HGC ENGINEERING

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ACOUSTIC AUDIT - IMMISSION REPORT BOREALIS ICE PROTECTION SYSTEM

Amherst Island Wind Project

Amherst Island, Ontario

Version 1

Project Number: 02000707

Prepared for:

Windlectric Inc.
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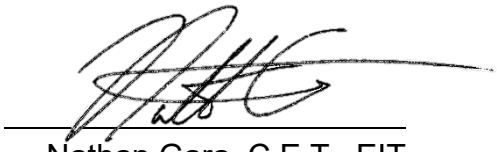
Oakville, ON
L6J 2X1

Prepared by:



Nathan Gara, C.E.T., EIT

Checked by:

Ian R. Bonsma, PEng

March 10, 2022

VERSION CONTROL

Amherst Island Wind Project
Acoustic Audit - Immission Report, Borealis Ice Protection System

Version	Date	Version Description
1	March 10, 2022	Original Report

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EXECUTIVE SUMMARY

Howe Gastmeier Chapnik Limited ("HGC Engineering") was retained by Windlectric Inc. to complete an immission audit at one location near Wind Turbine Generator S37 ("WTG S37"), part of the Amherst Island Wind Project ("Wind Project") in Loyalist Township, Ontario. The immission audit is required as a condition of Renewable Energy Approval Amendment 7123-9W9NH2 ("REA Amendment"), issued to the Wind Project by the Ontario Ministry of the Environment, Conservation and Parks ("MECP") on July 28, 2021. HGC Engineering has assessed the acoustic impact against the acoustic criteria of the MECP and in accordance with the requirements of the MECP's *Compliance Protocol for Wind Turbine Noise*. The results of the immission audit indicate that the Wind Project is operating in compliance of the MECP criteria at monitoring location M1. Furthermore, sound levels collected during anti-icing mode and de-icing mode operation indicate that the ice protection system has a negligible acoustic impact at monitoring location M1. This report presents the results from the measurement campaign, completed between September 16, 2021, and January 10, 2022. Details of the measurements and analysis are provided herein.

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1 INTRODUCTION

Howe Gastmeier Chapnik Limited ("HGC Engineering") was retained by Windlectric Inc. to complete an Acoustic Audit – Immission ("Audit") at one location near Wind Turbine Generator S37 ("WTG S37"), part of the Amherst Island Wind Project ("Wind Project"). The Wind Project is located in Loyalist Township, Ontario and consists of 26 Siemens SWT-xx-113 wind turbine generators, each rated at either 2772 kW or 2942 kW. All wind turbine generators have a hub height of 99.5 m.

WTG S37 is outfitted with a retrofit blade ice protection system manufactured by Borealis Wind Inc. The system consists of a blade heater installed in each blade and a control cabinet installed in the nacelle. The ice protection system has two modes of operation: ON and OFF. De-icing refers to the operation of the ice protection system while the wind turbine is parked, and anti-icing refers to the operation of the ice protection system during normal turbine operation to prevent ice accumulation on the blades.

The Audit is required as a condition of a Renewable Energy Approval Amendment 7123-9W9NH2 ("REA Amendment"), issued to the Wind Project by the Ontario Ministry of the Environment, Conservation and Parks ("MECP") on July 28, 2021. As per Condition X2 of the REA Amendment, the measurements and analysis described herein were conducted in accordance with the requirements of Part D of the MECP's *Compliance Protocol for Wind Turbine Noise* ("Compliance Protocol") [1]. This report summarizes the results of the Audit.

2 MONITORING LOCATION

As required by the REA Amendment, one monitoring location was selected to represent noise sensitive receptors to the north of WTG S37 with a predicted Wind Project only sound level of 39.2 dBA. The final monitoring location was selected based on sound levels predicted by an acoustic model prepared by HGC Engineering, landowner permission, and absence of local interfering sound (i.e. trees, crops, etc.). Note that the selected location is not a receptor location with respect to either the original Renewable Energy Approval for the project or the *Noise*

Assessment Report ("NAR") [2] prepared by Hatch, but rather represents a non-participating receptor with the highest predicted sound level from the Wind Project.

The selected monitoring location, designated M1, is a vacant lot 740 m northwest of WTG S37. The sound level meter was installed approximately 60 m east of the intersection of Concession Road 3 and Stella 40 Foot Road. The microphone was placed at a height of 4.5 m.

The Wind Project area is generally rural in nature with infrequently travelled gravel roads. An overview of the monitoring location is shown in Figure 1, and photos of the installation are provided in Appendix A.

The predicted sound level at the monitoring location, along with its UTM coordinates and distance to the nearest wind turbine can be found in Table 1.

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

Location	UTM Coordinates		Nearest Wind Turbine		Predicted Sound Level [dBA]
	Easting	Northing	ID	Distance [m]	
M1	365061	4890441	S37	740	39.2 *

* Sound level predicted by acoustic model prepared by HGC Engineering.

3 INSTRUMENTATION

The 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 a Svantek 977 sound level meter connected to a ½" microphone. The microphone was set at a height of approximately 4.5 m and equipped with a 175 mm diameter windscreen 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. An anemometer and wind vane were installed on a 10 m tall tower, approximately 4 m from the sound monitoring equipment, to collect local wind speed and direction. Weather conditions including temperature, humidity, and precipitation were measured at location M1.

The various instruments deployed by HGC Engineering are summarized in Table 2.

Table 2: Measurement Instrumentation at Monitoring Location M1

Instrumentation Make and Model	Serial Number	Dates Deployed	Calibration Date	Calibration Due Date
Svantek 977	36426	September 16 to December 1, 2021	December 23, 2020	December 23, 2021
Svantek 977	45419	December 1, 2021, to January 10, 2022	March 5, 2021	March 5, 2022
Vaisala WXT 520	R3150067	September 16 to November 5, 2021	July 28, 2021	July 28, 2023
NRG #40C anemometer	179500266979	November 5, 2021, to January 10, 2022	January 13, 2020	January 13, 2022

Each sound level meter was 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. Calibration verification was carried out on several occasions throughout the measurement period.

A windscreen was used on the microphone, consistent with the requirements of MECP technical publication *NPC-103*, *Procedures* [3]. A large wind screen, 175 mm in diameter, was used on the sound level meters 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.

As shown in Table 2, all the equipment was within its annual or bi-annual calibration, confirmed by the calibration certificates found in Appendix B.

4 ASSESSMENT CRITERIA

The MECP 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 3 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 3 Area [dBA]	40.0	40.0	40.0	43.0	45.0	49.0	51.0

If the ambient sound levels (OFF condition) are greater than the applicable limits identified in Table 3, then the applicable limits are the determined ambient sound (OFF condition) in each of the integer wind speed bins.

It should be noted that the sound level limits of the MECP 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.

5 METHODOLOGY

The Audit was 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 wind turbines operating. The ON condition is defined as any period where all wind turbine generators within 3 km of the measurement location are operational. The OFF condition is defined as any period where sufficient nearby wind turbine generators are

parked (i.e. 0 rpm) to reduce the total sound level contribution of the facility at the measurement location to less than 30 dBA.

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 L_{EQ} 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). In accordance with the environmental specifications of the instrumentation, data measured during periods with temperatures below -10°C or relative humidity greater than 90% were omitted from the analysis. 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).

