 of the MECP protocol, at least 120 data points in each wind bin are required for Turbine ON measurements, and 60 data points for the ambient measurements. For wind speeds where the sufficient number of samples was not achieved, the results are presented and indicated as such.

3.4 Measurement Location

Receptors R3306, R3330, and R3344 were chosen to be representative of the worst-case impact from the facility. Of the receptors located in the predominantly downwind direction of the farm, R3306, R3330, and R3344 had the highest predicted impact at 39.4dBA, 39.9dBA, and 39.4dBA respectively. The following describes the measurement locations in relation to the above listed receptors:

- R3306: Measurement equipment was placed in an open field south-east of R3306, 594m to the nearest turbine.
- R3330: Measurement equipment was placed in an open field just to the north-west of R3330, 660m to the nearest turbine.
- R3344: Measurement equipment was placed in an open field just to the north-west of R3344, 855m to the nearest turbine.

The following table provides a summary of the receptor location. Detailed site plans showing the receptor and audit locations are attached in Appendix A.

Table 2 Receptor Measurement Locations

	Audit Receptor ID Nearest Turbine ID	R3306 P108	R3330 P108	R3344 P036
Receptor	UTM Coordinates (X,Y)	17T 416061mE 4691837mN	17T 416509mE 4691369mN	17T 416804mE 4691109mN
	Distance to Nearest Turbine	618 m	689 m	854 m
	Predicted Level dBA*	39.4	39.9	39.4
Monitor	UTM Coordinates (X,Y)	17T 416109mE 4691787mN	17T 416473mE 4691405mN	17T 416760mE 4691149mN
	Distance to Nearest Turbine	594 m	660 m	855 m

* Predicted level from Noise Assessment Report for South Kent Wind Project – HATCH [3]

3.5 Weather Conditions

Ambient conditions encountered over the measurement campaign were as follows:

- Ambient Humidity: 45% to 94%
- Ambient Temperature: -10˚C to 22˚C
- 10m Wind Speed: 0 m/s to 14 m/s

Historically, the predominant wind direction is from the south-west for this site. The wind direction varied over the course of the audit campaign. Wind roses have been provided in Appendix B for both the ON and OFF campaigns separately. Wind directions shown on the wind roses indicate the direction the wind is coming from.

3.6 Operational Conditions

Turbine operational data for the duration of the measurement campaign was supplied by SKWF. Measurement data at each receptor was filtered to include only intervals when all turbines in the immediate vicinity were operational, or, in the case of the ambient noise measurements, were not operational. The turbines included in this study were chosen such that when they are turned off, the partial impact of the remaining turbines was less than 30dBA; 10dB below the sound level limit. See Appendix C for turbine operational data for the duration of the measurement campaign, received from the site operator.

4 Sound Level Limits

The purpose of the sound measurements was to confirm whether the sound emitted by the wind facility is in compliance with the MECP allowable sound level limits. The MECP sound level limits for wind turbines vary with wind speed defined at a 10m height. The details of the sound level limits are presented in Table 3 below.

Table 3 MECP Sound Level Limits for Wind turbines

Wind speed at 10m height [m/s]	MECP Sound level limit [dBA]
≤ 4	40
5	40
6	40
7	43
8	45
9	49

5 Audit Results

The following tables detail the sound levels measured at all three receptors when all the nearby turbines were on (Turbine ON) and when all the nearby turbines were off (Turbine OFF).

Table 4 R3306 Sound levels measured for Turbine ON and OFF

	Wind speed at 10m height [m/s]	3	4	5	6	7
Turbine ON	Number of Samples	1788	1059	382	169	134
	LAeq [dBA]	39	39	42	45	48
	Std Dev [dB]	3.7	3.4	3.0	2.2	1.2
Turbine OFF	Number of Samples	59	129	84	193	112
	LAeq [dBA]	38	39	41	44	48
	Std Dev [dB]	2.6	1.6	1.8	1.6	1.5
Turbine ONLY		29	32	34	40	40

Table 5 R3330 Sound levels measured for Turbine ON and OFF

	Wind speed at 10m height [m/s]	3	4	5	6	7
Turbine ON	Number of Samples	2076	1687	1128	451	150
	LAeq [dBA]	39	39	41	42	45
	Std Dev [dB]	3.6	3.1	2.6	2.0	1.6
Turbine OFF	Number of Samples	140	119	172	103	96
	LAeq [dBA]	38	38	39	40	45
	Std Dev [dB]	1.5	2.1	1.9	1.6	1.7
Turbine ONLY		27	32	36	38	n/a**

** Measured Turbine OFF level greater than measured Turbine ON level

Table 6 R3344 Sound levels measured for Turbine ON and OFF

	Wind speed at 10m height [m/s]	3	4	5	6	7
Turbine ON	Number of Samples	1893	1685	1049	453	125
	LAeq [dBA]	37	38	40	42	46
	Std Dev [dB]	4.2	3.2	2.6	2.1	2.1
Turbine OFF	Number of Samples	218	146	174	119	114
	LAeq [dBA]	36.3	37	39	43	47
	Std Dev [dB]	2.0	1.8	2.0	2.3	1.5
Turbine ONLY		30	33	33	n/a**	n/a**

** Measured Turbine OFF level greater than measured Turbine ON level

The following figures are the plots of the measured sound levels at all three receptors when all the nearby turbines were on (Turbine ON) and when all the nearby turbines were off (Turbine OFF). Note that all plots include the 95% confidence interval as a dashed line above and below the average value.

