aercoustics

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

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

IMMISSION AUDIT REPORT – Phase 2
Project: 16115.01

Nation Rise Wind Farm

North Stormont, ON

Prepared for:

Nation Rise Wind Farm Limited Partnership
Dufferin Liberty Centre
219 Dufferin St., Unit 217C
Toronto, Ontario
M6K 3J1

Prepared by:

Aron Sigurðsson, B.E.Sc.

Kohl Clark, B.Eng.

Duncan Halstead, B.A.Sc., P.Eng

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Revision History

Version	Description	Author	Reviewed	Date
1	Initial Report	KC	DH	December 13, 2022
R1	Revised Report based on MECP Comments: - Clarity added regarding valid temperature range of microphones in Section 4.3 - Added clarity regarding the audit periods for the R1883 and X0003 locations in Section 5.2. - Additional details regarding X0006 background sound level in Appendix F	KC	DH	February 10, 2023

Important Notice and Disclaimer

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1 Introduction

Aercoustics Engineering Limited (“Aercoustics”) has been retained by EDP Renewables (“EDP”) on behalf of Nation Rise Wind Farm Limited Partnership to complete an Immission Audit (“I-audit”) of the Nation Rise Wind Farm (“Nation Rise”). Nation Rise operates under Renewable Energy Approval ("REA") #0871-AV3TFM [1].

This I-audit has been conducted per the methodology outlined in Part D and Part E of the 2017 Compliance Protocol for Wind Turbine Noise (“Compliance Protocol”) [2]. The Compliance Protocol is an Ontario Ministry of the Environment, Conservation and Parks (“MECP”) document used to evaluate noise from a wind facility at nearby receptors.

This report summarizes the results of the Phase 2 I-audit testing, conducted as required by Condition E1 of the Nation Rise REA.

2 Facility Description

Nation Rise is a Class 4 wind facility located in North Stormont comprising twenty-nine (29) wind turbine generators (“turbines”), having a total nameplate capacity of ninety-nine point seven six (99.76) megawatts. Each turbine has a hub height of one hundred and thirty-one (131) metres. No other wind facilities are located in the vicinity of the project.

The facility has a single 115 megavolt-ampere transformer substation located to the east of Nine Mile Road between County Road 13 and Ouderkirk Road.

The facility is designed to operate 24 hours per day, 7 days per week.

3 Audit Location

The receptor selection process, monitoring equipment, and details regarding the monitoring locations are provided in this section.

3.1 Receptor Selection

A total of five (5) audit receptors were selected for this I-audit. The receptor selection criteria, including prevailing wind direction and predicted sound levels, used to select the audit receptors are detailed in this section.

3.1.1 Receptor Selection Criteria

Per the requirements of the Compliance Protocol, audit receptors were selected such that they represent the location of the greatest predicted noise impacts[1].

The Compliance Protocol requires data be collected during downwind periods. As such, receptors in locations that are downwind[2] of the nearest turbines are prioritized to assist with timely completion of the I-audit data collection.

Based on the noise model used to generate the acoustic assessment report [3] for the Nation Rise Wind Farm, there are only four locations with high predicted noise impacts that are downwind with respect to the prevailing wind direction – two of these locations are excluded for being participating receptors or for being locationally redundant. Accordingly, Condition E1(3) of the Nation Rise REA has been invoked as follows:

> E1(3): *If any of the five (5) Points of Reception cannot be selected on the basis of the criteria described in Condition E1(2) due to access restrictions or for any other reason, the Company must select alternate Points of Reception or locations (other than a Point of Reception), and must provide a clear written explanation to the Director and District Manager prior to undertaking the acoustic audit measurements as to why the criteria described in Condition E1(2) could not be met and the basis for selecting the alternate Points of Reception or locations. The Company must obtain the written agreement of the Director, and follow any directions provided, for the use of these alternate Points of Reception or locations prior to proceeding with the acoustic audit measurements.*

Following Condition E1(3) several other alternative locations which are not associated with a Receptor were identified in a memo submitted to the MECP dated July 9, 2021 which has been included in Appendix B. As a result, three (3) alternative locations were selected for monitoring.

3.1.2 Prevailing Wind Direction

Historical wind direction information was provided to Aercoustics by EDPR and used to support the selection of suitable I-audit receptors. This wind direction information is provided in Figure 1. The most frequently occurring wind direction is taken to be the prevailing wind direction.

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[1] "Predicted noise impact" refers to the predicted impacts determined using the sound model prepared by DNV-GL for the acoustic assessment report [3] which is understood to reflect the as-built turbine layout.

[2] A "Downwind" receptor indicates that the direction from receptor to turbine is within +/-45° of the direction of the prevailing winds.

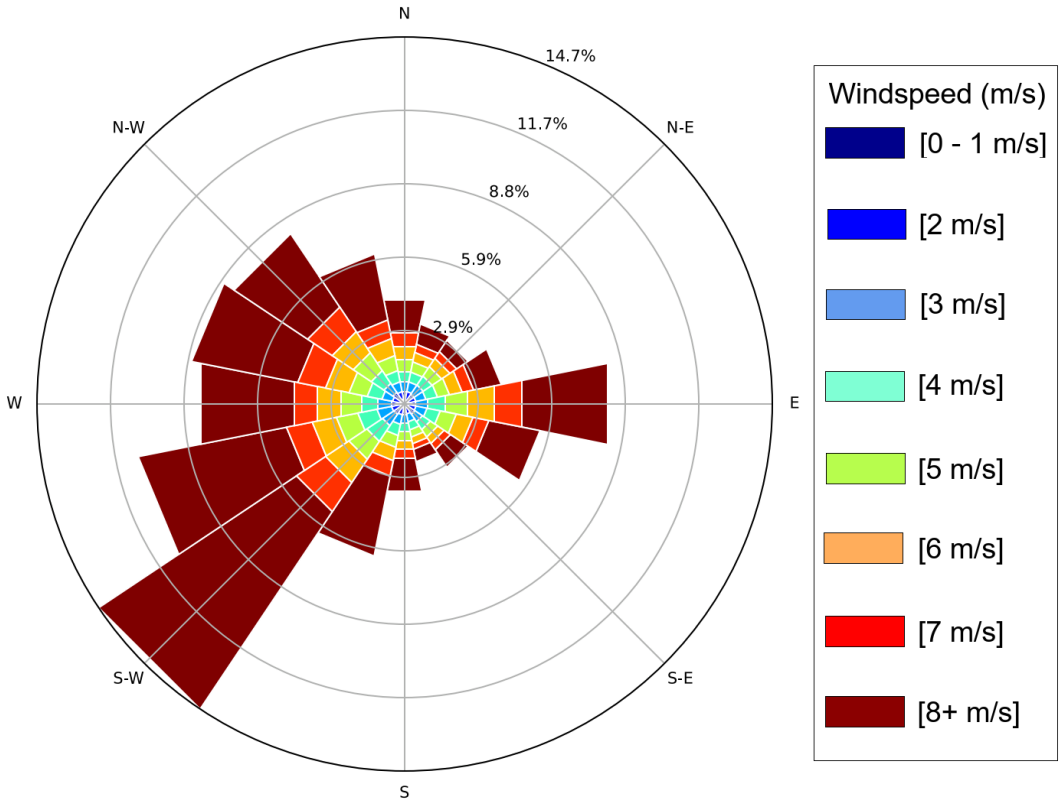


Figure 1: Historical Wind Rose used for Receptor Selection

From the information in Figure 1, the prevailing downwind direction for Nation Rise is determined to be 225° (S-W).

3.1.3 Receptor Selection Table

Receptors to Nation Rise with the greatest predicted noise impacts and a downwind direction are shown in Table 1, sorted in descending order. The receptor list in Table 1 reflects the full list of locations which are downwind with respect of the prevailing wind direction, and which have a predicted noise impact greater than or equal to 37 dBA[3]. The three (3) locations not associated with a receptor, discussed in 3.1.1, have also been included in the table. A more detailed receptor selection table showing all potential receptors has been included in Appendix B.

[3] 37 dBA is the threshold indicated in the Compliance Protocol for receptors having a high predicted noise output.

Table 1: Receptor Selection Table.

Receptor ID	Receptor Type	Receptor Height (m)	Distance to Closest Turbine (m)	Closest Turbine ID	Predicted SPL‡ (dBA)	Prevailing Wind Direction†	Notes
V4288	Participating	4.5	404	T41	40.5	DW	Participating
X0003	Alternative Location	4.5	550	T28	37.9	DW	**Selected**
V4329	Vacant Lot	4.5	745	T21	37.8 / 38.4	DW	**Selected**
R1883	Receptor	4.5	605	T54	37.3 / 37.9	DW	**Selected**
X0002	Alternative Location	4.5	584	T09	37.5	DW	**Selected**
X0006	Alternative Location	4.5	568	T48	37.3	DW	**Selected**
V4319	Vacant Lot	4.5	838	T21	37.1	DW	Redundant with V4329

† Direction from turbine to monitor relative to prevailing wind direction, +/-45°

‡ Predicted SPL for the receptor and associated monitor locations, respectively. For X0002, X0003, and X0006, there is no distinction between the monitor and receptor location.

Predicted receptor and monitor noise impacts were determined using the as-built Noise Model for Nation Rise, prepared by DNV-GL.

3.2 Monitoring Location

The location of the monitoring equipment for each audit location is described below. Coordinates for receptor and monitor locations, as well as distances to the nearest or primary[4] turbine are provided in Table 2. Monitoring equipment was deployed in locations consistent with the Phase 1 monitor locations. For additional details regarding these positions, please refer to the Nation Rise Phase 1 Acoustic Audit Report. In the case of the X0002, X0003, and X0006 locations, there is no distinction between the monitor and receptor location.

> **R1883**: The monitor was erected approximately 46 metres from the audit receptor. The ground cover between the monitoring location and the nearest turbines was open field with intermittent snow cover. There is a large deciduous tree roughly 60 m to the northwest of the R1883 monitoring equipment and several smaller

[4] Primary turbine refers to the individual turbine having the highest predicted noise impact at the subject receptor. In certain cases, this may not correspond to the closest turbine.

conifers 15 m to the north between 2-4 m tall. The monitoring equipment for R1883 is situated approximately 133 m from Goldfield Road.

V4329: The monitor was erected approximately 132 metres from the audit receptor due to land access restrictions at the receptor location. The ground cover between the monitoring location and the nearest turbines was open field with intermittent snow cover. The field to the north of the V4329 monitor had a crop of corn that was harvested shortly after the deployment of the noise monitor, prior to the collection of measurement data. The monitoring equipment for V4329 is situated approximately 14 m from Concession 7-8 Road.

X0002: The ground cover between the monitoring location and the nearest turbines was open field with intermittent snow cover. The field of the X0002 monitor had a crop of corn that was harvested shortly after the deployment of the noise monitor, prior to the collection of measurement data. The monitoring equipment for X0002 is situated approximately 130 m from Concession 10-11 Road. There are no trees within 150 m of the X0002 monitoring equipment.

X0003: The ground cover between the monitoring location and the nearest turbines was open field with intermittent snow cover with a line of short trees approximately 300 m away. The monitoring equipment for X0003 is situated approximately 430 m from Concession Road 2.

X0006: The ground cover between the monitoring location and the nearest turbines was open field with intermittent snow cover with a line of short trees approximately 150 m away. The monitoring equipment for X0006 is situated approximately 215 m from County Road 43 and approximately 450 m to the southeast of a rail line.

Table 2: Coordinates and Primary Turbine for each Receptor and Monitor Location

Audit Receptor	Coordinates (UTM x,y, Zone 17T)		Primary Turbine ID	Distance to Primary Turbine	
	Receptor	*Monitor*		*Receptor*	*Monitor*
R1883	488286 mE / 4998909 mN	488267 mE / 4998867 mN	T54	605 m	559 m
V4329	487451 mE / 5003559 mN	487389 mE / 5003441 mN	T21	745 m	672 m
X0002	485655 mE / 5007111 mN		T09	584 m	
X0003	492816 mE / 5004338 mN		T28	550 m	
X0006	491562 mE / 4997684 mN		T48	568 m	

Site plans and photographs of the monitoring equipment are provided in Appendix A. Details regarding the monitoring equipment are provided in Section 4.1.

3.3 Ambient Environment

Nation Rise is located in a rural (Class III) area. Ambient noise in rural areas is typically driven by a mixture of flora, fauna, traffic, and nearby industry. Each of these sources and their impacts on the ambient environment are discussed in this section. If the ambient noise is extraneous – such as a short-duration event, or noise concentrated at specific frequencies – then filtering is employed to reduce or remove it (see Section 4.3.2). If the ambient noise is not extraneous, then efforts are made to ensure that the noise is equally represented in both *Total Noise* and *Background* periods (see Section 4.3.3).

In addition to ambient noise sources, self-generated noise from the monitoring equipment will typically be present in the measurement data at high wind speeds. This noise is minimized by the usage of a primary and secondary wind screen installed around the microphone. The larger secondary wind screen meets the requirements of Section D2.1.4 of the Compliance Protocol and the insertion loss of the wind screen is tested and accounted for in the analysis. Self-generated noise is assumed to be equally present in *Total Noise* and *Background* periods for a given wind speed.

3.3.1 Flora

Noise from flora was found to be a consistent source of the ambient noise during the I-audit. The area surrounding Nation Rise is a mix of isolated patches of trees, shelter belts surrounding fields and dwellings, and short shrubs and crops. The audit locations, however, are generally setback from major sources of foliage noise. Nonetheless, some level of ambient noise from flora is present in the datasets. The noise generated from these features is proportional to wind speed – both ground level and hub-height – with higher wind speeds generating increased amounts of noise.

3.3.2 Fauna

Noise from fauna was not found to be significant during the I-audit at any receptor location. Occasional noise from birds was observed in the dataset and was removed from the dataset wherever possible (See Section 4.3.2).

3.3.3 Traffic

Noise from traffic was found to be an occasional source of extraneous noise during the I-audit at all receptors with a minimal influence at all locations except X0006 where noise from County Road 43 was observed to be prevalent. Other roadways near the project measurement locations include Goldfield Road, Concession 7-8 Road, Concession 10-11 Road, and Concession Road 7. Intervals influenced by car passbys were removed from the dataset whenever possible (see Section 4.3.2).

3.3.4 Industry

Noise suspected to originate from nearby farming activities was observed during listening analysis at the X0006 receptor location; data that was significantly contaminated by this

extraneous noise was removed from the assessment dataset. Noise from other industrial sources was found to be insignificant during the I-audit at all other locations.

3.3.5 Other Sources

Noise from overhead aircraft was found to be an occasional source of extraneous noise at all audit locations. Noise from a nearby rail line was found to be an occasional source of extraneous noise during the I-audit at the X0006 location. Intervals influenced by train and aircraft passbys were removed from the dataset whenever possible (See Section 4.3.2).

4 Audit Methodology

For the duration of the I-audit, acoustic and weather data are logged simultaneously in one-minute intervals at each monitoring location. Analysis and filtering are conducted per Section D5.2 and E5.5 of the Compliance Protocol with additional filters applied as needed – following the guidance the Compliance Protocol – to remove or reduce extraneous ambient noise (see Section 4.3.2) and ensure representative ambient conditions (see Section 4.3.3).

Intervals that pass the filtering criteria are sorted into integer wind bins[5] depending on the measured wind speed and classified as either *Total Noise* or *Background* depending on the operation of the nearby Nation Rise turbines (see Section 4.3.1). The *Turbine-Only* sound level at each wind bin is then determined by logarithmically subtracting the average *Background* level from the *Total Noise* level in wind bins having sufficient data for assessment. Minimum thresholds for sufficient data are discussed in Section 4.5.1.

4.1 Monitoring Equipment

The following acoustic and non-acoustic monitoring equipment was installed at each monitoring location.

- One (1) Type 1 sound level meter with microphone and pre-amplifier, installed at receptor height
- One (1) primary and one (1) secondary[6] windscreen for the microphone.
- One (1) anemometer installed 10 metres above ground level (“10m-AGL”).

The monitoring equipment was configured to log one-minute equivalent sound levels (L_{eq}) in A-weighted broadband and 1/3rd octave band frequencies. The microphone was installed at least 5 meters away from any large reflecting surfaces, as far away as

[5] An integer wind bin spans 1 m/s, centred on each integer wind speed, open at the low end and closed at the high end.
[6] The 1/3 octave band insertion loss of the secondary windscreen has been tested and has been accounted for in the data analysis.

practically possible from trees and other foliage, and in direct line of sight to the nearest Nation Rise turbines.

Table 3 lists the specific make, model, and serial number for the monitoring equipment used at each audit receptor.

Table 3: Monitoring Equipment Details

Audit Receptor	Equipment	Make/Model	Serial Number	Date of Last Calibration
R1883	Sound Level Meter	NI 9234	1E2B18D	July 6, 2021
	Microphone	PCB 377B02	167926	August 10, 2021
	Pre-amplifier	PCB 426E01	44003	August 10, 2021
	Signal Conditioner	PCB 480E09	35341	June 30, 2021
	Weather Station	Vaisala WXT530	P4111045	June 29, 2021
V4329	Sound Level Meter	NI 9234	1E2B19A	June 1, 2022
	Microphone	PCB 377B02	314652	June 23, 2022
	Pre-amplifier	PCB 426E01	064218	June 23, 2022
	Signal Conditioner	PCB 480E09	00035339	June 29, 2022
	Weather Station	Vaisala WXT530	R3250322	June 29, 2021
X0002	Sound Level Meter	NI 9234	1854438	October 3, 2022
	Microphone	PCB 377B02	150498	June 23, 2022
	Pre-amplifier	PCB 426E01	037448	June 23, 2022
	Signal Conditioner	PCB 480E09	00036935	June 24, 2022
	Weather Station	Vaisala WXT530	P4111045	June 29, 2021
X0003	Sound Level Meter	NI 9234	1B3CDE4	July 14, 2021
	Microphone	PCB 377B02	333461	September 30, 2021
	Pre-amplifier	PCB 426E01	074777	September 30, 2021
	Signal Conditioner	PCB 480E09	33659	June 24, 2021
	Weather Station	Vaisala WXT530	R3250414	June 29, 2021
X0006	Sound Level Meter	NI 9234	1B97D76	October 5, 2022
	Microphone	PCB 377B02	177693	June 23, 2022
	Pre-amplifier	PCB 426E01	051457	June 23, 2022
	Signal Conditioner	PCB 480E09	00037187	March 4, 2022
	Weather Station	Vaisala WXT530	M4910199	June 29, 2021

Each measurement chain was calibrated before, during, and after the measurement period using a type 4231 Brüel & Kjær acoustic calibrator. The monitoring equipment is also verified by laboratory calibration per the requirements in Section D2.3 of the Compliance Protocol; calibration certificates are provided in Appendix C.

4.2 Measurement Parameters

The monitoring equipment is configured to run nightly from approximately 9pm to 6am, local time. The measurement parameters acquired and used in the audit are listed in Table 4.

Table 4: Measurement parameters used for the I-audit

Parameter Group	Measurement Parameters	Notes
Acoustic (Microphone height)	L_{Aeq}	dBA
	L_{90}	dBA
	1/3rd Octave Band	dBA (20 Hz–10 kHz)
	Signal Recording	Uncompressed raw files
Weather (10m height)	Wind Speed	m/s
	Wind Direction	0-360˚
	Temperature	˚C
	Humidity	0-100%
	Precipitation	mm
Turbine (Hub height)	Wind Speed	m/s
	Yaw Angle	0-360˚
	Power Output	kW
	Rotational Speed	RPM

Turbine operational information was obtained from the facility SCADA system and provided to Aercoustics by Enercon.

In addressing an MECP comment in their review of the Nation Rise Emission Audit Report [4], a 14° discrepancy was found in the yaw angle of the Nation Rise turbines, accounting for the difference between true and magnetic north. This discrepancy has been corrected and accounted for in this assessment.

4.3 Filtering Criteria

Analyses and filtering of the intervals in the measurement dataset are conducted per the requirements outlined in Section D5.2 and E5.5 of the Compliance Protocol. Intervals are included or excluded from analysis depending on several filtering criteria. Some of these criteria apply to all intervals and some apply only for *Total Noise* or *Background* intervals. Measurement intervals are first passed through the *All Intervals* filters, after which they are sorted into either *Total Noise* or *Background* categories based on the operation of the nearby turbines. Intervals that fail to meet the applicable filtering criteria are excluded from analysis.

All Intervals

- Have occurred between 10pm – 5am
- Have no precipitation within one hour before or after
- Have an ambient temperature above -20˚C[7]
- Have minimal influence from extraneous ambient noise (see Section 4.3.2)

Total Noise Intervals

- Have all nearby turbines operating (see Section 4.3.1)
- Have primary turbine generating at least 87% of its maximum rated power output, corresponding to at least 90% of the maximum sound power output
- Have a downwind wind direction (primary turbine to monitor, +/- 45°)

Background Intervals

- Have all nearby turbines parked (see Section 4.3.1)
- Have ambient conditions representative of Total Noise periods (Section 4.3.3)

Measurement intervals that pass the filtering criteria above form the assessment dataset for the I-audit.

An electrical power output of 2,993 kW was found to correspond to 90% of the turbine's maximum sound power output based on documentation within the Nation Rise Turbine Specification Report [5]; please see Appendix D for further details. As such, an electrical power threshold of 87% has been applied during filtering for Total Noise intervals.

4.3.1 Turbines in Study Area

As noted above, several filtering criteria are applied based on the operation of the primary turbine or the turbines in the surrounding area. To verify the operation of these turbines, information from the facility SCADA system is examined.

In order for a measurement interval to be considered for the *Total Noise* or *Background* periods, all the turbines in the study area must be operating or parked, respectively. The minimum number of turbines included in the study area for each receptor are selected based on the guidance of Section D3.5.2 of the Compliance Protocol:

> ***D3.5.2 Acoustic measurements with wind turbines parked***
>
> *"Ambient noise measurements shall be carried out at a point of reception with all turbines in the vicinity of the point of reception parked. The prediction model will be used to*

[7] Per the manufacturer's specifications included in Appendix C, the microphone and preamplifier are rated to temperatures between -40˚C and 80˚C.

determine the number of turbines that require parking in order for the predicted noise contribution of the wind facility to fall to 30 dBA or 10 dB less than the applicable criterion."

The Nation Rise turbines in the audit study area for each receptor are listed in Table 5 and conform to the Compliance Protocol requirements listed above. All turbines were confirmed to be operating for Total Noise periods and parked for Background periods.

Table 5: Turbines included in the study area for each receptor

Audit Receptor	Turbines in Study Area
R1883	T32, T54
V4329	T18, T20, T21, T23
X0002	T05, T09
X0003	T28, T29
X0006	T48
All Audit Locations	T05, T09, T18, T20, T21, T23, T28, T29, T32, T48, T54

Parked turbines do not rotate or generate power. There is some idling of the blades (~1 rpm or less), but the acoustic impact of the turbines in this condition is negligible at the receptor. The turbines in the study area were confirmed to be running in their normal operating mode for the duration of the monitoring campaign; see Appendix E for a statement from the operator.

4.3.2 Removal of Extraneous Noise

'Extraneous noise' is noise unrelated to the operation of the wind facility that is not part of the typical ambient environment in the area. It is typically noise that is short-duration (i.e. transient) or noise that is limited to specific frequencies. Extraneous noise is considered acoustic contamination and should be removed from the measurement dataset wherever possible. The Compliance Protocol provides the following guidance regarding extraneous noise:

C2.4.7 Extraneous noise sources[8]

"Measurements are to be inhibited when the sound level is affected by noise from extraneous sources such as vehicle noise, dogs barking and wind gusts (i.e. other than wind turbine sound)."

[8] It is acknowledged that the measurements in this report follow Part D and Part E of the Compliance Protocol and this guidance is from Part C. Nevertheless, the guidance regarding the removal of extraneous noise in Part C is applicable here as the requirement to remove contamination from the measurement dataset follows good engineering principles for noise measurements.

> *The same result can also be achieved by digitally recording the sound level time history and later editing out the extraneous events and recalculating the descriptors such as Leq. This should address measurement situations where extraneous sounds were not inhibited.*
>
> ***D3.5 Acoustic measurements***
>
> *"[…] In addition, if the background sound levels are greater than the applicable exclusion limits then the applicable limits are the background sound levels without extraneous noise sources."*
>
> ***D5.3 Effects of insects and fauna***
>
> *"The analysis shall identify the influence of any insects, fauna, or other extraneous but constant sources of noise and verify them through sound recordings. Noise from insects can be removed from the 1/3rd octave spectra of each measurement. It has to be shown, however, that the contribution of the wind turbine noise in those frequencies is minimal."*
>
> ***D6 Assessment of compliance***
>
> *"[…] However, if the background sound levels are greater than the applicable exclusion limits then the applicable limits are now the background sound levels without extraneous noise sources."*

Extraneous noise can be steady or transient. Steady extraneous noise, such as the noise from crickets or other insects, may be removed via filtering of specific 1/3rd octave bands affected by the contamination (see Protocol section D5.3).

Transient extraneous noise, such as the noise from car passes, dogs, or wind gusts, may be removed via a combination of automatic and manual filtering techniques. Automatic filtering of transient extraneous noise is achieved by removing points where the measured L_{Aeq} is significantly greater than the measured L_{90} for the same interval. Manual filtering of extraneous noise is conducted via listening tests to identify intervals having audible contamination.

Note: the identification and removal of extraneous noise in the measurement datasets presented in this report is achieved by listening tests and an automatic filter that excludes any *Total Noise* or *Background* interval if the difference between average and minimum sound level for the interval (LAeq-L90) is greater than 10 dB for all monitors, except for X0006. For X0006, a 6 dB threshold for the LAeq-L90 filter is employed due to road traffic from County Road 43 contributing a more significant amount of transient noise compared to other monitoring locations.

4.3.3 Representative Ambient Conditions

The ambient conditions present in the *Total Noise* and *Background* periods should be similar. Section D3.8.2 of the Compliance Protocol specifically states that weather and wind shear conditions should be similar:

D3.8.2 Overall equivalent sound level – wind turbines parked

"Ambient noise measurements should be performed with the turbines parked and conducted within the same general measurement period and with the same weather and wind shear conditions. Measurements of ambient noise obtained during other periods are not recommended and should only be used with great caution to ensure that they represent the "current" ambient noise."

