HGC ENGINEERING

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ACOUSTIC AUDIT - IMMISSION REPORT

Unifor Wind Turbine

Port Elgin, Ontario

Prepared for:

Union Building Corporation of Canada
205 Placer Ct.
North York, ON
M2H 3H9

Prepared by

Nathan Gara

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DN: cn=Nathan Gara, o=HGC Engineering, ou, email=ngara@hgcengineering.com, c=CA
Date: 2018.01.08 10:04:30 -05'00'

Nathan Gara, C.E.T.

and

Ian Bonsma

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Date: 2018.01.08 10:34:52 -05'00'

Ian R. Bonsma, PEng

January 8, 2018

VERSION CONTROL

Version	Date	Version Description
1	December 15, 2017	Original Report
2	January 8, 2018	Typographical Corrections Made to Table 4a

EXECUTIVE SUMMARY

Howe Gastmeier Chapnik Limited ("HGC Engineering") was retained by Union Building Corporation of Canada to complete an acoustic immission audit of the Unifor Wind Turbine ("Wind Project"). The Wind Project includes one Enercon wind turbine generator, rated at 500 kW. The audit was completed to abide with a previous commitment made by Unifor (formerly CAW) to conduct noise testing. HGC Engineering has assessed the acoustic impact against the acoustic criteria of the Ministry of the Environment and Climate Change ("MOECC") in accordance with the requirements of the MOECC's 2017 *Compliance Protocol for Wind Turbine Noise – Guidelines for Acoustic Assessment and Measurement* ("Compliance Protocol"). This immission audit was completed between September 21 and November 7, 2017.

The sound level measurements and analysis, as performed in accordance with the MOECC's Compliance Protocol, indicate that the Wind Project is operating in excess of the applicable sound level criteria at monitoring location M1. Details of the measurements and analysis are provided herein.

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TABLE OF CONTENTS

1 INTRODUCTION

Howe Gastmeier Chapnik Limited ("HGC Engineering") was retained by Union Building Corporation of Canada to complete an Acoustic Audit – Immission of the Unifor Wind Turbine ("Wind Project"). The Wind Project is located at the Unifor Family Education Center in the Town of Port Elgin, Ontario and consists of one Enercon E-48 wind turbine generator, designated turbine T1. Turbine T1 is rated at 500 kW and has a hub height of 76 m.

The audit was completed to abide with a previous commitment made by Unifor (formerly CAW) to conduct noise testing.

2 MONITORING LOCATIONS

The *Environmental Noise Impact Report: Enercon E48 500 kW constrained operation, CAW Clean Wind Energy Project* ("ENIR") [1] prepared by M.K. Ince and Associates Ltd. dated March 1, 2012, provides sound level predictions for locations within 1000 m of the Wind Project wind turbine generator.

A number of locations were considered for use as sound level monitoring locations for the audit, as shown in Table A1 of Appendix A. Predicted sound levels for the receptors surrounding the Wind Project were taken from the ENIR.

The receptors were selected based on their predicted sound level and consultation with the land owners. The annual wind rose for the area is provided in Figure A1 of Appendix A. Photos of the selected receptor locations can be found in Appendix B.

HGC Engineering developed an acoustic predictive model of the site to determine the sound levels at the selected monitoring locations. The predicted sound levels at the monitoring and receptor locations, along with UTM coordinates can be found in Table 1.

Table 1: Predicted Sound Levels and UTM Coordinates of Selected Locations

Location		Easting	Northing	Predicted Sound Level [dBA]
J	Receptor	467256	4919594	42.7[±]
	Monitoring Location M1	467348	4919607	43.9[*]
T	Receptor	467416	4919124	40.1[±]
	Monitoring Location M2	467474	4919119	39.2[*]
Q	Receptor	467169	4919269	42.0[±]
	Monitoring Location M3	467212	4919266	44.1[*]

[±] Sound level taken from ENIR [1].
[*] Sound level predicted by acoustic model created by HGC Engineering.

Receptor location J is a single storey cottage located at 12 Globe Place. Turbine T1 is approximately 210 m to the southeast. The sound level meter was installed on a fence at the northwest side of the Unifor property, approximately 205 m from T1, designated Monitoring Location M1. The microphone was placed at a height of 4.5 m, consistent with the ENIR.

Receptor location T is a two storey home located at 77 CAW Road (Bruce County Road 25). Turbine T1 is approximately 290 m to the north. The sound level meter was installed in an agricultural field to the west of the property, approximately 315 m from turbine T1, designated Monitoring Location M2. The microphone was placed at a height of 4.5 m, consistent with the ENIR.

Receptor location Q is a two storey home located at 107 CAW Road (Bruce County Road 25). The turbine, T1 is approximately 230 m to the northeast. The sound level meter was installed in an agricultural field to the west of the property, approximately 205 m from turbine T1, designated Monitoring Location M3. The microphone was placed at a height of 4.5 m, consistent with the ENIR.

The Wind Project area is generally residential in nature. Locations M2 and M3 were located next to a frequently travelled road. Location M1 was located next to a baseball diamond.

3 INSTRUMENTATION

The MOECC document, *Compliance Protocol for Wind Turbine Noise – Guidelines for Acoustic Assessment and Measurement* [2] ("Compliance Protocol") provides instrumentation requirements for Acoustical Audits of wind energy projects. The instrumentation used for this acoustic audit satisfies the requirements of the Compliance Protocol.

Audio frequency sound levels were measured using Svantek 977 sound level meters, each connected to ½" microphones. The microphones were set at a height of approximately 4.5 m and equipped with 175 mm diameter windscreens to minimize wind-induced microphone self-noise.

The energy-equivalent average sound level, denoted L_{EQ} was recorded by the instrumentation. The audio-frequency measurements are presented as A-weighted sound levels as they are intended to represent the loudness of sounds as perceived by the human ear. The overall audio-frequency sound level monitoring results are summarized in this report.

In addition to the acoustic instrumentation, meteorological instruments were used. A Davis weather station was deployed at Monitoring Location M1 to collect ground weather conditions including temperature, humidity, and precipitation. NRG anemometers and wind vanes were used at each receptor location to collect 10 m height wind speed and direction.

The various instruments deployed by HGC Engineering are summarized in Table 2, and their respective locations are shown in Figure 1.

Table 2: Measurement Instrumentation

Location	Instrumentation Make and Model	Serial Number
M1	Svantek 977 sound level meter	36439
	NRG #40C anemometer connected to a Campbell Scientific datalogger	179500262926
M2	Svantek 977 sound level meter	36426
	NRG #40C anemometer connected to a Campbell Scientific datalogger	179500262946
M3	Svantek 977 sound level meter	36428
	NRG #40C anemometer connected to a Campbell Scientific datalogger	179500265230

The sound level meters were configured to measure and record spectral (frequency-dependent) one-minute L_{EQ} sound level measurements. For identification of dominant sources, the sound level meters also recorded audio files.

Correct calibration of the acoustic instrumentation was verified using an acoustic calibrator manufactured by Brüel & Kjær (B&K). Calibration verification was carried out on a bi-weekly basis throughout the measurement period.

Windscreens were used on the microphones, consistent with the requirements of MOECC technical publication NPC-103, *Procedures* [3]. A large wind screen, 175 mm in diameter, was used on each sound level meter to minimize wind-induced microphone self-noise at higher wind speeds. Sound level data included herein has not been adjusted for the sound insertion loss of the large wind screen.

All the equipment was within its annual or bi-annual calibration, and the calibration certificates can be found in Appendix C.