A modified electrical power filter of 75% of the rated electrical output of turbine WTG S37 was used to increase the number of valid data points. It has been established on previous Audits conducted at the Wind Project that the turbine operational (ON) sound levels remained relatively unchanged between the modified power filter rating (75% of the rated electrical output) and the 85% rated electrical output prescribed by the Compliance Protocol. Furthermore, an Acoustic Test Report for WTG S37, completed by HGC Engineering, dated June 9, 2021 [5], supports the

use of a modified power filter. The Acoustic Test Report indicates the maximum sound power of the wind turbine is reached at approximately 72% of the rated electrical power output in the downwind condition.

The specific yaw position and power filter used at location M1 are summarized in Table 4. Additionally, all wind turbines within 3 km of the measurement location were operational.

Table 4: Yaw Position and Power Filters

Location	Rated Electrical Power [kW]	Acceptable Yaw Position (Downwind)	Acceptable S37 Power Output [kW]
M1	2942	98° to 188°	2207 (75%)

If the measurement campaign does not yield enough data to satisfy the minimum requirements of Part D of the Compliance Protocol, a Revised Assessment Methodology Immission 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). Appropriate justification for a reduced amount of data is determined on a case-by-case basis and may include the length of the monitoring campaign (greater than 6 weeks) and lower standard deviation of the sound levels.

The Compliance Protocol allows for the removal of individual events to improve the signal to noise ratio. A filter to remove gusty wind events that cause low frequency buffeting on the microphone was used to omit data where the maximum recorded 10 m height wind speed was more than 3 m/s greater than the average wind speed recorded over the same minute. An additional filter was used to exclude periods where WTG S37 was parked, and the wind speed measured at hub-height was below the cut-in wind speed of the turbine (3 m/s). Under these conditions, the ambient sound level with the turbine parked is not representative of the ambient sound level with the turbine operating, and these data points are excluded from the analysis.

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 (birds, car passbys, voices, dogs, wind gusts, waves, etc.).

Adjustments to the measured sound levels may be required based on wind turbine tonality, if any. If during the 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* [6] or at the MECP Director's discretion another equivalent standard/procedure. 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* [7].

Data was collected both with and without the ice protection system operating, in accordance with Section X2 or the REA Amendment. To collect data with and without the Borealis operating under similar environmental conditions, the Borealis system cycled on and off every hour between 22:00 and 05:00 every night of the measurement campaign. The Borealis was cycled on and off both with WTG S37 operational and parked.

6 MEASUREMENTS AND RESULTS

Instrumentation was deployed on September 16, 2021. The weather during the monitoring period varied, including several days with rain and snow. Temperatures ranged from -17°C to 25°C. Ground conditions immediately surrounding the measurement locations were fallow grassland or light snow cover for the duration of the monitoring period.

Wind speeds at 10 m height ranged from 0 m/s up to 17 m/s. The prevailing wind direction during the monitoring period was from the northwest. Figures 2a and 2b show the wind direction for monitoring location M1 and WTG S37 during nighttime periods over the duration of the measurement campaign.

Appendix C includes a statement from the Wind Project indicating the wind turbine generators were operating normally from September 16, 2021, to January 10, 2022, during operational ON data and the required turbines were shut down for ambient OFF data.

6.1 Summary of Valid Data Points Collected

The number of valid data points collected at location M1 is summarized in Table 5.

Table 5: Summary of Valid Data Points

Wind Project Condition	10 m Height Wind Speed [m/s]						
	1	2	3	4	5	6	7
Turbine S37 Operating (ON) Borealis Operating (ON)	0^	3^	8^	19^	66	110	151
Turbine S37 Operating (ON) Borealis not Operating (OFF)	0^	0^	2^	34	107	140	120
Turbine S37 Parked (OFF) Borealis Operating (OFF)	0^	0^	0^	17^	30	31	35

^ Insufficient data. Fewer than 60 Operational (ON) or 30 Ambient (OFF) data points collected.

6.2 Sound Level Summary

The sound level summary for data collected at location M1 with and without the Borealis ice protection system operating is shown in Tables 6a and 6b, respectively.

Table 6a: Sound Level Summary, Borealis Operational, L_{EQ} [dBA]

L_{EQ} Sound Level [dBA]	10 m Height Wind Speed [m/s]					
	5		6		7	
Average Operating (ON) / Std Dev.	43	0.8	44	1.1	45	1.1
Average Ambient (OFF) / Std Dev.	43	0.8	44	1.2	44	1.0
Wind Project Only	**-***		**-***		**37**	
Exclusionary Minimum Criteria	40		40		43	
Applicable Criteria	43		44		44	
Excess	**0**		**0**		**0**	

* Ambient (OFF) sound level is equal or greater than Operational (ON) sound level.

Table 6b: Sound Level Summary, Borealis Not Operational, L_{EQ} [dBA]

L_{EQ} Sound Level [dBA]	10 m Height Wind Speed [m/s]					
	5		6		7	
Average Operating (ON) / Std Dev.	43	1.0	45	1.3	46	1.5
Average Ambient (OFF) / Std Dev.	43	0.8	44	1.2	44	1.0
Wind Project Only	**-***		**36**		**41**	
Exclusionary Minimum Criteria	40		40		43	
Applicable Criteria	43		44		44	
Excess	**0**		**0**		**0**	

* Ambient (OFF) sound level is equal or greater than Operational (ON) sound level.

The Wind Project Only sound level results with and without the Borealis operating are equivalent, within the standard deviation of the measurement. This strongly suggests that the Borealis is a negligible sound source as measured from monitoring location M1.

Based on the data presented above, and in Figures 3 and 4, the Wind Project is compliant with the MECP's sound level criteria at monitoring location M1.

6.3 Tonality Assessment

As requested by the MECP, a detailed tonality analysis was completed following methods from ISO/PAS 20065 [8]. The audio recordings collected at location M1 during the monitoring campaign were utilized to generate 3-second narrow-band spectra between 20 Hz and 6000 Hz. Due to the prevalence of higher frequency natural sounds in the area (i.e., birds, crickets, frogs, etc.), the upper frequency limit of the tonality analysis was limited to 1000 Hz. This upper frequency limit is consistent with any potential tones identified during the Emission Test for WTG S37 [5]. The tonal audibility results for each 3-second spectra were binned into integer wind speeds and logarithmically averaged in accordance with the standard to determine the tonal audibility value for each wind speed bin. Where tonal audibility greater than 4 dB is determined, adjustments are made to the wind project only sound levels based on the procedure described in ISO 1996-2.

Summary results of the tonality analysis are found in Tables 7 and 8.

Table 7: Summary of Tonality Results, Borealis Operational

10 m Height Wind Speed Bin	Tone Count (below 1000 Hz)	Number of Spectra Analyzed	Tone Presence	Average Tonal Audibility [dB]	Tonal Penalty [dB]
5	2	1320	0.2%	< -3	**0**
6	6	2200	0.3%	< -3	**0**
7	8	3020	0.3%	< -3	**0**

Table 8: Summary of Tonality Results, Borealis Not Operational

10 m Height Wind Speed Bin	Tone Count (below 1000 Hz)	Number of Spectra Analyzed	Tone Presence	Average Tonal Audibility [dB]	Tonal Penalty [dB]
5	4	2140	0.2%	< -3	**0**
6	4	2800	0.1%	< -3	**0**
7	7	2400	0.3%	< -3	**0**

The tonality analysis found no tonal audibility (i.e., tonal audibility greater than 0 dB) and no penalties are applicable for this measurement campaign. Detailed tonality analysis results are available electronically, upon request.