Figure 1 R3306 Measured Turbine ON levels

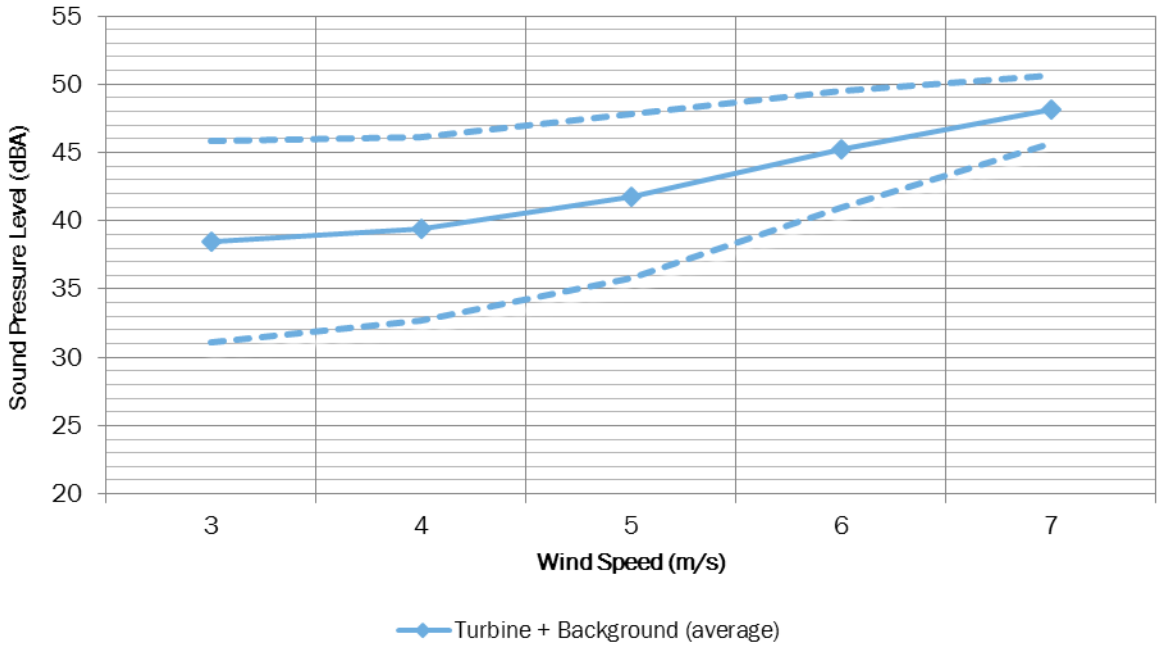


Figure 2 R3306 Measured Turbine OFF (Background) levels

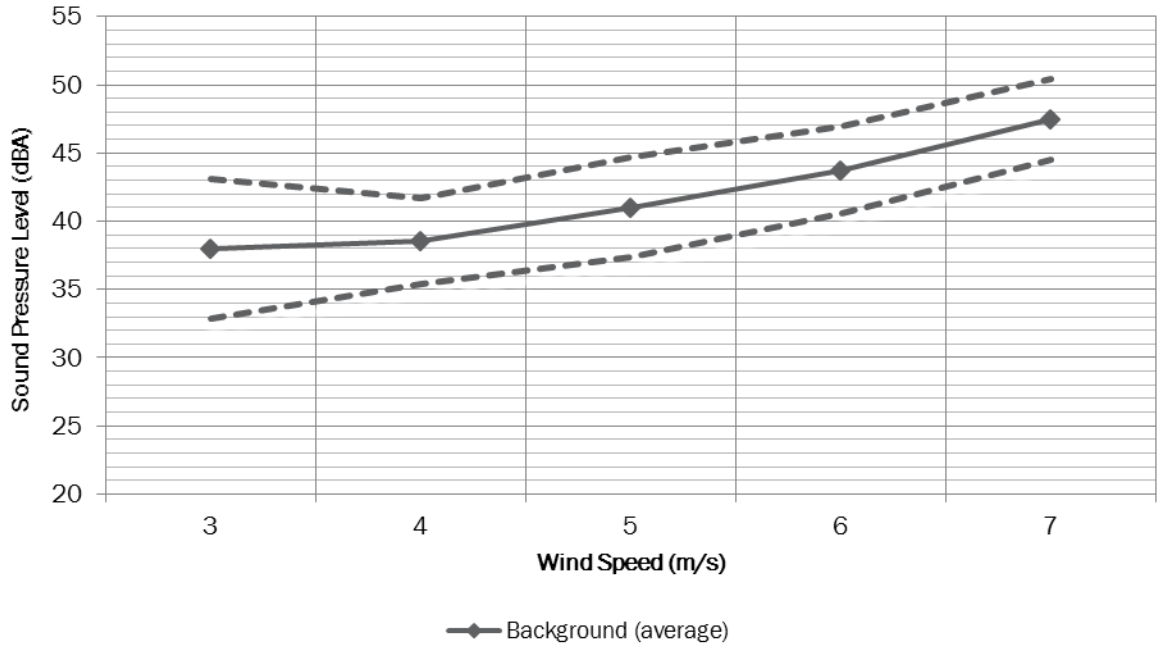


Figure 3 R3330 Measured Turbine ON levels

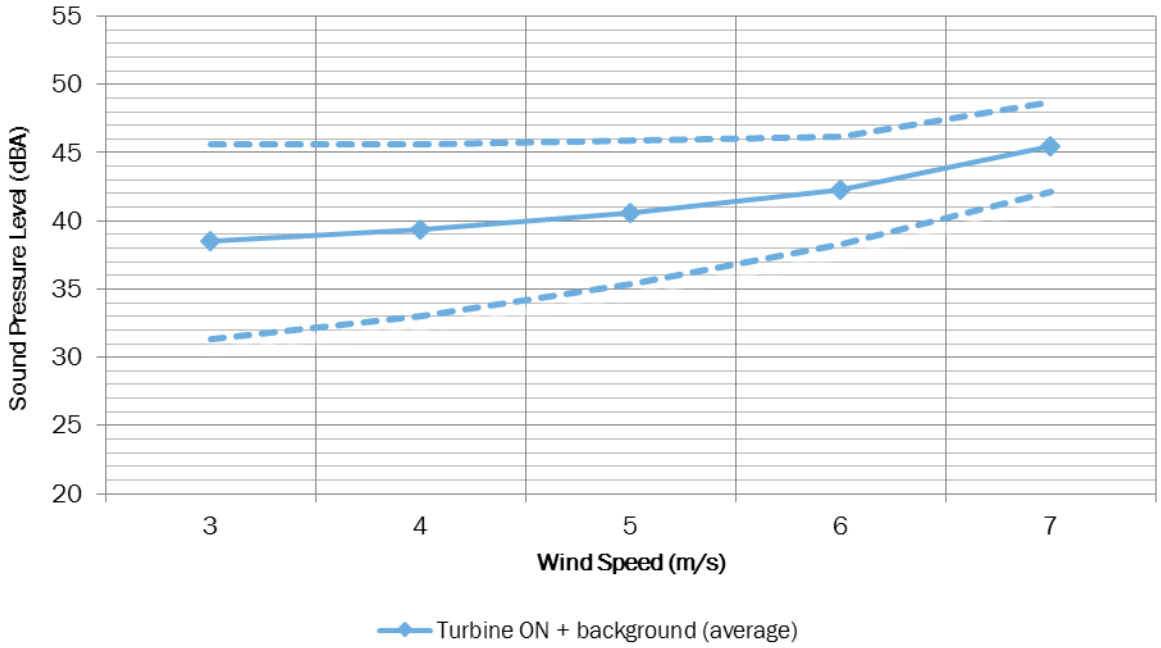


Figure 4 R3330 Measured Turbine OFF (Background) levels

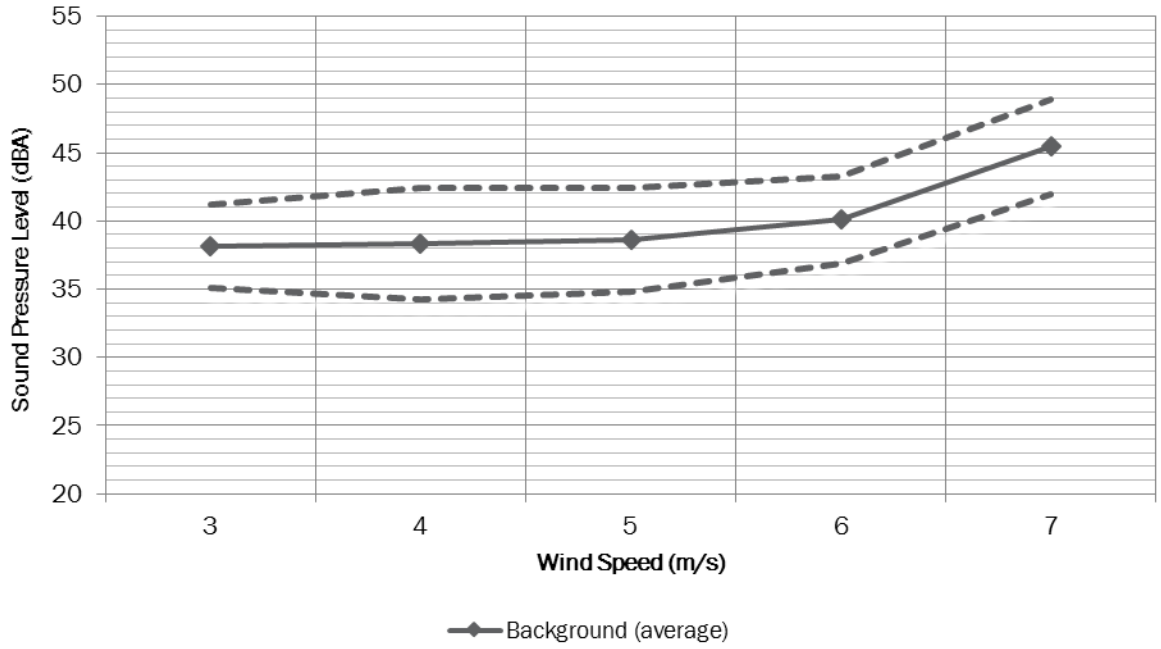


Figure 5 R3344 Measured Turbine ON levels

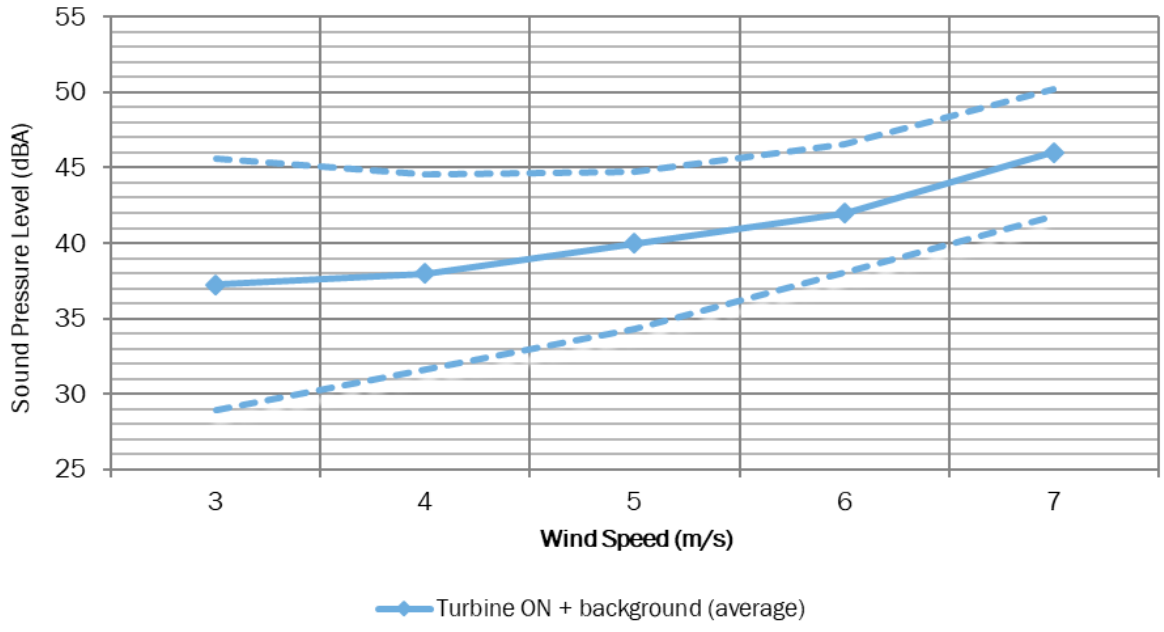
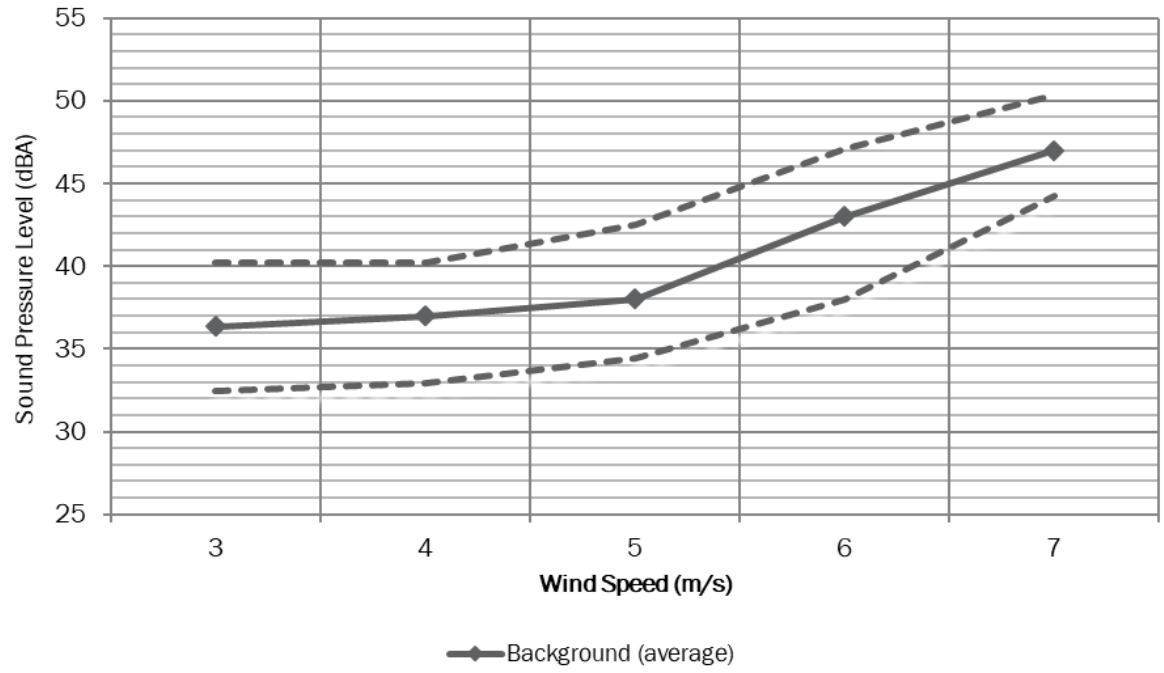


Figure 6 R3344 Measured Turbine OFF (Background) levels



6 Discussion

6.1 Overall Sound Level

The turbine component of the sound level was derived from a logarithmic subtraction of the ambient noise from that of the sound level measured with the turbines operating. The resulting sound level can be attributed to the turbines.

There were some instances, at higher wind speeds, where the measured ambient level was higher than the average measured level when all turbines were operating. This indicates that local ambient noise sources, rather than the turbines, are driving the overall sound level at that receptor. In these