4 ASSESSMENT CRITERIA

The MOECC publication *Noise Guidelines for Wind Farms – Interpretation for Applying MOE NPC Publications to Wind Power Generation Facilities* [4] indicates the applicable sound level limit for wind energy projects in a Class 2 environment. Additionally, the Compliance Protocol includes the same sound level limits which are shown in Table 3.

Table 3: Wind Turbine Noise Criteria [dBA]

10 m Height Wind Speed [m/s]	4	5	6	7	8	9	10
Wind Turbine Sound Level Limits Class 2 Area [dBA]	45.0	45.0	45.0	45.0	45.0	49.0	51.0

It should be noted that the sound level limits of the MOECC apply only to the sound level contribution of the sound source under assessment, in this case the sound from the wind turbine generators. Thus, where a sound level measured at a receptor location includes significant sound due to the relevant sound source and unrelated background sound sources (i.e., road vehicles, trains, air traffic, farming machinery, wind, etc.), some form of evaluation must be made to determine the sound level contribution of the source under assessment in the absence of the background sounds. Methodology prescribed by the MOECC to complete an assessment of a wind energy project is discussed in the following section.

5 METHODOLOGY

The MOECC requested the acoustic audit be completed in accordance with Part D of the Compliance Protocol. Part D includes requirements for instrumentation, measurement, and data reduction procedures to assist with determining compliance.

A series of one-minute energy-equivalent sound level measurements are collected with ("ON") and without ("OFF") the turbines operating. Simultaneously, wind speed and direction at 10 m height are measured and collected in one-minute intervals. The measured sound level data is separated into integer wind speed "bins" where the sound levels corresponding to each integer wind speed are logarithmically averaged to determine the average sound level when the wind turbines are operational and when they are parked. The ambient L_{EQ} (turbines parked) is logarithmically subtracted from the overall L_{EQ} (turbines operational) to determine the sound level contribution of the wind turbines alone. Supplementary data including wind speed at turbine hub height, wind speed at noise measurement height, turbine electrical power output, turbine yaw position, temperature, humidity, and statistical noise indices (Ln) can also be measured during the monitoring campaign to aid in the analysis.

Part D of the Compliance Protocol requires at least 120 one-minute intervals be measured for each 10 m height wind speed between 4 and 7 m/s when the turbines are operating and at least 60 one-minute intervals be measured for each 10 m height wind speed between 4 and 7 m/s when the turbines are parked. Prior to determining the number of data points measured in each wind speed bin, the data is filtered to only include night-time hours (between 22:00 and 05:00) and data outside of rainfall (no rain within one hour of the measurement interval). Data is also filtered to only include periods where the closest turbine is operating at greater or equal to 85% of its rated electrical power output and at least 90% of its maximum sound power, and the turbine yaw position is +/-45 degrees from the line of sight between the closest turbine and the measurement location (measurement location is downwind).

If the measurement campaign does not yield sufficient data to satisfy the minimum requirements of Part D of the Compliance Protocol, a Revised Assessment Methodology Immission Audit ("RAM I-Audit") can be completed. As described in Part E5.5 of the Compliance Protocol, three wind speed bins between 1 and 7 m/s or two wind speed bins between 1 and 4 m/s are required. With appropriate justification, the number of one-minute intervals required in each bin may be reduced to 60 for turbine operational measurements (ON) and 30 for ambient measurements (OFF). If there is insufficient ambient sound level data (OFF), a value of 30 dBA or data from a lower wind speed bin may be used to represent a wind speed bin.

The Compliance Protocol allows for the removal of individual events to improve the signal to noise ratio. A review of the audio recordings allows for the identification of the dominant noise source within a given one-minute interval, and the subsequent removal of data points that contain interference.

Adjustments to the measured sound levels may be required based on wind turbine tonality, if any. If during the acoustic measurement campaign the project wind turbines exhibit tonal characteristics (a whine, screech, buzz or hum) then an assessment of the tonal audibility is required according to the CAN/CSA publication *Wind Turbine Generator Systems – Part 11: Acoustical Measurement Techniques* [5]. The average tonal audibility correction must be determined for each integer wind speed and the correction added to the final noise contribution

of the Wind Project at those wind speeds, in accordance with International Standards Organization *1996-2* [6].

6 TONALITY ASSESSMENT

Based on our site observations up close to the wind turbine generator there were no tones identified/observed at the turbine or the monitoring locations.

7 MEASUREMENTS AND RESULTS

Sound level measurements were conducted between September 21 and November 7, 2017. The weather during the monitoring period varied, including several days with rain. Temperatures ranged from -10 to 25°C. Wind speeds at 10 m height ranged from 0 m/s up to 15 m/s. The prevailing wind direction during the measurement campaign was from the southeast and northwest, inconsistent with the historical wind rose, which shows wind predominantly from the southwest. Figure 2 show the wind rose for the receptor location during the ON and OFF conditions.

The sound level summary for data collected at monitoring location M1 is shown in Tables 4a and 4b. Data were collected between September 21 and November 7, 2017.

Table 4a: Monitoring Location M1 - Sound Level Summary

	10 m Height Wind Speed [m/s]							
L_{EQ} Sound Level [dBA]	**1**		**2**		**3**		**4**	
Average Operating (ON) / Std Dev.	-[1]		-[1]		47.9	1.5	48.7	1.4
Average Ambient (OFF) / Std Dev.	34.4	3.3	36.3	3.2	40.2	2.4	42.8	1.4
Wind Project Only	-		-		47		47	
Criteria	45		45		45		45	
Excess	-		-		**2**		**2**	

[1] Less than 60 data points for Operating (ON) Condition

Table 4b: Monitoring Location M1 - Summary of Valid Data Points

	10 m Height Wind Speed [m/s]			
Wind Project Condition	**1**	**2**	**3**	**4**
Operating (ON)	12[1]	54[1]	117	134
Ambient (OFF)	1981	1492	393	30

[1] Less than 60 data points for Operating (ON) Condition

The measurement data and analysis indicate a sound level excess of 2 dBA at 3 and 4 m/s. Based on the data presented above and in Figures 3a and 3b, the Wind Project is not compliant with the MOECC sound level criteria at Monitoring Location M1.

Locations M2 and M3 were deployed between October 23 and November 7, 2017, however, insufficient data were collected and no results are available.

Appendix C includes a statement from Union Building Corporation of Canada indicating the wind turbine generator were operating normally from September 21 to November 7, 2017.

8 CONCLUSIONS

The measurements and analysis, performed in accordance with the methods prescribed by the Ontario Ministry of the Environment and Climate Change's 2017 publication *Compliance Protocol for Wind Turbine Noise* indicates that the Wind Project is operating in excess of the MOECC's sound level criteria at Monitoring Location M1. A noise abatement action plan may need to be developed by Unifor to bring the Wind Project into compliance with the sound level limits.