Ambient sound levels have been found to increase with 10m-AGL and hub-height wind speeds[9]. Given that the hub-height wind speeds during *Total Noise* periods must be high enough for the turbines to generate the minimum required power output, representative *Background* conditions must also have a high hub-height wind speed. *Background* sound levels measured during periods having low hub-height wind speeds are expected to have quieter ambient sound levels compared to those present during *Total Noise* periods.

Note: turbine shutdowns were conducted periodically throughout the I-audit to ensure similar weather conditions between *Total Noise* and *Background* periods. Further, Background intervals having hub-height wind speeds below 6 m/s were excluded to remove calm conditions from the *Background* period. Calm conditions are not representative of the periods when the turbine would be running at high power output, and therefore are removed from the assessment. The lowest hub-height windspeed for *Total Noise* intervals in the assessment datasets was between 7.5 and 8.0 m/s; applying a threshold of 6.0 m/s to the *Background* periods is therefore conservative.

4.4 Adjacent Wind Facilities

There are no adjacent wind facilities in the area.

4.5 Compliance Criteria

The criteria for an assessment of compliance per the Compliance Protocol are detailed in this section.

4.5.1 Sample Size Requirements

This audit follows the requirements of the Revised Assessment Methodology – Immission ("RAM-I"). Analysis parameters for RAM-I are detailed in Section E5.5 of the Compliance Protocol. Relevant sections regarding sample size requirements as they pertain to this I-audit are also copied below:

E5.5(1): "The objective of the RAM I-Audit is to assess the acoustic immission at the measurement location at wind speeds between 1 and 7 m/s (inclusive). At a minimum, data must be acquired to satisfy the requirements of at least one of the following:

[9] Halstead D., Tam N. "A study of background noise levels measured during far-field receptor testing of wind turbine facilities" in *8th International Conference on Wind Turbine Noise*, Lisbon Portugal, June 12-14, 2019

a. *three (3) of the wind speed bins between 1 and 7 m/s (inclusive), or*
b. *two (2) of the wind speed bins between 1 and 4 m/s (inclusive).”*

> *E5.5(5): “The Ministry may accept a reduced number of data points for each wind speed bin with appropriate justification (i.e. 60 data points in place of 120 for turbine operational measurements and 30 data points in place of 60 data points for ambient measurements). The acceptable number of data points will be influenced by the quality of the data (standard deviation).”*

In this study, a wind bin is considered complete if there are at least 60 valid *Total Noise* and 30 valid *Background* intervals.

In situations where the minimum Background data count requirements are not met, the Protocol allows for the use of assumed Background sound levels of either 30 dB or the average Background sound level of a lower wind bin having sufficient data counts:

> *D5.5(6): “If the measurement campaign is unable to acquire the minimum number of ambient sound level data, the owner/operator of the wind facility will be permitted to use one of the provisions described below: use the ambient sound level data from a lower wind speed bin to represent a higher wind speed bin (i.e. if 6 m/s data is unavailable, the owner/operator is permitted to use 5 m/s data to represent the 6 m/s data bin), or use a value of 30 dBA.”*

Wind bins where assumed Background sound levels have been used are highlighted in Table 11, Table 13, and Table 14.

4.5.2 Sound Level Limits

The area surrounding Nation Rise has been designated as Class III. Exclusion limits for a Class III area are summarized in Table 6 below.

Table 6: MECP Exclusion Limits (Class III)

Wind speed at 10m height (m/s)	Sound Level Exclusion Limit (dBA)
≤ 6	40
7	43

Sections D3.5 and D6 of the Compliance Protocol state that where the measured *Background* sound level exceeds the exclusion limits, the sound level limit for that wind bin is the *Background* sound level without extraneous noise sources:

> *D3.5 “In addition, if the background sound levels are greater than the applicable exclusion limits then the applicable limits are the background sound levels without extraneous noise sources.”*

Wind bins where the measured *Background* sound level exceed the exclusion limits are noted in Table 14.

4.5.3 Tonality

A tonality assessment of the measurement data has been conducted due to prominent tones being observed in the measurement data. The calculation of the mean tonal audibility attributable to the Nation Rise turbines is determined in accordance with the IEC 61400-11:2012 standard [6]. Frequencies of interest were determined from analysis of the I-audit receptor data and from the IEC test of Nation Rise Turbine T12 [4] to be roughly 125 Hz. Calculations were conducted using narrowband spectra calculated using the measurement intervals from the assessment dataset. Per the IEC 61400-11 Edition 3.0 Standard, tones with centre frequencies between 100 Hz and 150 Hz were assessed and attributed to the 125 Hz centre frequency. Tonal audibility penalties, if applicable, for each wind bin are calculated according to Annex C of ISO 1996-2:2007 [7] and Section E5.5.2 of the Compliance Protocol.

Applicable tonal penalties are determined using the mean tonal audibility, the calculation method of the tonal penalty is summarized in Table 7. Tonal penalties are applied to the turbine-only sound level.

Table 7: Calculation of Applicable Tonal Penalty

Mean Audibility, ΔL	Tonal Adjustment, K_T
$\Delta L \leq 4$ dB	0 dB
4 dB < $\Delta L \leq 10$ dB	ΔL – 4 dB
10 dB < ΔL	6 dB

4.6 Deviations

Any deviations from the methods prescribed in the Compliance Protocol are discussed in this section.

4.6.1 Measurement Bandwidth

As noted in Table 4, the measurement bandwidth used is 20-10,000 Hz. This is a deviation from the Compliance Protocol Section D2.1.1 requirement of a 20-20,000 Hz frequency response. Due to the high attenuation of noise levels at high frequencies, noise at the receptor from the wind facility above 10,000 Hz will be insignificant[10].

5 Audit Results

Measurement results of the Phase 2 I-audit are summarized in the following sections. Sound levels presented here are rounded to the nearest integer, whereas all calculations are conducted using un-rounded values.

[10] From Table 2 of ISO 9613-2, acoustic frequencies above 8 kHz experience attenuation from atmospheric absorption of more than 80 dB/km. This, combined with the other sources of attenuation, will reduce high frequency noise to negligible levels by the time it reaches the receptor.

5.1 Audit Duration

The length of monitoring time at each location is summarized below in Table 8.

Table 8: Length of monitoring campaign for each audit receptor

Audit Receptor	Audit Start Date	Audit End Date	Monitoring Duration (weeks)
R1883	February 7, 2022[11]	March 1, 2022	3
V4329	October 22, 2022	November 24, 2022	5
X0002	October 27, 2022	November 7, 2022	2
X0003	February 7, 2022[1]	March 1, 2022	3
X0006	October 22, 2022	November 17, 2022	4

The timespan between the deployment of these monitors reflects difficulties encountered in securing land access for some locations in addition to delays related to availability of the relevant turbines, some of which were down for maintenance.

5.2 Weather Conditions

The range of weather parameters measured at each monitor during the I-audit are summarized in Table 9. These values show the range in weather conditions measured in the assessment dataset.

Table 9: Range of weather conditions in assessment dataset

Audit Receptor	Atmospheric Pressure (hPa)	10m-AGL Wind Speed (m/s)	Relative Humidity (%)	Temperature (°C)	Hub-Height Wind Speed (m/s)
R1883	994 - 1019	0.5 - 7.5	58 - 91	-20 - 7	6.0 - 16.0
V4329	1000 - 1026	0.6 - 7.5	36 - 86	-13 - 14	6.0 - 14.8
X0002	1005 - 1017	0.8 - 7.4	50 - 83	3 - 17	6.0 - 16.2
X0003	994 - 1017	1.1 - 7.5	53 - 93	-15 - 7	6.0 - 16.4
X0006	994 - 1030	0.5 - 7.5	26 - 90	-3 - 22	6.0 - 15.6

Wind roses showing the measured wind directions at each audit location are provided in Figure 2. This data represents the range of wind directions for all measurement data collected during the audit. Note that wind directions shown on the wind roses indicate the direction the wind is coming from, and the red shaded area represent the downwind angle for each receptor.

[11] The Phase 1 I-Audit period at the R1883 and X0003 locations concluded at 12:00 AM on February 7, 2022 and the Phase 2 I-Audit period at these locations commenced at 12:01 AM February 7, 2022; there is no overlap in the assessment data.

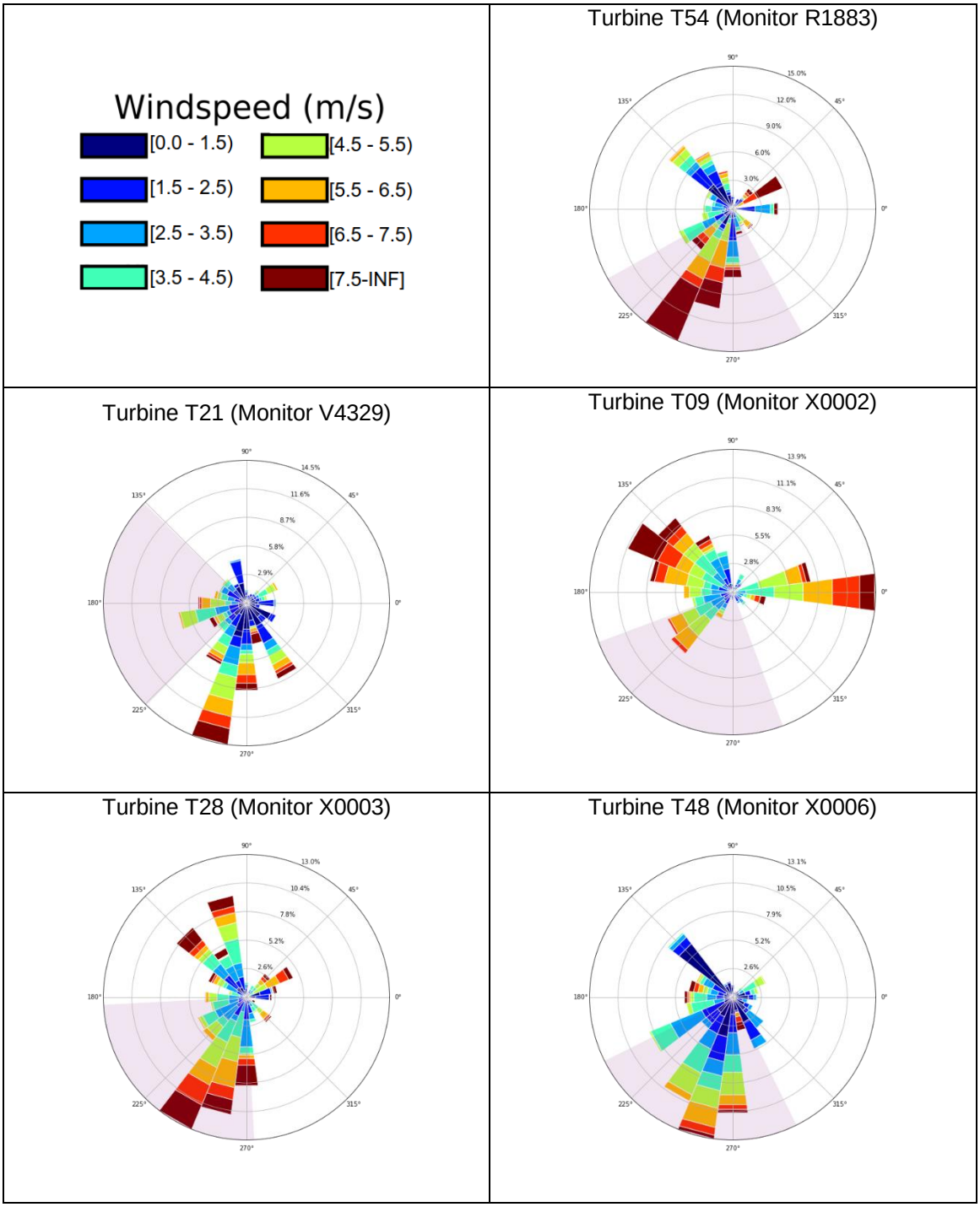


Figure 2: Nation Rise Wind Roses – All Measured Data

From Figure 2 the distribution of wind directions observed during the I-audit aligns with what was expected based on the historical wind rose shown in Figure 1, with the exception of the X0002 location having a large portion of the easterly and northwesterly winds.

5.3 Data Excluded due to Filtering Criteria

A range of wind and weather conditions were measured over the course of the I-audit. The Compliance Protocol requires that assessment data be counted only during downwind and high-power conditions, both of which vary independently with time. As a measure of how often the minimum suitable conditions materialized during the audit, the total proportion of measurement time where these two conditions were satisfied is presented in Table 10 for each audit location.

Table 10: Prevalence of Occurrence of Suitable Turbine Conditions

Audit Receptor	Primary Turbine	Prevalence of Downwind	Prevalence of High Output, >87% power	Prevalence of Downwind and High Output
R1883	T54	44%	39%	21%
V4329	T21	27%	14%	5%
X0002	T09	37%	9%	10%
X0003	T28	44%	33%	21%
X0006	T48	50%	14%	10%

It noted that the proportion of measurement data indicated above in Table 10 represents the maximum available data for assessment. Additional filters applied to remove contaminated or otherwise unsuitable measurement data (as discussed in Section 4.3) will further reduce the assessment dataset.

5.4 Measured Sound Levels

Valid measurement intervals that pass the filtering criteria are logarithmically averaged and sorted by wind bin into *Total Noise* and *Background* datasets. These average sound levels are presented below in Table 11 with data points plotted in the subsequent figures.

Table 11: Average measured sound levels at each monitoring Location

Audit Receptor	Period	Measurement Parameter	Wind Bin (m/s) 1	2	3	4	5	6	7
R1883	Total Noise	Number of Samples	47	68	60	86	108	368	220
		Average L_{Aeq} [dBA]	39*	38	37	38	39	41	44
		Standard Deviation [dB]	0.6*	0.5	0.4	0.6	1.1	0.8	1.5
	Background	Number of Samples	10	75	59	46	15	4	0
		Average L_{Aeq} [dBA]	26*	27	28	29	34*	-	-
		Standard Deviation [dB]	3.5*	3.8	4.1	2.2	1.5*	-	-
V4329	Total Noise	Number of Samples	1	21	60	88	176	81	11
		Average L_{Aeq} [dBA]	-	-	39	40	41	42	-
		Standard Deviation [dB]	-	-	0.9	1.0	0.8	1.0	-
	Background	Number of Samples	17	37	172	182	210	216	50
		Average L_{Aeq} [dBA]	33*	31	31	34	36	40	45
		Standard Deviation [dB]	2.6*	2.1	2.1	2.6	2.3	2.6	2.5
X0002	Total Noise	Number of Samples	10	19	91	109	90	28	3
		Average L_{Aeq} [dBA]	-	-	39	39	41	-	-
		Standard Deviation [dB]	-	-	0.8	1.0	1.2	-	-
	Background	Number of Samples	5	43	52	115	167	128	28
		Average L_{Aeq} [dBA]	-	31	31	32	35	40	-
		Standard Deviation [dB]	-	2.3	2.1	2.1	2.1	1.8	-
X0003	Total Noise	Number of Samples	10	55	158	105	261	316	272
		Average L_{Aeq} [dBA]	-	39*	39	40	41	44	47
		Standard Deviation [dB]	-	0.7*	1.1	1.3	1.0	1.3	1.4
	Background	Number of Samples	0	13	35	25	4	2	0
		Average L_{Aeq} [dBA]	-	-	31	31‡	-	-	-
		Standard Deviation [dB]	-	-	2.9	2.9‡	-	-	-
X0006	Total Noise	Number of Samples	10	33	100	79	96	141	45
		Average L_{Aeq} [dBA]	40	39	39	40	42	45	49
		Standard Deviation [dB]	1.6	0.6	0.8	0.9	1.2	1.5	2.2
	Background	Number of Samples	146	178	283	275	310	87	5
		Average L_{Aeq} [dBA]	33	31	32	35	38	42	-
		Standard Deviation [dB]	3.2	2.9	2.7	2.4	2.2	2.0	-

- Minimum sample size not met in this wind bin, sound levels not reported except as noted by (*).

* Below minimum sample size requirements, data presented for information only.

‡ As the background data sample size requirements in the 4m/s wind bin have not been met, the background sound level of 31 dBA in the 3 m/s wind bin has been assumed for the 4 m/s wind bin per Section 5.5.6 of the Protocol.

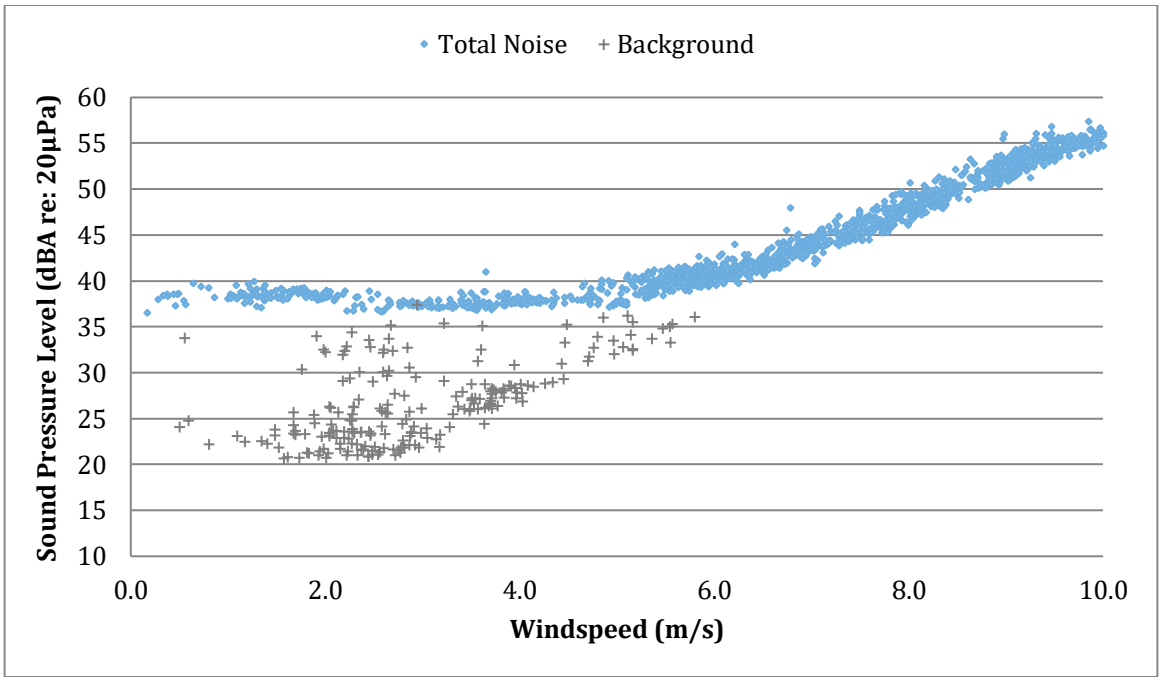


Figure 3: All valid Total Noise and Background intervals measured at R1883 Monitor

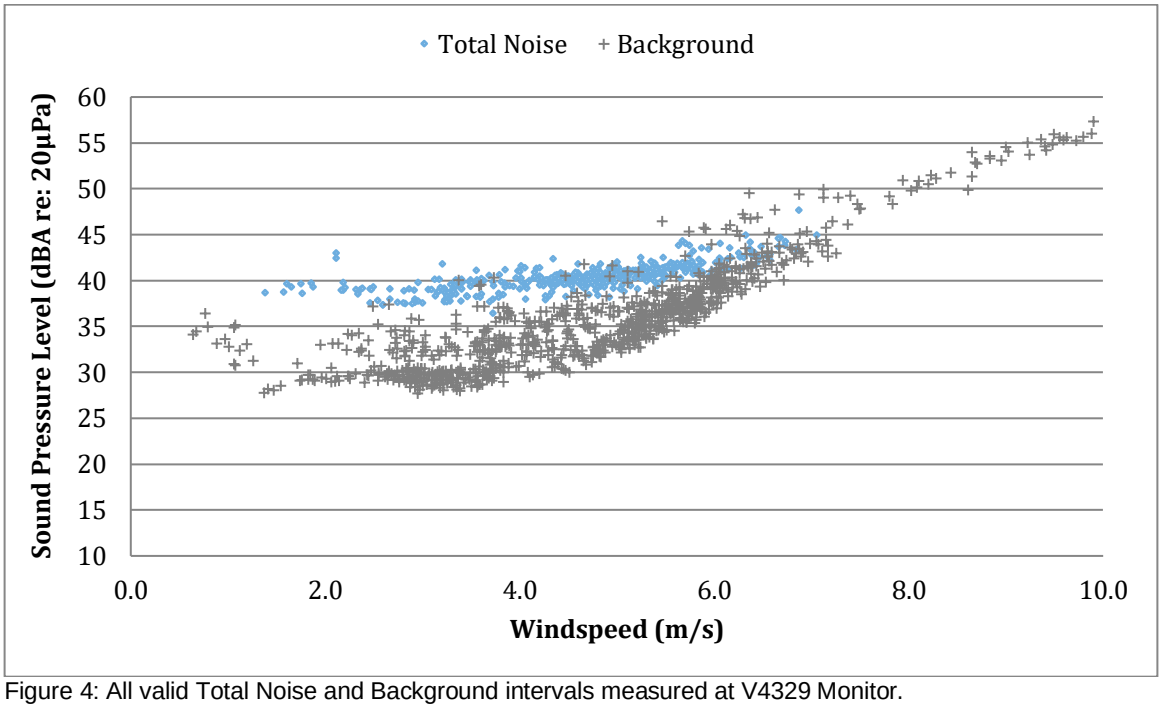


Figure 4: All valid Total Noise and Background intervals measured at V4329 Monitor.

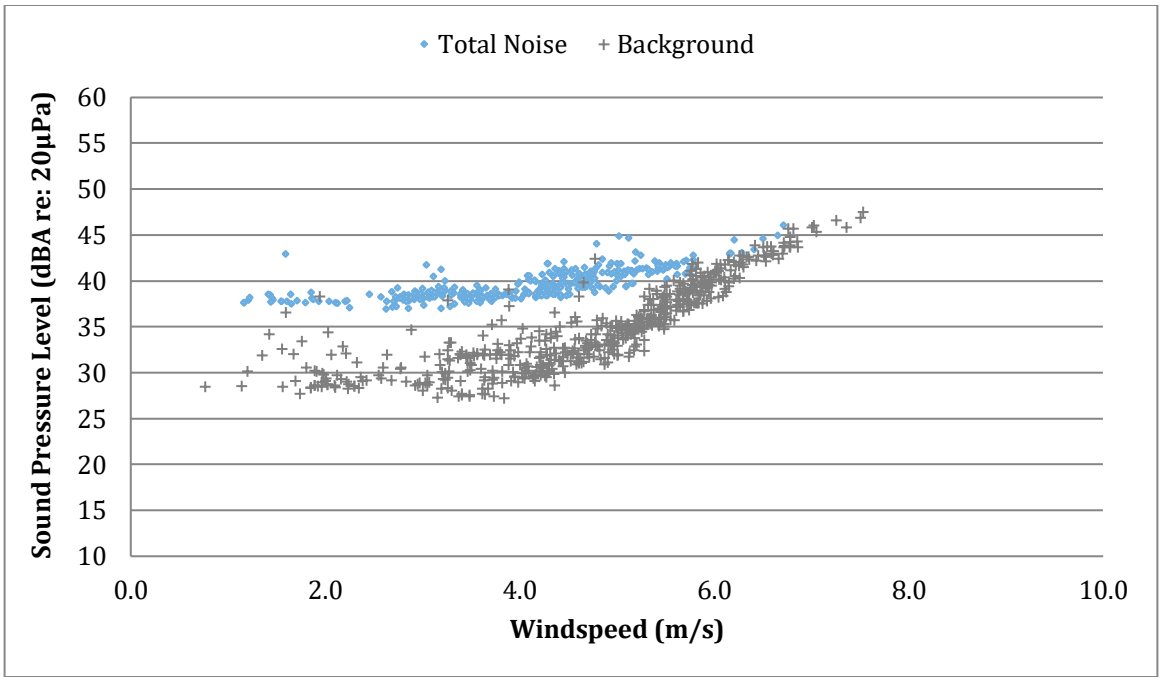


Figure 5: All valid Total Noise and Background intervals measured at X0002 Monitor.

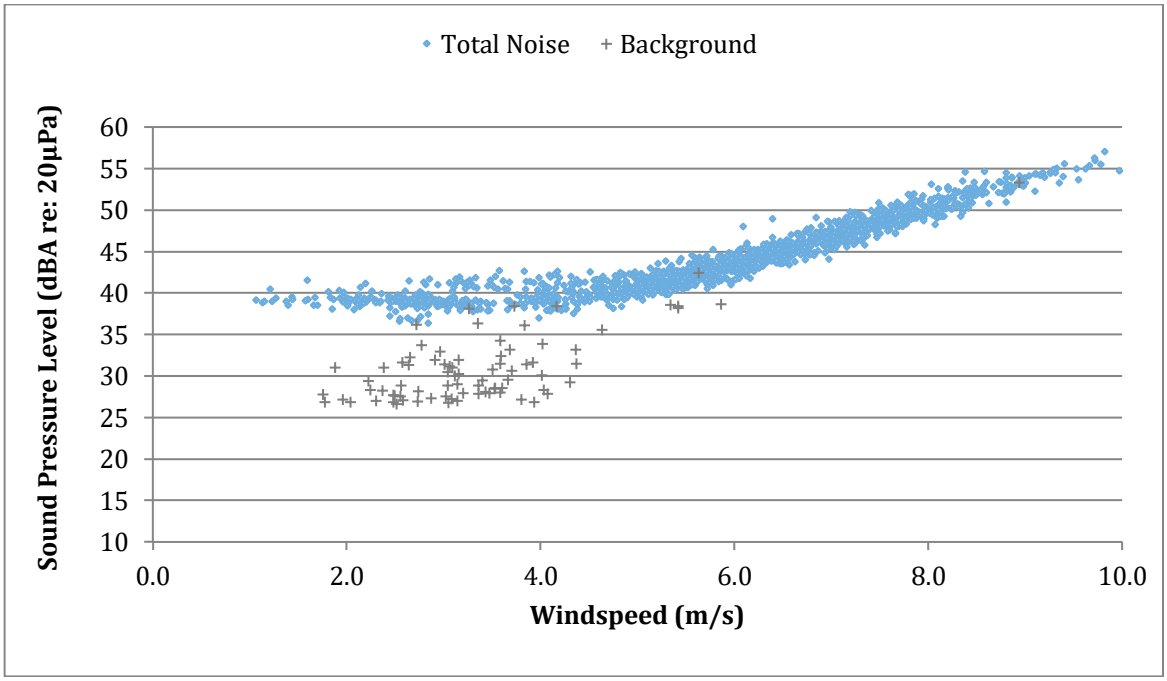


Figure 6: All valid Total Noise and Background intervals measured at X0003 Monitor.