6.4 Assessment of De-Icing Mode Sound Levels

As per Condition X2, Section 4.c of the REA Amendment, data was collected while WTG S37 was parked and the Borealis system was operational. This operation is referred to herein as the de-icing mode.

The analysis of the data collected during de-icing operation is outside of the scope of the Compliance Protocol, and therefore a statement of compliance with respect to the Protocol can not be provided for the Borealis system operating in de-icing mode. Regardless, efforts have been made to assess the acoustic impact of the Borealis system as measured from monitoring location M1 by comparing data collected with and without the Borealis system operational, both while WTG S37 was parked.

A previous study completed by HGC Engineering measured sound levels of the Borealis system operating in de-icing mode. The measurements were conducted at approximately 150 m from WTG S37, during a period with calm winds (i.e., low background interference) to simulate a

worse-case scenario for the sound level impact of the ice protection system. The results of the study, summarized in a report dated January 22, 2021 [9], indicate that the sound power level of the Borealis system is greater than 10 dB less than the manufacturer rated sound power of the turbine in which it is installed (105 dBA).

The number of data points collected in the downwind direction while the Borealis system was operating in de-icing mode at location M1 is summarized in Table 9.

Table 9: Summary of Valid Data, Borealis Operating in De-Icing Mode

Wind Project Condition	10 m Height Wind Speed [m/s]						
	1	2	3	4	5	6	7
De-Icing Mode (Borealis ON, WTG S37 OFF)	3	1	13	24	38	9	12

The sound level summary for data collected at location M1 with the Borealis ice protection system operating in de-icing mode is shown in Table 12, below. The data is presented as a comparison to ambient data (i.e., WTG S37 and Borealis system not operating). Note that data collected in the 1 m/s and 2 m/s wind speed bins has been omitted due to lack of available data points and the absence of ambient data for comparison.

Table 10: Sound Level Summary, Borealis Operating in De-Icing Mode, L_{EQ} [dBA]

L_{EQ} Sound Level [dBA]	10 m Height Wind Speed [m/s]									
	3		4		5		6		7	
Borealis System ON (De-Icing Mode) / Std Dev.	41	0.5	41	1.1	43	1.3	44	1.8	44	0.8
Ambient (Borealis and WTG S37 Off) / Std Dev.	-	-	42	0.4	43	0.8	44	1.2	44	1.0
Borealis System Only	-^		-*		-*		-*		-*	

^ Ambient data is unavailable.
* Sound level with Borealis operating in De-icing mode is equal or less than ambient sound level.

Based on the data summarized in Table 10, the sound levels with and without the Borealis operating and WTG S37 parked are equivalent, within the standard deviation of the measurement, indicating that the Borealis operating in de-icing mode is a negligible sound

source as measured from monitoring location M1. This result agrees with the conclusion presented in the HGC Engineering report *Acoustic Testing, Blade De-Icing System [9].*

7 CONCLUSIONS

The measurements and analysis, performed in accordance with the methods prescribed by the Ontario Ministry of the Environment, Conservation and Parks' publication *Compliance Protocol for Wind Turbine Noise* indicate that the Amherst Island Wind Project is operating in compliance with the MECP's sound level criteria at monitoring location M1, under the conditions detailed in this report. Furthermore, sound levels collected during anti-icing mode and de-icing mode operation indicate that the ice protection system has a negligible acoustic impact at monitoring location M1.

REFERENCES

1. Ontario Ministry of the Environment, Conservation and Parks, *Compliance Protocol for Wind Turbine Noise Guideline for Acoustic Assessment and Measurement,* April 2017.
2. Hatch, *Amherst Island Wind Project Noise Assessment Report*, May 3, 2013.
3. Ontario Ministry of the Environment, Conservation and Parks Publication, NPC-103, *Procedures.*
4. Ontario Ministry of the Environment, Conservation and Parks Publication, *Noise Guidelines for Wind Farms*, May 2016.
5. HGC Engineering, *Acoustic Test Report – WTG S37, Version 3,* June 9, 2021.
6. CAN/CSA-C61400-11:13, *Wind Turbine Generator Systems – Part 11: Acoustical Measurement Techniques,* 2018.
7. International Standards Organization 1996-2, *Acoustics – Description, assessment and measurement of environmental noise – Part 2: Determination of environmental noise levels*, 2007.
8. ISO/PAS 20065:2016, *Acoustics — Objective method for assessing the audibility of tones in noise — Engineering method*, July 2016.
9. HGC Engineering, *Acoustic Testing, Blade De-Icing System, Version 1,* January 22, 2021.