REFERENCES

1. M.K. Ince and Associates Ltd., *Environmental Noise Impact Report: Enercon E48 500 kW constrained operation, CAW Clean Wind Energy Project*, March 1, 2012.
2. Ontario Ministry of the Environment and Climate Change, *Compliance Protocol for Wind Turbine Noise Guideline for Acoustic Assessment and Measurement,* April 2017.
3. Ontario Ministry of the Environment and Climate Change Publication, NPC-103, *Procedures.*
4. Ontario Ministry of the Environment and Climate Change Publication, *Noise Guidelines for Wind Farms, Interpretation for Applying MOE NPC Publications to Wind Power Generation Facilities*, October 2008.
5. CAN/CSA-C61400-11:07, *Wind Turbine Generator Systems – Part 11: Acoustical Measurement Techniques,* October, 2007
6. International Standards Organization 1996-2, *Acoustics – Description, assessment and measurement of environmental noise – Part 2: Determination of environmental noise levels*, 2007.
7. Government of Canada, *Canadian Wind Energy Atlas*, Retrieved from http://www.windatlas.ca/nav-en.php?no=24&field=EU&height=30&season=ANU on November 12, 2017

Figure 1: Receptor Monitoring Locations
Unifor Wind Energy Project

Figure 2: Wind Direction - Unifor Wind Turbine
Monitoring Location M1,10 m Height, Wind Speeds 0.5 to 7.5 m/s
ON and OFF Conditions, September 21 to November 7, 2017

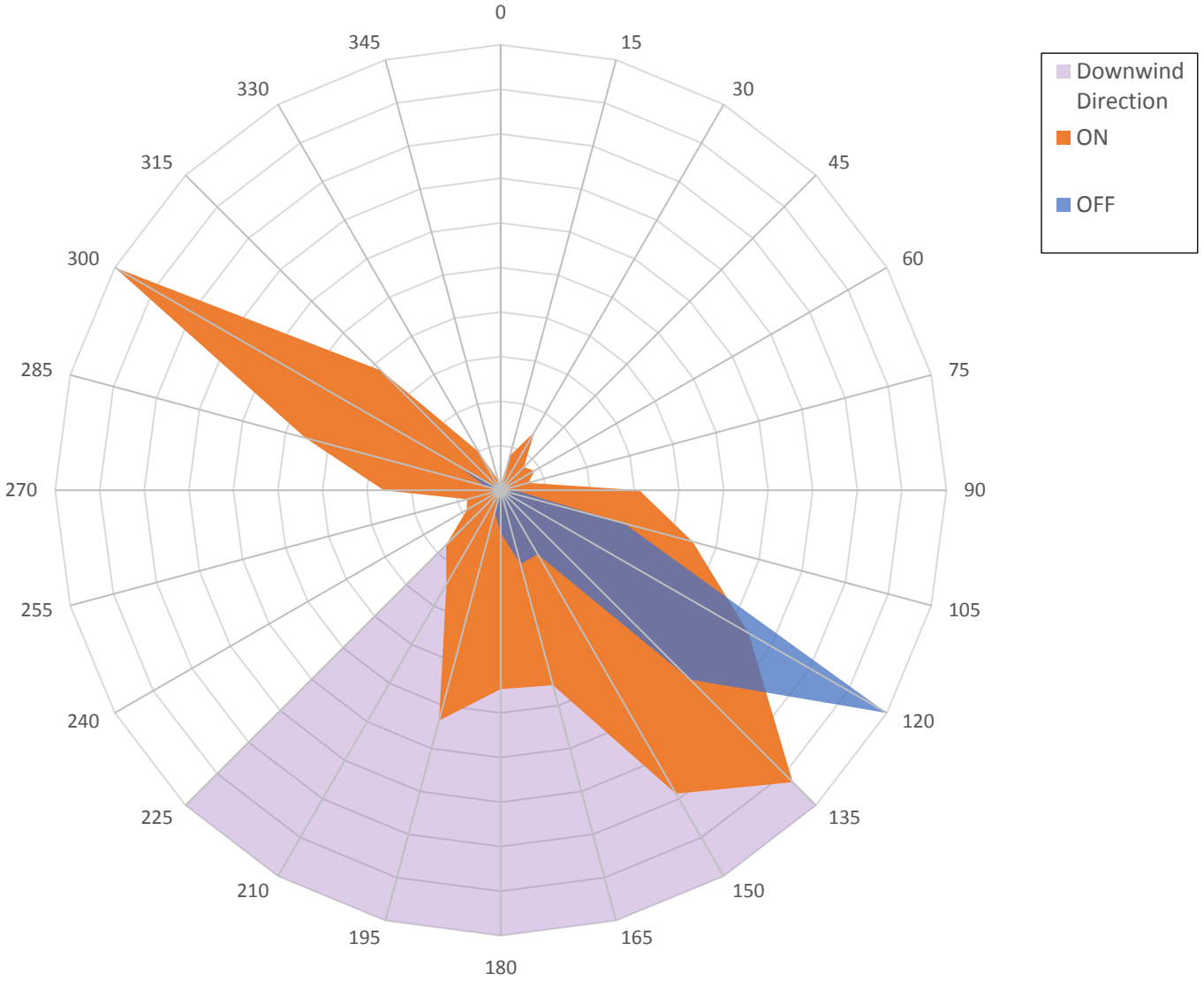


Figure 3a: Unifor Wind Turbine, Immission Results
Monitoring Location M1, September 21 to November 7, 2017