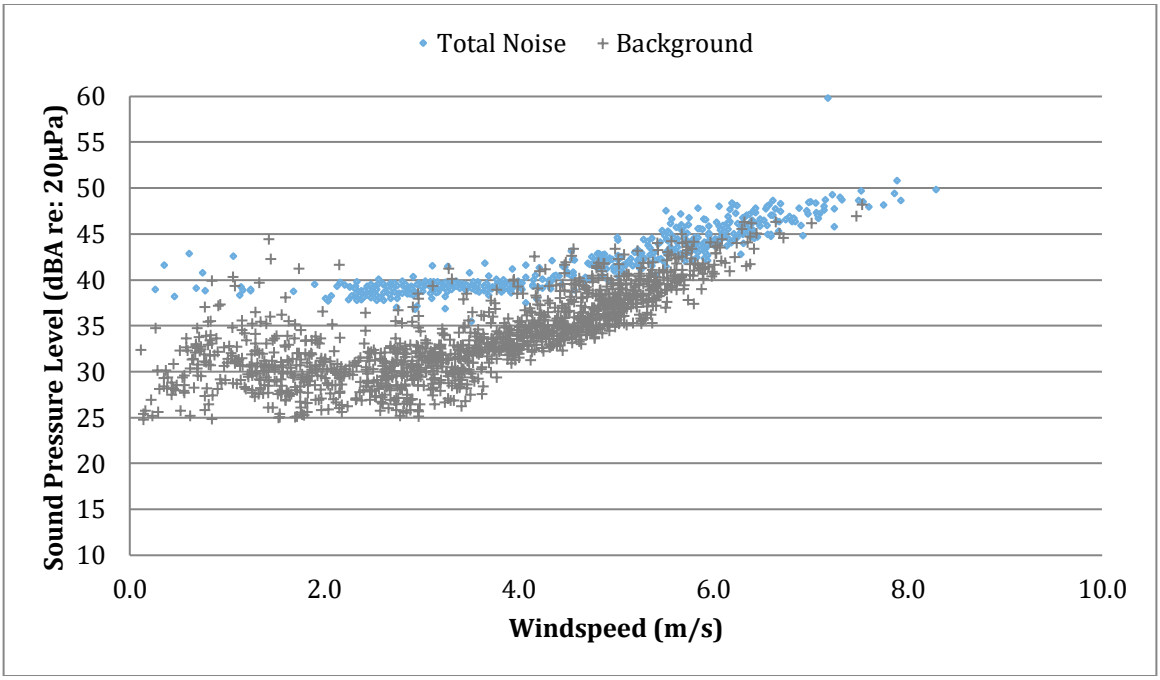


Figure 7: All valid Total Noise and Background intervals measured at X0006 Monitor.

5.5 Sound Level Adjustments

The following sections detail any adjustments made to the sound levels presented in Section 5.4.

5.5.1 Tonal Adjustment

Tonal audibility results and applicable tonal penalties are presented in Table 12.

Table 12: Tonality Assessment Table 100 Hz – 150 Hz Assessment Range)

Audit Receptor	Tonality Parameter	Wind Bin (m/s)						
		1	2	3	4	5	6	7
R1883	Average Frequency [Hz]	130	131	127	128	131	132	132
	Data Points in Wind Bin	47	68	60	86	108	368	220
	Data Points with Tone	45	66	60	86	107	361	188
	Tonal Presence	96%	97%	100%	100%	99%	98%	85%
	Tonality, ΔL_t [dB]	1.0*	1.7	1.5	0.5	-1.7	-0.5	-0.8
	Tonal Audibility, ΔL_a [dB]	3.1*	3.7	3.5	2.5	0.3	1.5	1.2
	Tonal Adjustment, K_T [dB]	0.0*	0.0	0.0	0.0	0.0	0.0	0.0
V4329	Average Frequency [Hz]	126	130	128	129	129	131	131
	Data Points in Wind Bin	1	21	60	88	176	81	11
	Data Points with Tone	1	21	60	88	176	80	9
	Tonal Presence	100%	100%	100%	100%	100%	99%	82%
	Tonality, ΔL_t [dB]	-0.3*	0.1*	-0.3	-1.5	-1.7	-2.2	-3.5*
	Tonal Audibility, ΔL_a [dB]	1.7*	2.2*	1.7	0.5	0.3	-0.2	-1.5*
	Tonal Adjustment, K_T [dB]	-	-	0.0	0.0	0.0	0.0	-
X0002	Average Frequency [Hz]	126	125	128	129	130	131	131
	Data Points in Wind Bin	10	19	91	109	90	28	3
	Data Points with Tone	10	19	91	109	89	27	3
	Tonal Presence	100%	100%	100%	100%	99%	96%	100%
	Tonality, ΔL_t [dB]	2.1*	2.7*	0.7	1.3	1.4	-2.0*	-4.1*
	Tonal Audibility, ΔL_a [dB]	4.1*	4.7*	2.7	3.3	3.4	0.0*	-2.1*
	Tonal Adjustment, K_T [dB]	-	-	0.0	0.0	0.0	-	-
X0003	Average Frequency [Hz]	127	128	128	130	130	130	130
	Data Points in Wind Bin	10	55	158	105	261	316	272
	Data Points with Tone	10	55	158	105	261	312	219
	Tonal Presence	100%	100%	100%	100%	100%	99%	81%
	Tonality, ΔL_t [dB]	0.1*	-0.2*	0.1	0.9	-0.3	-1.2	-4.7
	Tonal Audibility, ΔL_a [dB]	2.1*	1.8*	2.1	2.9	1.8	0.8	-2.7
	Tonal Adjustment, K_T [dB]	-	0.0*	0.0	0.0	0.0	0.0	0.0
X0006	Average Frequency [Hz]	128	129	130	129	128	129	131
	Data Points in Wind Bin	10	33	100	79	96	141	45
	Data Points with Tone	10	33	100	78	91	106	18
	Tonal Presence	100%	100%	100%	99%	95%	75%	40%
	Tonality, ΔL_t [dB]	-1.6*	2.9*	4.1	2.1	-3.4	-4.9	-5.1*
	Tonal Audibility, ΔL_a [dB]	0.5*	4.9*	6.1	4.1	-1.4	-2.9	-3.1*
	Tonal Adjustment, K_T [dB]	-	0.9*	2.1	0.1	0.0	0.0	-

\- Minimum sample size not met in this wind bin, tonal audibility levels not reported except as noted by (*).

* Below minimum sample size requirements, data presented for information only.

5.5.2 Distance Adjustment

No distance adjustment has been applied for this assessment, although the two locations having Points of Reception were installed in locations with higher predicted sound levels than their respective PORs. An assessment of compliance at these higher-impacted locations is conservative.

5.5.3 Other Adjustments

No other adjustments, other than those already noted, have been made to the wind bin sound levels.

5.6 Turbine-Only Sound Levels

The average *Total Noise* and *Background* sound levels by wind bin at each monitoring location are presented in Table 13. Any sound level adjustments used to determine the Turbine-Only sound level at the audit receptor (Point of Reception, “POR”) are also presented and are reflected in the reported Turbine-Only sound levels. Wind bins having sufficient data to be used in the determination of compliance have been highlighted in blue.

Table 13: Calculated Turbine-Only Sound Levels

Audit Receptor	Measurement Period	Wind Bin (m/s)						
		1	2	3	4	5	6	7
R1883	Total Noise (dBA)	39*	38	37	38	39	41	44
	Background (dBA)	26*	27	28	29	34*	-	-
	Signal to Noise (dBA)	12.2	9.9	8.3	8.8	5.5	-	-
	Tonal Adjustment	0.0	0.0	0.0	0.0	0.0	-	-
	Turbine-Only (dBA) [POR]	38*	38	37	37	38*	-	-
V4329	Total Noise (dBA)	-	-	39	40	41	42	-
	Background (dBA)	33*	31	31	34	36	40	45
	Signal to Noise (dBA)	-	-	7.6	6.1	4.8	2.1	-
	Tonal Adjustment	-	-	0.0	0.0	0.0	0.0	-
	Turbine-Only (dBA) [POR]	-	-	38	39	39	38[a]	-
X0002	Total Noise (dBA)	-	-	39	39	41	-	-
	Background (dBA)	-	31	31	32	35	40	-
	Signal to Noise (dBA)	-	-	7.7	7.4	5.8	-	-
	Tonal Adjustment	-	-	0.0	0.0	0.0	-	-
	Turbine-Only (dBA) [POR]	-	-	38	38	40	-	-
X0003	Total Noise (dBA)	-	39*	39	40	41	44	47
	Background (dBA)	-	28*	31	31‡	-	-	-
	Signal to Noise (dBA)	-	10.9	8.2	8.8	-	-	-
	Tonal Adjustment	-	0.0	0.0	0.0	-	-	-
	Turbine-Only (dBA) [POR]	-	39*	39	40	-	-	-
X0006	Total Noise (dBA)	-	39*	39	40	42	45	-
	Background (dBA)	33	31	32	35	38	42	-
	Signal to Noise (dBA)	-	7.6	7.6	4.7	4.0	3.1	-
	Tonal Adjustment	-	0.9*	2.1	0.1	0.0	0.0	-
	Turbine-Only (dBA) [POR]	-	39*	40	38	40	42	-

\- Minimum sample size not met in this wind bin, sound levels not reported except as noted by (*).

* Below minimum sample size requirements, data presented for information only.

[a] Signal-to-noise level less than 3 dB. Increased uncertainty in determination of Turbine-Only Sound Impact.

‡ As the background data sample size requirements in the 4m/s wind bin have not been met, the background sound level of 31 dBA in the 3 m/s wind bin has been assumed for the 4 m/s wind bin per Section 5.5.6 of the Protocol.

An assessment compliance of the Turbine-Only sound levels at the Point of Reception is provided in Table 14.

6 Discussion

The data collected at the Nation Rise audit locations was generally of a high quality, with wind bin-average Total Noise sound levels having standard deviations ranging between

0.4-1.5 dB in wind bins with sufficient data counts. This standard deviation is within the MECP standard deviation target of 2/2.5 dB (Section E5.5(8) of the Protocol) and indicates that sound level variations were low when the turbines were operating.

The high quality of the assessment data collected during the audit is further exemplified by the signal-to-noise ratio (SNR) present in many of the assessment wind bins. SNR values of 6 dB are a typical target for minimizing the influence of ambient noise, and SNR values of 3 dB or below are subject to increased uncertainty in the determination of the Turbine-Only sound level. All the assessment datasets in this report have at least one wind bin with an SNR above 6 dB, indicating a high-quality dataset and strong basis for a determination of compliance.

It was also found that the Total Noise sound levels in wind bins below 5 m/s meet the MECP exclusion limits without the need for an ambient correction, with the exception of the X0006 location which experienced higher levels of ambient noise from road traffic. This finding further illustrates the high quality of data collected at the audit locations and strengthens the assessment of compliance. Where the data quality is highest, compliance can be demonstrated even with a conservative approach.

A tone with a centre frequency of roughly 125 Hz was observed in the assessment data at all audit locations. The tonal audibility of the 125 Hz tone was high in some wind bins and was prominent enough to warrant tonal penalties in the in the 3 m/s and 4 m/s assessment wind bins for Receptor X0006 with resultant Turbine-Only sound levels that comply with the sound level limits. This tone was also observed in the IEC test carried out at Nation Rise T12 [4], which found a maximum tonal audibility level of 1.1 dB. It is somewhat unexpected to see a tone level increase from turbine to receptor, and this may indicate that the magnitude of the 125 Hz tone varies between turbines. However, any potential variation has more than adequately been captured given the high number of turbines in the study area for this audit (see Table 5).

It is noted that the Turbine-Only sound levels at the V4329, X0003, and X0006 locations exceed the predicted sound levels for those locations by 1-3 dB. However, the worst-case predicted noise impact at a non-participating receptor – 37.9 dBA at Receptor R1314 [3] – has been captured in this audit from the measurements at the R1883, V4329, and X0003 monitor locations (see Table 1). Therefore, despite the increased sound impact, the facility remains below the applicable MECP sound level limits and, given the high-quality measurement data collected in this study, this determination of compliance can reasonably be extended to other Nation Rise Points of Reception not considered in the study.

Finally, the X0006 has one wind bin (6 m/s) where Turbine-Only sound levels exceed the exclusion limit. However, it does not exceed the Background sound level and therefore is still a compliant condition. The Turbine-Only sound levels for X0006 at the lower wind bins

having higher SNRs represent a higher quality determination of Turbine-Only sound level. The elevated background sound levels in the 6 m/s wind bin are illustrated in Appendix F.

7 Assessment of Compliance

This section provides the results of the measurements and calculations as they pertain to the determination of compliance of the facility. Section 4.5 details the criteria used to evaluate compliance.

7.1 Assessment Table

Final Turbine-Only sound levels at the audit receptor (Point of Reception) are compared to the exclusion limits and Background sound levels in Table 14. Turbine-Only sound levels at the audit receptor are calculated by taking the Turbine-Only sound level at the monitoring location and applying any applicable adjustments as indicated in Table 13. Wind bins having sufficient data for the determination of compliance have been highlighted in blue.

Table 14: Assessment Table

Audited Receptor	Wind speed at 10m-AGL [m/s]	1	2	3	4	5	6	7
R1883	Turbine-Only Sound Level (Point of Reception) [dBA]	38*	38	37	37	38*	-	-
	Background Sound Level [dBA]	26*	27	28	29	34*	-	-
MECP Exclusion Limit [dBA]		40	40	40	40	40	40	43
Compliance? (Y/N)		-	Y	Y	Y	-	-	-
V4329	Turbine-Only Sound Level (Point of Reception) [dBA]	-	-	38	39	39	38[a]	-
	Background Sound Level [dBA]	-	31	31	34	36	40	45[b]
MECP Exclusion Limit [dBA]		40	40	40	40	40	40	43
Compliance? (Y/N)		-	-	Y	Y	Y	Y	-
X0002	Turbine-Only Sound Level (Point of Reception) [dBA]	-	-	38	38	40	-	-
	Background Sound Level [dBA]	33*	31	31	32	35	40	-
MECP Exclusion Limit [dBA]		40	40	40	40	40	40	43
Compliance? (Y/N)		-	-	Y	Y	Y	-	-
X0003	Turbine-Only Sound Level (Point of Reception) [dBA]	-	39*	39	39	-	-	-
	Background Sound Level [dBA]	-	28*	31	31‡	-	-	-
MECP Exclusion Limit [dBA]		40	40	40	40	40	40	43
Compliance? (Y/N)		-	-	Y	Y	-	-	-
X0006	Turbine-Only Sound Level (Point of Reception) [dBA]	-	39*	40	38	40	42	-
	Background Sound Level [dBA]	33	31	32	35	38	42[b]	-
MECP Exclusion Limit [dBA]		40	40	40	40	40	40[b]	43
Compliance? (Y/N)		-	-	Y	Y	Y	Y[Δ]	-

- Minimum sample size not met in this wind bin, sound levels not reported except as noted by (*).

* Below minimum sample size requirements, data presented for information only.

[a] Signal-to-noise level less than 3 dB. Increased uncertainty in determination of Turbine-Only Sound Impact.

[b] Average measured Background sound level higher than MECP Exclusion Limit.

‡ Turbine-Only Sound Level calculated using Background sound level from lower (3m/s) wind bin, per Protocol Section E5.5.6a).

[Δ] Turbine-Only Sound Level higher than exclusion limit not higher than Background sound level. This is compliant per Section D6 of the Protocol. Additional discussion in Appendix F.

7.2 Statement of Compliance

Based on the results presented in Table 14, the Turbine-Only sound levels at the R1883, V4329, X0002, X0003, and X0006 audit receptors for Nation Rise are in compliance with the applicable sound level limits.

8 Conclusion

An acoustic immission audit per the requirements of the MECP Compliance Protocol for Wind Turbine Noise was conducted at Nation Rise receptors R1883, V4329, and three alternative measurement locations identified as X0002, X0003 and X0006. Per the results presented in this report and summarized in Table 14, the noise impacts at all five audit locations were found to be in in compliance with the applicable sound level limits.

9 References

[1] P. Mohsen Keyvani, “Renewable Energy Approval Number #0871-AV3TFM,” Ministry of the Environment and Climate Change, Toronto, ON, 2018.

[2] Ontario Ministry of the Environment and Climate Change, “NPC-350 - Compliance Protocol for Wind Turbine Noise,” Ontario Ministry of the Environment and Climate Change, Toronto, 2017.

[3] A. Nercessian and K. Varnik, “Nation Rise Wind Farm - Renewable Energy Approval Application - Noise Impact Assessment,” DNV-GL Energy, Montreal, 2019.

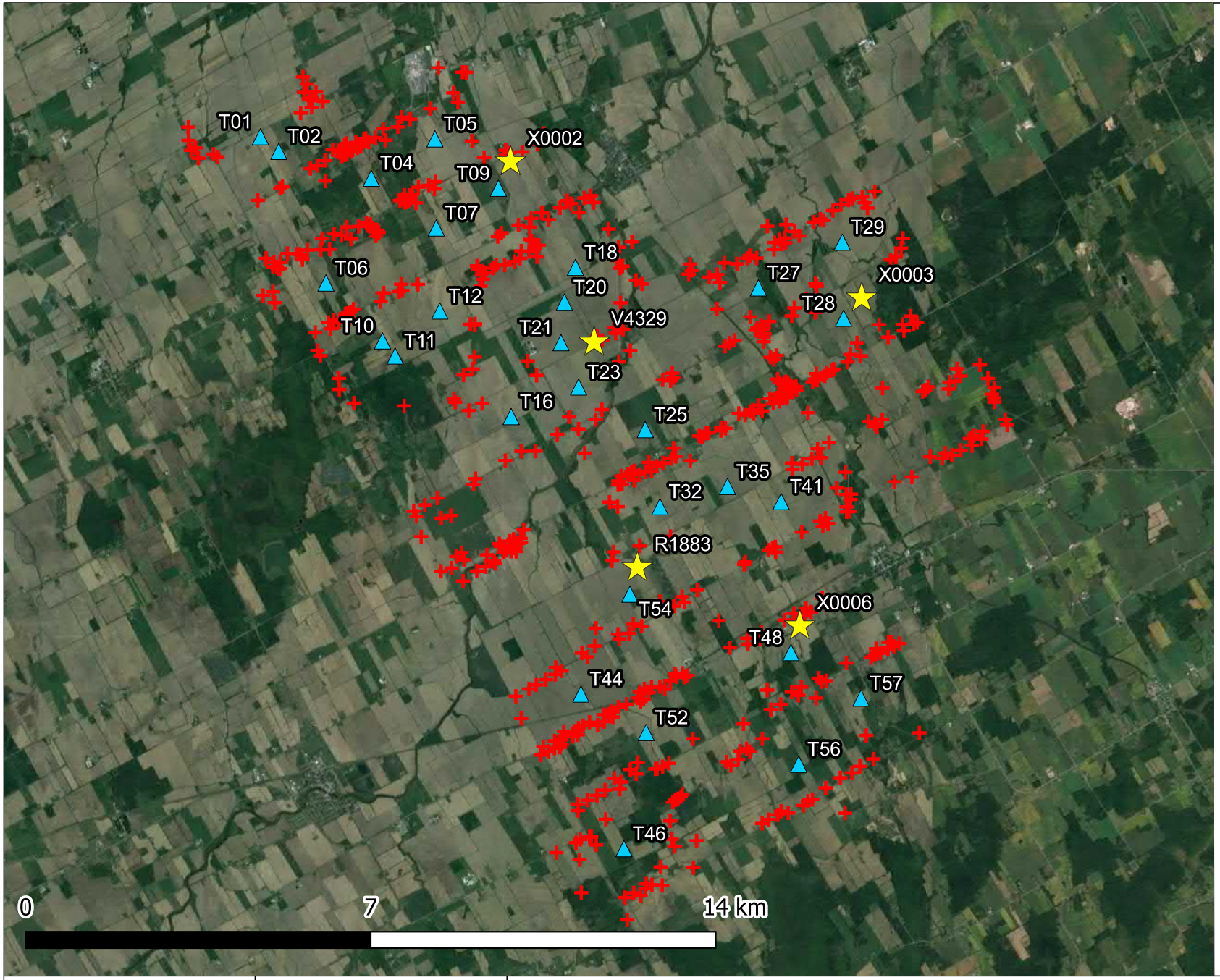
[4] N. Tam, K. Clark and D. Halstead, “Nation Rise Wind Farm / Turbine T12 IEC 61400-11 Edition 3.0 Measurement Report,” Aercoustics Engineering Limited, Mississauga, Ontario, 2022.

[5] Nercessian, Aren; Varnik, Kristjan, “Nation Rise Wind Farm - Specifications Report, Wind Facility,” DNV-GL Energy, Montreal, 2019.

[6] IEC Technical Committee 88, “IEC 61400-11:2012 - Wind Turbines - Part 11: Acoustic noise measurement techniques,” International Electrotechnical Comission (IEC), Geneva, 2012.

[7] Technical Committee ISO/TC 43, Acoustics, Subcommittee SC 1, Noise, “ISO 1996-2:2007 - Acoustics - Description, measurement, and assessment of environmental noise - Part 2: determination of environmental noise levels,” International Standards Organization (ISO), Geneva, 2007.

Appendix A
Site Details



aercoustics

Project ID: 16115.01

Scale: As Indicated
Drawn by: AS
Reveiwed by: KC
Date: Dec 2022
Revision: 1

Project Name

Nation Rise Wind Farm

Figure Title

Site Plan Overview

Figure A.1

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Date: Dec 2022
Revision: 1

Project Name

Nation Rise Wind Farm

Figure Title

R1883 - Monitor and Receptor Location

Figure A.2

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Project ID: 16115.01

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Drawn by: AS
Reveiwed by: KC
Date: Dec 2022
Revision: 1