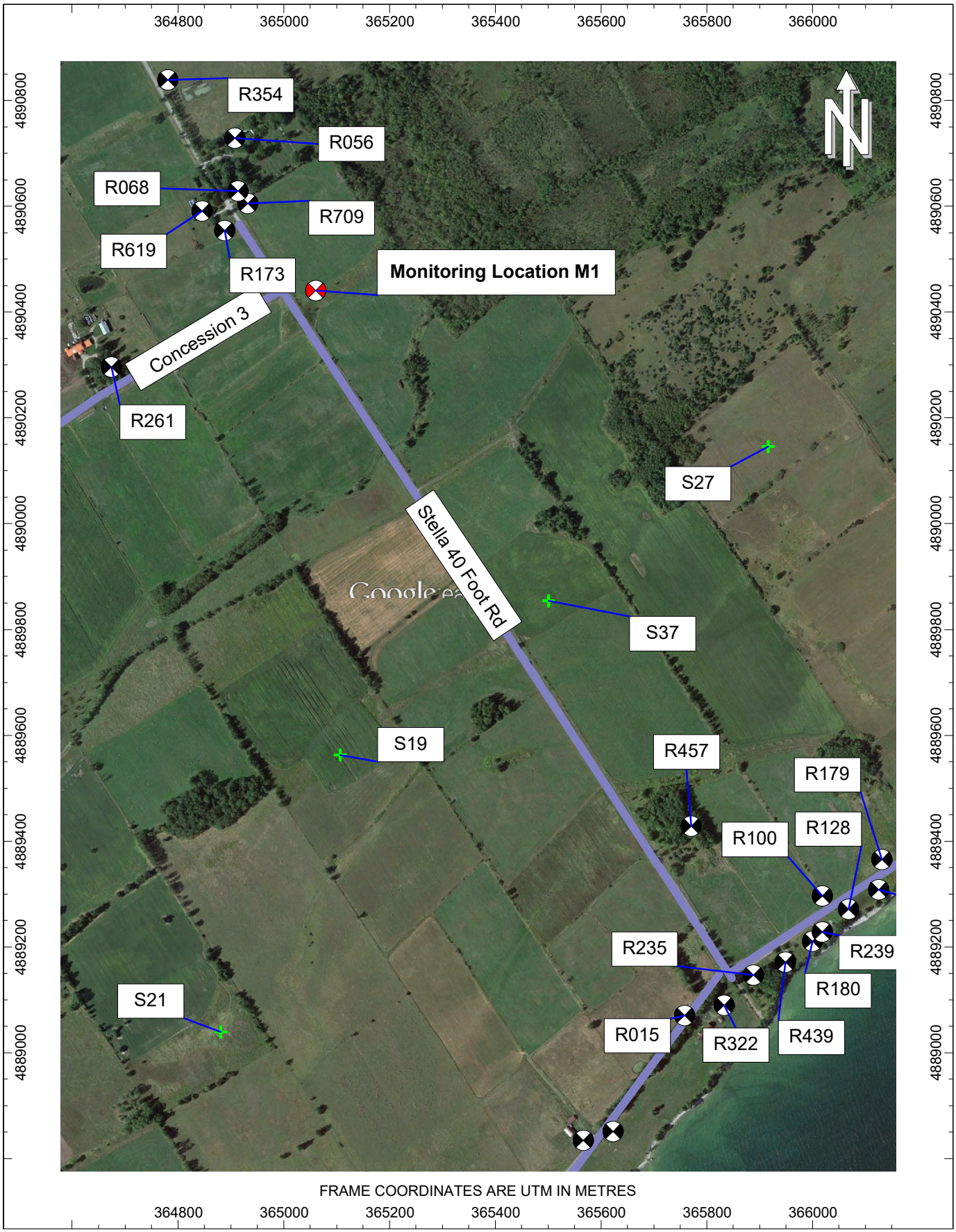


Figure 1 - Overview of Monitoring Location M1

Figure 2a: Wind Direction, Amherst Island Wind Project
10 m Height Meteorological Tower at Monitoring Location M1, Nighttime Period (22:00 to 5:00)
September 16, 2021, to January 10, 2022

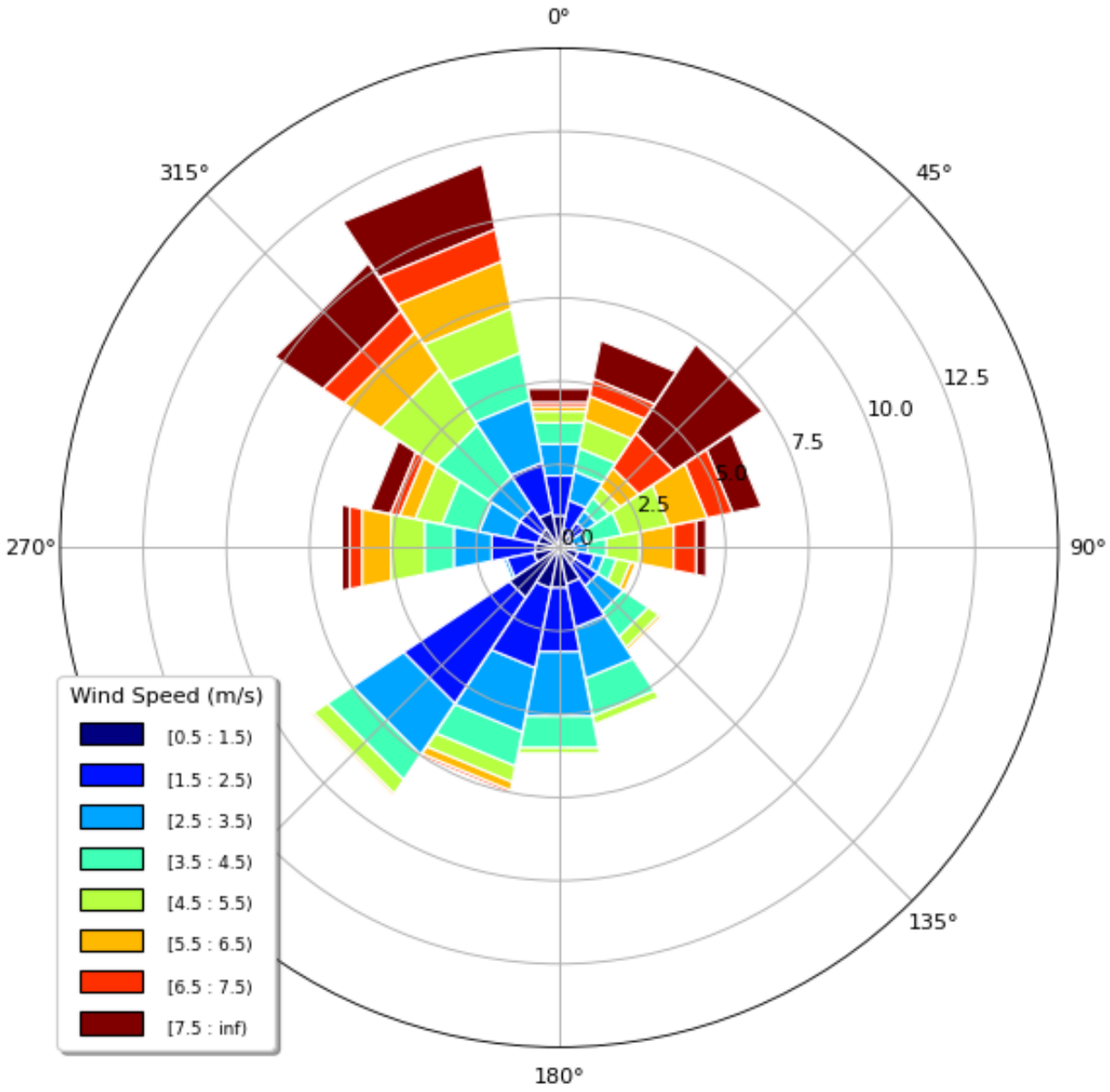


Figure 2b: Wind Direction, Amherst Island Wind Project
Hub Height Wind Speed and Azimuth Angle, WTG S37, Nighttime Period (22:00 to 5:00)
September 16, 2021, to January 10, 2022