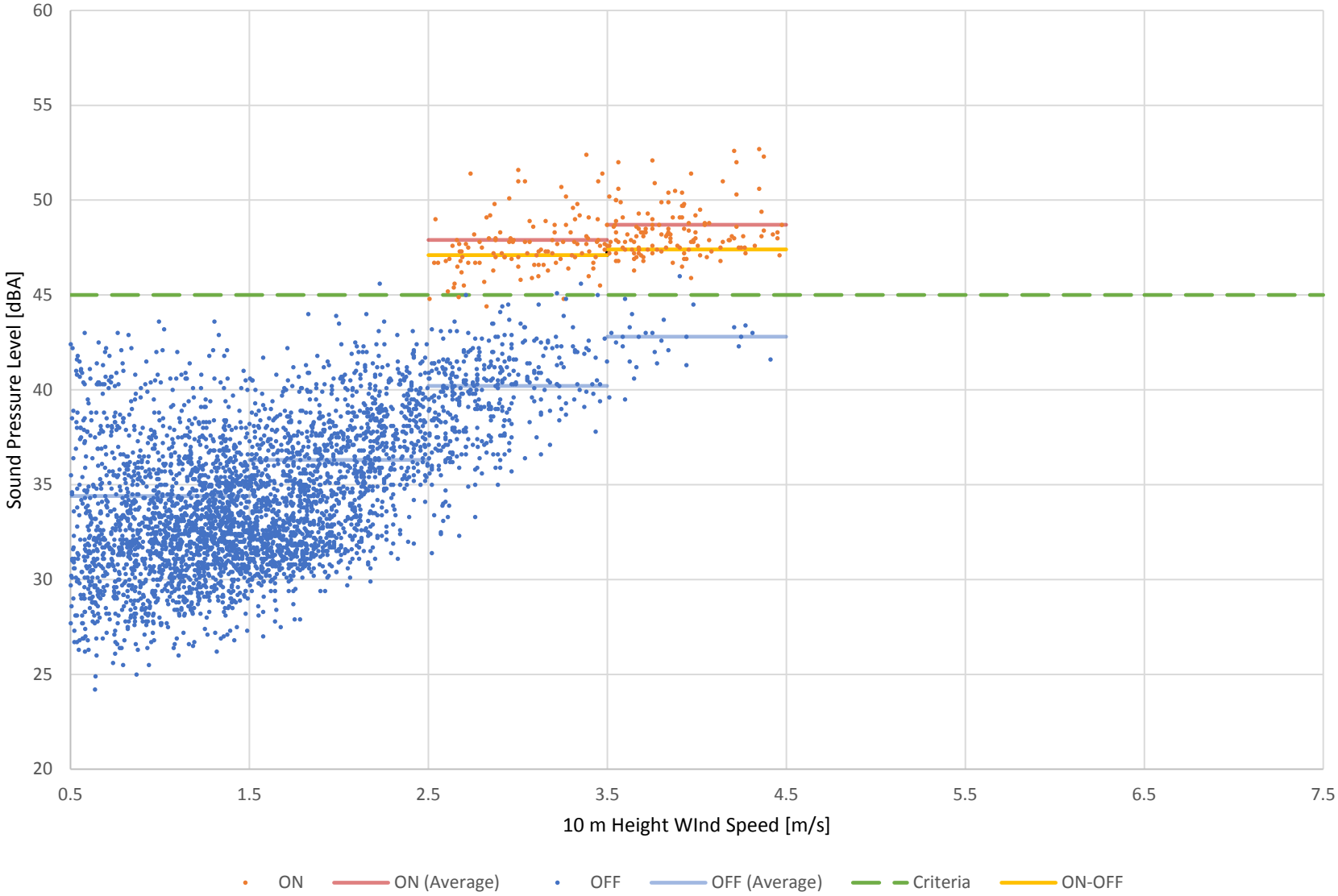
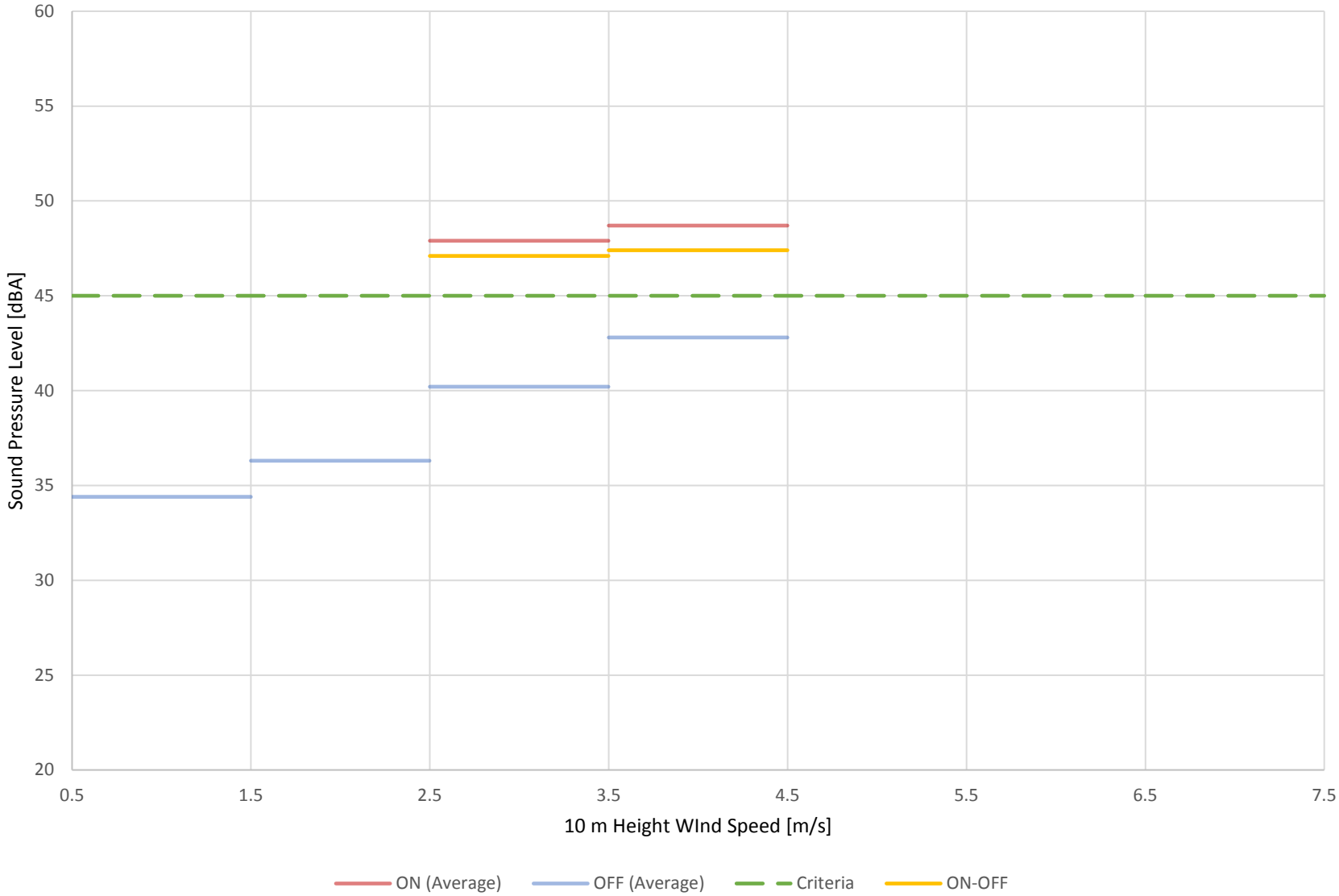


Figure 3b: Unifor Wind Turbine, Immission Results
Monitoring Location M1, September 21 to November 7, 2017



APPENDIX A:
MONITORING LOCATION SELECTION

Figure A1: Annual Wind Rose [7]