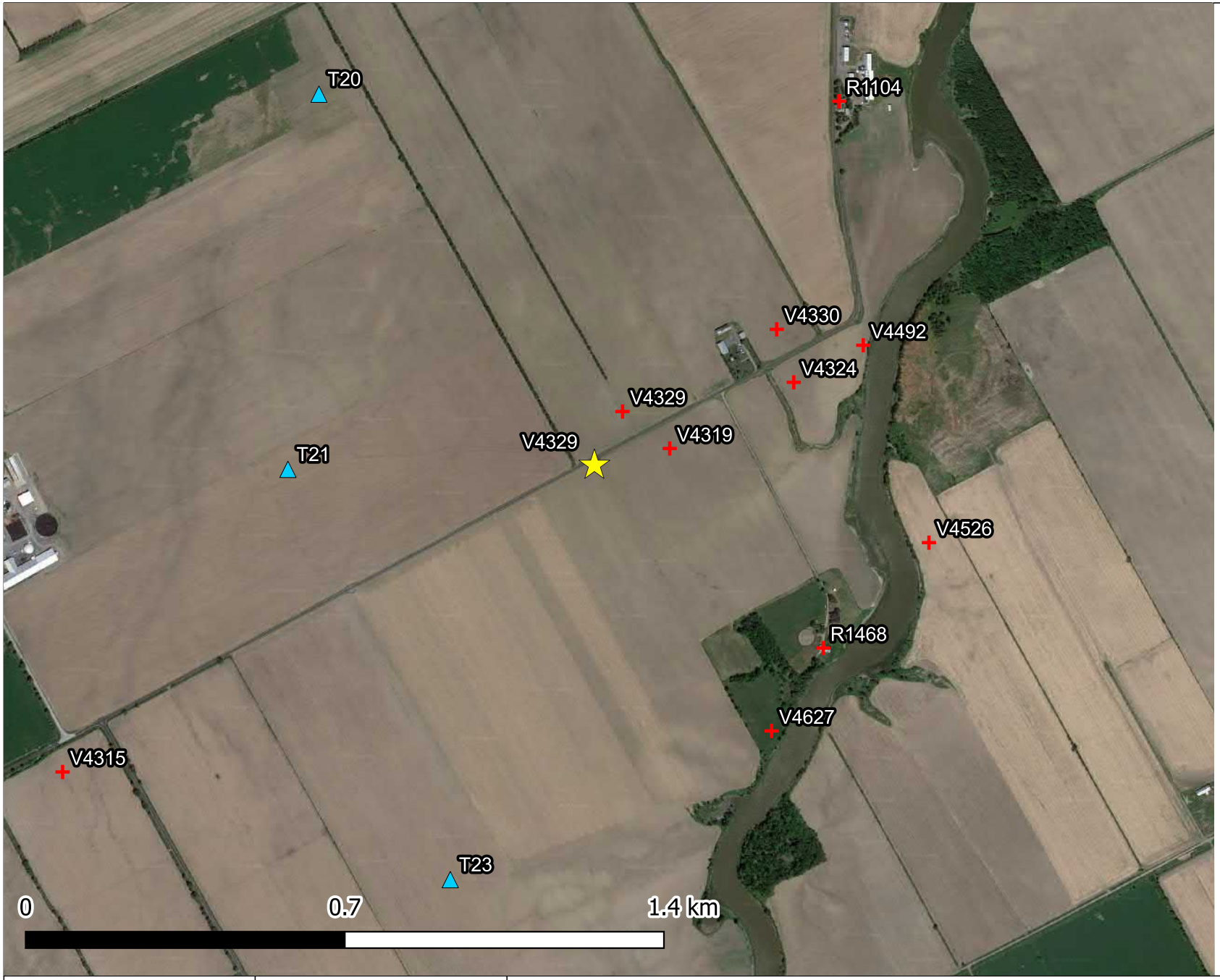
Project Name

Nation Rise
Wind Farm

Figure Title

R1883 - Monitor and Receptor

Figure A.3



aercoustics

Project ID: 16115.01

Scale: As Indicated
Drawn by: AS
Reveiwed by: KC
Date: Dec 2022
Revision: 1

Project Name

Nation Rise Wind Farm

Figure Title

V4329 - Monitor and Receptor Location

Figure A.4

aercoustics

Project ID: 16115.01

Scale: As Indicated
Drawn by: AS
Reveiwed by: KC
Date: Dec 2022
Revision: 1

Project Name

Nation Rise
Wind Farm

Figure Title

V4329 - Monitor and Receptor

Figure A.5

aercoustics

Project ID: 16115.01

Scale: As Indicated
Drawn by: AS
Reveiwed by: KC
Date: Dec 2022
Revision: 1

Project Name

Nation Rise Wind Farm

Figure Title

X0002 - Monitor and Receptor Location

Figure A.6

aercoustics

Project ID: 16115.01

Scale:	As Indicated
Drawn by:	AS
Reveiwed by:	KC
Date:	Dec 2022
Revision:	1

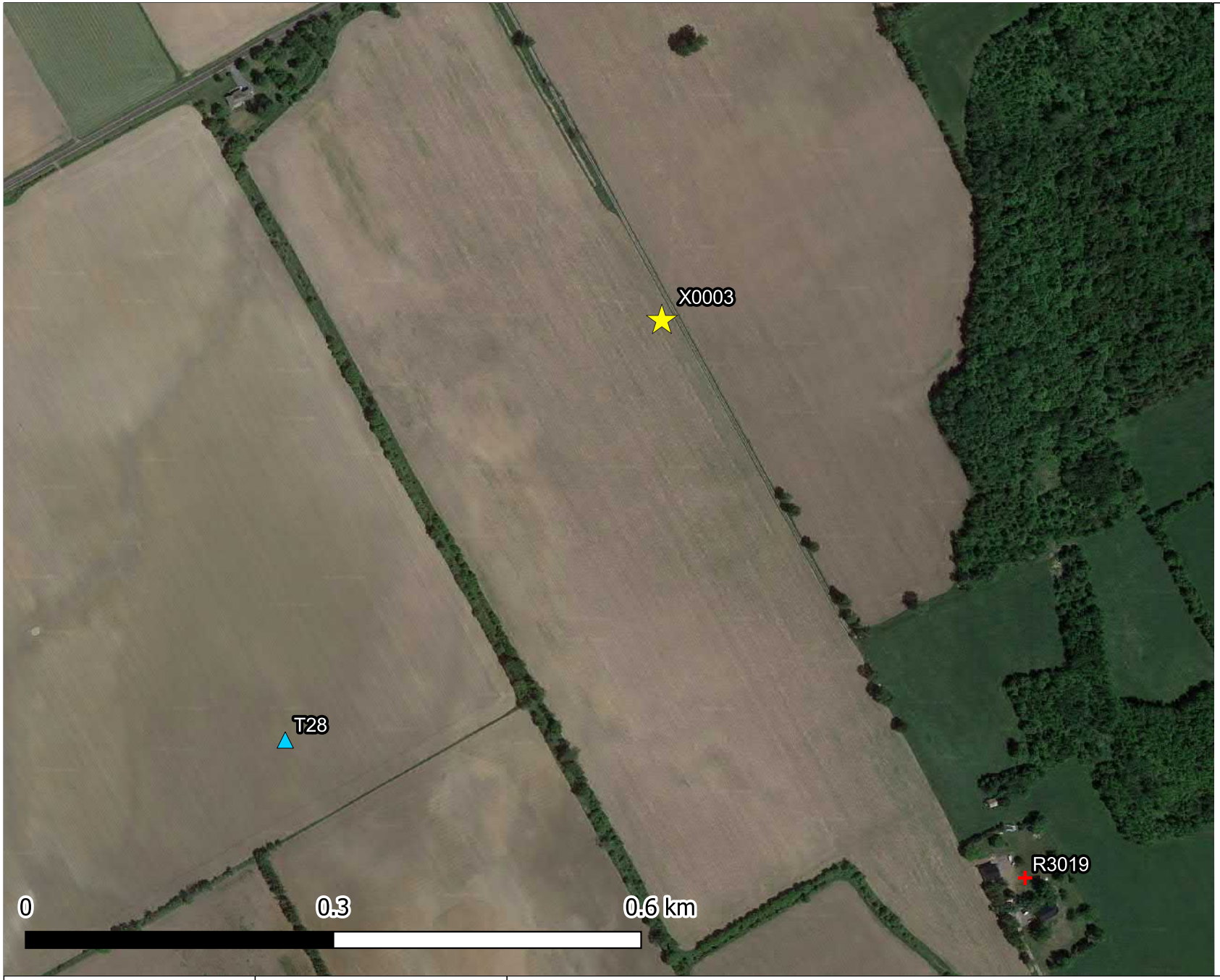
Project Name

Nation Rise
Wind Farm

Figure Title

X0002 - Monitor and Receptor

Figure A.7



aercoustics

Project ID: 16115.01

Scale: As Indicated
Drawn by: AS
Reveiwed by: KC
Date: Dec 2022
Revision: 1

Project Name

Nation Rise Wind Farm

Figure Title

X0003 - Monitor and Receptor Location

Figure A.8

aercoustics

Project ID: 16115.01

Scale: As Indicated
Drawn by: AS
Reveiwed by: KC
Date: Dec 2022
Revision: 1

Project Name

Nation Rise
Wind Farm

Figure Title

X0003 - Monitor and Receptor

Figure A.9

aercoustics

Project ID: 16115.01

Scale: As Indicated
Drawn by: AS
Reveiwed by: KC
Date: Dec 2022
Revision: 1

Project Name

Nation Rise Wind Farm

Figure Title

X0006 - Monitor and Receptor Location

Figure A.10

aercoustics

Project ID: 16115.01

Scale:	As Indicated
Drawn by:	AS
Reveiwed by:	KC
Date:	Dec 2022
Revision:	1

Project Name

Nation Rise
Wind Farm

Figure Title

X0006 - Monitor and Receptor

Figure A.11

Appendix B
Receptor Selection

Receptor Selection Table

The following receptor selection table is based on the as-built CadnaA model, prepared by DNV-GL and includes all Nation Rise Points of Receptions ranked in order of the predicted Sound Pressure Level (SPL).

Table B-1: Receptor Selection Table based on Nation Rise Points of Reception

SPL Rank	Point of Reception ID	Height (m)	Distance to Nearest Turbine (m)	Nearest Turbine	Predicted Impact (dBA)	Wind Direction	Potential / Excluded	Added notes
1	V4328	4.5	424	T21	41.5	CW	Excluded	Participating
2	V4288	4.5	404	T41	40.5	**DW**	Excluded	Participating
3	V4314	4.5	510	T16	38.9	CW	Excluded	Participating
4	R1302	4.5	551	T04	38.6	CW	Excluded	Participating
5	V4235	4.5	547	T28	38.3	CW	Excluded	Participating
6	R1366	4.5	513	T27	38.2	CW	Excluded	Participating
7	R1445	4.5	671	T10	38.2	CW	Excluded	Participating
8	R1314	4.5	654	T07	37.9	CW	Excluded	Crosswind
9	V4315	4.5	828	T21	37.9	UW	Excluded	Upwind
10	V4326	4.5	627	T23	37.9	CW	Excluded	Participating
11	V4491	4.5	661	T23	37.9	CW	Excluded	Crosswind
12	**V4329**	**4.5**	**745**	**T21**	**37.8**	**DW**	**Potential**	**Selected**
13	R1454	4.5	706	T21	37.7	UW	Excluded	Participating
14	R1467	4.5	637	T23	37.7	UW	Excluded	Upwind
15	V4108	4.5	598	T52	37.7	CW	Excluded	Participating
16	R1441	4.5	698	T12	37.6	CW	Excluded	Crosswind
17	R1500	4.5	660	T25	37.6	CW	Excluded	Participating
18	R1502	4.5	672	T25	37.6	CW	Excluded	Crosswind
19	R2092	4.5	588	T28	37.6	CW	Excluded	Crosswind
20	V4130	4.5	587	T44	37.6	CW	Excluded	Participating
21	R1252	4.5	635	T02	37.5	CW	Excluded	Participating
22	R1305	4.5	735	T04	37.5	CW	Excluded	Crosswind
23	R1453	4.5	759	T21	37.5	CW	Excluded	Participating
24	V4126	4.5	622	T44	37.5	CW	Excluded	Crosswind
25	V4343	4.5	726	T07	37.5	CW	Excluded	Participating
26	V4348	4.5	768	T06	37.5	CW	Excluded	Crosswind
27	V4506	4.5	746	T23	37.5	CW	Excluded	Participating

SPL Rank	Point of Reception ID	Height (m)	Distance to Nearest Turbine (m)	Nearest Turbine	Predicted Impact (dBA)	Wind Direction	Potential / Excluded	Added notes
28	R1306	4.5	764	T04	37.4	CW	Excluded	Crosswind
29	R1308	4.5	793	T07	37.4	CW	Excluded	Crosswind
30	R1309	4.5	776	T07	37.4	CW	Excluded	Crosswind
31	R1310	4.5	754	T04	37.4	CW	Excluded	Crosswind
32	R1446	4.5	767	T06	37.4	CW	Excluded	Crosswind
33	R1447	4.5	751	T06	37.4	CW	Excluded	Crosswind
34	R1503	4.5	735	T32	37.4	CW	Excluded	Crosswind
35	R1751	4.5	564	T48	37.4	CW	Excluded	Participating
36	V4165	4.5	771	T21	37.4	UW	Excluded	Upwind
37	**R1883**	**4.5**	**605**	**T54**	**37.3**	**DW**	**Potential**	**Selected**
38	R1115	4.5	743	T06	37.3	CW	Excluded	Crosswind
39	R1307	4.5	828	T07	37.3	CW	Excluded	Crosswind
40	R1311	4.5	853	T07	37.3	CW	Excluded	Crosswind
41	V4119	4.5	598	T44	37.3	CW	Excluded	Crosswind
42	V4293	4.5	779	T25	37.3	CW	Excluded	Crosswind
43	V4296	4.5	695	T32	37.3	CW	Excluded	Participating
44	V4434	4.5	796	T10	37.3	CW	Excluded	Crosswind
45	V4494	4.5	801	T07	37.3	CW	Excluded	Crosswind
46	V4989	4.5	812	T10	37.3	CW	Excluded	Crosswind
47	R1312	4.5	837	T07	37.2	CW	Excluded	Crosswind
48	R1396	4.5	571	T28	37.2	CW	Excluded	Crosswind
49	R1504	4.5	759	T32	37.2	CW	Excluded	Crosswind
50	R1505	7.5	775	T32	37.2	CW	Excluded	Crosswind
51	V4125	4.5	701	T44	37.2	CW	Excluded	Crosswind
52	V4167	4.5	674	T12	37.2	CW	Excluded	Crosswind
53	V4196	4.5	597	T05	37.2	CW	Excluded	Participating
54	V4282	4.5	691	T35	37.2	UW	Excluded	Participating
55	V4294	4.5	767	T25	37.2	CW	Excluded	Crosswind
56	V4342	4.5	791	T07	37.2	CW	Excluded	Crosswind
57	R1080	4.5	605	T06	37.1	CW	Excluded	Participating
58	R1253	4.5	661	T02	37.1	CW	Excluded	Participating
59	R1729	4.5	701	T44	37.1	CW	Excluded	Crosswind
60	V4291	4.5	797	T35	37.1	UW	Excluded	Participating

SPL Rank	Point of Reception ID	Height (m)	Distance to Nearest Turbine (m)	Nearest Turbine	Predicted Impact (dBA)	Wind Direction	Potential / Excluded	Added notes
61	V4319	4.5	838	T21	37.1	**DW**	Excluded	**Redundant with V4329**
62	V4373	4.5	746	T23	37.1	CW	Excluded	Crosswind
63	R1315	4.5	903	T07	37.0	CW	Excluded	Crosswind
64	R1356	4.5	578	T29	37.0	CW	Excluded	Crosswind
65	R1497	4.5	687	T25	37.0	CW	Excluded	Crosswind
66	V4074	4.5	569	T46	37.0	CW	Excluded	Crosswind
67	V4103	4.5	745	T52	37.0	CW	Excluded	Crosswind
68	V4193	4.5	871	T05	37.0	CW	Excluded	Crosswind
69	V4195	4.5	684	T09	37.0	CW	Excluded	Crosswind
70	V4349	4.5	879	T07	37.0	CW	Excluded	Crosswind
71	V4997	4.5	643	T32	37.0	CW	Excluded	Crosswind

As noted in Section 3.1.1 and illustrated in the table above, there are a limited number of non-participating Points of Reception which are located downwind of the prevailing wind direction which have predicted Sound Pressure Levels greater than 37.0 dBA. Accordingly, three alternative Points of Reception were selected as approved by the Director in accordance with Condition E1(3) of the Nation Rise REA. These locations are described in the table below.

Table B-2: Alternative Points of Reception

SPL Rank	Location ID	Height (m)	Distance to Nearest Turbine (m)	Nearest Turbine	Predicted Impact (dBA)	Wind Direction	Potential / Excluded	Added notes
-	X0002	4.5	594	T09	37.5	**DW**	Potential	**Selected**
-	X0003	4.5	550	T28	37.9	**DW**	Potential	**Selected**
-	X0006	4.5	568	T48	37.3	**DW**	Potential	**Selected**

These three Alternative Points of Reception, in addition to those indicated as ‘Selected’ in Table B-1, comprise the five (5) Nation Rise audit locations as detailed in Section 3.1.3 of this report.

aercoustics

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

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

To: Kenneth Little, ken.little@edpr.com

From: Kohl Clark, kohlc@aercoustics.com

Copies: Payam Ashtiani, Aercoustics
Ben Phillipson, Aercoustics
Nathan Roscoe, EDPR
Doug Ziegler, EDPR

Subject: Nation Rise Wind Farm Acoustic Audit – Immission – Monitoring Location Selection – Phase 1 Audit Campaign
REA# #0871-AV3FTM
Aercoustics Project #: 16115.01

Date: July 9, 2021

Aercoustics Engineering Limited ("Aercoustics") has been retained by EDP Renewables ("EDPR") to complete the acoustic audit outlined in the Renewable Energy Approval (REA) for the Nation Rise Wind Farm ("Nation Rise"). Nation Rise operates under REA #0871-AV3FTM, originally issued on May 4, 2018.

The following memo outlines the receptor selection methodology employed to satisfy the acoustic immission audit requirement outlined in condition E of the Nation Rise REA.

In order to facilitate consultation with the Ministry of the Environment, Conservation and Parks (MECP) regarding the Nation Rise acoustic audit, Aercoustics has prepared this letter to outline the measurement locations that are under consideration, pending confirmation of land access.

REA Requirements

Per the Nation Rise REA conditions E1(1) and E1(2), the acoustic immission audit must be carried out by an Independent Acoustical Consultant on two (2) separate occasions at five (5) different Points of Reception. The audit must be conducted according to the Part D of the Compliance Protocol for Wind Turbine Noise (the "Protocol"). Specifically, audit locations selected according to the Protocol must satisfy the following conditions:

- Monitoring locations are situated in the prevailing downwind direction with respect to the nearest wind turbine

- Monitoring locations are those which have the greatest predicted noise impact of non-participating receptors
- Monitoring locations have a predicted cumulative noise impact greater than 37 dBA
- Nation Rise turbines must be parked during ambient measurements such that the predicted impact in the area (from transformers, wind turbines, and third-party sources) is below 30 dBA

Receptor Audit Locations

Based on historical wind data provided by EDPR, the prevailing historical wind direction at Nation Rise is from approximately the southwest (225 degrees). This is based on data which has been filtered for hub height wind speeds above 9 m/s, to isolate for conditions when the wind farm is expected to generate max power. This wind rose has been included at the end of this memo as Figure 1. With reference to the Turbine location, downwind directions are ± 45 degrees from the line of sight between the turbine and receptor/measurement location. Determination of the predicted cumulative noise impact levels was based on a CadnaA model provided by DNV-GL which reflects the as-built turbine layout including a total of 29 wind turbines. It is to be noted that four (4) of the turbines identified in the REA – T38, T43, T47 and T58 – were not constructed and accordingly have not been included in this assessment.

The following table summarizes the highest ranked receptors that have been selected as candidates for the I-Audit for the Nation Rise according to Condition E1(2) of the Nation Rise REA. In selecting candidate receptor locations, care was taken to ensure that the locations chosen weren't in the same area. For this reason, receptor locations within roughly 750 m of each other are classified as part of the same "group".

Table 1: Summary of Receptor Candidates per REA Condition E1(2)

Receptor Group	ID	Height (m)	Distance to Nearest Turbine (m)	Nearest Turbine	Calculated Sound Level (dBA)[1]	Wind Direction[2]
1	V4329	4.5	745	T21	37.8	Downwind
2	R1883	4.5	605	T54	37.3	Downwind
1	V4319	4.5	838	T21	37.1	Downwind

[1] Sound Pressure Level at the receptor location determined using an as-built sound model created by DNV-GL

[2] Relative to the prevailing wind direction, +/-45°

Per Table 2 above, there are only three non-participating receptor locations which meet the requirements of being downwind with high predicted noise impact greater than 37 dBA. Two of these locations (V4319, and V4329) are situated very close to one another such that conducting audit measurements at one location would be representative of the noise

impact at the other. Accordingly, only two (2) receptor locations can be selected according to REA condition E1(2).

Please see Table 3 included at the end of this memo for an unfiltered list of the 71 receptors with a predicted impact of 37 dBA or greater, sorted by predicted sound level. Reasons for exclusion have been included for all locations not being pursued.

REA condition E1(3) provides an alternative methodology for receptor selection, stipulating that:

> "*if any of the five (5) Points of Reception cannot be selected on the basis of the criteria described in Condition E1(2) due to access restrictions or for any other reason, the Company must select alternate Points of Reception or locations (other than a Point of Reception), and must provide a clear written explanation to the Director and the District Manager prior to undertaking the acoustic audit measurements as to why the criteria described in Condition E1(2) could not be met and the basis for selecting the alternate Points of Reception or locations."*

Since only two (2) locations can be selected based on the criteria of REA Condition E1(2), consideration has been given to the remaining three (3) of the five (5) audit locations which must be selected.

It is therefore proposed that three (3) of the five (5) audit locations other than a Point of Reception be selected per Condition E1(3) of the REA, based on the following guidelines:

- Situated downwind with respect to the closest turbine
- Locations are to be distributed across the project footprint
- Where possible, locations are situated close to turbines which are the Primary Turbine for a location where MECP or residents might have concerns about compliance
- Locations have a high predicted cumulative noise impact comparable to that of the non-participating Point of Reception with the highest predicted noise impact (R1314 at 37.9 dBA)

Locations selected according to these guidelines would serve as Proxy Locations and would provide information about the noise impact at key areas around the wind farm where suitable audit locations cannot be selected according to the criteria provided in the Compliance Protocol. Situating measurement locations in the prevailing downwind direction, sufficiently far from foliage or other sources of ambient noise may yield a higher quantity of high-quality data compared to a crosswind location.

Table 2: Additional location options that are not Points of Reception

Receptor Group	ID	Height (m)	Distance to Nearest Turbine (m)	UTM Coordinates [Easting, Northing, Zone 18T]	Nearest Turbine	Calculated Sound Level (dBA)[1]	Wind Direction[2]
3	X0001	4.5	713	481209 m E, 5008014 m N	T01	37.7	Downwind
3	X0002[2]	4.5	556	485717 m E, 5007051 m N	T09	37.8	Downwind
4	X0003	4.5	550	492816 m E, 5004338 m N	T28	37.9	Downwind
4	X0004[2]	4.5	528	492808 m E, 5005834 m N	T29	37.8	Downwind
5	X0005	4.5	524	488734 m E, 4995958 m N	T52	38.1	Downwind
5	X0006[2]	4.5	553	491544 m E, 4997674 m N	T48	37.5	Downwind

1 Relative to the prevailing wind direction, +/-45°

2 Proxy Receptor locations with ID's ending in even numbers (example: X0002) have been included as alternative locations within the respective receptor 'group'. Such receptors will be pursued only in the event that monitoring is prohibited due to land access restrictions or other unforeseen complications at the primary location within the Receptor Group, as indicated by ID's ending in odd numbers (Example X0001).

A site map been included at the end of this memo showing all turbines and the candidate monitoring locations that have been identified. The monitor setup locations provided in this memo are approximate; final confirmation of receptor locations will be provided to the MECP after land-access discussions have taken place.

Deployment of these monitors for the first phase of the Immission audit is currently scheduled for mid-September. We kindly ask that any concerns with the locations selected be communicated as soon as possible to allow time for any necessary adjustment to our planned approach.

Sincerely,

AERCOUSTICS ENGINEERING LIMITED

Kohl Clark, B.Eng.,

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

Table 3: Receptors Sorted by Sound Level

Rank	Point of Reception ID	Height (m)	Distance to Nearest Turbine (m)	Nearest Turbine	Predicted Impact (dBA)	Wind Direction	Selected / Potential / Excluded	Added notes
1	V4328	4.5	424	T21	41.5	CW	Excluded	Participating/Crosswind
2	V4288	4.5	404	T41	40.5	DW	Excluded	Participating
3	V4314	4.5	510	T16	38.9	CW	Excluded	Participating/Crosswind
4	R1302	4.5	551	T04	38.6	CW	Excluded	Participating/Crosswind
5	V4235	4.5	547	T28	38.3	CW	Excluded	Participating/Crosswind
6	R1366	4.5	513	T27	38.2	CW	Excluded	Participating/Crosswind
7	R1445	4.5	671	T10	38.2	CW	Excluded	Participating/Crosswind
8	R1314	4.5	654	T07	37.9	CW	Excluded	Crosswind
9	V4315	4.5	828	T21	37.9	UW	Excluded	Upwind
10	V4326	4.5	627	T23	37.9	CW	Excluded	Participating/Crosswind
11	V4491	4.5	661	T23	37.9	CW	Excluded	Crosswind
12	**V4329**	**4.5**	**745**	**T21**	**37.8**	**DW**	**Potential**	**Selected**
13	R1454	4.5	706	T21	37.7	UW	Excluded	Participating/Upwind
14	R1467	4.5	637	T23	37.7	UW	Excluded	Upwind
15	V4108	4.5	598	T52	37.7	CW	Excluded	Participating/Crosswind
16	R1441	4.5	698	T12	37.6	CW	Excluded	Crosswind
17	R1500	4.5	660	T25	37.6	CW	Excluded	Participating/Crosswind
18	R1502	4.5	672	T25	37.6	CW	Excluded	Crosswind
19	R2092	4.5	588	T28	37.6	CW	Excluded	Crosswind
20	V4130	4.5	587	T44	37.6	CW	Excluded	Participating/Crosswind

Rank	Point of Reception ID	Height (m)	Distance to Nearest Turbine (m)	Nearest Turbine	Predicted Impact (dBA)	Wind Direction	Selected / Potential / Excluded	Added notes
21	R1252	4.5	635	T02	37.5	CW	Excluded	Participating/Crosswind
22	R1305	4.5	735	T04	37.5	CW	Excluded	Crosswind
23	R1453	4.5	759	T21	37.5	CW	Excluded	Participating/Crosswind
24	V4126	4.5	622	T44	37.5	CW	Excluded	Crosswind
25	V4343	4.5	726	T07	37.5	CW	Excluded	Participating/Crosswind
26	V4348	4.5	768	T06	37.5	CW	Excluded	Crosswind
27	V4506	4.5	746	T23	37.5	CW	Excluded	Participating/Crosswind
28	R1306	4.5	764	T04	37.4	CW	Excluded	Crosswind
29	R1308	4.5	793	T07	37.4	CW	Excluded	Crosswind
30	R1309	4.5	776	T07	37.4	CW	Excluded	Crosswind
31	R1310	4.5	754	T04	37.4	CW	Excluded	Crosswind
32	R1446	4.5	767	T06	37.4	CW	Excluded	Crosswind
33	R1447	4.5	751	T06	37.4	CW	Excluded	Crosswind
34	R1503	4.5	735	T32	37.4	CW	Excluded	Crosswind
35	R1751	4.5	564	T48	37.4	CW	Excluded	Participating/Crosswind
36	V4165	4.5	771	T21	37.4	UW	Excluded	Upwind
37	R1115	4.5	743	T06	37.3	CW	Excluded	Crosswind
38	R1307	4.5	828	T07	37.3	CW	Excluded	Crosswind
39	R1311	4.5	853	T07	37.3	CW	Excluded	Crosswind
40	**R1883**	**4.5**	**605**	**T54**	**37.3**	**DW**	**Potential**	**Selected**
41	V4119	4.5	598	T44	37.3	CW	Excluded	Crosswind

Rank	Point of Reception ID	Height (m)	Distance to Nearest Turbine (m)	Nearest Turbine	Predicted Impact (dBA)	Wind Direction	Selected / Potential / Excluded	Added notes
42	V4293	4.5	779	T25	37.3	CW	Excluded	Crosswind
43	V4296	4.5	695	T32	37.3	CW	Excluded	Participating/Crosswind
44	V4434	4.5	796	T10	37.3	CW	Excluded	Crosswind
45	V4494	4.5	801	T07	37.3	CW	Excluded	Crosswind
46	V4989	4.5	812	T10	37.3	CW	Excluded	Crosswind
47	R1312	4.5	837	T07	37.2	CW	Excluded	Crosswind
48	R1396	4.5	571	T28	37.2	CW	Excluded	Crosswind
49	R1504	4.5	759	T32	37.2	CW	Excluded	Crosswind
50	R1505	7.5	775	T32	37.2	CW	Excluded	Crosswind
51	V4125	4.5	701	T44	37.2	CW	Excluded	Crosswind
52	V4167	4.5	674	T12	37.2	CW	Excluded	Crosswind
53	V4196	4.5	597	T05	37.2	CW	Excluded	Participating/Crosswind
54	V4282	4.5	691	T35	37.2	UW	Excluded	Participating/Upwind
55	V4294	4.5	767	T25	37.2	CW	Excluded	Crosswind
56	V4342	4.5	791	T07	37.2	CW	Excluded	Crosswind
57	R1080	4.5	605	T06	37.1	CW	Excluded	Participating/Crosswind
58	R1253	4.5	661	T02	37.1	CW	Excluded	Participating/Crosswind
59	R1729	4.5	701	T44	37.1	CW	Excluded	Crosswind
60	V4291	4.5	797	T35	37.1	UW	Excluded	Participating/Upwind
61	**V4319**	**4.5**	**838**	**T21**	**37.1**	**DW**	**Potential**	**Tentatively Selected***
62	V4373	4.5	746	T23	37.1	CW	Excluded	Crosswind

Rank	Point of Reception ID	Height (m)	Distance to Nearest Turbine (m)	Nearest Turbine	Predicted Impact (dBA)	Wind Direction	Selected / Potential / Excluded	Added notes
63	R1315	4.5	903	T07	37	CW	Excluded	Crosswind
64	R1356	4.5	578	T29	37	CW	Excluded	Crosswind
65	R1497	4.5	687	T25	37	CW	Excluded	Crosswind
66	V4074	4.5	569	T46	37	CW	Excluded	Crosswind
67	V4103	4.5	745	T52	37	CW	Excluded	Crosswind
68	V4193	4.5	871	T05	37	CW	Excluded	Crosswind
69	V4195	4.5	684	T09	37	CW	Excluded	Crosswind
70	V4349	4.5	879	T07	37	CW	Excluded	Crosswind
71	V4997	4.5	643	T32	37	CW	Excluded	Crosswind

* Receptor V4319 is locationally redundant with receptor V4329 and will only be selected in the event that monitoring at Receptor V4329 is not possible.