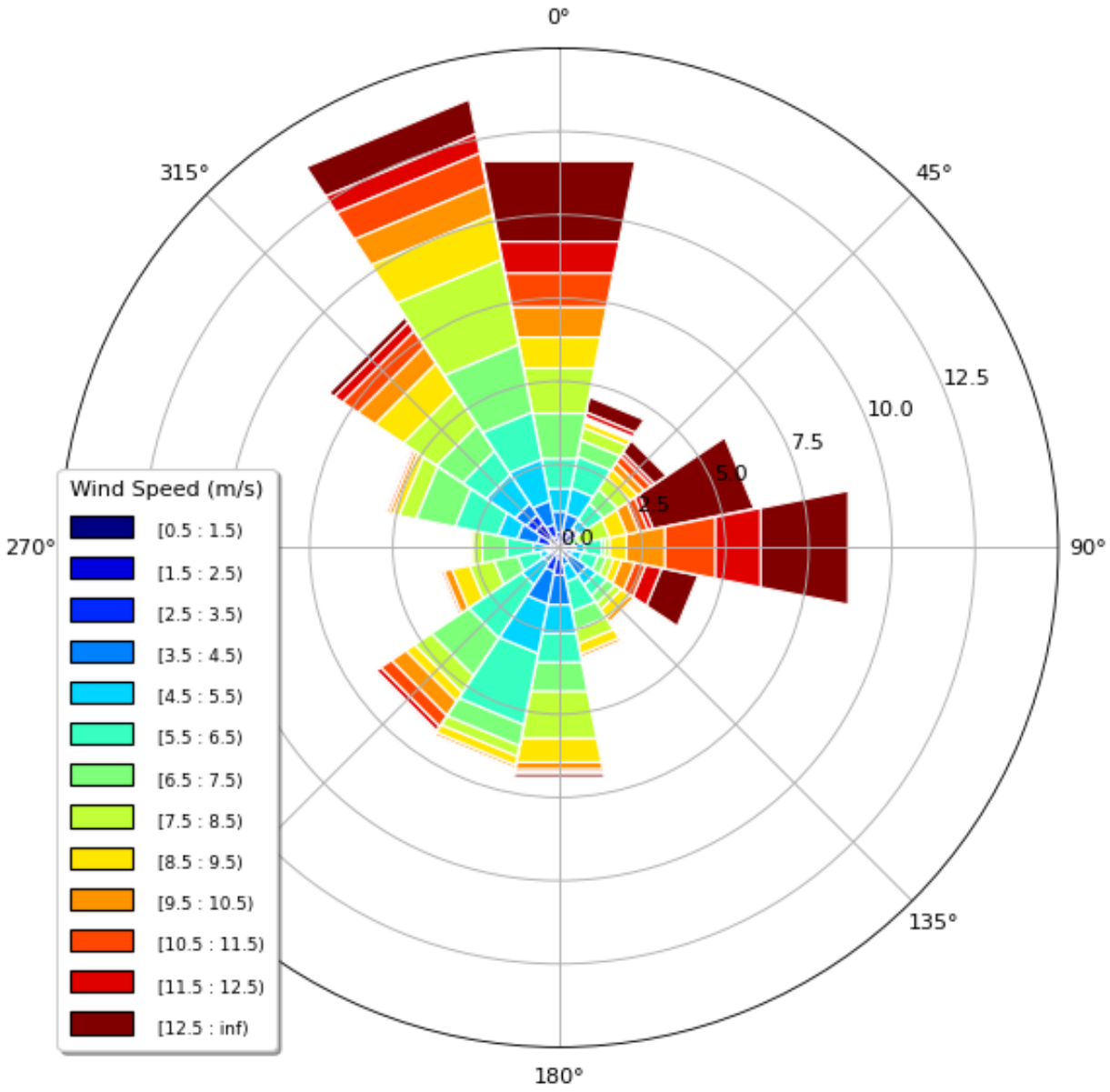


Figure 3: Immission Results, Monitoring Location M1, Borealis System Operational

Amherst Island Wind Project, September 16, 2021, to January 10, 2022

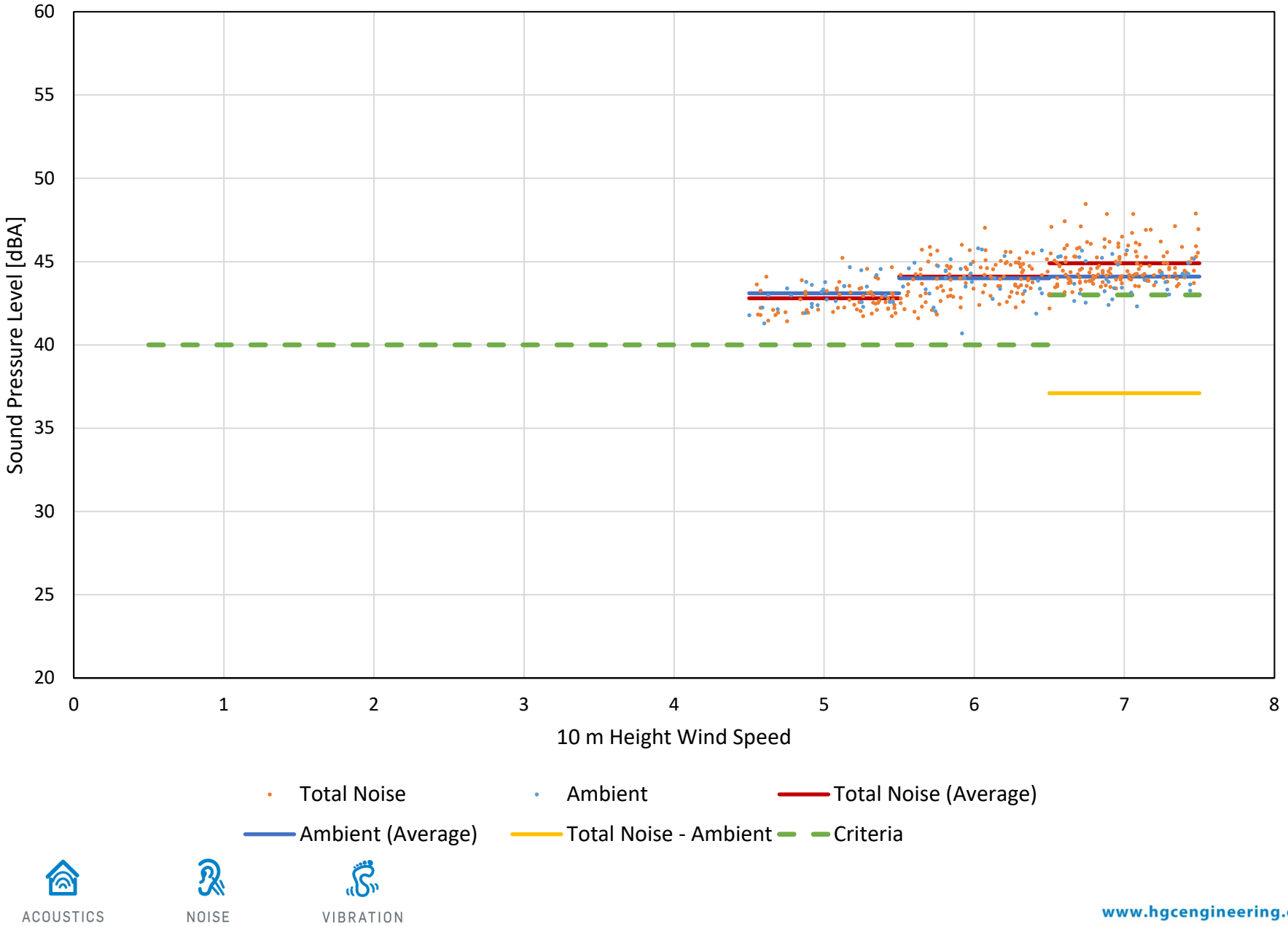
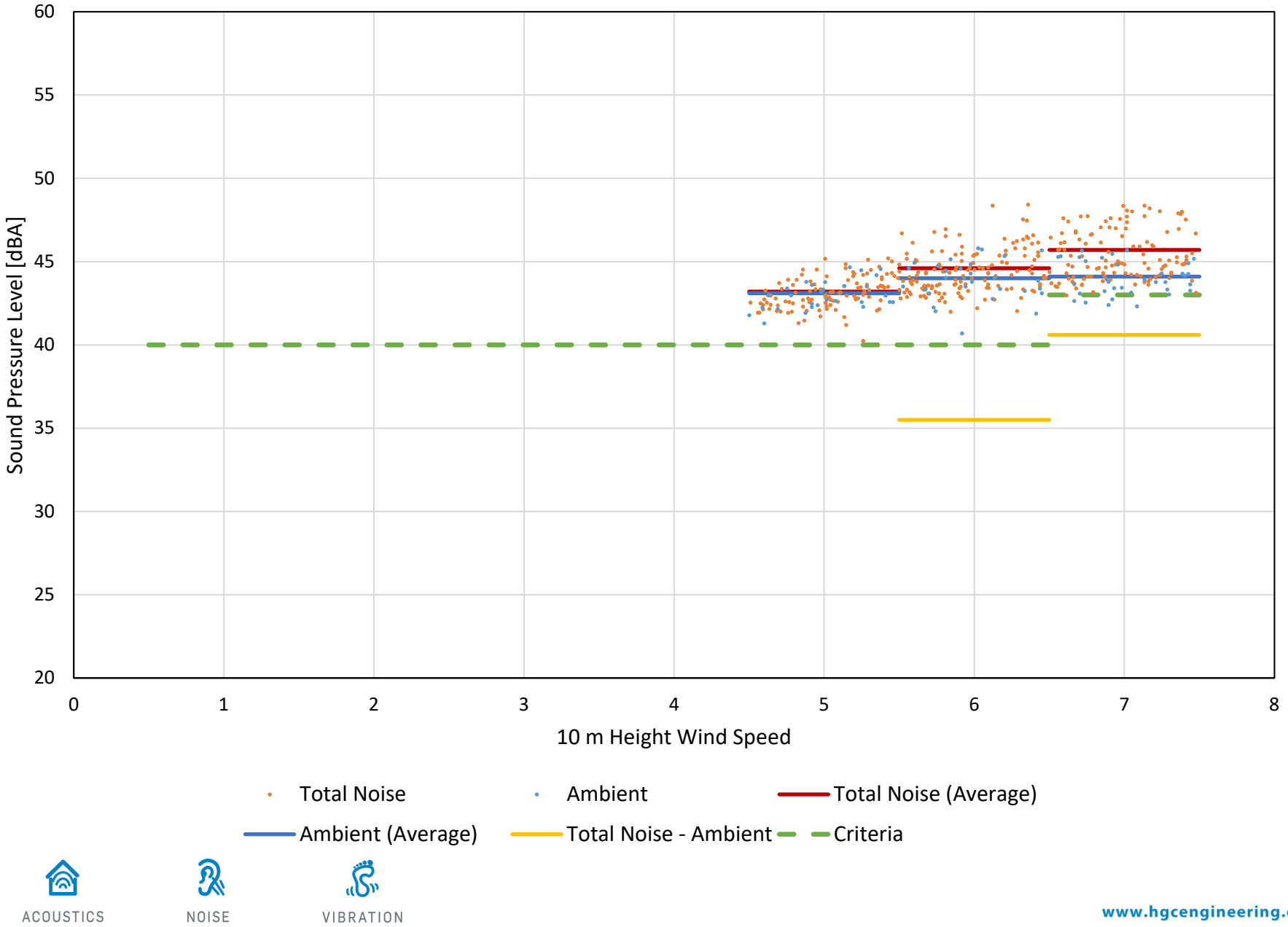