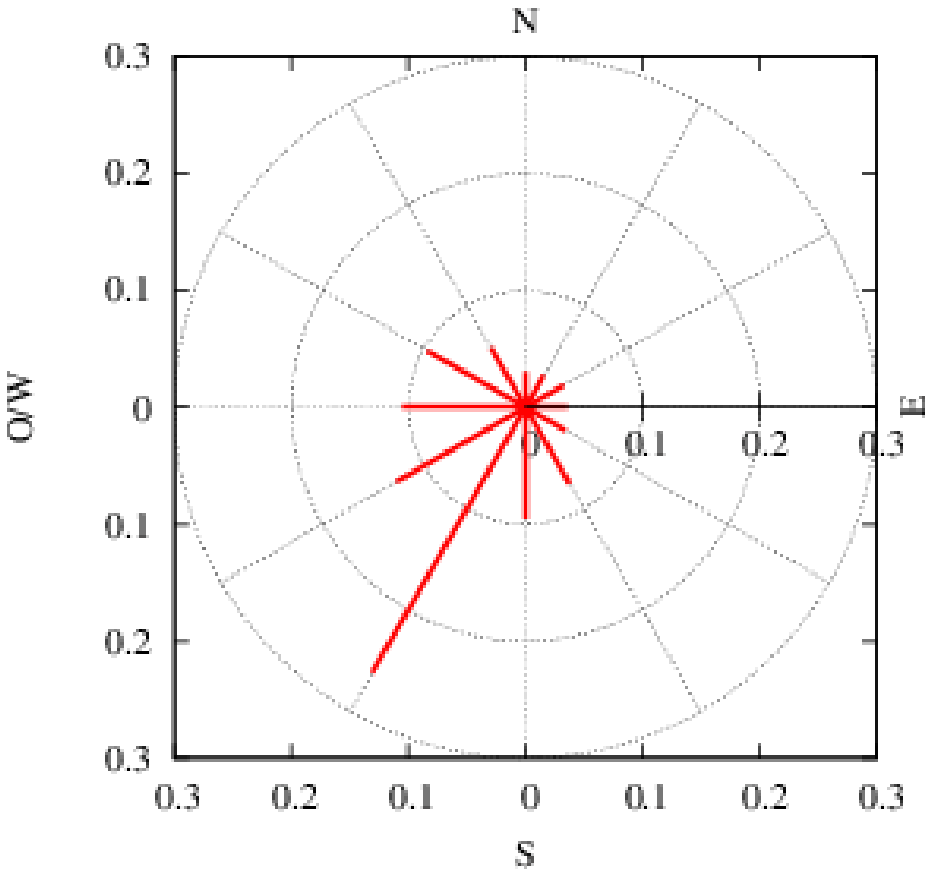


Table A1: Potential Receptor Locations

ID	Distance to Turbine T1 [m]	Predicted Sound Pressure Level [dBA] [1]	Comments
J	213	42.7	Selected Receptor
M1	194	43.9*	Monitoring Location
W	219	42.4	Monitoring Location M1 is representative
H	218	42.6	Permission Not Granted
R	219	42.5	Permission Not Granted
Q	231	42	Selected Receptor
M3	233	44.1*	Monitoring Location
V	232	42	Unsuitable Location
X	242	41.5	Monitoring Location M1 is Representative
I	246	41.5	Unsuitable Location
K	246	41.4	Monitoring Location M1 is Representative
S	242	41.7	Permission Not Granted
F	248	41.3	Monitoring Location M1 is Representative
P	263	40.8	Monitoring Location M1 is Representative
L	270	40.5	Monitoring Location M1 is Representative
O	285	40.1	Monitoring Location M1 is Representative
T	289	40.1	Selected Receptor
M2	292	39.2*	Monitoring Location

[1] Sound levels taken from ENIR [1].
* Sound level predicted by acoustic model prepared by HGC Engineering.

APPENDIX B:

MONITORING LOCATION PHOTOS

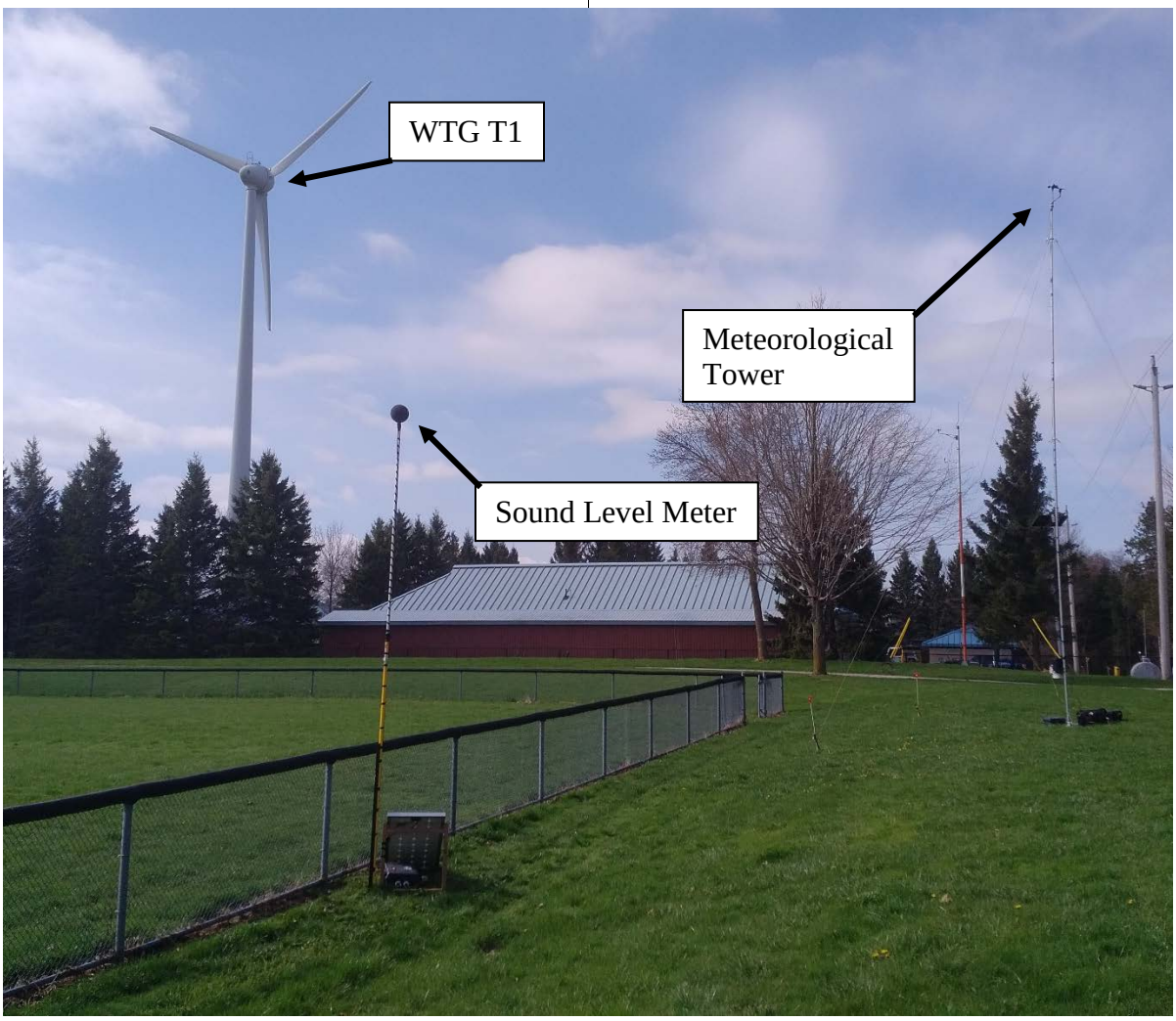


Photo of Meteorological Tower and Sound Level Meter at Location M1 (looking southwest)