instances, it is known that the Turbine ONLY contribution to the receptor sound level is at least 3dB less than the Turbine ON level (which includes ambient sources). This is a very conservative assessment; in reality, the Turbine ONLY level is expected to be much lower.

Table 7 Assessment Table

Measurement Location	Wind speed at 10m height [m/s]	3	4	5	6	7
R3306	Turbine ON LAeq [dBA]	39	39	42	45	48
	Turbine OFF LAeq [dBA]	38	39	41	44	48
	Calculated Turbine ONLY LAeq [dBA]	29	32	34	40	40
R3330	Turbine ON LAeq [dBA]	39	39	41	42	45
	Turbine OFF LAeq [dBA]	38	38	39	40	45
	Calculated Turbine ONLY LAeq [dBA]	27	32	36	38	<42*
R3344	Turbine ON LAeq [dBA]	37	38	40	42	46
	Turbine OFF LAeq [dBA]	36	37	38	43	47
	Calculated Turbine ONLY LAeq [dBA]	30	33	33	<39*	<43*
MECP Limit		40	40	40	40	43

*Calculated by subtracting 3dB from the measured Turbine ON level

The audit at measurement locations #1, #2 and #3 are considered representative of the noise levels at Receptors R3306, R3330 and R3344 respectively, given the placement of the monitoring rigs. The data from Table 7 is plotted in Figure 7, Figure 8, and Figure 9.