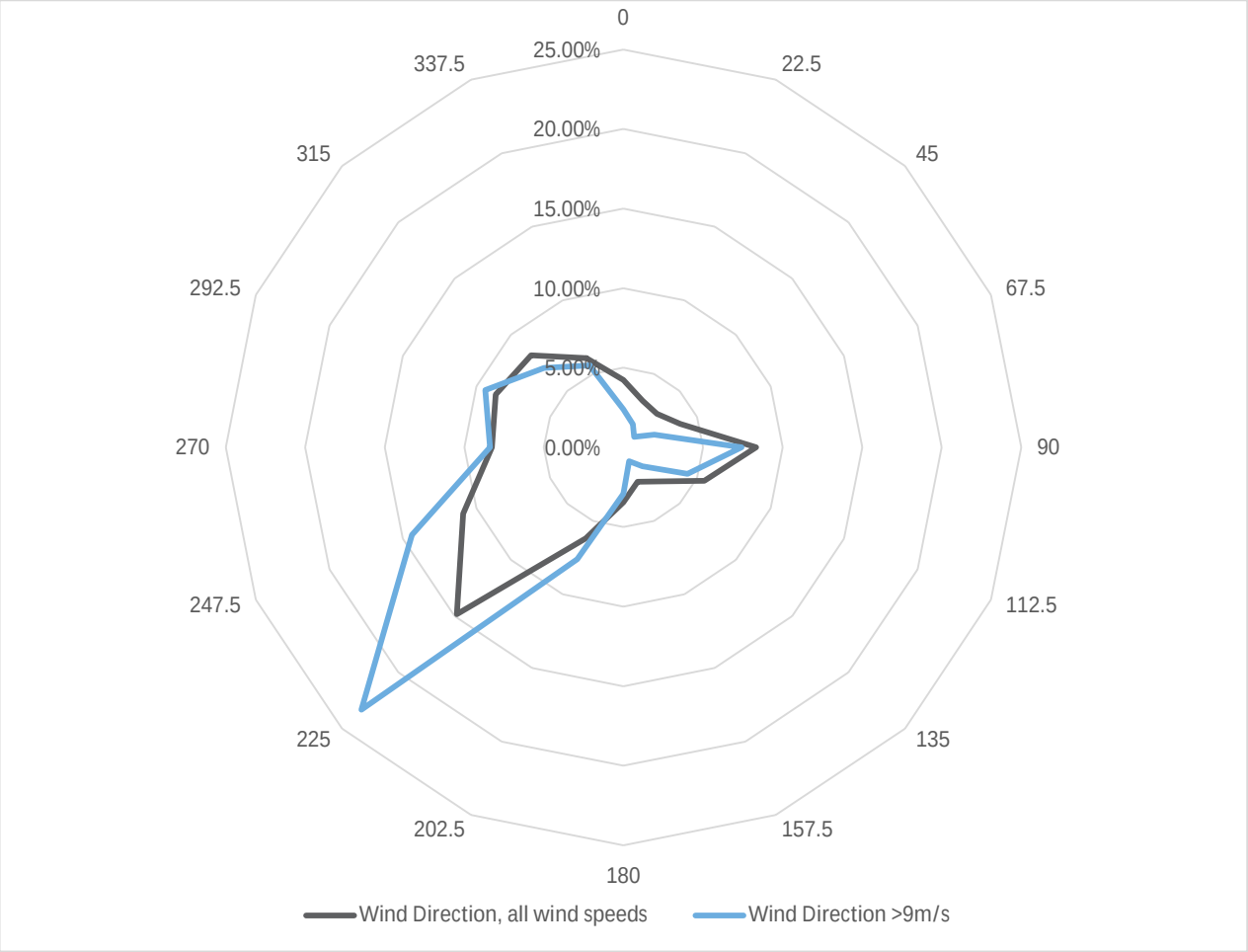
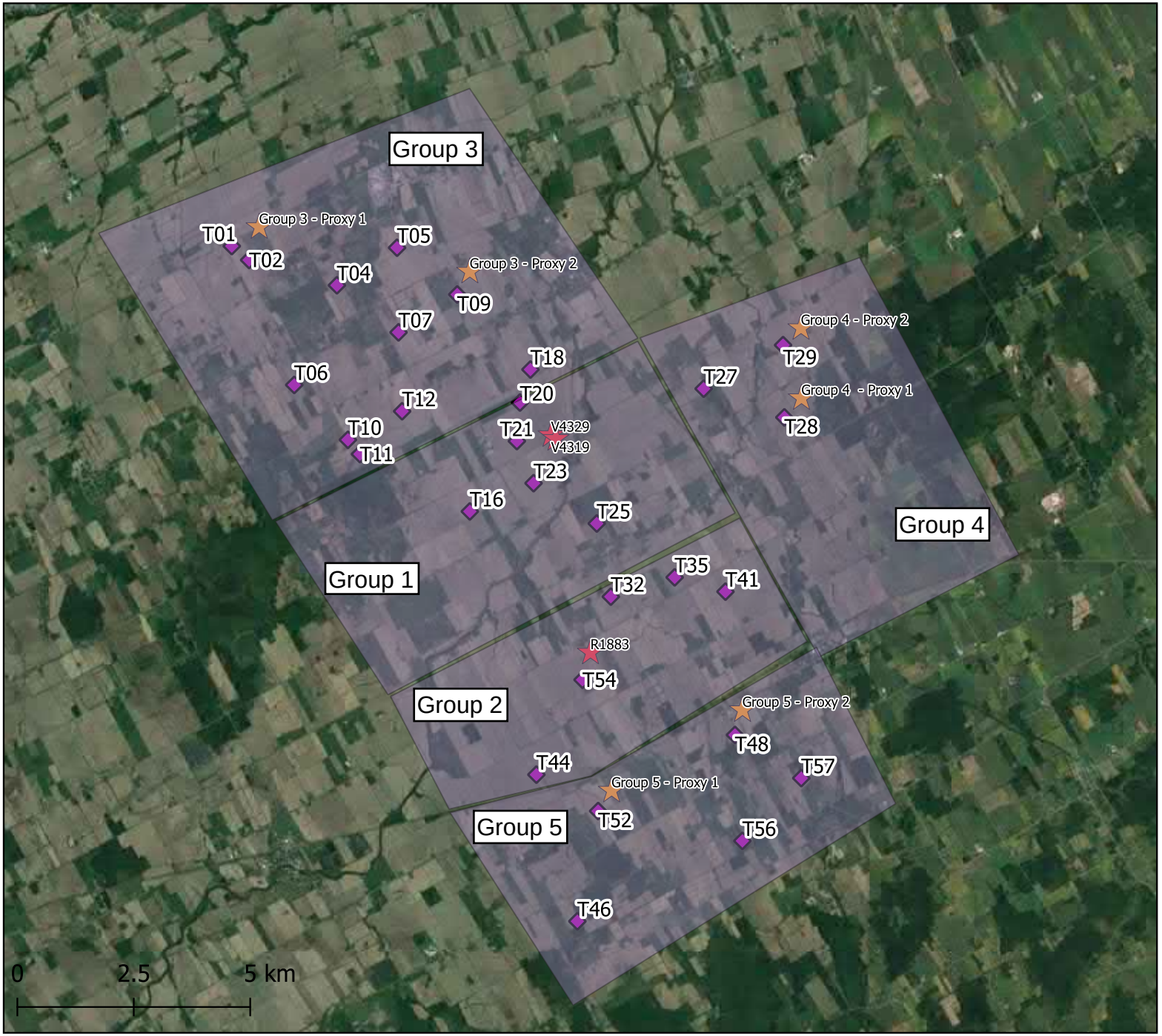


Figure 1- Nation Rise Wind Rose



Legend

- 2021 Groups
- 2021 Proxy Receptor Locations
- 2021 Protocol Receptors
- Nation Rise WTGs

N

Project ID:	16115.01
Drawn by:	BP
Reviewed by:	KC
Date:	June 1, 2021
Revision:	0
Scale:	As Indicated

Nation Rise Wind Farm
Turbine locations, Group designations, and monitors for Groups

aercoustics

Appendix C
Calibration Certificates

Model Number	ICP MICROPHONE SYSTEM	Revision: F
378B02		ECN #: 47338

Performance	**ENGLISH**	**SI**	
Nominal Microphone Diameter	1/2"	1/2"	
Frequency Response Characteristic(at 0° incidence)	Free-Field	Free-Field	
Sensitivity	50 mV/Pa	50 mV/Pa	[3]
Sensitivity(± 1.5 dB)	-26 dB re 1 V/Pa	-26 dB re 1 V/Pa	[3]
Frequency Range(± 2 dB)	3.75 to 20,000 Hz	3.75 to 20,000 Hz	
Frequency Range(± 1 dB)	7 to 10,000 Hz	7 to 10,000 Hz	
Lower Limiting Frequency(-3 dB)	1.0 to 3.0 Hz	1.0 to 3.0 Hz	
Inherent Noise	15.5 dB(A) re 20 µPa	15.5 dB(A) re 20 µPa	[2]
Dynamic Range(3% Distortion Limit)	137 dB re 20 µPa	137 dB re 20 µPa	[2]
TEDS Compliant	Yes	Yes	[4]
Environmental			
Temperature Range(Operating)	-40 to +176 °F	-40 to +80 °C	
Temperature Coefficient of Sensitivity(+14 to +158°F (-10 to +70°C))	0.005 dB/°F	0.009 dB/°C	[2][3]
Static Pressure Coefficient	-0.013 dB/kPa	-0.013 dB/kPa	[2][3]
Humidity Coefficient of Sensitivity(0 to 100%, non-condensing)	± 0.001 dB/%RH	± 0.001 dB/%RH	[3]
Influence of Axial Vibration(0.1g (1 m/s²))	63 dB re 20 µPa	63 dB re 20 µPa	[2]
Electrical			
Polarization Voltage	0 V	0 V	[1]
Excitation Voltage	20 to 30 VDC	20 to 30 VDC	
Constant Current Excitation	2 to 20 mA	2 to 20 mA	
Output Bias Voltage	10 to 14 VDC	10 to 14 VDC	
Maximum Output Voltage	± 7 Vpk	± 7 Vpk	
Output Impedance	<50 Ohm	<50 Ohm	
Physical			
Housing Material	Stainless Alloy	Stainless Alloy	
Venting	Rear	Rear	[5]
Electrical Connector	BNC Jack	BNC Jack	
Mounting Thread(Grid)	0.5 - 60 UNS	0.5 - 60 UNS	
Size (Diameter x Height)(with grid)	0.52 in x 3.62 in	13.2 mm x 91.9 mm	
Size (Diameter x Height)(without grid)	0.50 in x 3.58 in	12.7 mm x 90.9 mm	
Weight	1.63 oz	45.8 gm	[2]

CE[6]

All specifications are at room temperature unless otherwise specified.
In the interest of constant product improvement, we reserve the right to change specifications without notice.

ICP® is a registered trademark of PCB Group, Inc.

OPTIONAL VERSIONS

Optional versions have identical specifications and accessories as listed for the standard model except where noted below. More than one option may be used.

NOTES:

[1] Prepolarized
[2] Typical.
[3] re 250 Hz
[4] TEDS Capable Digital Communication, compliant with IEEE 1451.4
[5] Venting through Preamp.
[6] See PCB Declaration of Conformance PS064 for details.

SUPPLIED ACCESSORIES:

Model ACS-63 Calibration (with TEDS) of Precision Condenser Microphones and Preamplifiers together (mated pair). (1)

Entered: LK	Engineer: MT	Sales: MV	Approved: MT	Spec Number:
Date: 10/17/2017	Date: 10/17/2017	Date: 10/17/2017	Date: 10/17/2017	**57824**

PCB PIEZOTRONICS
3425 Walden Avenue, Depew, NY 14043

Phone: 716-684-0001
Fax: 716-684-0987
E-Mail: info@pcb.com

R1883 Calibration Certificates

Details are disclosed in the table below regarding the calibration of the equipment used for the Phase 2 I-Audit campaign at R1883. The associated calibration certificates are provided in this appendix.

Please note that the serial number displayed on the microphone system calibration certificate encompasses both the microphone and the pre-amplifier which are submitted for calibration as a pair. The calibration certificate is valid for both the microphone and pre-amplifier. Their individual model and serial numbers are displayed on the page following the certificate as well as denoted in the table below.

Equipment	Make/Model	Serial Number	Date of Last Calibration	Measurement Interval	Confirmation of Validity for Measurement Interval?
Sound Level Meter	NI 9234	1E2B18D	July 6, 2021	February 7, 2022 – March 1, 2022	Yes
Microphone/Pre-amplifier Pair	PCB 377B02	125630	August 10, 2021	February 7, 2022 – March 1, 2022	Yes
Microphone	PCB 377B02	167926	August 10, 2021	February 7, 2022 – March 1, 2022	Yes
Pre-amplifier	PCB 426E01	44003	August 10, 2021	February 7, 2022 – March 1, 2022	Yes
Signal Conditioner	PCB 480E09	35341	June 30, 2021	February 7, 2022 – March 1, 2022	Yes
Weather Station	Vaisala WXT530	P4111045	June 29, 2021	February 7, 2022 – March 1, 2022	Yes

Compliant Calibration Certificate

Certificate Number:	6821293.1	**OE Number**:	22176912
Customer:	Aercoustics Engineering Ltd 5335 Lucas Court ONTARIO Mississauga, L4Z 4A9 CANADA	**Page**:	1 of 14
Manufacturer:	National Instruments	**Model**:	NI 9234
Serial Number:	1E2B18D		
Part Number:	195551D-01L	**Description**:	MODULE ASSY,NI 9234, 4 AI CONFIGURABLE
Calibration Date:	06-JUL-2021	**Issued Date:**	06-JUL-2021
Procedure Name:	NI 9234	**Recommended Calibration Due**:	06-JUL-2022
Procedure Version:	3.6.1.0	**Verification Results:**	As Found: Passed As Left: Passed
Lab Technician:	Zsolt 2 Molnár	**Calibration Executive Version**:	6.2.0.0
		Driver Info:	NI-DAQmx:20.0.0
Temperature:	22.9° C	**Humidity**:	44.7% RH

The data found in this certificate must be interpreted as:

As Found The calibration data of the unit as received by National Instruments, if the unit is functional.

As Left The calibration data of the unit when returned from National Instruments.

The As Found and As Left readings are identical for units not adjusted or repaired.

This calibration conforms to ANSI/NCSL Z540.1 requirement.

The TUR (Test Uncertainty Ratio) of this calibration is maintained at a ratio of 4:1 or greater, unless otherwise indicated in the measurements. A TUR determination is not possible for singled sided specification limits and therefore the absence of a value should not be interpreted as a TUR of 4:1 or greater, but rather undetermined. When provided, the expanded measurement uncertainty is calculated according to the Guide to the Expression of Uncertainty in Measurement (GUM) for a confidence level of approximately 95%.

Measured values greater than the Manufacturer's specification limits are marked as 'Failed', measured values within the Manufacturer's specifications are marked as 'Passed'. NI Service Labs do not consider uncertainties when making statements of compliance to a specification.

This certificate applies exclusively to the item identified above and shall not be reproduced except in full, without National Instruments written authorization. Calibration certificates without signatures are not valid.

The Calibration Certificate can be viewed or downloaded online at www.ni.com/calibration/. To request a hard copy, contact NI Customer Service at Tel:(800) 531-5066 or Email orders@ni.com.

Authorized By:

Zoltán Szabó
Technical Manager

NI Calibration Services Debrecen
NI Hungary Kft.
Határ út 1/A
Debrecen, Hajdú-Bihar 4031
Hungary
Tel: +36-52-515-400

CERTIFICATE of CALIBRATION

Make : PCB Piezotronics

Reference # : 166958

Model : 378B02

Customer : Aercoustics Engineering Ltd
Mississauga, ON

Descr. : Microphone System 1/2" Free Field

Serial # : 125630

P. Order : 2021.07.28C

Asset # : 00981

Cal. status : Received in spec's, no adjustment made.
Preamp System with Mic 377B02 s/n 167926

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 : Aug 10, 2021

By : Petro Onasko

Cal. Due : Aug 10, 2023

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

Standards used : J-216 J-324 J-333 J-420 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

6375 Dixie Rd Unit # 7
Mississauga ON L5T 2E7
Tel: (905) 565-1583
Fax: (905) 565-8325

Form: 378B02	Approved by: J.R.	Feb-16	Ver 1.0

Calibration Report for Certificate : 166958

Make		Model	Serial №	Asset	Cal by
PCB Piezotronics		378B02	125630		
PCB Piezotronics		426E01	044003	00981	P.O.
PCB Piezotronics		377B02	167926		

Ambient Conditions:

Static Pressure	*99.3 kPa*
Temperature	*25.0°C*
Rel.Humidity	*51%*

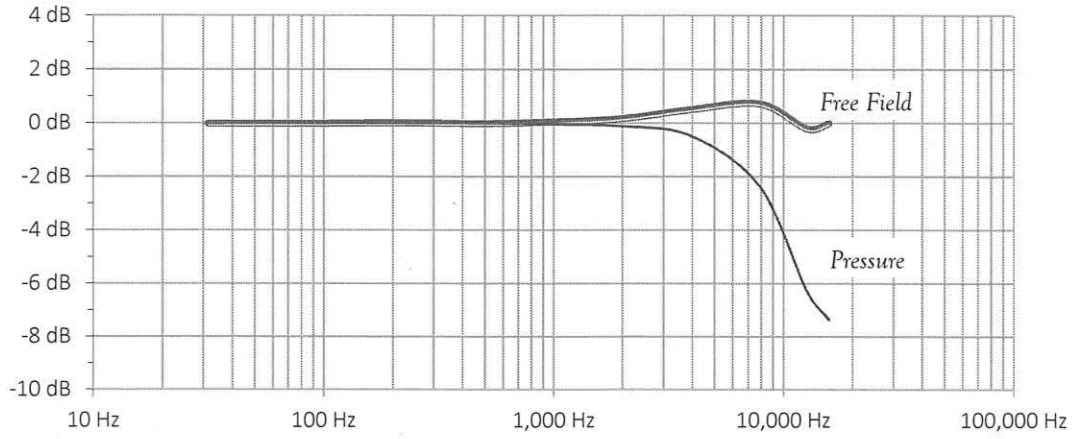
Sensitivity at 250 Hz

Specs Nom	Unit	Min	Reading	Max		In/Out
50.0 mV/Pa		39.72	*42.8 mV/Pa*	62.94		In
−26.02 dB	re 1 V/Pa	-28.02	*−27.4 dB*	-24.02		In
0 dB	re 50 mV/Pa	-2	*−1.4 dB*	2		In

Frequency response

Ref

Frequency	Pressure	Free Field
32 Hz	*−0.02 dB*	*−0.03 dB*
63 Hz	*−0.01 dB*	*−0.03 dB*
126 Hz	*0.00 dB*	*−0.01 dB*
251 Hz	*0.00 dB*	*0.00 dB*
503 Hz	*−0.01 dB*	*−0.02 dB*
1005 Hz	*−0.05 dB*	*+0.04 dB*
1979 Hz	*−0.11 dB*	*+0.16 dB*
3958 Hz	*−0.48 dB*	*+0.50 dB*
7915 Hz	*−2.38 dB*	*+0.71 dB*
12663 Hz	*−6.29 dB*	*−0.21 dB*
15830 Hz	*−7.36 dB*	*−0.02 dB*



CERTIFICATE of CALIBRATION

Make :	PCB Piezotronics	Reference # :	166560
Model :	480E09	Customer :	Aercoustics Engineering Ltd Mississauga, ON
Descr. :	Conditioning Amplifier		
Serial # :	00035341	P. Order :	2021.06.16C
Asset # :	01193		

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 : Jun 30, 2021 By : 

Cal. Due : Jun 30, 2023 Petro Onasko

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

Standards used : J-255 J-367 J-512

Navair Technologies

REPAIR AND CALIBRATION TRACEABLE TO NRC AND NIST

6375 Dixie Rd. Mississauga, ON, L5T 2E7 http: // www.navair.com
Phone : 800-668-7440 Fax: 905 565 8325 e-Mail: service @ navair.com

6375 Dixie Rd Unit # 7
Mississauga ON L5T 2E7
Tel: (905) 565-1583
Fax: (905) 565-8325

Form: 480E09	Approved by: J. R.	Jun-19	Ver 2.0

Calibration Report part of Certificate # 166560

Make	Model	Serial №	Asset	Cal by
PCB Piezotronics	480E09	00035341	01193	P.O.

Test	Setting	Input	Min	Reading	Max		In/Out
Excitation Voltage							
• 1			25 Vdc	26.7 Vdc	29 Vdc		In
Constant Current Excitation							
• 1			2.0 mA	2.96 mA	3.2 mA		In
Voltage Gain Accuracy at 1 kHz							
• 1	1.000 V		0.98	1.000	1.02		In
• 10	0.100 V		9.80	10.01	10.20		In
• 100	0.010 V		98.0	99.9	102.0		In

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.US2.04677 **Date of issue:** June 29, 2021

Type: Vaisala Weather Transmitter, WXT530 **Serial number:** P4111045

Manufacturer: Vaisala, Oyj, Pl 26, FIN-00421 Helsinki, Finland

Client: Aercoustics Engineering Ltd., 1004 Middlegate RD, Suite 1100, S.Tower, Mississauga, ON L4Y 1M4, Canada

Anemometer received: June 24, 2021 **Anemometer calibrated:** June 29, 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] = 0.99256 · U [m/s] + 0.12172

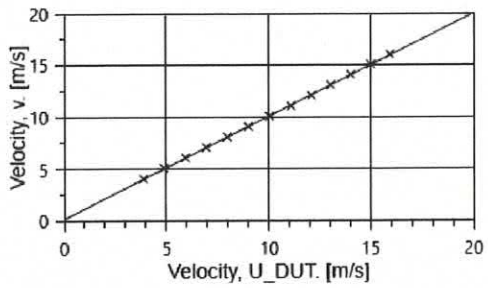
Standard uncertainty, slope: 0.00348 **Standard uncertainty, offset:** 0.30320

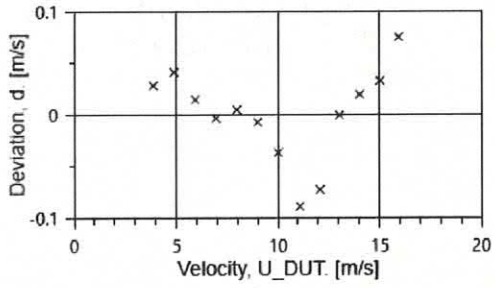
Covariance: -0.0001193 (m/s)²/m/s **Coefficient of correlation:** $\rho = 0.999933$

Absolute maximum deviation: -0.089 m/s at 11.043 m/s

Barometric pressure: 1008.0 hPa **Relative humidity:** 51.8%

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	9.32	27.7	27.0	4.011	3.8900	0.028	0.023
13-last	14.59	27.9	27.0	5.019	4.8933	0.041	0.026
2	21.04	27.7	27.0	6.025	5.9333	0.014	0.030
12	28.50	28.0	27.0	7.016	6.9500	-0.004	0.034
3	37.46	27.7	27.0	8.040	7.9733	0.004	0.039
11	47.41	28.0	27.0	9.050	9.0033	-0.008	0.043
4	58.48	27.7	27.0	10.046	10.0367	-0.037	0.047
10	70.57	28.0	27.0	11.043	11.0933	-0.089	0.051
5	83.99	27.8	27.0	12.042	12.0833	-0.073	0.056
9	98.69	28.0	27.0	13.060	13.0367	-0.001	0.060
6	114.40	27.8	27.0	14.056	14.0200	0.019	0.064
8	131.26	28.0	27.0	15.062	15.0200	0.032	0.069
7	148.54	27.9	27.0	16.021	15.9433	0.074	0.073





EQUIPMENT USED

Serial Number	Description
Njord2	Wind tunnel, blockage factor = 1.0035
13924	Control cup anemometer
-	Mounting tube, D = 19 mm
TT005	PR Electronics, PT100, 0-10V Output, wind tunnel temp.
TT003	Summit Electronics, 1XPT100, 0-10V Output, differential pressure box temp.
DP008	Setra Model 239, 0-1inWC, differential pressure transducer
HY004	Dwyer RHP-2D20, 0-10V Output, humidity transmitter
BP001	Setra Model 278, barometer
PL3	Pitot tube
XB001	Computer Board. 16 bit A/D data acquisition board
Njord2-PC	PC dedicated to data acquisition

The accuracies of all measurements were traceable to the SI through NIST or CIPM recognized NMI's.

Photo of the wind tunnel setup. The cross-sectional area is 2.5m x 2.5m.

UNCERTAINTIES

The documented uncertainty is the total combined uncertainty at 95% confidence level (k=2) in accordance with EA-4/02. The uncertainty at 10 m/s comply with the requirements in the IEC 61400-12-1:2005 procedure. See Document US.12.01.004 for further details.

COMMENTS

This sensor was oriented in the 0° position during calibration.