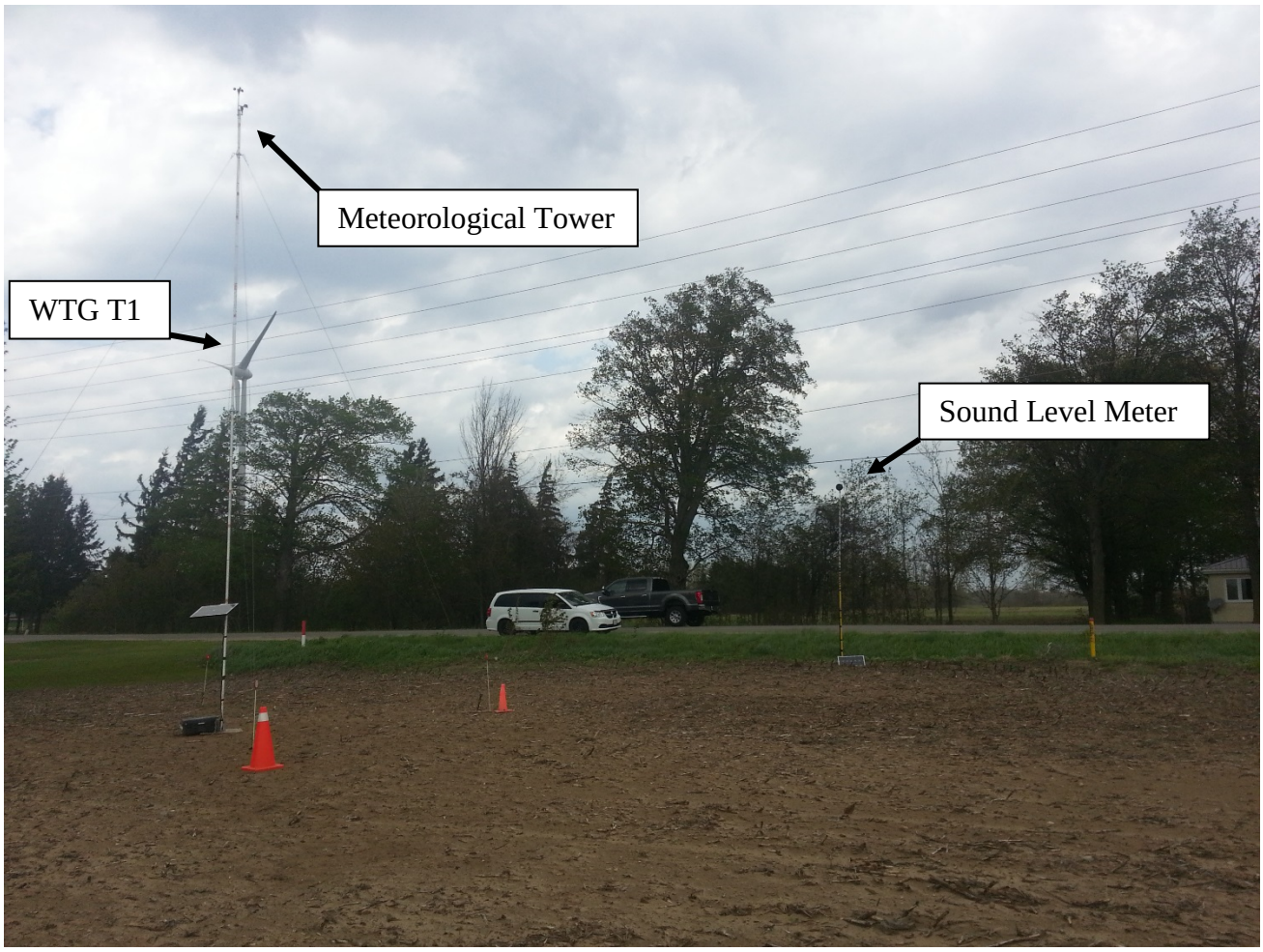


Photo of Meteorological Tower and Sound Level Meter at Location M2 (looking northeast)

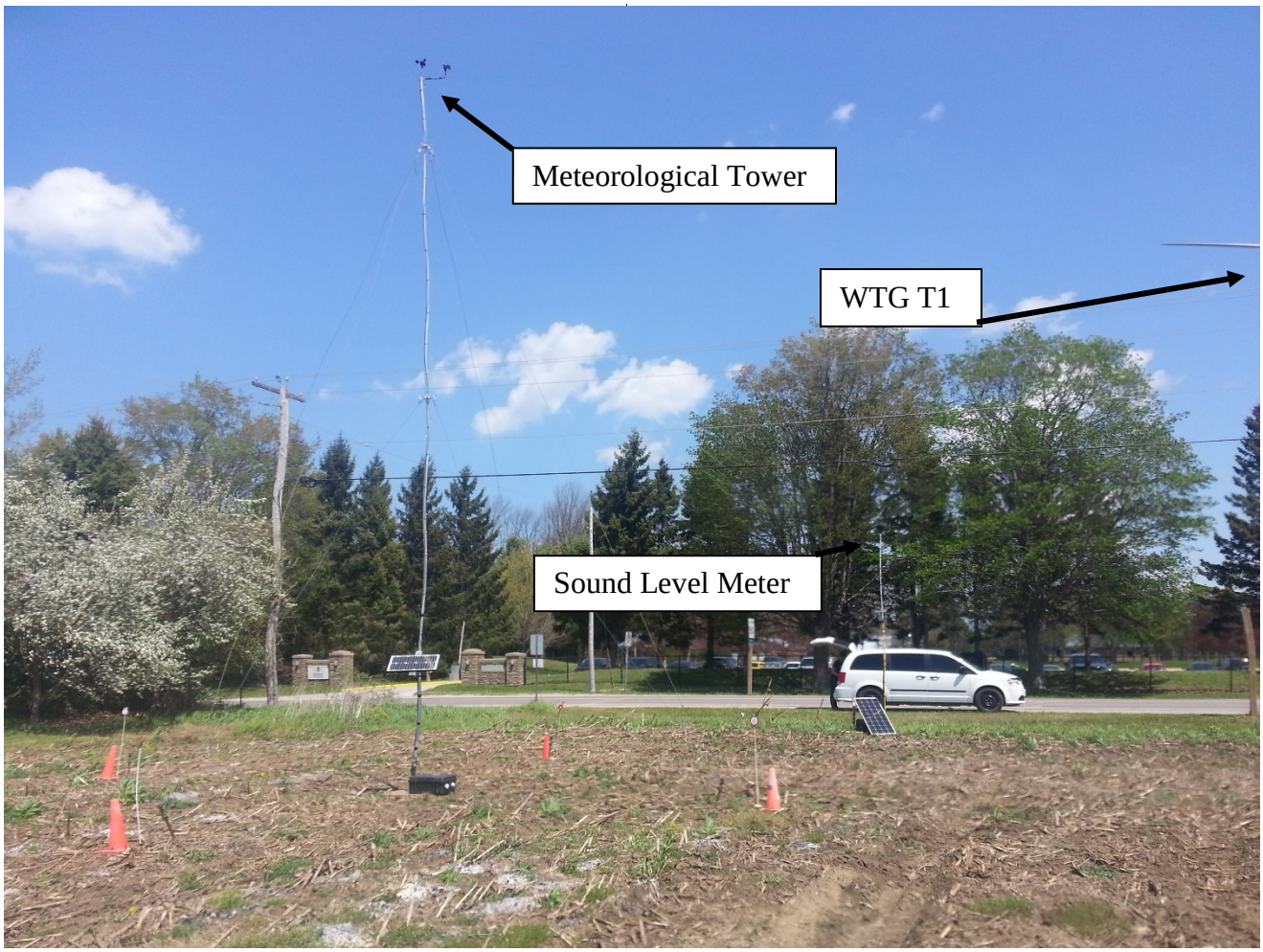


Photo of Meteorological Tower and Sound Level Meter at Location M3 (looking north)

APPENDIX C:

CALIBRATION CERTIFICATES

SOH Wind Engineering LLC

141 Leroy Road · Williston, VT 05495 · USA

Tel 802.316.4368 · Fax 802.735.9106 · www.sohwind.com

CERTIFICATE FOR CALIBRATION OF CUP ANEMOMETER

Certificate number: 16.US2.01516 **Date of issue:** February 9, 2016

Type: RNRG 40C Anemometer **Serial number:** 179500262926

Manufacturer: Renewable NRG Systems Inc, 110 Riggs Road, Hinesburg, VT 05461, USA

Client: Renewable NRG Systems Inc, 110 Riggs Road, Hinesburg, VT 05461, USA

Anemometer received: February 2, 2016 **Anemometer calibrated:** 12:54 February 9, 2016

Calibrated by: mej **Procedure:** MEASNET, IEC 61400-12-1:2005(E) Annex F

Certificate prepared by: Software Revision 7 **Approved by:** Calibration engineer, rds

Calibration equation obtained: v [m/s] = 0.76201 · f [Hz] + 0.32169

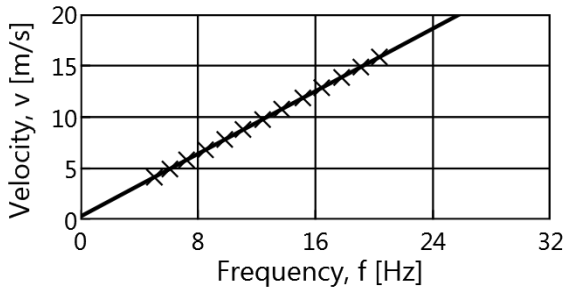
Standard uncertainty, slope: 0.00134 **Standard uncertainty, offset:** 0.04255