Figure 7 R3306 Turbine Levels compared to MECP Limits

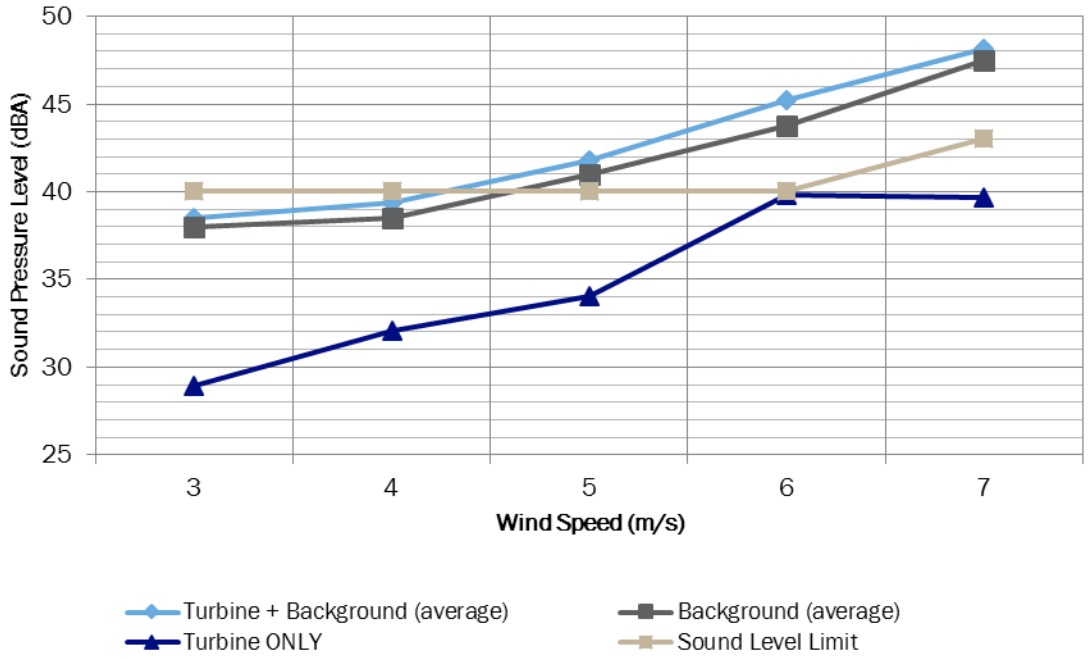


Figure 8 R3330 Turbine Levels compared to MECP Limits

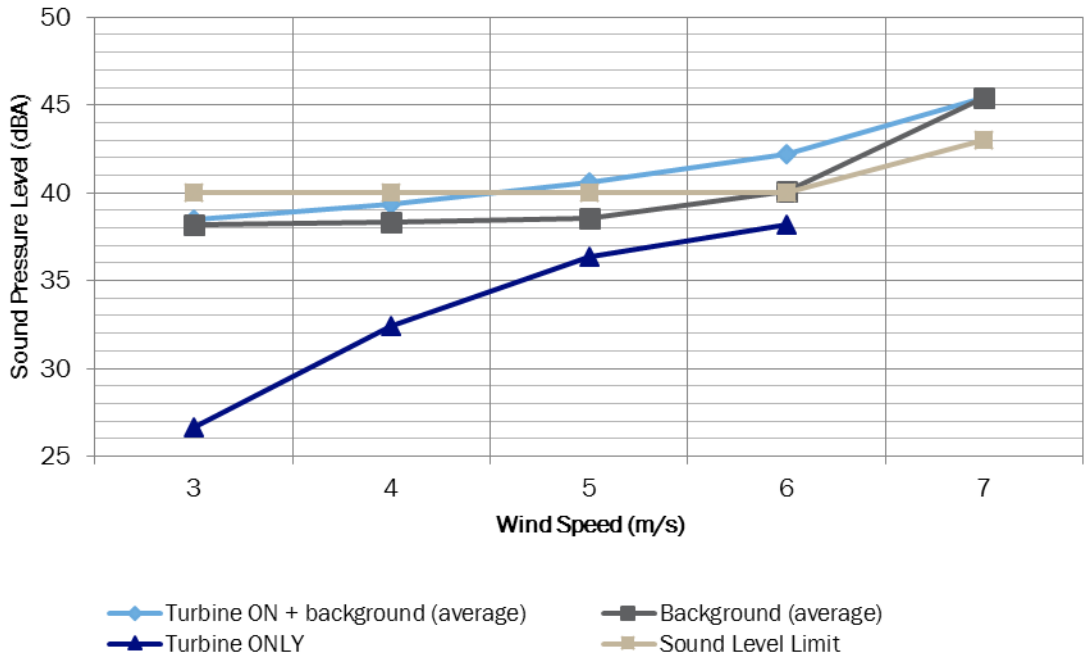
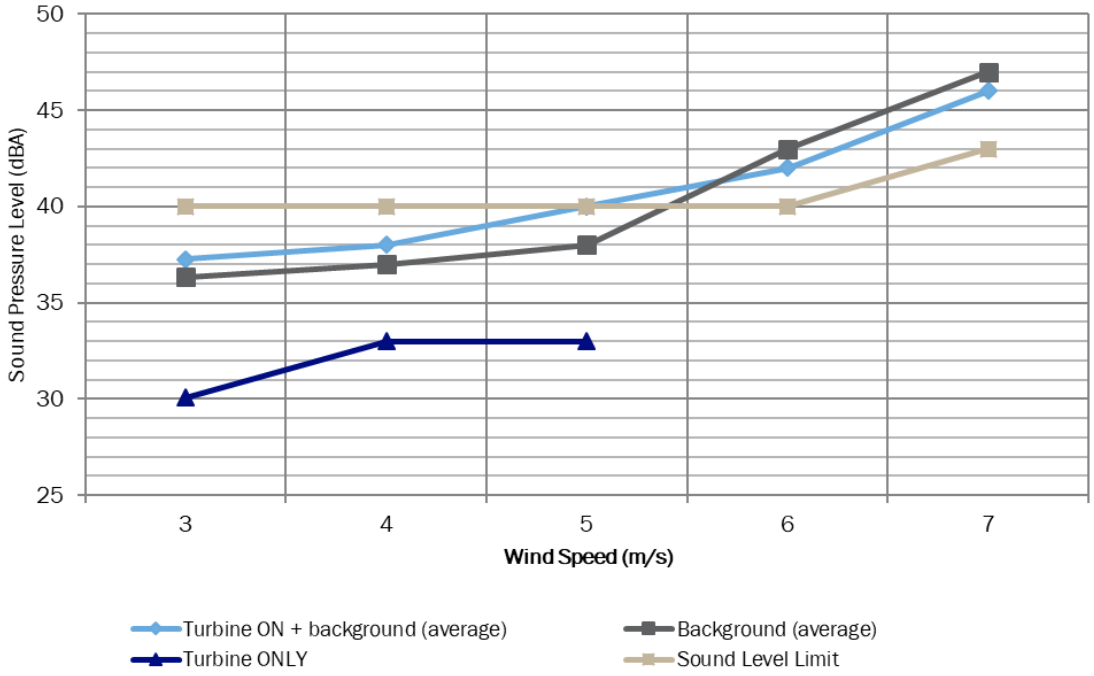


Figure 9 R3344 Turbine Levels compared to MECP Limits



6.2 Tonality

Our site observations qualitatively indicate no presence of distinctly audible tones at the measurement location. The noise from the wind turbines was subjectively assessed not to be tonal.

7 Assessment of Compliance

Based on the calculated turbine only component indicated in Table 7 and Figures 7-9, the South Kent Wind Farm is compliant with MECP limits at Receptors R3306, R3330 and R3344.

8 Conclusion

Aercoustics Engineering Limited has completed the acoustic audit outlined in the Renewable Energy Approval for the South Kent Wind Farm. The audit was completed as per the methodology outlined in Part D of the "MOE Compliance Protocol for Wind Turbine Noise." The levels measured were compared to the MECP limits, and the facility was determined in compliance at all three receptors audited.

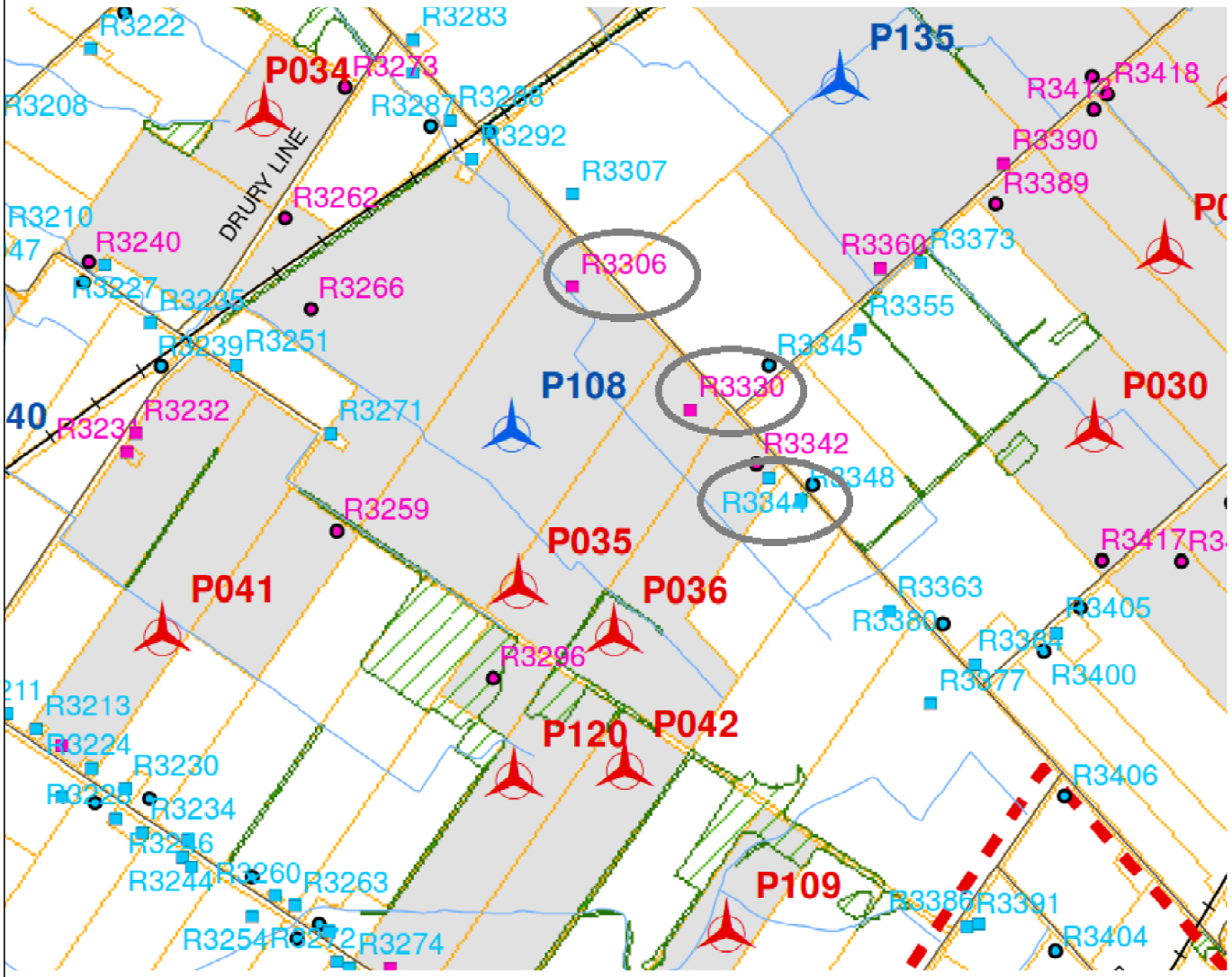
9 References

[1] V. Schroter, “Renewable Energy Approval #2871-8UKGPC”, Ontario Ministry of the Environment, Toronto, ON, June 15, 2012

[2] Ministry of the Environment, “Compliance Protocol for Wind Turbine Noise – Guideline for Acoustic Assessment and Measurement”, Ontario Ministry of the Environment, Toronto, ON, 2011.

[3] D. McIntosh and M. Choy, “Noise Assessment Report for South Kent Wind Project” HATCH, Niagara Falls, ON, Rev. 7, May 7, 2013.