Figure 4: Immission Results, Monitoring Location M1, Borealis System Not Operational

Amherst Island Wind Project, September 16, 2021, to January 10, 2022



APPENDIX A:
MONITORING LOCATION PHOTOS

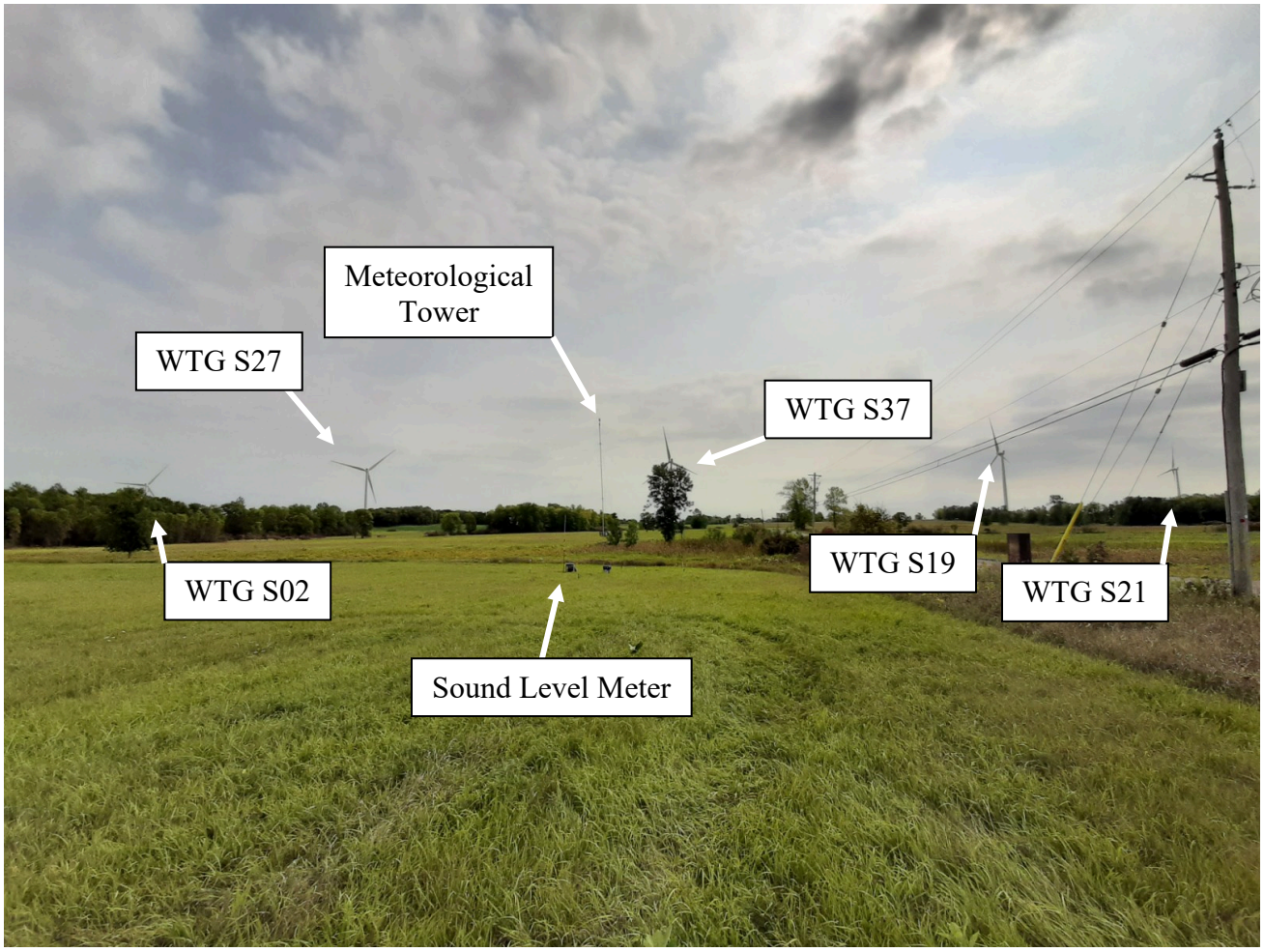


Photo of Meteorological Tower and Sound Level Meter at Monitoring Location M1 (looking south)