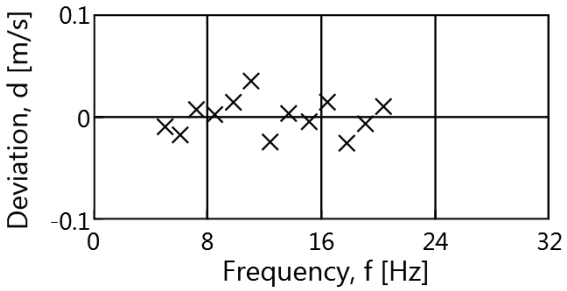
Covariance: -0.0000130 (m/s)²/Hz **Coefficient of correlation:** ρ = 0.999990

Absolute maximum deviation: 0.035 m/s at 8.793 m/s

Barometric pressure: 989.3 hPa **Relative humidity:** 11.8%

Succession	Velocity pressure, q. [Pa]	Temperature in wind tunnel [°C]	d.p. box [°C]	Wind velocity, v. [m/s]	Frequency, f. [Hz]	Deviation, d. [m/s]	Uncertainty u_c (k=2) [m/s]
2	10.01	23.8	27.5	4.155	5.0431	-0.009	0.026
4	14.22	23.8	27.5	4.952	6.0999	-0.017	0.026
6	19.78	23.8	27.5	5.842	7.2345	0.007	0.028
8	26.95	23.8	27.4	6.819	8.5229	0.002	0.030
10	35.51	23.8	27.4	7.827	9.8308	0.014	0.033
12	44.81	23.8	27.4	8.793	11.0712	0.035	0.035
13-last	55.14	23.8	27.4	9.754	12.4104	-0.024	0.038
11	67.22	23.8	27.4	10.770	13.7072	0.004	0.042
9	81.51	23.8	27.5	11.860	15.1484	-0.005	0.045
7	95.72	23.8	27.5	12.853	16.4255	0.015	0.048
5	111.13	23.8	27.5	13.849	17.7853	-0.025	0.052
3	128.01	23.8	27.5	14.863	19.0919	-0.006	0.055
1-first	145.46	23.8	27.5	15.843	20.3556	0.010	0.058





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CERTIFICATE FOR CALIBRATION OF CUP ANEMOMETER

Certificate number: 16.US2.01527 **Date of issue:** February 9, 2016

Type: RNRG 40C Anemometer **Serial number:** 179500262946

Manufacturer: Renewable NRG Systems Inc, 110 Riggs Road, Hinesburg, VT 05461, USA

Client: Renewable NRG Systems Inc, 110 Riggs Road, Hinesburg, VT 05461, USA

Anemometer received: February 2, 2016 **Anemometer calibrated:** 16:51 February 9, 2016

Calibrated by: ncm **Procedure:** MEASNET, IEC 61400-12-1:2005(E) Annex F

Certificate prepared by: Software Revision 7 **Approved by:** Calibration engineer, rds

Calibration equation obtained: v [m/s] = 0.76022 · f [Hz] + 0.35579

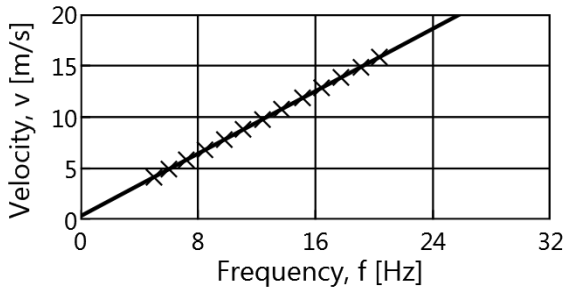
Standard uncertainty, slope: 0.00146 **Standard uncertainty, offset:** 0.04188

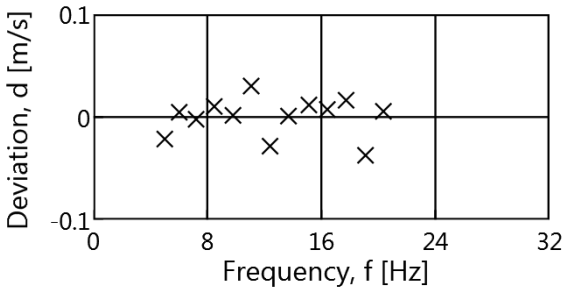
Covariance: -0.0000154 (m/s)²/Hz **Coefficient of correlation:** ρ = 0.999988

Absolute maximum deviation: 0.037 m/s at 14.838 m/s

Barometric pressure: 988.5 hPa **Relative humidity:** 11.8%

Succession	Velocity pressure, q. [Pa]	Temperature in wind tunnel [°C]	d.p. box [°C]	Wind velocity, v. [m/s]	Frequency, f. [Hz]	Deviation, d. [m/s]	Uncertainty u_c (k=2) [m/s]
2	9.96	24.1	27.5	4.149	5.0172	-0.021	0.026
4	14.15	24.2	27.5	4.946	6.0312	0.005	0.026
6	19.72	24.2	27.5	5.839	7.2156	-0.002	0.028
8	26.89	24.2	27.5	6.818	8.4869	0.010	0.030
10	35.29	24.1	27.4	7.810	9.8036	0.002	0.032
12	44.87	24.1	27.4	8.807	11.0769	0.030	0.035
13-last	55.06	24.1	27.5	9.756	12.4022	-0.028	0.038
11	67.07	24.1	27.4	10.768	13.6953	0.001	0.042
9	81.45	24.1	27.4	11.867	15.1267	0.012	0.045
7	95.42	24.2	27.5	12.845	16.4187	0.007	0.048
5	110.99	24.2	27.5	13.854	17.7341	0.016	0.052
3	127.30	24.1	27.5	14.838	19.0987	-0.037	0.055
1-first	144.98	24.1	27.5	15.834	20.3533	0.006	0.058





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CERTIFICATE FOR CALIBRATION OF CUP ANEMOMETER

Certificate number: 16.US2.03537 **Date of issue:** March 29, 2016

Type: RNRG 40C Anemometer **Serial number:** 179500265230

Manufacturer: Renewable NRG Systems Inc, 110 Riggs Road, Hinesburg, VT 05461, USA

Client: Renewable NRG Systems Inc, 110 Riggs Road, Hinesburg, VT 05461, USA

Anemometer received: March 22, 2016 **Anemometer calibrated:** 19:30 March 29, 2016

Calibrated by: ncm **Procedure:** MEASNET, IEC 61400-12-1:2005(E) Annex F

Certificate prepared by: Software Revision 7 **Approved by:** Calibration engineer, rds

Calibration equation obtained: v [m/s] = 0.76461 · f [Hz] + 0.31796

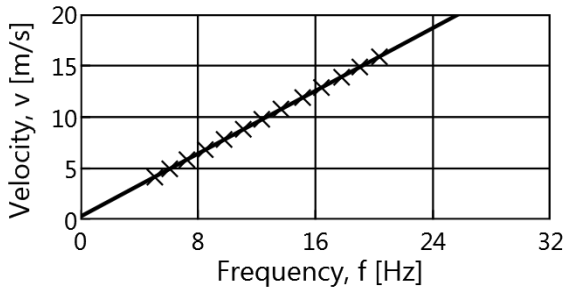
Standard uncertainty, slope: 0.00180 **Standard uncertainty, offset:** 0.05789