APPENDIX A – LOCATION DETAILS



LEGEND

- RAIL
- ROAD
- EXISTING TRANSMISSION LINE
- INTERMITTENT WATERCOURSE
- WATERCOURSE
- PARCEL
- MUNICIPAL BOUNDARY
- WATERBODY
- SIGNIFICANT WETLAND
- WOODED AREA

PROJECT COMPONENTS

- R# POINT OF RECEPTION - EXISTING - NON PARTICIPATING
- R# POINT OF RECEPTION - EXISTING - PARTICIPATING
- R# POINT OF RECEPTION - VACANT - NON PARTICIPATING
- R# POINT OF RECEPTION - VACANT - PARTICIPATING
- PROJECT AREA (PROJECT AREA INDICATED SHOWS PERIMETER ONLY AND NOT SPECIFIC LANDS USED FOR THE PROJECT)
- PARTICIPATING PARCEL (OWNER WITH INFRASTRUCTURE)
- SOUTH KENT SWT-2.3-101, MAX. POWER 1824 KW
- SOUTH KENT SWT-2.3-101, MAX. POWER 1903 KW
- SOUTH KENT SWT-2.3-101, MAX. POWER 2126 KW
- SOUTH KENT SWT-2.3-101, MAX. POWER 2221 KW

aercoustics

50 Ronson Dr, Suite 165, Toronto ON
P: 416 249 3361 F: 416 249 9813

Scale: NTS
Drawn: DH
Eng: PA
Date: January 2015

The scope of the work outlined in this document is limited to the acoustic, noise, and/or vibration control aspects of the design. Contractors to verify all dimensions

Project:
South Kent Wind Farm - 1st Acoustic Immission Audit

Project Number: 13228

Drawing Title:
Site Plan

Figure: A.1

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50 Ronson Dr, Suite 165, Toronto ON
P: 416 249 3361 F: 416 249 9813

Scale: NTS
Drawn: DH
Eng: PA
Date: January 2015

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Project:
South Kent Wind Farm - 1st Acoustic Immission Audit

Project Number: 13228

Drawing Title:
Monitor Locations R3306 & R3330

Figure: A.2

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P: 416 249 3361 F: 416 249 9813

Scale: NTS
Drawn: DH
Eng: PA
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South Kent Wind Farm - 1st Acoustic Immission Audit

Project Number: 13228

Drawing Title:
Monitor Locations R3330 & R3344

Figure: A.3

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50 Ronson Dr, Suite 165, Toronto ON
P: 416 249 3361 F: 416 249 9813

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South Kent Wind Farm - 1st Acoustic Immission Audit

Project Number: 13228

Drawing Title:
Measurement Location 1 - Receptor R3306

Figure: A.4

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50 Ronson Dr, Suite 165, Toronto ON
P: 416 249 3361 F: 416 249 9813

Scale: NTS
Drawn: DH
Eng: PA
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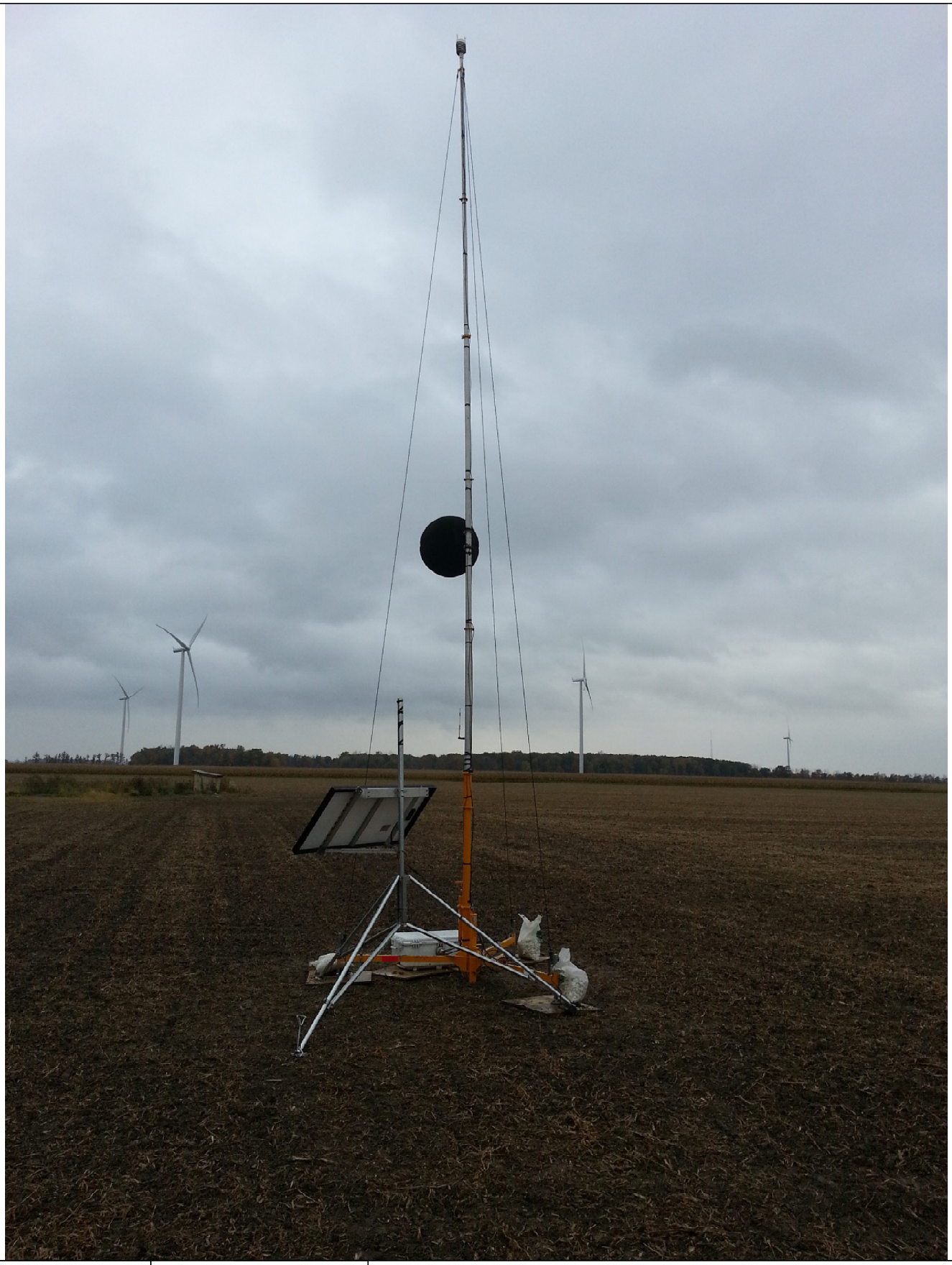
Project:
South Kent Wind Farm - 1st Acoustic Immission Audit
Project Number: 13228

Drawing Title:
Measurement Location 2 - Receptor R3330
Figure: A.5



aercoustics

50 Ronson Dr, Suite 165, Toronto ON
P: 416 249 3361 F: 416 249 9813

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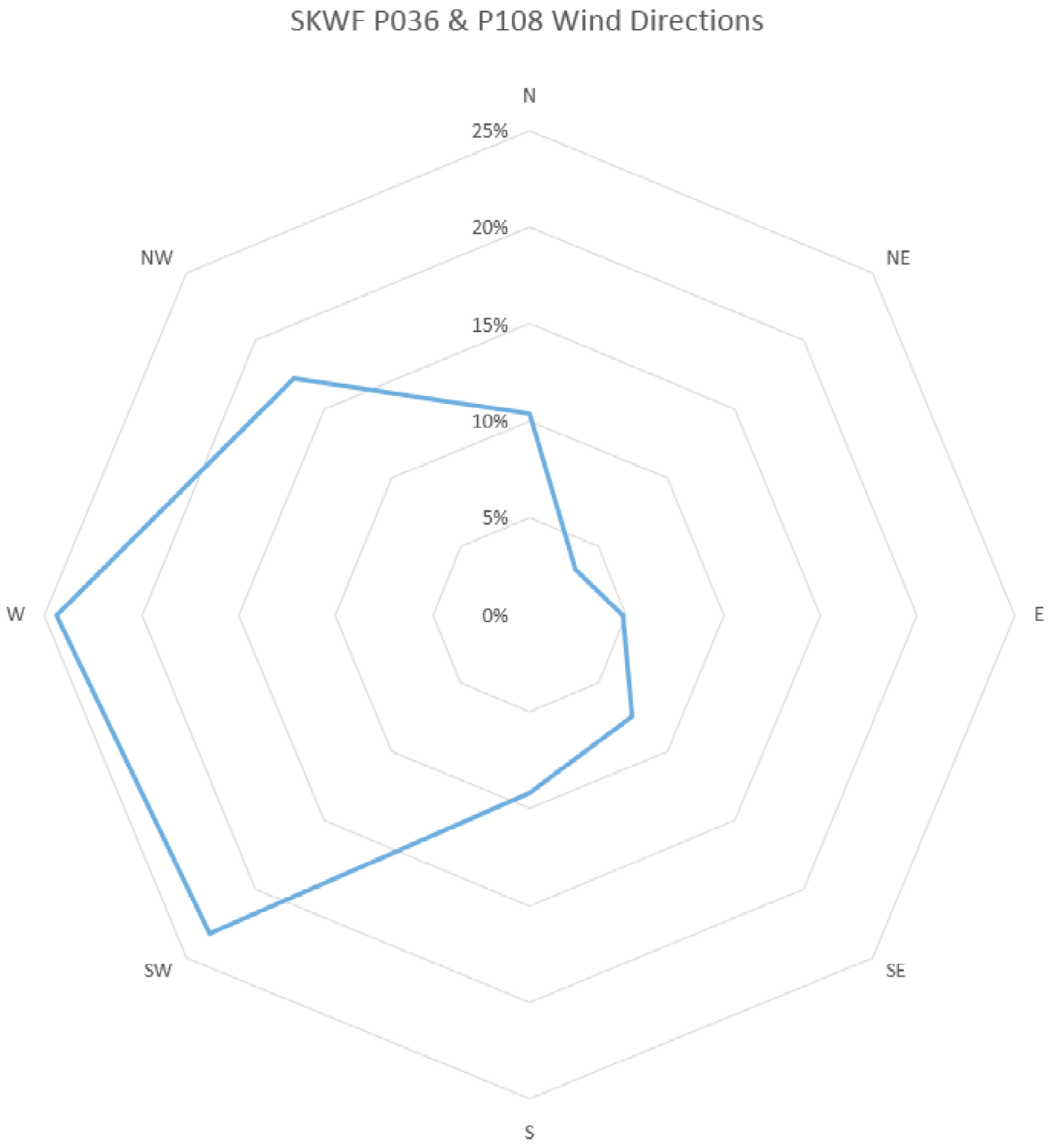
Project:
South Kent Wind Farm - 1st Acoustic Immission Audit
Project Number: 13228