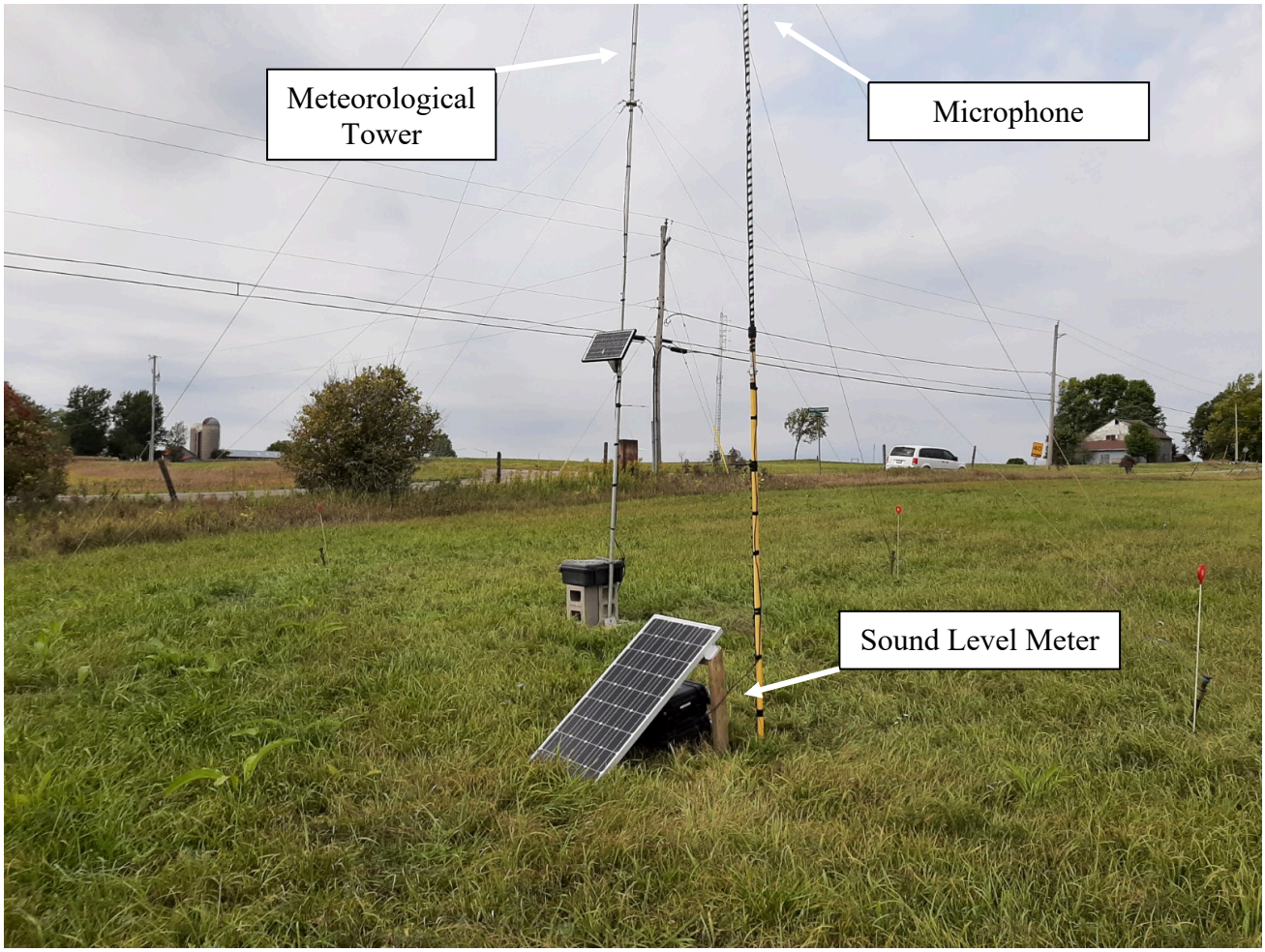


Photo of Instrumentation Deployed at Monitoring Location M1 (looking northwest)

APPENDIX B:
CALIBRATION CERTIFICATES

NRG 15

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

NC

Certificate number: 20.US1.00229 **Date of issue:** January 13, 2020

Type: NRG 40C Anemometer **Serial number:** 179500266979

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

Client: HGC Engineering, 2000 Argentia Road, Plaza One, Suite 203, Mississauga, ON L5N 1P7, Canada

Anemometer received: January 09, 2020 **Anemometer calibrated:** January 13, 2020

Calibrated by: MEJ **Procedure:** MEASNET, IEC 61400-12-1:2017 Annex F

Certificate prepared by: EJF **Approved by:** Calibration engineer, EJF

Eric Jeffcoat

Calibration equation obtained: v [m/s] = 0.75991 · f [Hz] + 0.37060

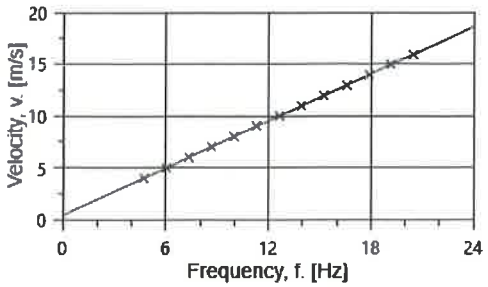
Standard uncertainty, slope: 0.00072 **Standard uncertainty, offset:** 0.01993

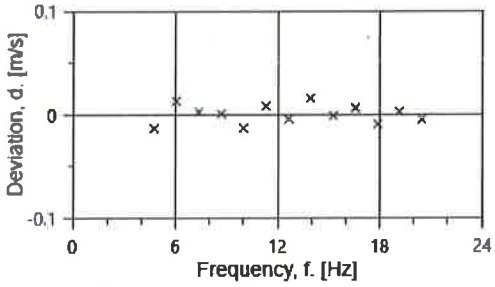
Covariance: -0.0000038 (m/s)²/Hz **Coefficient of correlation:** $\rho = 0.999997$

Absolute maximum deviation: 0.016 m/s at 10.987 m/s

Barometric pressure: 1016.3 hPa **Relative humidity:** 20.6%

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	9.58	18.3	24.5	3.973	4.7584	-0.013	0.023
4	14.99	18.4	24.5	4.971	6.0379	0.013	0.026
6	21.63	18.4	24.6	5.972	7.3680	0.002	0.030
8	29.56	18.4	24.6	6.982	8.7002	0.000	0.034
10	38.42	18.4	24.6	7.961	10.0059	-0.013	0.038
12	48.85	18.5	24.6	8.978	11.3157	0.008	0.042
13-last	60.25	18.5	24.6	9.971	12.6403	-0.005	0.046
11	73.17	18.4	24.6	10.987	13.9501	0.016	0.051
9	86.76	18.4	24.6	11.964	15.2588	-0.001	0.055
7	102.09	18.4	24.6	12.978	16.5820	0.006	0.059
5	118.09	18.4	24.6	13.957	17.8925	-0.010	0.063
3	135.07	18.3	24.5	14.927	19.1514	0.003	0.068
1-first	153.76	18.2	24.5	15.924	20.4739	-0.005	0.072





AC-1746

SOH Wind Engineering LLC
141 Leroy Road · Williston, VT 05495 · USA
Tel 802.316.4368 · Fax 802.735.9106 · www.sohwind.com