Certificate number: 21.US2.04677

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

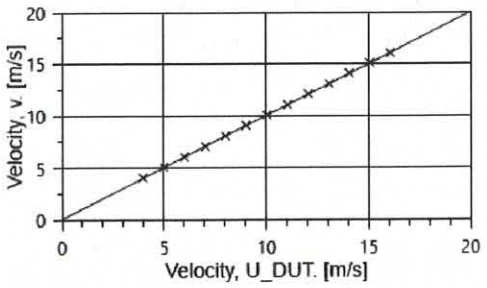
Certificate number: 21.US2.04678 **Date of issue:** June 29, 2021
Type: Vaisala Weather Transmitter, WXT530 **Serial number:** P4111045
Manufacturer: Vaisala, Oyj, Pl 26, FIN-00421 Helsinki, Finland
Client: Aercoustics Engineering Ltd., 1004 Middlegate RD, Suite 1100, S.Tower, Mississauga, ON L4Y 1M4, Canada

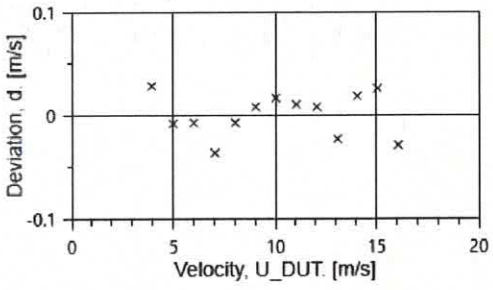
Anemometer received: June 24, 2021 **Anemometer calibrated:** June 29, 2021
Calibrated by: MEJ **Procedure:** MEASNET, IEC 61400-12-1:2017 Annex F
Certificate prepared by: EJF **Approved by:** Calibration engineer, EJF

Calibration equation obtained: v [m/s] = 0.99604 · U [m/s] + 0.04459

Standard uncertainty, slope: 0.00160 **Standard uncertainty, offset:** 0.38395
Covariance: -0.0000256 (m/s)²/m/s **Coefficient of correlation:** $\rho = 0.999986$
Absolute maximum deviation: -0.037 m/s at 7.027 m/s
Barometric pressure: 1007.9 hPa **Relative humidity:** 51.6%

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	9.38	27.9	27.0	4.023	3.9667	0.028	0.023
13-last	14.58	28.0	27.0	5.020	5.0033	-0.008	0.026
2	21.03	27.8	27.0	6.026	6.0133	-0.008	0.030
12	28.57	28.1	27.0	7.027	7.0467	-0.037	0.034
3	37.49	27.8	27.0	8.045	8.0400	-0.008	0.039
11	47.45	28.1	27.0	9.057	9.0400	0.008	0.043
4	58.58	27.8	27.0	10.058	10.0367	0.016	0.047
10	70.60	28.1	27.0	11.048	11.0367	0.010	0.051
5	84.22	27.9	27.0	12.061	12.0567	0.008	0.056
9	98.49	28.1	27.0	13.050	13.0800	-0.023	0.060
6	114.63	27.9	27.0	14.074	14.0667	0.018	0.064
8	131.52	28.1	27.0	15.080	15.0700	0.026	0.069
7	148.67	28.0	27.0	16.032	16.0800	-0.029	0.073





EQUIPMENT USED

Serial Number	Description
Njord2	Wind tunnel, blockage factor = 1.0035
13924	Control cup anemometer
-	Mounting tube, D = 19 mm
TT005	PR Electronics, PT100, 0-10V Output, wind tunnel temp.
TT003	Summit Electronics, 1XPT100, 0-10V Output, differential pressure box temp.
DP008	Setra Model 239, 0-1inWC, differential pressure transducer
HY004	Dwyer RHP-2D20, 0-10V Output, humidity transmitter
BP001	Setra Model 278, barometer
PL3	Pitot tube
XB001	Computer Board. 16 bit A/D data acquisition board
Njord2-PC	PC dedicated to data acquisition

The accuracies of all measurements were traceable to the SI through NIST or CIPM recognized NMI's.

Photo of the wind tunnel setup. The cross-sectional area is 2.5m x 2.5m.

UNCERTAINTIES

The documented uncertainty is the total combined uncertainty at 95% confidence level (k=2) in accordance with EA-4/02. The uncertainty at 10 m/s comply with the requirements in the IEC 61400-12-1:2005 procedure. See Document US.12.01.004 for further details.

COMMENTS

This sensor was oriented in the 90° position during calibration.

Certificate number: 21.US2.04678

V4329 Calibration Certificates

Details are disclosed in the table below regarding the calibration of the equipment used for the Phase 2 I-Audit campaign at V4329. The associated calibration certificates are provided in this appendix.

Please note that the serial number displayed on the microphone system calibration certificate encompasses both the microphone and the pre-amplifier which are submitted for calibration as a pair. The calibration certificate is valid for both the microphone and pre-amplifier. Their individual model and serial numbers are displayed on the page following the certificate as well as denoted in the table below.

Equipment	Make/Model	Serial Number	Date of Last Calibration	Measurement Interval	Confirmation of Validity for Measurement Interval?
Sound Level Meter	NI 9234	1E2B19A	June 1, 2022	October 22, 2022 – November 24, 2022	Yes
Microphone/Pre-amplifier Pair	PCB 377B02	142560	June 23, 2022	October 22, 2022 – November 24, 2022	Yes
Microphone	PCB 377B02	314652	June 23, 2022	October 22, 2022 – November 24, 2022	Yes
Pre-amplifier	PCB 426E01	064218	June 23, 2022	October 22, 2022 – November 24, 2022	Yes
Signal Conditioner	PCB 480E09	00035339	June 29, 2022	October 22, 2022 – November 24, 2022	Yes
Weather Station	Vaisala WXT530	R3250322	June 29, 2021	October 22, 2022 – November 24, 2022	Yes

CERTIFICATE of CALIBRATION

Make :	National Instruments	Reference # :	171289
Model :	NI9234	Customer :	Aercoustics Engineering Ltd Mississauga, ON
Descr. :	ADC Module 4Ch 24Bit		
Serial # :	1E2B19A	P. Order :	2022.05.30C
Asset # :	01436		

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 : Jun 01, 2022 By : Petro Onasko

Cal. Due : Jun 01, 2024

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

Standards used : J-190 J-367 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

NT NAVAIR TECHNOLOGIES

6375 Dixie Rd Unit# 7
Mississauga, ON L5T 2E7
Tel: (905)565-1583
Fax: (905)565-8325

Form:	NI 9234	Approved by: J. Raposo	Mar-19	Ver 1.2

Calibration Report part of Certificate # 171289

Make	Model	Serial №	Asset	Cal by
National Instruments	NI 9234	1E2B19A	01436	P.O.

Test	Channel	Input	Min	Reading	Max	In/Out
Gain Accuracy						
	AI 0	+4.0000 V	3.9952	+4.0000 V	4.0048	In
		0.0000 V	-0.0012	+0.0001 V	0.0012	In
		−4.0000 V	-4.0048	−4.0000 V	-3.9952	In
	AI 1	+4.0000 V	3.9952	+4.0000 V	4.0048	In
		0.0000 V	-0.0012	−0.0001 V	0.0012	In
		−4.0000 V	-4.0048	−4.0000 V	-3.9952	In
	AI 2	+4.0000 V	3.9952	+3.9999 V	4.0048	In
		0.0000 V	-0.0012	−0.0000 V	0.0012	In
		−4.0000 V	-4.0048	−4.0000 V	-3.9952	In
	AI 3	+4.0000 V	3.9952	+4.0000 V	4.0048	In
		0.0000 V	-0.0012	−0.0001 V	0.0012	In
		−4.0000 V	-4.0048	−4.0000 V	-3.9952	In
Channel Gain Match						
	AI 0		-0.04	−0.000 dB	0.04	In
	AI 1		-0.04	−0.000 dB	0.04	In
	AI 2		-0.04	−0.000 dB	0.04	In
	AI 3		-0.04	−0.000 dB	0.04	In
Flatness Accuracy						
		0.1 to 22.5 kHz	Ref: 1.000 kHz			
	AI 0	4.5 V p-p	-0.04	+0.020 dB	0.04	In
	AI 1	4.5 V p-p	-0.04	+0.020 dB	0.04	In
	AI 2	4.5 V p-p	-0.04	+0.019 dB	0.04	In
	AI 3	4.5 V p-p	-0.04	+0.017 dB	0.04	In
AC/DC coupling						Pass
IEPE Operation						Pass

CERTIFICATE of CALIBRATION

Make :	PCB Piezotronics	Reference # :	171576
Model :	378B02	Customer :	Aercoustics Engineering Ltd Mississauga, ON
Descr. :	Microphone System 1/2" Free Field		
Serial # :	142560	P. Order :	2022.06.16C
Asset # :	AEL 1420		

Cal. status : Received in spec's, no adjustment made.
Preamp System with Mic 377B02 s/n 314652

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 : Jun 23, 2022 By : Petro Onasko

Cal. Due : Jun 23, 2024

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

Standards used : J-216 J-324 J-333 J-420 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
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e-Mail: service @ navair.com

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6375 Dixie Rd Unit # 7
Mississauga ON L5T 2E7
Tel: (905) 565-1583
Fax: (905) 565-8325

Form: PCB 378B02	Approved by: J.R.	Feb-16	Ver 1.0

Calibration Report for Certificate # 171576

Make		Model	Serial №	Asset	Cal by
PCB Piezotronics		378B02	142560		
PCB Piezotronics		426E01	064218	AEL 1420	P.O.
PCB Piezotronics		377B02	314652		

Ambient Conditions:

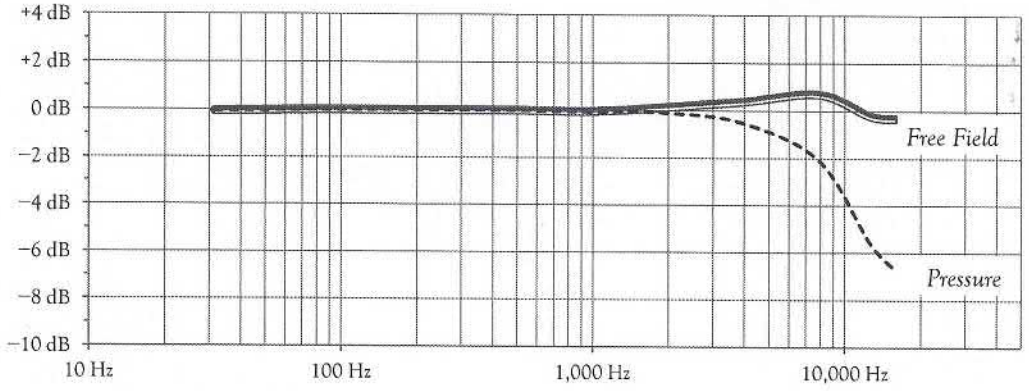
Barometric Pressure	*99.6 kPa*
Temperature	*24.2°C*
Relative Humidity	*36%*

Sensitivity at 250 Hz

Specs Nom	Unit	Min	Reading	Max		In/Out
50.0 mV/Pa		39.72	*48.8 mV/Pa*	62.94		In
−26.02 dB	re 1 V/Pa	-28.02	*−26.2 dB*	-24.02		In
0 dB	re 50 mV/Pa	-2	*−0.2 dB*	2		In

Frequency Response

	Frequency	Pressure	Free Field
	32 Hz	*−0.06 dB*	*−0.06 dB*
	63 Hz	*−0.02 dB*	*−0.02 dB*
	126 Hz	*0.00 dB*	*0.00 dB*
Reference	251 Hz	*0.00 dB*	*0.00 dB*
	503 Hz	*−0.01 dB*	*−0.01 dB*
	1005 Hz	*−0.06 dB*	*−0.04 dB*
	1979 Hz	*−0.10 dB*	*+0.15 dB*
	3958 Hz	*−0.52 dB*	*+0.39 dB*
	7915 Hz	*−2.10 dB*	*+0.70 dB*
	12663 Hz	*−5.62 dB*	*−0.21 dB*
	15830 Hz	*−6.71 dB*	*−0.31 dB*



CERTIFICATE of CALIBRATION

Make :	PCB Piezotronics	Reference # :	171584
Model :	480E09	Customer :	Aercoustics Engineering Ltd Mississauga, ON
Descr. :	Conditioning Amplifier		
Serial # :	00035339	P. Order :	2022.06.16C
Asset # :	01213		

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 : Jun 29, 2022 By : Petro Onasko

Cal. Due : Jun 29, 2024

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

Standards used : J-255 J-367 J-512

Navair Technologies

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Mississauga ON L5T 2E7
Tel: (905) 565-1583
Fax: (905) 565-8325

Form: 480E09	Approved by: J. R.	Jun-19	Ver 2.0

Calibration Report part of Certificate # 171584

Make	Model	Serial №	Asset	Cal by
PCB Piezotronics	480E09	00035339	01213	P.O.

Test	Setting	Input	Min	Reading	Max	In/Out
Excitation Voltage						
	• 1		25 Vdc	*26.3 Vdc*	29 Vdc	In
Constant Current Excitation						
	• 1		2.0 mA	*2.56 mA*	3.2 mA	In
Voltage Gain Accuracy at 1 kHz						
	• 1	1.000 V	0.98	*1.000*	01.02	In
	• 10	0.100 V	9.80	*10.00*	10.20	In
	• 100	0.010 V	98.0	*99.9*	102.0	In

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

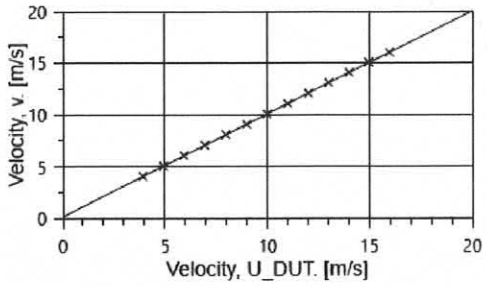
Certificate number: 21.US2.04681 **Date of issue:** June 29, 2021
Type: Vaisala Weather Transmitter, WXT530 **Serial number:** R3250322
Manufacturer: Vaisala, Oyj, Pl 26, FIN-00421 Helsinki, Finland
Client: Aercoustics Engineering Ltd., 1004 Middlegate RD, Suite 1100, S.Tower, Mississauga, ON L4Y 1M4, Canada

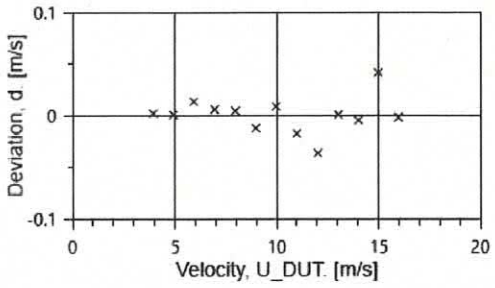
Anemometer received: June 24, 2021 **Anemometer calibrated:** June 29, 2021
Calibrated by: MEJ **Procedure:** MEASNET, IEC 61400-12-1:2017 Annex F
Certificate prepared by: EJF **Approved by:** Calibration engineer, EJF

Calibration equation obtained: v [m/s] = 0.99468 · U [m/s] + 0.11319

Standard uncertainty, slope: 0.00138 **Standard uncertainty, offset:** 0.12966
Covariance: -0.0000189 (m/s)²/m/s **Coefficient of correlation:** $\rho = 0.999989$
Absolute maximum deviation: 0.041 m/s at 15.055 m/s
Barometric pressure: 1007.6 hPa **Relative humidity:** 51.5%

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	9.35	28.1	27.0	4.021	3.9267	0.002	0.023
13-last	14.51	28.3	27.0	5.011	4.9233	0.000	0.026
2	21.00	28.1	27.0	6.025	5.9300	0.013	0.030
12	28.52	28.3	27.0	7.025	6.9433	0.006	0.034
3	37.47	28.1	27.0	8.048	7.9733	0.004	0.039
11	47.25	28.4	27.0	9.043	8.9900	-0.013	0.043
4	58.40	28.1	27.0	10.048	9.9800	0.008	0.047
10	70.45	28.4	27.0	11.043	11.0067	-0.018	0.051
5	83.85	28.1	27.0	12.042	12.0300	-0.037	0.056
9	98.73	28.4	27.0	13.074	13.0300	0.000	0.060
6	114.20	28.2	27.0	14.057	14.0233	-0.005	0.064
8	130.90	28.4	27.0	15.055	14.9800	0.041	0.069
7	148.00	28.3	27.0	16.006	15.9800	-0.002	0.073





EQUIPMENT USED

Serial Number	Description
Njord2	Wind tunnel, blockage factor = 1.0035
13924	Control cup anemometer
-	Mounting tube, D = 19 mm
TT005	PR Electronics, PT100, 0-10V Output, wind tunnel temp.
TT003	Summit Electronics, 1XPT100, 0-10V Output, differential pressure box temp.
DP008	Setra Model 239, 0-1inWC, differential pressure transducer
HY004	Dwyer RHP-2D20, 0-10V Output, humidity transmitter
BP001	Setra Model 278, barometer
PL3	Pitot tube
XB001	Computer Board. 16 bit A/D data acquisition board
Njord2-PC	PC dedicated to data acquisition

The accuracies of all measurements were traceable to the SI through NIST or CIPM recognized NMI's.

Photo of the wind tunnel setup. The cross-sectional area is 2.5m x 2.5m.

UNCERTAINTIES

The documented uncertainty is the total combined uncertainty at 95% confidence level (k=2) in accordance with EA-4/02. The uncertainty at 10 m/s comply with the requirements in the IEC 61400-12-1:2005 procedure. See Document US.12.01.004 for further details.

COMMENTS

This sensor was oriented in the 0° position during calibration.

Certificate number: 21.US2.04681

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.US2.04682 **Date of issue:** June 29, 2021

Type: Vaisala Weather Transmitter, WXT530 **Serial number:** R3250322

Manufacturer: Vaisala, Oyj, Pl 26, FIN-00421 Helsinki, Finland

Client: Aercoustics Engineering Ltd., 1004 Middlegate RD, Suite 1100, S.Tower, Mississauga, ON L4Y 1M4, Canada

Anemometer received: June 24, 2021 **Anemometer calibrated:** June 29, 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] = 0.98862 · U [m/s] + 0.06229

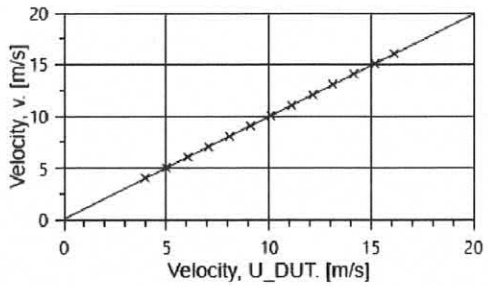
Standard uncertainty, slope: 0.00201 **Standard uncertainty, offset:** 0.34338

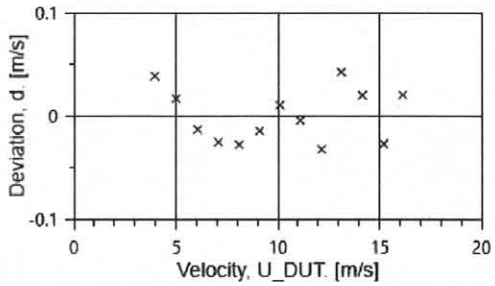
Covariance: -0.0000397 $(m/s)^2/m/s$ **Coefficient of correlation:** $\rho = 0.999978$

Absolute maximum deviation: 0.042 m/s at 13.075 m/s

Barometric pressure: 1007.6 hPa **Relative humidity:** 51.4%

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	28.2	27.0	4.019	3.9633	0.038	0.023
13-last	14.53	28.4	27.0	5.015	4.9933	0.016	0.026
2	21.07	28.2	27.0	6.037	6.0567	-0.013	0.030
12	28.49	28.4	27.0	7.023	7.0667	-0.026	0.034
3	37.33	28.2	27.0	8.035	8.0933	-0.028	0.039
11	47.27	28.5	27.0	9.047	9.1033	-0.015	0.043
4	58.48	28.2	27.0	10.058	10.1000	0.010	0.047
10	70.44	28.5	27.0	11.045	11.1133	-0.005	0.051
5	83.94	28.3	27.0	12.051	12.1600	-0.033	0.056
9	98.71	28.5	27.0	13.075	13.1200	0.042	0.060
6	114.50	28.3	27.0	14.078	14.1567	0.020	0.064
8	131.09	28.5	27.0	15.069	15.2067	-0.027	0.069
7	148.55	28.4	27.0	16.039	16.1400	0.020	0.073





AC-1746

EQUIPMENT USED

Serial Number	Description
Njord2	Wind tunnel, blockage factor = 1.0035
13924	Control cup anemometer
-	Mounting tube, D = 19 mm
TT005	PR Electronics, PT100, 0-10V Output, wind tunnel temp.
TT003	Summit Electronics, 1XPT100, 0-10V Output, differential pressure box temp.
DP008	Setra Model 239, 0-1inWC, differential pressure transducer
HY004	Dwyer RHP-2D20, 0-10V Output, humidity transmitter
BP001	Setra Model 278, barometer
PL3	Pitot tube
XB001	Computer Board. 16 bit A/D data acquisition board
Njord2-PC	PC dedicated to data acquisition

The accuracies of all measurements were traceable to the SI through NIST or CIPM recognized NMI's.

Photo of the wind tunnel setup. The cross-sectional area is 2.5m x 2.5m.

UNCERTAINTIES

The documented uncertainty is the total combined uncertainty at 95% confidence level (k=2) in accordance with EA-4/02. The uncertainty at 10 m/s comply with the requirements in the IEC 61400-12-1:2005 procedure. See Document US.12.01.004 for further details.

COMMENTS

This sensor was oriented in the 90° position during calibration.

Certificate number: 21.US2.04682

X0002 Calibration Certificates

Details are disclosed in the table below regarding the calibration of the equipment used for the Phase 2 I-Audit campaign at X0002. The associated calibration certificates are provided in this appendix.

Please note that the serial number displayed on the microphone system calibration certificate encompasses both the microphone and the pre-amplifier which are submitted for calibration as a pair. The calibration certificate is valid for both the microphone and pre-amplifier. Their individual model and serial numbers are displayed on the page following the certificate as well as denoted in the table below.

Equipment	Make/Model	Serial Number	Date of Last Calibration	Measurement Interval	Confirmation of Validity for Measurement Interval?
Sound Level Meter	NI 9234	1854438	October 3, 2022	October 27, 2022 – November 7, 2022	Yes
Microphone/Pre-amplifier Pair	PCB 377B02	118498	June 23, 2022	October 27, 2022 – November 7, 2022	Yes
Microphone	PCB 377B02	150498	June 23, 2022	October 27, 2022 – November 7, 2022	Yes
Pre-amplifier	PCB 426E01	037448	June 23, 2022	October 27, 2022 – November 7, 2022	Yes
Signal Conditioner	PCB 480E09	00036935	June 24, 2022	October 27, 2022 – November 7, 2022	Yes
Weather Station	Vaisala WXT530	P4111045	June 29, 2021	October 27, 2022 – November 7, 2022	Yes

CERTIFICATE of CALIBRATION

Make :	National Instruments	Reference # :	172819
Model :	NI9234	Customer :	Aercoustics Engineering Ltd Mississauga, ON
Descr. :	ADC Module 4Ch 24Bit		
Serial # :	1854438	P. Order :	2022.09.27C
Asset # :	00302		

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 : Oct 03, 2022 By : Petro Onasko

Cal. Due : Oct 03, 2024

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

Standards used : J-190 J-367 J-512

Navair Technologies

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6375 Dixie Rd., Unit # 7
Mississauga ON L5T 2E7
Tel: (905) 565-1583
Fax: (905) 565-8325

Form: NI 9234	Approved by: J. R.	Mar-19	Ver 1.2

Calibration Report part of Certificate # 172819

Make	Model	Serial №	Asset	Cal by
National Instruments	NI 9234	1854438	00302	P.O.