Drawing Title:
Measurement Location 3 - Receptor R3344
Figure: A.6

APPENDIX B – WIND ROSE



aercoustics

50 Ronson Dr, Suite 165, Toronto ON
P: 416 249 3361 F: 416 249 9813

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Project:
South Kent Wind Farm - 1st Acoustic Immission Audit
Project Number: 13228

Drawing Title:
Wind Rose

Figure: B.1

APPENDIX C – TURBINE OPERATIONAL DATA STATEMENT FROM OPERATOR

Pattern Operators Canada ULC
100 Simcoe Street, Suite 105
Toronto, ON M5H 3G2 Canada

T +1 416 263 8025
F +1 416 979 8428
www.patternenergy.com

January 28, 2015

Ministry of the Environment and Climate Change
620-4510 Rhodes Dr.
Windsor, ON N8W 5K5

Subject: **South Kent Wind -- Renewable Energy Approval Number 2871-8UKGPC; Condition – Receptor audit immission part 1 of 2**

To whom it may concern

Please accept this letter as confirmation that all turbines tested during the fall 2014 acoustic measurement campaign conducted by Aercoustics Engineering Ltd. from October 4, 2014 through December 23, 2014 were operating as normal for the duration of the campaign.

Sincerely,

Robert Boak, Facility Manager
South Kent Wind
5873 Seventh Line
Merlin Ontario
N0P 1W0
1-519-689-7301
robert.boak@patternenergy.com

APPENDIX D – WIND GUSTING ANALYSIS

aercoustics

Aercoustics Engineering Ltd.
50 Ronson Drive, Suite 165
Toronto, ON M9W 1B3

Tel: 416-249-3361
Fax 416-249-3613
aercoustics.com

Wind Gusting Analysis Summary

The purpose of this document is to provide supporting information for wind turbine receptor audits in which the wind speed gusting filter deviates from that prescribed by the Ministry of the Environment and Climate Change (MOECC). The Compliance Protocol for Wind Turbine Noise requires that the maximum and minimum wind speeds be within 2 m/s of the average wind speed in a measurement interval (1-minute average). Any intervals that do not meet this requirement would be excluded from the analysis. Aercoustics examined the possibility of changing this filtering to only exclude intervals where the maximum wind speed is more than 2 m/s above the average without filtering based on minimum wind speed.

Aercoustics reviewed 11 different data sets representing measurements from 3 different wind farms and 10 different receptor locations. Each data set was filtered using both the prescribed and the modified methods for wind speed gusting. The resulting sound pressure levels for Turbine On and Background measurements were computed for each wind bin. The change in number of valid data points and the change in measured sound pressure level were calculated. The increase in number of data points and change in sound pressure from the prescribed filtering method to the proposed method were averaged across the 11 data sets. The mean values by wind speed are presented in Table 1 below.

Table 1: Results

Wind Bins	Turbine ON		Background	
	Difference (pts)	Difference (dB)	Difference (pts)	Difference (dB)
3	2%	0.0	3%	0.0
4	6%	0.1	7%	0.0
5	10%	0.1	9%	0.1
6	11%	0.1	13%	0.1
7	21%	0.1	25%	0.1

These results clearly show that the proposed modification of the wind speed gusting filter increases the number of data points in all wind bins, with a more pronounced effect at high wind speeds. The over 20% increase in data points in the 7 m/s wind bins is significant as these wind speeds are typically the most difficult to measure and can considerably increase the time required to complete an audit. There are negligible increases in the measured sound levels, which occur during both Turbine On and Background measurements.

aercoustics

Aercoustics Engineering Ltd.
1004 Middlegate Road, Suite 1100
Mississauga, ON L4Y 0G1

Tel: 416-249-3361
Fax 416-249-3613
aercoustics.com

10 January 2019

Ministry of Environment Conservation and Parks
Environmental Assessment & Permissions Branch
135 St. Clair Avenue West,
Toronto, Ontario, Canada
M4V 1P5

Attn: Denton Miller, Senior Noise Engineer
Approval Services Section – Team 5 (Renewable Energy)

Re: Fall Immission Acoustic Audit for the South Kent Wind Farm – Supplementary Information #1

Aercoustics has been retained by South Kent Wind LP to complete a post construction Immission acoustic audit of the South Kent Wind Farm ("SKWF") as outlined in the SKWF Renewable Energy Approval ("REA") #2871-8UKGPC, issued on June 15, 2012.

A report entitled South Kent Wind Farm 1st Acoustic Immission Audit Report, dated January 30, 2015 was prepared which summarizes the methodology, analysis procedure and results of the 1st acoustic immission audit.

The MECP deemed that the first set of I-Audits were incomplete due to the minimum sample size requirement at Receptor R3334 not being satisfied in one wind bin for Turbine ON at 7m/s. The MECP provided SKWF with the following the option to supplement the audit with existing data to address this issue:

a. *Option #1: Supplement Audits with Existing Data*
   - *The proponent or the consultant that conducted the audit may have additional data that was not initially provided to the Ministry. This option allows proponents to revisit all existing data already collected and use it to supplement their audit reports, and then re-submit them to the ministry. The supplementary data may be enough to deem the I-Audit Report(s) complete without further measurements being required. For additional details, please refer to the Protocol.*

This memo and the attached updated 1st acoustic immission audit report provide rationale and the additional existing data to supplement the incomplete audit at receptor R3334.

To address the incomplete wind bin for Turbine ON at 7m/s wind bin a modified wind gusting filter has been implemented for Receptor R3334 only. The maximum measured wind speed at 10m was adjusted to no more than 2.3m/s higher than the recorded average for the interval, +0.3 m/s above the standard gusting filter of 2m/s as per the 2011 Compliance Protocol.

Table 1 and Table 2 below present the results at receptor R3344 with a 2m/s maximum gust filter and a 2.3m/s maximum gust filter respectively.

Table 1 R3344 Sound levels measured for Turbine ON and OFF [2m/s max. gust filter]

	Wind speed at 10m height [m/s]	3	4	5	6	7
Turbine ON	Number of Samples	1885	1658	1011	428	102
	LAeq [dBA]	37.3	38.1	39.5	42.2	45.8
	Std Dev [dB]	4.2	3.2	2.6	2.1	2.0
Turbine OFF	Number of Samples	193	106	156	105	89
	LAeq [dBA]	36.5	36.8	38.3	42.3	47.1
	Std Dev [dB]	1.9	1.8	1.9	2.3	1.5

Table 2 R3344 Sound levels measured for Turbine ON and OFF [2.3m/s max. gust filter]

	Wind speed at 10m height [m/s]	3	4	5	6	7
Turbine ON	Number of Samples	1893	1685	1049	453	125
	LAeq [dBA]	37.3	38.1	39.5	42.3	46.0
	Std Dev [dB]	4.2	3.2	2.6	2.1	2.1
Turbine OFF	Number of Samples	218	146	174	119	114
	LAeq [dBA]	36.3	36.6	38.5	42.6	47.3
	Std Dev [dB]	2.0	1.8	2.0	2.3	1.5

Table 3 below presents the difference in standard deviation between 2m/s maximum gust filter and 2.3m/s maximum gust filter analysis methods.