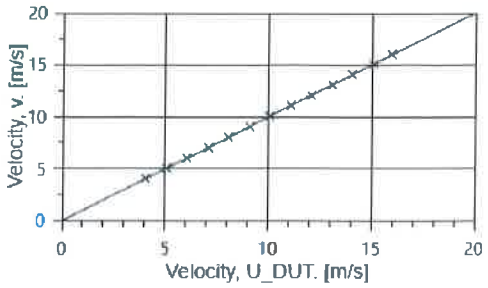
CERTIFICATE FOR CALIBRATION OF SONIC ANEMOMETER

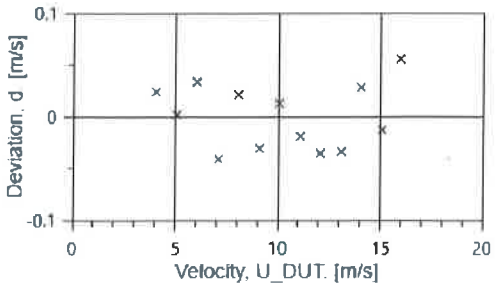
Certificate number: 21.US2.05462 **Date of issue:** July 28, 2021
Type: Vaisala Weather Transmitter, WXT536 **Serial number:** R3150067
Manufacturer: Vaisala, Oyj, Pl 26, FIN-00421 Helsinki, Finland
Client: HGC Engineering, 2000 Argentia Road, Plaza One, Suite 203, Mississauga, ON L5N 1P7, Canada
Anemometer received: July 26, 2021 **Anemometer calibrated:** July 28, 2021
Calibrated by: MEJ **Procedure:** MEASNET, IEC 61400-12-1:2017 Annex F
Certificate prepared by: EJF **Approved by:** Calibration engineer, EJF

Calibration equation obtained: v [m/s] = 1.00370 · U [m/s] + -0.07279

Standard uncertainty, slope: 0.00242 **Standard uncertainty, offset:** -0.35764
Covariance: -0.0000592 (m/s)²/m/s **Coefficient of correlation:** ρ = 0.999968
Absolute maximum deviation: 0.055 m/s at 16.003 m/s
Barometric pressure: 1004.1 hPa **Relative humidity:** 45.8%

Succession	Velocity pressure, q. [Pa]	Temperature in wind tunnel [°C]	d.p. box [°C]	Wind velocity, v. [m/s]	Anemometer Output, U. [m/s]	Deviation, d. [m/s]	Uncertainty u_c (k=2) [m/s]
1-first	9.34	27.2	26.9	4.016	4.0500	0.024	0.023
13-last	14.55	27.4	26.9	5.014	5.0667	0.002	0.026
2	21.02	27.2	26.9	6.025	6.0425	0.033	0.030
12	28.46	27.4	26.9	7.015	7.1024	-0.041	0.034
3	37.38	27.2	26.9	8.035	8.0571	0.021	0.039
11	47.23	27.4	26.9	9.037	9.1071	-0.031	0.043
4	58.33	27.2	26.9	10.039	10.0619	0.012	0.047
10	70.62	27.5	26.9	11.051	11.1024	-0.019	0.051
5	83.63	27.2	26.9	12.022	12.0857	-0.036	0.056
9	98.39	27.5	26.9	13.046	13.1048	-0.034	0.060
6	114.26	27.3	26.9	14.055	14.0476	0.028	0.064
8	130.90	27.5	26.9	15.048	15.0786	-0.013	0.069
7	148.08	27.4	26.9	16.003	15.9619	0.055	0.073





All OK 776 3 Aug 2021

CERTIFICATE of CALIBRATION

Make :	Svantek	Reference # :	164212
Model :	SVAN977	Customer :	HGC Engineering Mississauga, ON
Descr. :	Sound Level Meter Type 1		
Serial # :	36426	P. Order :	Sean Richardson
Asset # :	SV977_02		

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-9001-2015 and is registered under certificate CA96/269, 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 : Dec 23, 2020 By : T. Beilin

Cal. Due : Dec 23, 2021

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 : 800-668-7440 Fax: 905 565 8325
http: // www.navair.com
e-Mail: service @ navair.com

CERTIFICATE of CALIBRATION

Make :	Svantek	Reference # :	165047
Model :	SVAN977	Customer :	HGC Engineering Mississauga, ON
Descr. :	Sound Level Meter Type 1		
Serial # :	45419	P. Order :	No Paperwork
Asset # :	SV977-7		

NG
16 Mar 2021

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-9001-2015 and is registered under certificate CA96/269, 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 : Mar 05, 2021 By : T. Beilin

Cal. Due : Mar 05, 2022

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 : 800-668-7440 Fax: 905 565 8325
http: // www.navair.com
e-Mail: service @ navair.com

APPENDIX C:
STATEMENT OF OPERATION

Liberty
354 Davis Rd, Suite 100
Oakville, Ontario, Canada L6J 2X1
T 905-465-4500
F 905-465-4514
libertyenergyandwater.com

March 9, 2022

Re: Statement of Operation

Amherst Island Wind Project

Amherst Island, Ontario

To whom it may concern,

This letter is to confirm that the wind turbine generators at the Amherst Island Wind Project were operating normally during the post-construction acoustic audit of noise-sensitive receptors near WTG S37, conducted between September 16, 2021 and January 10, 2022. Additionally, this letter confirms that the relevant turbines were parked for ambient (OFF) condition measurements.

Yours Truly,

Anthony Jones

Manager, Environment

(365) 292-0178

anthony.jones@libertyutilities.com

APPENDIX D:
IMMISSION AUDIT CHECKLIST

Information Required in the Acoustic Audit Report – Immission

Amherst Island Wind Project, Second Immission Audit – Borealis Ice Protection System, Version 1

Requirement	Complete?	Notes
Did the Sound level Meter meet the Type 1 Sound level meter requirements according to the IEC standard 61672-1 Sound level Meters, Part 1: Specifications?	Y ☒ N ☐ N/A ☐	
Was the complete sound measurement system, including any recording, data logging or computing systems calibrated immediately before and after the measurement session at one or more frequencies using an acoustic calibrator on the microphone (must not exceed ±0.5dB)?	Y ☒ N ☐ N/A ☐	
Are valid calibration certificate(s) of the noise monitoring equipment and calibration traceable to a qualified laboratory? Is the validity duration of the calibration stated for each item of equipment?	Y ☒ N ☐ N/A ☐	
Was the predictable worst case parameters such as high wind shear and wind direction toward the Receptor considered? Section D3.2	Y ☒ N ☐ N/A ☐	
Is there a Wind Rose showing the wind directions at the site?	Y ☒ N ☐ N/A ☐	
Did the results cover a wind speed range of at least 4-7 m/s as outlined in section D 3.8.?	Y ☐ N ☐ N/A ☒	RAM-I audit used (Section E5.2)
Was the weather report during the measurement campaign included in the report?	Y ☒ N ☐ N/A ☐	
Did the audit state there was compliance with the limits at each wind speed category?	Y ☒ N ☐ N/A ☐	Compliance determined for complete datasets.
Are pictures of the noise measurement setup near Point of reception provided?	Y ☒ N ☐ N/A ☐	
Was there justification of the Receptor location choice(s) prior to commencement of the I-Audit?	Y ☐ N ☐ N/A ☒	Receptor locations were not selected by HGC Engineering.
Was there sufficient valid data for different wind speeds?	Y ☒ N ☐ N/A ☐	
Was the turbine (operational) specific information during the measurement campaign in tabular form (i.e. wind speed at hub height, anemometer wind speed at 10 m height, air temperature and pressure and relative humidity)?	Y ☒ N ☐ N/A ☐	

Requirement	Complete?	Notes
Were all the calculated standard deviations at all relevant integer wind speeds provided?	Y [X] N [ ] N/A [ ]	
Compliance statement	Y [X] N [ ] N/A [ ]	Compliance was only determined for complete datasets
All data included in an Excel spreadsheet	Y [X] N [ ] N/A [ ]	To be provided separately
If deviations from standard; was justification of the deviations provided	Y [ ] N [ ] N/A [X]	