Test	Channel	Input	Min	Reading	Max	In/Out
Gain Accuracy						
	AI 0	+4.0000 V	3.9952	+4.0000 V	4.0048	In
		0.0000 V	-0.0012	+0.0000 V	0.0012	In
		−4.0000 V	-4.0048	−4.0000 V	-3.9952	In
	AI 1	+4.0000 V	3.9952	+4.0000 V	4.0048	In
		0.0000 V	-0.0012	−0.0000 V	0.0012	In
		−4.0000 V	-4.0048	−4.0000 V	-3.9952	In
	AI 2	+4.0000 V	3.9952	+4.0000 V	4.0048	In
		0.0000 V	-0.0012	+0.0000 V	0.0012	In
		−4.0000 V	-4.0048	−4.0000 V	-3.9952	In
	AI 3	+4.0000 V	3.9952	+4.0000 V	4.0048	In
		0.0000 V	-0.0012	+0.0000 V	0.0012	In
		−4.0000 V	-4.0048	−4.0000 V	-3.9952	In
Channel Gain Match						
	AI 0		-0.04	0.000 dB	0.04	In
	AI 1		-0.04	0.000 dB	0.04	In
	AI 2		-0.04	0.000 dB	0.04	In
	AI 3		-0.04	0.000 dB	0.04	In
Flatness Accuracy						
		0.1 to 22.5 kHz	Ref: 1.000 kHz			
	AI 0	4.5 V p-p	-0.04	+0.021 dB	0.04	In
	AI 1	4.5 V p-p	-0.04	+0.025 dB	0.04	In
	AI 2	4.5 V p-p	-0.04	+0.024 dB	0.04	In
	AI 3	4.5 V p-p	-0.04	+0.019 dB	0.04	In

CERTIFICATE of CALIBRATION

Make :	PCB Piezotronics	Reference # :	171579
Model :	378B02	Customer :	Aercoustics Engineering Ltd Mississauga, ON
Descr. :	Microphone System 1/2" Free Field		
Serial # :	118498	P. Order :	2022.06.16C
Asset # :	AEL234		

Cal. status : Received in spec's, no adjustment made.
Preamp System with Mic 377B02 s/n 150498

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 : Jun 23, 2022 By : Petro Onasko

Cal. Due : Jun 23, 2024

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

Standards used : J-216 J-324 J-333 J-420 J-512

Navair Technologies

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6375 Dixie Rd Unit # 7
Mississauga ON L5T 2E7
Tel: (905) 565-1583
Fax: (905) 565-8325

Form: PCB 378B02	Approved by: J.R.	Feb-16	Ver 1.0

Calibration Report for Certificate # 171579

Make		Model	Serial №	Asset	Cal by
PCB Piezotronics		378B02	118498		
PCB Piezotronics		426E01	037448	AEL234	P.O.
PCB Piezotronics		377B02	150498		

Ambient Conditions:

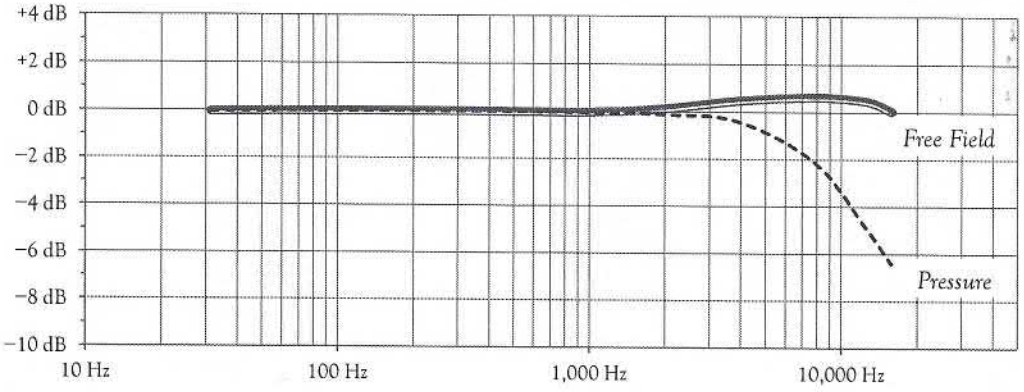
Barometric Pressure	*99.6 kPa*
Temperature	*24.2°C*
Relative Humidity	*36%*

Sensitivity at 250 Hz

Specs Nom	Unit	Min	Reading	Max		In/Out
50.0 mV/Pa		39.72	*49.2 mV/Pa*	62.94		In
−26.02 dB	re 1 V/Pa	-28.02	*−26.2 dB*	-24.02		In
0 dB	re 50 mV/Pa	-2	*−0.2 dB*	2		In

Frequency Response

	Frequency	Pressure	Free Field
	32 Hz	*−0.04 dB*	*−0.04 dB*
	63 Hz	*−0.02 dB*	*−0.02 dB*
	126 Hz	*−0.01 dB*	*−0.01 dB*
Reference	251 Hz	*0.00 dB*	*0.00 dB*
	503 Hz	*−0.01 dB*	*−0.01 dB*
	1005 Hz	*−0.05 dB*	*−0.03 dB*
	1979 Hz	*−0.12 dB*	*+0.14 dB*
	3958 Hz	*−0.43 dB*	*+0.48 dB*
	7915 Hz	*−2.17 dB*	*+0.63 dB*
	12663 Hz	*−4.96 dB*	*+0.47 dB*
	15830 Hz	*−6.42 dB*	*+0.04 dB*



CERTIFICATE of CALIBRATION

Make :	PCB Piezotronics	Reference # :	171583
Model :	480E09	Customer :	Aercoustics Engineering Ltd Mississauga, ON
Descr. :	Conditioning Amplifier		
Serial # :	00036935	P. Order :	2022.06.16C
Asset # :	01415		

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 : Jun 24, 2022 By : Petro Onasko

Cal. Due : Jun 24, 2024

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

Standards used : J-255 J-367 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

NAVAIR TECHNOLOGIES

6375 Dixie Rd Unit # 7
Mississauga ON L5T 2E7
Tel: (905) 565-1583
Fax: (905) 565-8325

Form: 480E09	Approved by: J. R.	Jun-19	Ver 2.0

Calibration Report part of Certificate # 171583

Make	Model	Serial №	Asset	Cal by
PCB Piezotronics	480E09	00036935	01415	P.O.

Test	Setting	Input	Min	Reading	Max	In/Out
Excitation Voltage						
	• 1		25 Vdc	26.8 Vdc	29 Vdc	In
Constant Current Excitation						
	• 1		2.0 mA	2.60 mA	3.2 mA	In
Voltage Gain Accuracy at 1 kHz						
	• 1	1.000 V	0.98	1.000	01.02	In
	• 10	0.100 V	9.80	10.00	10.20	In
	• 100	0.010 V	98.0	99.9	102.0	In

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.US2.04677 **Date of issue:** June 29, 2021

Type: Vaisala Weather Transmitter, WXT530 **Serial number:** P4111045

Manufacturer: Vaisala, Oyj, Pl 26, FIN-00421 Helsinki, Finland

Client: Aercoustics Engineering Ltd., 1004 Middlegate RD, Suite 1100, S.Tower, Mississauga, ON L4Y 1M4, Canada

Anemometer received: June 24, 2021 **Anemometer calibrated:** June 29, 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] = 0.99256 · U [m/s] + 0.12172

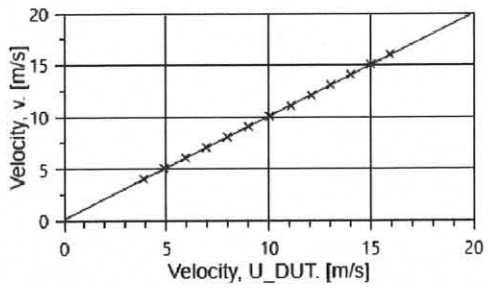
Standard uncertainty, slope: 0.00348 **Standard uncertainty, offset:** 0.30320

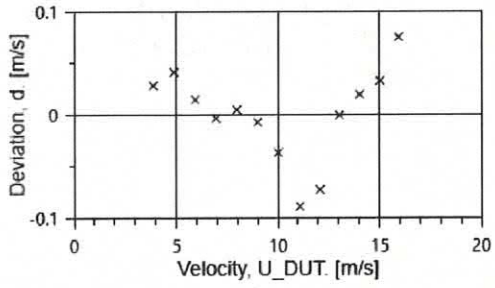
Covariance: -0.0001193 (m/s)²/m/s **Coefficient of correlation:** $\rho = 0.999933$

Absolute maximum deviation: -0.089 m/s at 11.043 m/s

Barometric pressure: 1008.0 hPa **Relative humidity:** 51.8%

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	9.32	27.7	27.0	4.011	3.8900	0.028	0.023
13-last	14.59	27.9	27.0	5.019	4.8933	0.041	0.026
2	21.04	27.7	27.0	6.025	5.9333	0.014	0.030
12	28.50	28.0	27.0	7.016	6.9500	-0.004	0.034
3	37.46	27.7	27.0	8.040	7.9733	0.004	0.039
11	47.41	28.0	27.0	9.050	9.0033	-0.008	0.043
4	58.48	27.7	27.0	10.046	10.0367	-0.037	0.047
10	70.57	28.0	27.0	11.043	11.0933	-0.089	0.051
5	83.99	27.8	27.0	12.042	12.0833	-0.073	0.056
9	98.69	28.0	27.0	13.060	13.0367	-0.001	0.060
6	114.40	27.8	27.0	14.056	14.0200	0.019	0.064
8	131.26	28.0	27.0	15.062	15.0200	0.032	0.069
7	148.54	27.9	27.0	16.021	15.9433	0.074	0.073





EQUIPMENT USED

Serial Number	Description
Njord2	Wind tunnel, blockage factor = 1.0035
13924	Control cup anemometer
-	Mounting tube, D = 19 mm
TT005	PR Electronics, PT100, 0-10V Output, wind tunnel temp.
TT003	Summit Electronics, 1XPT100, 0-10V Output, differential pressure box temp.
DP008	Setra Model 239, 0-1inWC, differential pressure transducer
HY004	Dwyer RHP-2D20, 0-10V Output, humidity transmitter
BP001	Setra Model 278, barometer
PL3	Pitot tube
XB001	Computer Board. 16 bit A/D data acquisition board
Njord2-PC	PC dedicated to data acquisition

The accuracies of all measurements were traceable to the SI through NIST or CIPM recognized NMI's.

Photo of the wind tunnel setup. The cross-sectional area is 2.5m x 2.5m.

UNCERTAINTIES

The documented uncertainty is the total combined uncertainty at 95% confidence level (k=2) in accordance with EA-4/02. The uncertainty at 10 m/s comply with the requirements in the IEC 61400-12-1:2005 procedure. See Document US.12.01.004 for further details.

COMMENTS

This sensor was oriented in the 0° position during calibration.

Certificate number: 21.US2.04677

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

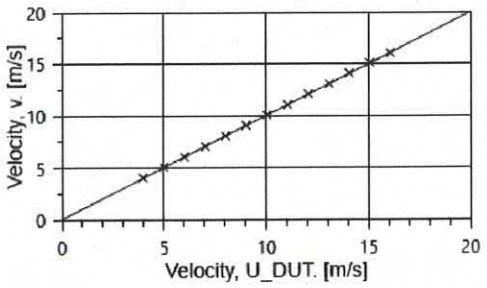
Certificate number: 21.US2.04678 **Date of issue:** June 29, 2021
Type: Vaisala Weather Transmitter, WXT530 **Serial number:** P4111045
Manufacturer: Vaisala, Oyj, Pl 26, FIN-00421 Helsinki, Finland
Client: Aercoustics Engineering Ltd., 1004 Middlegate RD, Suite 1100, S.Tower, Mississauga, ON L4Y 1M4, Canada

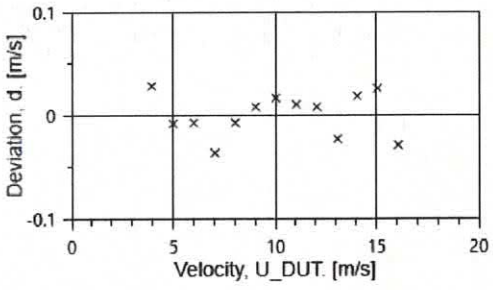
Anemometer received: June 24, 2021 **Anemometer calibrated:** June 29, 2021
Calibrated by: MEJ **Procedure:** MEASNET, IEC 61400-12-1:2017 Annex F
Certificate prepared by: EJF **Approved by:** Calibration engineer, EJF

Calibration equation obtained: v [m/s] = 0.99604 · U [m/s] + 0.04459

Standard uncertainty, slope: 0.00160 **Standard uncertainty, offset:** 0.38395
Covariance: -0.0000256 (m/s)²/m/s **Coefficient of correlation:** $\rho = 0.999986$
Absolute maximum deviation: -0.037 m/s at 7.027 m/s
Barometric pressure: 1007.9 hPa **Relative humidity:** 51.6%

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	9.38	27.9	27.0	4.023	3.9667	0.028	0.023
13-last	14.58	28.0	27.0	5.020	5.0033	-0.008	0.026
2	21.03	27.8	27.0	6.026	6.0133	-0.008	0.030
12	28.57	28.1	27.0	7.027	7.0467	-0.037	0.034
3	37.49	27.8	27.0	8.045	8.0400	-0.008	0.039
11	47.45	28.1	27.0	9.057	9.0400	0.008	0.043
4	58.58	27.8	27.0	10.058	10.0367	0.016	0.047
10	70.60	28.1	27.0	11.048	11.0367	0.010	0.051
5	84.22	27.9	27.0	12.061	12.0567	0.008	0.056
9	98.49	28.1	27.0	13.050	13.0800	-0.023	0.060
6	114.63	27.9	27.0	14.074	14.0667	0.018	0.064
8	131.52	28.1	27.0	15.080	15.0700	0.026	0.069
7	148.67	28.0	27.0	16.032	16.0800	-0.029	0.073





EQUIPMENT USED

Serial Number	Description
Njord2	Wind tunnel, blockage factor = 1.0035
13924	Control cup anemometer
-	Mounting tube, D = 19 mm
TT005	PR Electronics, PT100, 0-10V Output, wind tunnel temp.
TT003	Summit Electronics, 1XPT100, 0-10V Output, differential pressure box temp.
DP008	Setra Model 239, 0-1inWC, differential pressure transducer
HY004	Dwyer RHP-2D20, 0-10V Output, humidity transmitter
BP001	Setra Model 278, barometer
PL3	Pitot tube
XB001	Computer Board. 16 bit A/D data acquisition board
Njord2-PC	PC dedicated to data acquisition

The accuracies of all measurements were traceable to the SI through NIST or CIPM recognized NMI's.

Photo of the wind tunnel setup. The cross-sectional area is 2.5m x 2.5m.

UNCERTAINTIES

The documented uncertainty is the total combined uncertainty at 95% confidence level (k=2) in accordance with EA-4/02. The uncertainty at 10 m/s comply with the requirements in the IEC 61400-12-1:2005 procedure. See Document US.12.01.004 for further details.

COMMENTS

This sensor was oriented in the 90° position during calibration.

Certificate number: 21.US2.04678

X0003 Calibration Certificates

Details are disclosed in the table below regarding the calibration of the equipment used for the Phase 2 I-Audit campaign at X0003. The associated calibration certificates are provided in this appendix.

Please note that the serial number displayed on the microphone system calibration certificate encompasses both the microphone and the pre-amplifier which are submitted for calibration as a pair. The calibration certificate is valid for both the microphone and pre-amplifier. Their individual model and serial numbers are displayed on the page following the certificate as well as denoted in the table below.

Equipment	Make/Model	Serial Number	Date of Last Calibration	Measurement Interval	Confirmation of Validity for Measurement Interval?
Sound Level Meter	NI 9234	1B3CDE4	July 14, 2021	February 7, 2022 – March 1, 2022	Yes
Microphone/Pre-amplifier Pair	PCB 377B02	153939	September 30, 2021	February 7, 2022 – March 1, 2022	Yes
Microphone	PCB 377B02	333461	September 30, 2021	February 7, 2022 – March 1, 2022	Yes
Pre-amplifier	PCB 426E01	074777	September 30, 2021	February 7, 2022 – March 1, 2022	Yes
Signal Conditioner	PCB 480E09	33659	June 24, 2021	February 7, 2022 – March 1, 2022	Yes
Weather Station	Vaisala WXT530	R3250414	June 29, 2021	February 7, 2022 – March 1, 2022	Yes

Compliant Calibration Certificate

Certificate Number:	6828797.1	**OE Number**:	22178908
Customer:	Aercoustics Engineering Ltd 5335 Lucas Ct ONTARIO MISSISSAUGA, L4Z 4A9 CANADA	**Page**:	1 of 14
Manufacturer:	National Instruments	**Model**:	NI 9234
Serial Number:	1B3CDE4		
Part Number:	195551C-01L	**Description**:	MODULE ASSY,NI 9234, 4 AI CONFIGURABLE
Calibration Date:	14-JUL-2021	**Issued Date:**	14-JUL-2021
Procedure Name:	NI 9234	**Recommended Calibration Due**:	14-JUL-2022
Procedure Version:	3.6.1.0	**Verification Results:**	As Found: Passed As Left: Passed
Lab Technician:	Levente 2 Károly Kertész	**Calibration Executive Version**:	6.2.0.0
		Driver Info:	NI-DAQmx:20.0.0
Temperature:	22.9° C	**Humidity**:	49.1% RH

The data found in this certificate must be interpreted as:

As Found The calibration data of the unit as received by National Instruments, if the unit is functional.

As Left The calibration data of the unit when returned from National Instruments.

The As Found and As Left readings are identical for units not adjusted or repaired.

This calibration conforms to ANSI/NCSL Z540.1 requirement.

The TUR (Test Uncertainty Ratio) of this calibration is maintained at a ratio of 4:1 or greater, unless otherwise indicated in the measurements. A TUR determination is not possible for singled sided specification limits and therefore the absence of a value should not be interpreted as a TUR of 4:1 or greater, but rather undetermined. When provided, the expanded measurement uncertainty is calculated according to the Guide to the Expression of Uncertainty in Measurement (GUM) for a confidence level of approximately 95%.

Measured values greater than the Manufacturer's specification limits are marked as 'Failed', measured values within the Manufacturer's specifications are marked as 'Passed'. NI Service Labs do not consider uncertainties when making statements of compliance to a specification.

This certificate applies exclusively to the item identified above and shall not be reproduced except in full, without National Instruments written authorization. Calibration certificates without signatures are not valid.

The Calibration Certificate can be viewed or downloaded online at www.ni.com/calibration/. To request a hard copy, contact NI Customer Service at Tel:(800) 531-5066 or Email orders@ni.com.

Authorized By:

Zoltán Szabó
Technical Manager

NI Calibration Services Debrecen
NI Hungary Kft.
Határ út 1/A
Debrecen, Hajdú-Bihar 4031
Hungary
Tel: +36-52-515-400

~ Certificate of Calibration and Compliance ~

Model: 378B02	Serial Number: 153939	
Microphone Model: 377B02	Serial Number: 333461	Manufacturer: PCB
Preamplifier Model: 426E01	Serial Number: 074777	Manufacturer: PCB

Calibration Environmental Conditions

Environmental test conditions as printed on microphone calibration chart.

Reference Equipment

Manufacturer	Model #	Serial #	PCB Control #	Cal Date	Due Date
National Instruments	PCIe-6351	1896F08	CA1918	10/19/20	10/19/21
Larson Davis	PRM915	146	CA2115	4/13/21	4/13/22
Larson Davis	PRM902	5156	CA1795	4/15/21	4/15/22
Larson Davis	PRM916	128	CA1553	10/14/20	10/14/21
Larson Davis	CAL250	4213	CA1208	7/9/21	7/8/22
Larson Davis	2201	151	CA2073	11/24/20	11/24/21
Bruel & Kjaer	4192	3259547	CA3214	1/21/21	1/21/22
Larson Davis	GPRM902	5281	CA1595	12/8/20	12/8/21
Newport	iTHX-SD/N	1080002	CA1511	2/4/21	2/4/22
Larson Davis	PRA951-4	234	CA1154	11/11/20	11/11/21
Larson Davis	PRM915	136	CA1434	10/14/20	10/14/21
0	0	0	0	not required	not required
0	0	0	0	not required	not required
0	0	0	0	not required	not required
0	0	0	0	not required	not required

Frequency sweep performed with B&K UA0033 electrostatic actuator.

Condition of Unit

As Found: n/a

As Left: New Unit, In Tolerance

Notes

1. Calibration of reference equipment is traceable to one or more of the following National Labs; NIST, PTB or DFM.
2. This certificate shall not be reproduced, except in full, without written approval from PCB Piezotronics, Inc.
3. Calibration is performed in compliance with ISO 10012-1, ANSI/NCSL Z540.3 and ISO 17025.
4. See Manufacturer's Specification Sheet for a detailed listing of performance specifications.
5. System Sensitivity is measured following procedure AT603-5.
6. Measurement uncertainty (95% confidence level with coverage factor of 2) for sensitivity is +/-0.20 dB.
7. Unit calibrated per ACS-63.

Technician: Mike N. O'connor MO Date: September 30, 2021

ilac-MRA A2LA ACCREDITED
CALIBRATION CERT #1862.01

PCB PIEZOTRONICS VIBRATION DIVISION
3425 Walden Avenue, Depew, New York, 14043
TEL: 888-684-0013 FAX: 716-685-3886 www.pcb.com

ID:CAL112-3715903406.440+0

~ Calibration Report ~

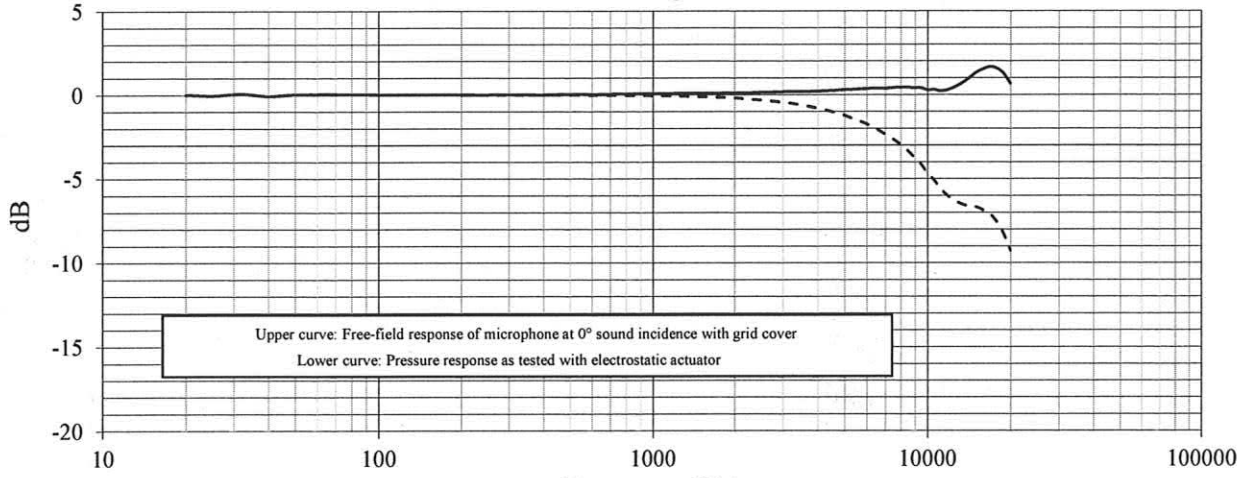
Model: 378B02 Serial Number: 153939
Microphone Model: 377B02 Serial Number: 333461 Description: 1/2" Free-Field Microphone
Preamplifier Model: 426E01 Serial Number: 074777 and Preamplifier

Calibration Data

System Sensitivity @ 251.2 Hz: 48.18 mV/Pa Polarization Voltage, External: 0 V
-26.34 dB re 1V/Pa

Temperature: 69 °F (21°C) Ambient Pressure: 998 mbar Relative Humidity: 41 %

Frequency Response (0 dB @ 251.2 Hz)



Freq (Hz)	Lower (dB)	Upper (dB)	Freq (Hz)	Lower (dB)	Upper (dB)	Freq (Hz)	Lower (dB)	Upper (dB)	Freq (Hz)	Lower (dB)	Upper (dB)
20.0	0.01	0.01	1679	-0.15	0.09	7499	-2.66	0.41	-	-	-
25.1	-0.04	-0.04	1778	-0.16	0.09	7943	-2.95	0.44	-	-	-
31.6	0.07	0.07	1884	-0.17	0.11	8414	-3.30	0.43	-	-	-
39.8	-0.07	-0.07	1995	-0.20	0.11	8913	-3.71	0.41	-	-	-
50.1	0.03	0.03	2114	-0.23	0.11	9441	-4.12	0.40	-	-	-
63.1	0.04	0.04	2239	-0.27	0.10	10000	-4.67	0.28	-	-	-
79.4	0.03	0.03	2371	-0.29	0.12	10593	-5.11	0.29	-	-	-
100.0	0.02	0.02	2512	-0.32	0.14	11220	-5.64	0.22	-	-	-
125.9	0.02	0.02	2661	-0.36	0.15	11885	-6.03	0.29	-	-	-
158.5	0.01	0.01	2818	-0.40	0.16	12589	-6.31	0.46	-	-	-
199.5	0.00	0.00	2985	-0.45	0.17	13335	-6.51	0.68	-	-	-
251.2	0.00	0.00	3162	-0.50	0.18	14125	-6.62	0.97	-	-	-
316.2	0.00	0.01	3350	-0.56	0.18	14962	-6.67	1.30	-	-	-
398.1	0.00	0.00	3548	-0.64	0.18	15849	-6.84	1.51	-	-	-
501.2	-0.01	0.03	3758	-0.71	0.19	16788	-7.07	1.65	-	-	-
631.0	-0.02	0.02	3981	-0.80	0.20	17783	-7.53	1.59	-	-	-
794.3	-0.04	0.05	4217	-0.89	0.22	18837	-8.25	1.26	-	-	-
1000.0	-0.06	0.07	4467	-1.00	0.23	19953	-9.28	0.65	-	-	-
1059.3	-0.06	0.07	4732	-1.11	0.26	-	-	-	-	-	-
1122.0	-0.07	0.07	5012	-1.24	0.29	-	-	-	-	-	-
1188.5	-0.08	0.07	5309	-1.40	0.30	-	-	-	-	-	-
1258.9	-0.08	0.08	5623	-1.55	0.33	-	-	-	-	-	-
1333.5	-0.09	0.09	5957	-1.72	0.35	-	-	-	-	-	-
1412.5	-0.11	0.09	6310	-1.91	0.38	-	-	-	-	-	-
1496.2	-0.12	0.08	6683	-2.15	0.37	-	-	-	-	-	-
1584.9	-0.13	0.08	7080	-2.41	0.37	-	-	-	-	-	-

Technician: Mike N. O'connor MO Date: September 30, 2021

ILAC-MRA A2LA ACCREDITED
CALIBRATION CERT #1862.01

PCB PIEZOTRONICS VIBRATION DIVISION
3425 Walden Avenue, Depew, New York, 14043
TEL: 888-684-0013 FAX: 716-685-3886 www.pcb.com

ID:CAL112-3715903406.440+0

CERTIFICATE of CALIBRATION

Make :	PCB Piezotronics	Reference # :	166376
Model :	480E09	Customer :	Aercoustics Engineering Ltd Mississauga, ON
Descr. :	Conditioning Amplifier		
Serial # :	00033659	P. Order :	2021.06.08C
Asset # :	00209		

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 : Jun 24, 2021 By : Petro Onasko

Cal. Due : Jun 24, 2023

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

Standards used : J-255 J-367 J-512

Navair Technologies

REPAIR AND CALIBRATION TRACEABLE TO NRC AND NIST

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Tel 802.316.4368 · Fax 802.735.9106 · www.sohwind.com

CERTIFICATE FOR CALIBRATION OF SONIC ANEMOMETER

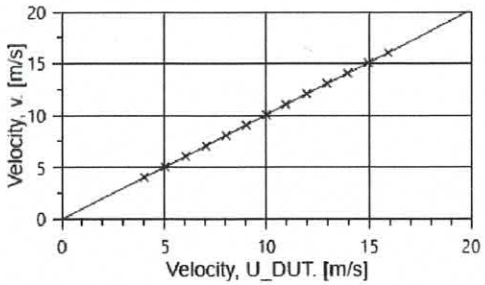
Certificate number: 21.US2.04685 **Date of issue:** June 29, 2021
Type: Vaisala Weather Transmitter, WXT530 **Serial number:** R3250414
Manufacturer: Vaisala, Oyj, Pl 26, FIN-00421 Helsinki, Finland
Client: Aercoustics Engineering Ltd., 1004 Middlegate RD, Suite 1100, S.Tower, Mississauga, ON L4Y 1M4, Canada

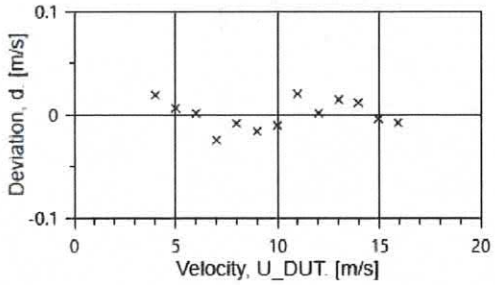
Anemometer received: June 28, 2021 **Anemometer calibrated:** June 29, 2021
Calibrated by: MEJ **Procedure:** MEASNET, IEC 61400-12-1:2017 Annex F
Certificate prepared by: EJF **Approved by:** Calibration engineer, EJF

Calibration equation obtained: v [m/s] = 1.00937 · U [m/s] + -0.04629

Standard uncertainty, slope: 0.00106 **Standard uncertainty, offset:** -0.24715
Covariance: -0.0000115 (m/s)²/m/s **Coefficient of correlation:** $\rho = 0.999994$
Absolute maximum deviation: -0.025 m/s at 7.021 m/s
Barometric pressure: 1007.4 hPa **Relative humidity:** 51.2%

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	9.30	28.5	27.1	4.013	4.0033	0.019	0.023
13-last	14.51	28.7	27.1	5.013	5.0067	0.006	0.026
2	21.03	28.5	27.1	6.035	6.0233	0.001	0.030
12	28.45	28.7	27.1	7.021	7.0267	-0.025	0.034
3	37.33	28.5	27.1	8.040	8.0200	-0.009	0.039
11	47.17	28.7	27.1	9.042	9.0200	-0.016	0.043
4	58.29	28.5	27.1	10.047	10.0100	-0.011	0.047
10	70.42	28.8	27.1	11.050	10.9733	0.020	0.051
5	84.02	28.5	27.1	12.064	11.9967	0.001	0.056
9	98.61	28.8	27.1	13.076	12.9867	0.014	0.060
6	113.95	28.6	27.1	14.053	13.9567	0.011	0.064
8	130.49	28.7	27.1	15.043	14.9533	-0.004	0.069
7	148.11	28.7	27.1	16.025	15.9300	-0.008	0.073





AC-1746

EQUIPMENT USED

Serial Number	Description
Njord2	Wind tunnel, blockage factor = 1.0035
13924	Control cup anemometer
-	Mounting tube, D = 19 mm
TT005	PR Electronics, PT100, 0-10V Output, wind tunnel temp.
TT003	Summit Electronics, 1XPT100, 0-10V Output, differential pressure box temp.
DP008	Setra Model 239, 0-1inWC, differential pressure transducer
HY004	Dwyer RHP-2D20, 0-10V Output, humidity transmitter
BP001	Setra Model 278, barometer
PL3	Pitot tube
XB001	Computer Board. 16 bit A/D data acquisition board
Njord2-PC	PC dedicated to data acquisition

The accuracies of all measurements were traceable to the SI through NIST or CIPM recognized NMI's.