Table 3 R3344 Sound levels measured for Turbine ON and OFF [2.3m/s max gusting filter]

	Wind speed at 10m height [m/s]	3	4	5	6	7
Turbine ON	2m/s gust filter Std Dev [dB]	4.2	3.2	2.6	2.1	2.0
	2.3m/s gust filter Std Dev [dB]	4.2	3.2	2.6	2.1	2.1
	Difference Std Dev [dB]	0.0	0.0	0.0	0.0	0.1
Turbine OFF	2m/s gust filter Std Dev [dB]	1.9	1.8	1.9	2.3	1.5
	2.3m/s gust filter Std Dev [dB]	2.0	1.8	2.0	2.3	1.5
	Difference Std Dev [dB]	0.1	0.0	0.1	0.0	0.0

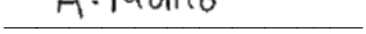
It can be seen from Table 3 that the standard deviations in each wind bin using the modified gusting filter was the same for 7 of 10 wind bins when compared to the standard 2m/s gusting filter. In 3 of the 10 wind bins the standard deviation varied by 0.1 dB. Due to the negligible changes in standard deviation; the modified gusting filter used for R3344 allows for the minimum data counts requirements to be satisfied without a change in data quality from wind gusts.

Additionally, calibration certificates have also been included in Appendix E of the updated Fall audit report.

Please do not hesitate to contact us should you have any questions or require anything further.

Regards,

Aercoustics Engineering Limited



Allan Munro, B.A.Sc. Payam Ashtiani, B.A.Sc., P.Eng

Attachments:

- Updated Fall Immission Report
- Excel sheet with data used for the analysis

APPENDIX E – Calibration Certificates

MANUFACTURER'S CERTIFICATE OF CONFORMANCE

We certify that Brüel & Kjær **-2250--D00-** Serial No. **3004506** has been tested and passed all production tests, confirming compliance with the manufacturer's published specification at the date of the test.

The final test has been performed using calibrated equipment, traceable to National or International Standards or by ratio measurements.

Brüel & Kjær is certified under ISO 9001:2008 assuring that all test data is retained on file and is available for inspection upon request.

Nærum 29-jan-2014

Torben Bjørn
Vice President, Operations

Please note that this document is not a calibration certificate.
For information on our calibration services please contact your nearest Brüel & Kjær office.

BA 0238 - 18

HEADQUARTERS: Brüel & Kjær Sound & Vibration Measurement A/S · DK-2850 Nærum · Denmark
Telephone: +45 77412000 · Fax: +45 45801405 · www.bksv.com · info@bksv.com
Local representatives and service organisations worldwide

Brüel & Kjær

Brüel & Kjær

Packing Note

Item	Description
-2250--D00-	2250-G4 Handheld Analyzer 2250-G4 Handheld Analyzer 2250-G4 Handheld Analyzer

Item		Qty	Description
-4189---	☑	1	1/2" Free-field Microphone, 6 Hz to 20 kHz, Prepolarized 1/2"-Freifeld-Mikrofon FALCON-Serie Klasse 1 vorpolarisiert 50 mV/Pa Microphone à condensateur 1/2" Falcon, prépolarisé (0 V), champ libre, 6Hz à 20KHz
BZ-5298---	☑	1	Software, Environmental Software Software, Environmental Software Software, Environmental Software
KE-0441---	☑	1	Protective Cover for Hand-held Analyzer Protective Cover for Hand-held Analyzer Protective Cover for Hand-held Analyzer
ZC-0032---	☑	1	Microphone Pre-amplifier for Hand-held Analyzer Microphone Pre-amplifier for Hand-held Analyzer Microphone Pre-amplifier for Hand-held Analyzer

QI
Performed by:

If the accessories included specified in the Product Data Sheet or Manual differ from the items supplied, the items mentioned on the Packing Note are valid.

MANUFACTURER'S CERTIFICATE OF CONFORMANCE

We certify that Brüel & Kjær **-2250--D00-** Serial No. **3004480** has been tested and passed all production tests, confirming compliance with the manufacturer's published specification at the date of the test.

The final test has been performed using calibrated equipment, traceable to National or International Standards or by ratio measurements.

Brüel & Kjær is certified under ISO 9001:2008 assuring that all test data is retained on file and is available for inspection upon request.

Nærum 29-jan-2014

Torben Bjørn
Vice President, Operations

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BA 0238 - 18

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Telephone: +45 77412000 · Fax: +45 45801405 · www.bksv.com · info@bksv.com
Local representatives and service organisations worldwide

Brüel & Kjær

Brüel & Kjær

Packing Note

Item	Description
-2250--D00-	2250-G4 Handheld Analyzer 2250-G4 Handheld Analyzer 2250-G4 Handheld Analyzer

Item		Qty	Description
-4189---	☑	1	1/2" Free-field Microphone, 6 Hz to 20 kHz, Prepolarized 1/2"-Freifeld-Mikrofon FALCON-Serie Klasse 1 vorpolarisiert 50 mV/Pa Microphone à condensateur 1/2" Falcon, prépolarisé (0 V), champ libre, 6Hz à 20KHz
BZ-5298---	☑	1	Software, Environmental Software Software, Environmental Software Software, Environmental Software
KE-0441---	☑	1	Protective Cover for Hand-held Analyzer Protective Cover for Hand-held Analyzer Protective Cover for Hand-held Analyzer
ZC-0032---	☑	1	Microphone Pre-amplifier for Hand-held Analyzer Microphone Pre-amplifier for Hand-held Analyzer Microphone Pre-amplifier for Hand-held Analyzer

QI
Performed by:
.....

If the accessories included specified in the Product Data Sheet or Manual differ from the items supplied, the items mentioned on the Packing Note are valid.

MANUFACTURER'S CERTIFICATE OF CONFORMANCE

We certify that Brüel & Kjær **-2250--D00-** Serial No. **3004431** has been tested and passed all production tests, confirming compliance with the manufacturer's published specification at the date of the test.

The final test has been performed using calibrated equipment, traceable to National or International Standards or by ratio measurements.

Brüel & Kjær is certified under ISO 9001:2008 assuring that all test data is retained on file and is available for inspection upon request.

Nærum 29-jan-2014

Torben Bjørn
Vice President, Operations

Please note that this document is not a calibration certificate.
For information on our calibration services please contact your nearest Brüel & Kjær office.

BA 0238 - 18

HEADQUARTERS: Brüel & Kjær Sound & Vibration Measurement A/S · DK-2850 Nærum · Denmark
Telephone: +45 7741 2000 · Fax: +45 4580 1405 · www.bksv.com · info@bksv.com
Local representatives and service organisations worldwide

Brüel & Kjær

Brüel & Kjær

Packing Note

Item	Description
-2250--D00-	2250-G4 Handheld Analyzer 2250-G4 Handheld Analyzer 2250-G4 Handheld Analyzer

Item	Qty	Description
-4189---	1	1/2" Free-field Microphone, 6 Hz to 20 kHz, Prepolarized 1/2"-Freifeld-Mikrofon FALCON-Serie Klasse 1 vorpolarisiert 50 mV/Pa Microphone à condensateur 1/2" Falcon, prépolarisé (0 V), champ libre, 6Hz à 20KHz
BZ-5298---	1	Software, Environmental Software Software, Environmental Software Software, Environmental Software
KE-0441---	1	Protective Cover for Hand-held Analyzer Protective Cover for Hand-held Analyzer Protective Cover for Hand-held Analyzer
ZC-0032---	1	Microphone Pre-amplifier for Hand-held Analyzer Microphone Pre-amplifier for Hand-held Analyzer Microphone Pre-amplifier for Hand-held Analyzer

QI
Performed by:
.....

If the accessories included specified in the Product Data Sheet or Manual differ from the items supplied, the items mentioned on the Packing Note are valid.

VAISALA

Test report no. H31-14050110

TEST REPORT

Instrument	WXT520 AAB0BA10B0
Serial number	K0550007
Manufacturer	Vaisala Oyj, Finland
Test date	31st January 2014

This test report certifies that the instrument was thoroughly tested and inspected, and found to meet its published test limits when it was shipped from Vaisala.

Test results

Test	Result	Limit	Passed
Rain response	424.0 mV	(345...575) mV	OK
Zero wind speed	0.00 m/s	(0...0.4) m/s	OK
Pressure	1032.3 hPa	PASS/FAIL	OK
Temperature	22.2 °C	PASS/FAIL	OK
Humidity	18.5 %RH	PASS/FAIL	OK
Heating	Not tested	N/A	Not tested
Current (service port)	0.58	(0.2...0.7) mA	OK
Communication (service port)	PASS	PASS/FAIL	OK
Current (main port)	0.33	(0.1...0.4) mA	OK
Communication (main port)	PASS	PASS/FAIL	OK

Signature

Technician

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Vaisala Oyj | PO Box 26, FI-00421 Helsinki, Finland
Phone +358 9 894 91 | Fax +358 9 8949 2227
Email firstname.lastname@vaisala.com | www.vaisala.com
Domicile Vantaa, Finland | VAT FI01244162 | Business ID 0124416-2

VAISALA

Calibration sheet no. H31-14050109

CALIBRATION SHEET

Instrument	WXTPTU
Serial number	K0330094
Manufacturer	Vaisala Oyj, Finland
Test date	31st January 2014

This test report certifies that the instrument was thoroughly tested and inspected, and found to meet its published test limits when it was shipped from Vaisala.