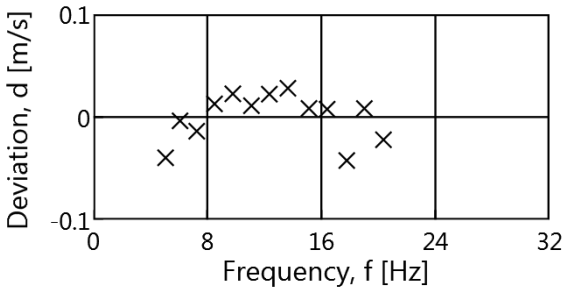
Covariance: -0.0000236 (m/s)²/Hz **Coefficient of correlation:** ρ = 0.999982

Absolute maximum deviation: 0.042 m/s at 13.873 m/s

Barometric pressure: 1005.9 hPa **Relative humidity:** 18.5%

Succession	Velocity pressure, q. [Pa]	Temperature in wind tunnel [°C]	d.p. box [°C]	Wind velocity, v. [m/s]	Frequency, f. [Hz]	Deviation, d. [m/s]	Uncertainty u_c (k=2) [m/s]
2	10.18	24.0	31.4	4.159	5.0755	-0.040	0.024
4	14.54	24.0	31.4	4.970	6.0893	-0.004	0.025
6	20.17	24.0	31.4	5.854	7.2578	-0.014	0.027
8	27.51	24.0	31.4	6.837	8.5089	0.013	0.029
10	36.04	24.0	31.5	7.825	9.7884	0.023	0.032
12	45.70	23.9	31.5	8.811	11.0937	0.011	0.035
13-last	56.35	23.9	31.4	9.784	12.3511	0.022	0.038
11	68.48	23.9	31.4	10.786	13.6543	0.028	0.041
9	83.29	24.0	31.5	11.897	15.1322	0.008	0.045
7	97.46	24.0	31.4	12.870	16.4059	0.008	0.048
5	113.23	24.0	31.4	13.873	17.7828	-0.042	0.052
3	130.05	24.0	31.4	14.868	19.0183	0.008	0.055
1-first	148.02	23.9	31.4	15.861	20.3573	-0.022	0.058





AC-1746

CERTIFICATE of CALIBRATION

Make : Svantek

Model : SVAN977

Descr. : Sound Level Meter Type 1

Serial # : 36426

Asset # : SV977-2

Reference # : 146973

Customer : HGC Engineering
Mississauga, ON

P. Order : Sean Richardson

Cal. status : Received in spec's, no adjustment made.

Navair Technologies certifies that the above listed instrument was calibrated on date noted and was released from this laboratory performing in accordance with the specifications set forth by the manufacturer.

Unless otherwise noted in the calibration report a 4:1 accuracy ratio was maintained for this calibration.

Our calibration system complies with the requirements of ISO-17025 standard, working standards used for calibration are certified by or traceable to the National Research Council of Canada or the National Institute of Standards and Technology.

Calibrated : Feb 22, 2017

Cal. Due : Feb 22, 2018

By : T. Beilin

Temperature : 23 °C ± 2 °C Relative Humidity : 30% to 70%

Standards used : J-216 J-303 J-512

Navair Technologies

REPAIR AND CALIBRATION TRACEABLE TO NRC AND NIST

6375 Dixie Rd. Mississauga, ON, L5T 2E7 http: // www.navair.com

Phone : 905 565 1584 Fax: 905 565 8325 e-Mail: service @ navair.com

CERTIFICATE of CALIBRATION

Make : Svantek

Model : SVAN977

Descr. : Sound Level Meter Type 1

Serial # : 36428

Asset # : SV977-3

Reference # : 146971

Customer : HGC Engineering
Mississauga, ON

P. Order : Sean Richardson

Cal. status : Received in spec's, no adjustment made.

76
Feb 24, 2017

Navair Technologies certifies that the above listed instrument was calibrated on date noted and was released from this laboratory performing in accordance with the specifications set forth by the manufacturer.

Unless otherwise noted in the calibration report a 4:1 accuracy ratio was maintained for this calibration.

Our calibration system complies with the requirements of ISO-17025 standard, working standards used for calibration are certified by or traceable to the National Research Council of Canada or the National Institute of Standards and Technology.

Calibrated : Feb 22, 2017

Cal. Due : Feb 22, 2018

By : T. Beilin

Temperature : 23 °C ± 2 °C Relative Humidity : 30% to 70%

Standards used : J-216 J-303 J-512

Navair Technologies

REPAIR AND CALIBRATION TRACEABLE TO NRC AND NIST

6375 Dixie Rd. Mississauga, ON, L5T 2E7
Phone : 905 565 1584 Fax: 905 565 8325
http: // www.navair.com
e-Mail: service @ navair.com

CERTIFICATE of CALIBRATION

Make : Svantek

Model : SVAN977

Descr. : Sound Level Meter Type 1

Serial # : 36439

Asset # : SV977-4

Reference # : 146966

Customer : HGC Engineering
Mississauga, ON

P. Order : Sean Richardson

Cal. status : Received in spec's, no adjustment made.

NG
Feb 24, 2017

Navair Technologies certifies that the above listed instrument was calibrated on date noted and was released from this laboratory performing in accordance with the specifications set forth by the manufacturer.

Unless otherwise noted in the calibration report a 4:1 accuracy ratio was maintained for this calibration.

Our calibration system complies with the requirements of ISO-17025 standard, working standards used for calibration are certified by or traceable to the National Research Council of Canada or the National Institute of Standards and Technology.

Calibrated : Feb 22, 2017

By : T. Beilin

Cal. Due : Feb 22, 2018

Temperature : 23 °C ± 2 °C Relative Humidity : 30% to 70%

Standards used : J-216 J-303 J-512

Navair Technologies

REPAIR AND CALIBRATION TRACEABLE TO NRC AND NIST

6375 Dixie Rd. Mississauga, ON, L5T 2E7
Phone : 905 565 1584 Fax: 905 565 8325
http: // www.navair.com
e-Mail: service @ navair.com

APPENDIX D:

STATEMENT OF OPERATION

National Office
205 Placer Court
Toronto, Ontario M2H 3H9

UNIFOR
theUnion | lesyndicat

Bureau national
205 Placer Court
Toronto (Ontario) M2H 3H9

Jerry Dias
National President
Président national

Renaud Gagné
Quebec Director
Directeur québécois

Robert J. Orr
National Secretary-Treasurer
Secrétaire-trésorier national

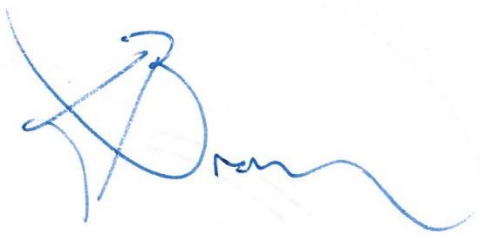
December 15, 2017

To whom it may concern,

Re: Statement of Operation
Union Building Corporation of Canada
Port Elgin, Ontario

This letter is to confirm that the wind turbine generator at the Unifor Family Education Center was functioning in its standard operational mode during the acoustic audit, conducted between September 21 and November 7, 2017. Additionally, this letter confirms that the turbine was shut down for ambient (OFF) condition measurements.

Yours Truly,



Graeme Brown
Director, Operations and Facilities

lgcope343