Calibration results

Test phase of calibration process	Reference value	Observed value	Error*	Uncertainty**
Pressure	1080.8 hPa	1080.8 hPa	0.0 hPa	± 0.4 hPa
Pressure	899.5 hPa	899.6 hPa	0.1 hPa	± 0.4 hPa
Pressure	799.5 hPa	799.5 hPa	0.0 hPa	± 0.4 hPa
Pressure	596.1 hPa	596.1 hPa	0.0 hPa	± 0.4 hPa
Temperature	59.7 °C	59.7 °C	0.0 °C	± 0.2 °C
Temperature	24.7 °C	24.7 °C	0.0 °C	± 0.2 °C
Temperature	-5.9 °C	-5.9 °C	0.0 °C	± 0.2 °C
Temperature	-32.8 °C	-32.8 °C	0.0 °C	± 0.2 °C
Temperature	-52.0 °C	-52.0 °C	0.0 °C	± 0.2 °C
Relative humidity	30.8 %RH	30.8 %RH	0.0 %RH	± 2 %RH
Relative humidity	57.7 %RH	57.7 %RH	0.0 %RH	± 2 %RH
Relative humidity	94.2 %RH	94.2 %RH	0.0 %RH	± 3 %RH

*The test points for error values are polynomial fitting curve fitting points.
**The calibration uncertainty given at 95 % confidence level, k = 2

Traceability
The working standards for pressure and temperature are calibrated at Vaisala Measurement Standards Laboratory (MSL) by using MSL working standards traceable to National Institute of Standards and Technology (NIST, USA). The relative humidity values are calculated from measured temperature and dew-point temperature values. The dew-point working standards are traceable to the Finnish National Humidity Laboratory (MIKES).

Signature

Technician

Vaisala Oyj | PO Box 26, FI-00421 Helsinki, Finland
Phone +358 9 894 91 | Fax +358 9 8949 2227
Email firstname.lastname@vaisala.com | www.vaisala.com
Domicile Vantaa, Finland | VAT FI01244162 | Business ID 0124416-2

VAISALA

Test report no. H31-14060138

TEST REPORT

Instrument	WXT520 AAB0BA10B0
Serial number	K0630016
Manufacturer	Vaisala Oyj, Finland
Test date	5th February 2014

This test report certifies that the instrument was thoroughly tested and inspected, and found to meet its published test limits when it was shipped from Vaisala.

Test results

Test	Result	Limit	Passed
Rain response	405.0 mV	(345...575) mV	OK
Zero wind speed	0.00 m/s	(0...0.4) m/s	OK
Pressure	1011.2 hPa	PASS/FAIL	OK
Temperature	22.8 °C	PASS/FAIL	OK
Humidity	20.3 %RH	PASS/FAIL	OK
Heating	Not tested	N/A	Not tested
Current (service port)	0.58	(0.2...0.7) mA	OK
Communication (service port)	PASS	PASS/FAIL	OK
Current (main port)	0.33	(0.1...0.4) mA	OK
Communication (main port)	PASS	PASS/FAIL	OK

Signature

Technician

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Vaisala Oyj | PO Box 26, FI-00421 Helsinki, Finland
Phone +358 9 894 91 | Fax +358 9 8949 2227
Email firstname.lastname@vaisala.com | www.vaisala.com
Domicile Vantaa, Finland | VAT FI01244162 | Business ID 0124416-2

VAISALA

Calibration sheet no. H31-14060137

CALIBRATION SHEET

Instrument	WXTPTU
Serial number	K0330051
Manufacturer	Vaisala Oyj, Finland
Test date	5th February 2014

This test report certifies that the instrument was thoroughly tested and inspected, and found to meet its published test limits when it was shipped from Vaisala.

Calibration results

Test phase of calibration process	Reference value	Observed value	Error*	Uncertainty**
Pressure	1079.9 hPa	1079.9 hPa	0.0 hPa	± 0.4 hPa
Pressure	898.5 hPa	898.5 hPa	0.0 hPa	± 0.4 hPa
Pressure	797.3 hPa	797.3 hPa	0.0 hPa	± 0.4 hPa
Pressure	595.7 hPa	595.7 hPa	0.0 hPa	± 0.4 hPa
Temperature	59.7 °C	59.7 °C	0.0 °C	± 0.2 °C
Temperature	24.7 °C	24.7 °C	0.0 °C	± 0.2 °C
Temperature	-5.8 °C	-5.8 °C	0.0 °C	± 0.2 °C
Temperature	-32.9 °C	-32.8 °C	0.1 °C	± 0.2 °C
Temperature	-51.9 °C	-51.9 °C	0.0 °C	± 0.2 °C
Relative humidity	30.7 %RH	30.7 %RH	0.0 %RH	± 2 %RH
Relative humidity	57.8 %RH	57.8 %RH	0.0 %RH	± 2 %RH
Relative humidity	92.0 %RH	92.0 %RH	0.0 %RH	± 3 %RH

*The test points for error values are polynomial fitting curve fitting points.
**The calibration uncertainty given at 95 % confidence level, k = 2

Traceability
The working standards for pressure and temperature are calibrated at Vaisala Measurement Standards Laboratory (MSL) by using MSL working standards traceable to National Institute of Standards and Technology (NIST, USA). The relative humidity values are calculated from measured temperature and dew-point temperature values. The dew-point working standards are traceable to the Finnish National Humidity Laboratory (MIKES).

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Email firstname.lastname@vaisala.com | www.vaisala.com
Domicile Vantaa, Finland | VAT FI01244162 | Business ID 0124416-2

VAISALA

Calibration sheet no. H31-13300155

CALIBRATION SHEET

Instrument	WXTPTU
Serial number	J2950004
Manufacturer	Vaisala Oyj, Finland
Test date	25th July 2013

This test report certifies that the instrument was thoroughly tested and inspected, and found to meet its published test limits when it was shipped from Vaisala.

Calibration results

Test phase of calibration process	Reference value	Observed value	Error*	Uncertainty**
Pressure	1082.4 hPa	1082.4 hPa	0.0 hPa	± 0.4 hPa
Pressure	897.3 hPa	897.3 hPa	0.0 hPa	± 0.4 hPa
Pressure	799.7 hPa	799.7 hPa	0.0 hPa	± 0.4 hPa
Pressure	597.0 hPa	597.0 hPa	0.0 hPa	± 0.4 hPa
Temperature	59.3 °C	59.3 °C	0.0 °C	± 0.2 °C
Temperature	24.7 °C	24.6 °C	-0.1 °C	± 0.2 °C
Temperature	-6.2 °C	-6.2 °C	0.0 °C	± 0.2 °C
Temperature	-33.0 °C	-33.0 °C	0.0 °C	± 0.2 °C
Temperature	-52.3 °C	-52.3 °C	0.0 °C	± 0.2 °C
Relative humidity	31.2 %RH	31.2 %RH	0.0 %RH	± 2 %RH
Relative humidity	58.0 %RH	58.0 %RH	0.0 %RH	± 2 %RH
Relative humidity	95.5 %RH	95.5 %RH	0.0 %RH	± 3 %RH

*The test points for error values are polynomial fitting curve fitting points.
**The calibration uncertainty given at 95 % confidence level, k = 2

Traceability
The working standards for pressure and temperature are calibrated at Vaisala Measurement Standards Laboratory (MSL) by using MSL working standards traceable to National Institute of Standards and Technology (NIST, USA). The relative humidity values are calculated from measured temperature and dew-point temperature values. The dew-point working standards are traceable to the Finnish National Humidity Laboratory (MIKES).

Signature

Technician

Vaisala Oyj | PO Box 26, FI-00421 Helsinki, Finland
Phone +358 9 894 91 | Fax +358 9 8949 2227
Email firstname.lastname@vaisala.com | www.vaisala.com
Domicile Vantaa, Finland | VAT FI01244162 | Business ID 0124416-2

VAISALA

Test report no. H31-13300156

TEST REPORT

Instrument WXT520 AAB0BA10B0
Serial number J3040014
Manufacturer Vaisala Oyj, Finland
Test date 25th July 2013

This test report certifies that the instrument was thoroughly tested and inspected, and found to meet its published test limits when it was shipped from Vaisala.

Test results

Test	Result	Limit	Passed
Rain response	1036.0 mV	(950...1600) mV	OK
Zero wind speed	0.00 m/s	(0...0.4) m/s	OK
Pressure	1011.6 hPa	PASS/FAIL	OK
Temperature	24.1 °C	PASS/FAIL	OK
Humidity	46.9 %RH	PASS/FAIL	OK
Heating	Not tested	N/A	Not tested
Current (service port)	0.56	(0.2...0.7) mA	OK
Communication (service port)	PASS	PASS/FAIL	OK
Current (main port)	0.32	(0.1...0.4) mA	OK
Communication (main port)	PASS	PASS/FAIL	OK

Signature

Technician

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Vaisala Oyj | PO Box 26, FI-00421 Helsinki, Finland
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