Photo of the wind tunnel setup. The cross-sectional area is 2.5m x 2.5m.

UNCERTAINTIES

The documented uncertainty is the total combined uncertainty at 95% confidence level (k=2) in accordance with EA-4/02. The uncertainty at 10 m/s comply with the requirements in the IEC 61400-12-1:2005 procedure. See Document US.12.01.004 for further details.

COMMENTS

This sensor was oriented in the 0° position during calibration.

Certificate number: 21.US2.04685

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

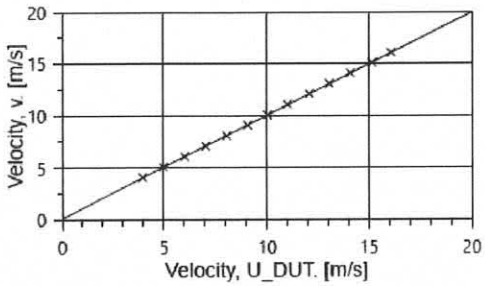
Certificate number: 21.US2.04686 **Date of issue:** June 29, 2021
Type: Vaisala Weather Transmitter, WXT530 **Serial number:** R3250414
Manufacturer: Vaisala, Oyj, Pl 26, FIN-00421 Helsinki, Finland
Client: Aercoustics Engineering Ltd., 1004 Middlegate RD, Suite 1100, S.Tower, Mississauga, ON L4Y 1M4, Canada

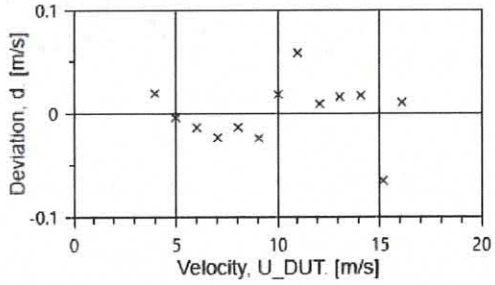
Anemometer received: June 28, 2021 **Anemometer calibrated:** June 29, 2021
Calibrated by: MEJ **Procedure:** MEASNET, IEC 61400-12-1:2017 Annex F
Certificate prepared by: EJF **Approved by:** Calibration engineer, EJF

Calibration equation obtained: v [m/s] = 0.99226 · U [m/s] + 0.07128

Standard uncertainty, slope: 0.00230 **Standard uncertainty, offset:** 0.34324
Covariance: -0.0000522 (m/s)²/m/s **Coefficient of correlation:** $\rho = 0.999971$
Absolute maximum deviation: -0.066 m/s at 15.058 m/s
Barometric pressure: 1007.3 hPa **Relative humidity:** 51.2%

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	28.6	27.1	4.023	3.9633	0.019	0.023
13-last	14.49	28.7	27.2	5.012	4.9833	-0.004	0.026
2	20.93	28.5	27.1	6.021	6.0100	-0.014	0.030
12	28.56	28.8	27.2	7.036	7.0433	-0.024	0.034
3	37.39	28.5	27.1	8.048	8.0533	-0.014	0.039
11	47.13	28.8	27.2	9.040	9.0633	-0.024	0.043
4	58.28	28.6	27.1	10.048	10.0367	0.018	0.047
10	70.41	28.9	27.2	11.051	11.0067	0.058	0.051
5	84.02	28.6	27.1	12.067	12.0800	0.009	0.056
9	98.15	28.9	27.2	13.049	13.0633	0.016	0.060
6	114.07	28.7	27.1	14.062	14.0833	0.017	0.064
8	130.71	28.8	27.2	15.058	15.1700	-0.066	0.069
7	148.47	28.7	27.1	16.047	16.0900	0.010	0.073





EQUIPMENT USED

Serial Number	Description
Njord2	Wind tunnel, blockage factor = 1.0035
13924	Control cup anemometer
-	Mounting tube, D = 19 mm
TT005	PR Electronics, PT100, 0-10V Output, wind tunnel temp.
TT003	Summit Electronics, 1XPT100, 0-10V Output, differential pressure box temp.
DP008	Setra Model 239, 0-1inWC, differential pressure transducer
HY004	Dwyer RHP-2D20, 0-10V Output, humidity transmitter
BP001	Setra Model 278, barometer
PL3	Pitot tube
XB001	Computer Board. 16 bit A/D data acquisition board
Njord2-PC	PC dedicated to data acquisition

The accuracies of all measurements were traceable to the SI through NIST or CIPM recognized NMI's.

Photo of the wind tunnel setup. The cross-sectional area is 2.5m x 2.5m.

UNCERTAINTIES

The documented uncertainty is the total combined uncertainty at 95% confidence level (k=2) in accordance with EA-4/02. The uncertainty at 10 m/s comply with the requirements in the IEC 61400-12-1:2005 procedure. See Document US.12.01.004 for further details.

COMMENTS

This sensor was oriented in the 90° position during calibration.

Certificate number: 21.US2.04686

X0006 Calibration Certificates

Details are disclosed in the table below regarding the calibration of the equipment used for the Phase 2 I-Audit campaign at X0006. The associated calibration certificates are provided in this appendix.

Please note that the serial number displayed on the microphone system calibration certificate encompasses both the microphone and the pre-amplifier which are submitted for calibration as a pair. The calibration certificate is valid for both the microphone and pre-amplifier. Their individual model and serial numbers are displayed on the page following the certificate as well as denoted in the table below.

Equipment	Make/Model	Serial Number	Date of Last Calibration	Measurement Interval	Confirmation of Validity for Measurement Interval?
Sound Level Meter	NI 9234	1B97D76	October 5, 2022	October 22, 2022 – November 17, 2022	Yes
Microphone/Pre-amplifier Pair	PCB 377B02	132190	June 23, 2022	October 22, 2022 – November 17, 2022	Yes
Microphone	PCB 377B02	177693	June 23, 2022	October 22, 2022 – November 17, 2022	Yes
Pre-amplifier	PCB 426E01	051457	June 23, 2022	October 22, 2022 – November 17, 2022	Yes
Signal Conditioner	PCB 480E09	00037187	March 4, 2022	October 22, 2022 – November 17, 2022	Yes
Weather Station	Vaisala WXT530	M4910199	June 29, 2021	October 22, 2022 – November 17, 2022	Yes

CERTIFICATE of CALIBRATION

Make :	National Instruments	Reference # :	172821
Model :	NI9234	Customer :	Aercoustics Engineering Ltd Mississauga, ON
Descr. :	ADC Module 4Ch 24Bit		
Serial # :	1B97D76	P. Order :	2022.09.27C
Asset # :	00922		

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 : Oct 05, 2022 By : Petro Onasko

Cal. Due : Oct 05, 2024

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

Standards used : J-190 J-367 J-512

Navair Technologies

REPAIR AND CALIBRATION TRACEABLE TO NRC AND NIST

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

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

CERTIFICATE of CALIBRATION

Make :	PCB Piezotronics	Reference # :	171581
Model :	378B02	Customer :	Aercoustics Engineering Ltd Mississauga, ON
Descr. :	Microphone System 1/2" Free Field		
Serial # :	132190	P. Order :	2022.06.16C
Asset # :	AEL 1159		

Cal. status : Received in spec's, no adjustment made.
Preamp System with Mic 377B02 s/n 177693

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 : Jun 23, 2022 By : Petro Onasko

Cal. Due : Jun 23, 2024

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

Standards used : J-216 J-324 J-333 J-420 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

NT NAVAIR TECHNOLOGIES

6375 Dixie Rd Unit # 7
Mississauga ON L5T 2E7
Tel: (905) 565-1583
Fax: (905) 565-8325

Form: PCB 378B02	Approved by: J.R.	Feb-16	Ver 1.0

Calibration Report for Certificate # 171581

Make		Model	Serial №	Asset	Cal by
PCB Piezotronics		378B02	132190		
PCB Piezotronics		426E01	051457	AEL 1159	P.O.
PCB Piezotronics		377B02	177693		

Ambient Conditions:

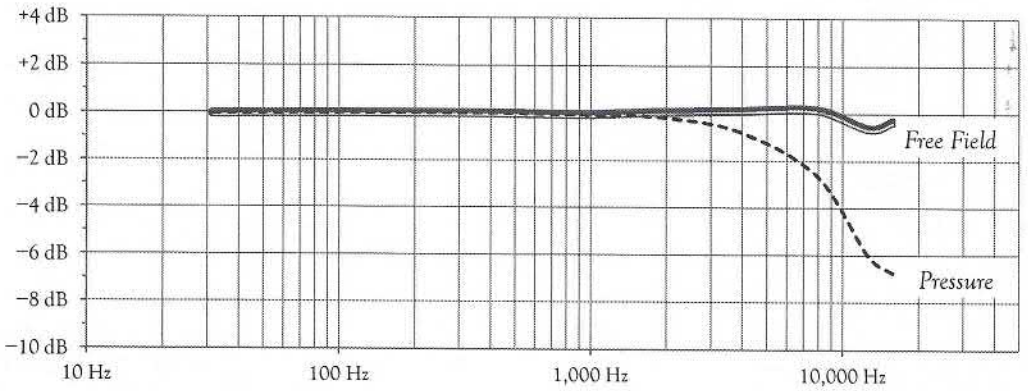
Barometric Pressure	99.6 kPa
Temperature	24.2°C
Relative Humidity	36%

Sensitivity at 250 Hz

Specs Nom	Unit	Min	Reading	Max		In/Out
50.0 mV/Pa		39.72	51.0 mV/Pa	62.94		In
−26.02 dB	re 1 V/Pa	-28.02	−25.8 dB	-24.02		In
0 dB	re 50 mV/Pa	-2	+0.2 dB	2		In

Frequency Response

	Frequency	Pressure	Free Field
	32 Hz	−0.05 dB	−0.05 dB
	63 Hz	−0.02 dB	−0.02 dB
	126 Hz	0.00 dB	0.00 dB
Reference	251 Hz	0.00 dB	0.00 dB
	503 Hz	−0.01 dB	−0.01 dB
	1005 Hz	−0.08 dB	−0.05 dB
	1979 Hz	−0.19 dB	+0.06 dB
	3958 Hz	−0.79 dB	+0.12 dB
	7915 Hz	−2.64 dB	+0.15 dB
	12663 Hz	−6.04 dB	−0.63 dB
	15830 Hz	−6.75 dB	−0.32 dB



CERTIFICATE of CALIBRATION

Make :	PCB Piezotronics	Reference # :	169835
Model :	480E09	Customer :	Aercoustics Engineering Ltd Mississauga, ON
Descr. :	Conditioning Amplifier		
Serial # :	00037187	P. Order :	2022.02.17C
Asset # :	01389		

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 : Mar 04, 2022 By : Petro Onasko

Cal. Due : Mar 04, 2024

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

Standards used : J-255 J-367 J-512

Navair Technologies

REPAIR AND CALIBRATION TRACEABLE TO NRC AND NIST

6375 Dixie Rd. Mississauga, ON, L5T 2E7 http: // www.navair.com
Phone : 800-668-7440 Fax: 905 565 8325 e-Mail: service @ navair.com

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

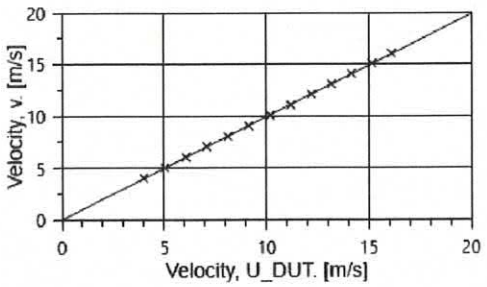
Certificate number: 21.US2.04680 **Date of issue:** June 29, 2021
Type: Vaisala Weather Transmitter, WXT530 **Serial number:** M4910199
Manufacturer: Vaisala, Oyj, Pl 26, FIN-00421 Helsinki, Finland
Client: Aercoustics Engineering Ltd., 1004 Middlegate RD, Suite 1100, S.Tower, Mississauga, ON L4Y 1M4, Canada

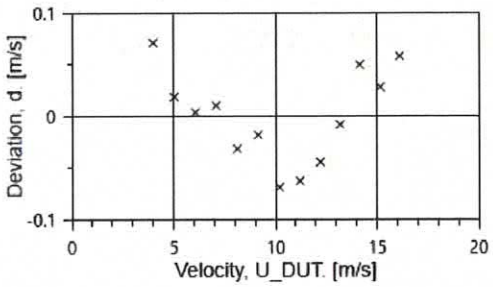
Anemometer received: June 24, 2021 **Anemometer calibrated:** June 29, 2021
Calibrated by: MEJ **Procedure:** MEASNET, IEC 61400-12-1:2017 Annex F
Certificate prepared by: EJF **Approved by:** Calibration engineer, EJF

Calibration equation obtained: v [m/s] = 0.99146 · U [m/s] + -0.00706

Standard uncertainty, slope: 0.00346 **Standard uncertainty, offset:** -5.25011
Covariance: -0.0001191 $(m/s)^2/m/s$ **Coefficient of correlation:** $\rho = 0.999934$
Absolute maximum deviation: 0.071 m/s at 4.029 m/s
Barometric pressure: 1007.7 hPa **Relative humidity:** 51.5%

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	9.40	28.0	27.0	4.029	4.0000	0.071	0.023
13-last	14.48	28.2	27.0	5.005	5.0367	0.018	0.026
2	20.98	28.0	27.0	6.021	6.0767	0.003	0.030
12	28.62	28.3	27.0	7.035	7.0933	0.010	0.034
3	37.33	28.0	27.0	8.032	8.1400	-0.032	0.039
11	47.27	28.3	27.0	9.043	9.1467	-0.019	0.043
4	58.33	28.0	27.0	10.040	10.2033	-0.069	0.047
10	70.49	28.3	27.0	11.044	11.2100	-0.063	0.051
5	84.14	28.1	27.0	12.060	12.2167	-0.045	0.056
9	98.58	28.3	27.0	13.062	13.1900	-0.009	0.060
6	114.56	28.1	27.0	14.075	14.1533	0.049	0.064
8	131.07	28.3	27.0	15.061	15.1700	0.028	0.069
7	148.45	28.2	27.0	16.026	16.1133	0.057	0.073





EQUIPMENT USED

Serial Number	Description
Njord2	Wind tunnel, blockage factor = 1.0035
13924	Control cup anemometer
-	Mounting tube, D = 19 mm
TT005	PR Electronics, PT100, 0-10V Output, wind tunnel temp.
TT003	Summit Electronics, 1XPT100, 0-10V Output, differential pressure box temp.
DP008	Setra Model 239, 0-1inWC, differential pressure transducer
HY004	Dwyer RHP-2D20, 0-10V Output, humidity transmitter
BP001	Setra Model 278, barometer
PL3	Pitot tube
XB001	Computer Board. 16 bit A/D data acquisition board
Njord2-PC	PC dedicated to data acquisition

The accuracies of all measurements were traceable to the SI through NIST or CIPM recognized NMI's.

Photo of the wind tunnel setup. The cross-sectional area is 2.5m x 2.5m.

UNCERTAINTIES

The documented uncertainty is the total combined uncertainty at 95% confidence level (k=2) in accordance with EA-4/02. The uncertainty at 10 m/s comply with the requirements in the IEC 61400-12-1:2005 procedure. See Document US.12.01.004 for further details.

COMMENTS

This sensor was oriented in the 0° position during calibration.

Certificate number: 21.US2.04680

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

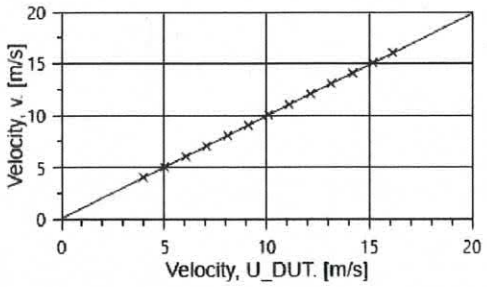
Certificate number: 21.US2.04679 **Date of issue:** June 29, 2021
Type: Vaisala Weather Transmitter, WXT530 **Serial number:** M4910199
Manufacturer: Vaisala, Oyj, Pl 26, FIN-00421 Helsinki, Finland
Client: Aercoustics Engineering Ltd., 1004 Middlegate RD, Suite 1100, S.Tower, Mississauga, ON L4Y 1M4, Canada

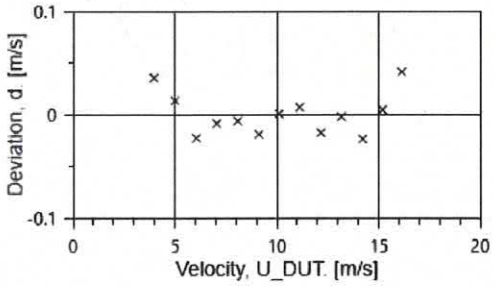
Anemometer received: June 24, 2021 **Anemometer calibrated:** June 29, 2021
Calibrated by: MEJ **Procedure:** MEASNET, IEC 61400-12-1:2017 Annex F
Certificate prepared by: EJF **Approved by:** Calibration engineer, EJF

Calibration equation obtained: v [m/s] = 0.98699 · U [m/s] + 0.06431

Standard uncertainty, slope: 0.00159 **Standard uncertainty, offset:** 0.26338
Covariance: -0.0000249 (m/s)²/m/s **Coefficient of correlation:** $\rho = 0.999986$
Absolute maximum deviation: 0.041 m/s at 16.035 m/s
Barometric pressure: 1007.7 hPa **Relative humidity:** 51.6%

Succession	Velocity pressure, q. [Pa]	Temperature in wind tunnel [°C]	Temperature in 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	9.36	27.9	27.0	4.021	3.9733	0.035	0.023
13-last	14.56	28.1	27.0	5.016	5.0033	0.013	0.026
2	20.96	27.9	27.0	6.016	6.0533	-0.023	0.030
12	28.54	28.1	27.0	7.024	7.0600	-0.009	0.034
3	37.51	27.9	27.0	8.049	8.0967	-0.006	0.039
11	47.29	28.2	27.0	9.043	9.1167	-0.019	0.043
4	58.50	27.9	27.0	10.053	10.1200	0.001	0.047
10	70.60	28.2	27.0	11.050	11.1233	0.007	0.051
5	84.10	27.9	27.0	12.055	12.1667	-0.018	0.056
9	98.51	28.2	27.0	13.054	13.1633	-0.002	0.060
6	114.40	28.0	27.0	14.062	14.2067	-0.024	0.064
8	131.07	28.2	27.0	15.058	15.1867	0.004	0.069
7	148.68	28.1	27.0	16.035	16.1400	0.041	0.073





ilac-MRA ANAB ACCREDITED CALIBRATION LABORATORY

SOH Wind Engineering LLC measnet USA

EQUIPMENT USED

Serial Number	Description
Njord2	Wind tunnel, blockage factor = 1.0035
13924	Control cup anemometer
-	Mounting tube, D = 19 mm
TT005	PR Electronics, PT100, 0-10V Output, wind tunnel temp.
TT003	Summit Electronics, 1XPT100, 0-10V Output, differential pressure box temp.
DP008	Setra Model 239, 0-1inWC, differential pressure transducer
HY004	Dwyer RHP-2D20, 0-10V Output, humidity transmitter
BP001	Setra Model 278, barometer
PL3	Pitot tube
XB001	Computer Board. 16 bit A/D data acquisition board
Njord2-PC	PC dedicated to data acquisition

The accuracies of all measurements were traceable to the SI through NIST or CIPM recognized NMI's.

Photo of the wind tunnel setup. The cross-sectional area is 2.5m x 2.5m.

UNCERTAINTIES

The documented uncertainty is the total combined uncertainty at 95% confidence level (k=2) in accordance with EA-4/02. The uncertainty at 10 m/s comply with the requirements in the IEC 61400-12-1:2005 procedure. See Document US.12.01.004 for further details.

COMMENTS

This sensor was oriented in the 90° position during calibration.

Certificate number: 21.US2.04679

Appendix D
Turbine 90% Sound Output Calculation

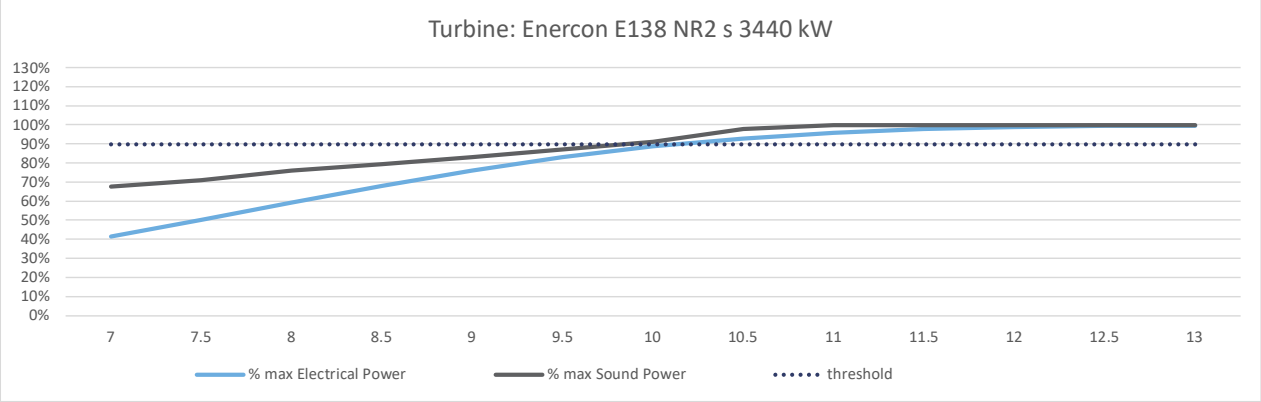
*Wind bins for interpolation are highlighted in light blue

Table G.1: Nation Rise Enercon E138 NR2 s 3440 kW Specified Sound Power Level

Enercon E138 NR2S Specified Sound Power Data - Source: Nation Rise Turbine Specifications Report [4]													
Enercon Data Sheet	7	7.5	8	8.5	9	9.5	10	10.5	11	11.5	12	12.5	13
Power (kW)	1429	1726	2034	2337	2617	2858	3051	3195	3294	3359	3397	3419	3431
SPL (dBA)	102.6	102.8	103.1	103.3	103.5	103.7	103.9	104.2	104.3	104.3	104.3	104.3	104.3

Table G.2: Power Thresholds for 90% Sound Power

	maximum sound power level (dBA)	90% sound power level (dBA)	rated electrical power output (kW)	electrical power at 90% sound level (kW)	percentage of rated power
Enercon E138 NR2 s 3440 kW	104.3	103.8	3440	2995	87%



Appendix E
Statement from the Operator

Nation Rise Wind Farm
219 Dufferin Street, Unit 217C
Toronto, ON M6K 3J1
T: 416 749 7363 | F: 416 520 1706

December 9, 2022

Aercoustics Engineering Limited
1004 Middlegate Road, Suite 1100
Mississauga, ON L4Y0G1
Attention Duncan Halstead

Re: **Wind Turbine Operating Conditions:** Service Agreement dated March 31, 2021 by and between Nation Rise Wind Farm Limited Partnership ("Owner") and Aercoustics Engineering Limited ("Contractor").

Dear Duncan Halstead,

Please accept this letter as confirmation that, to the best of Owner's knowledge, all the turbines around each receptor, referenced in below Table, were operating normally for the duration of the audit period indicated in the report, and were parked during ambient measurements and for occasional maintenance work.

Audit Receptor	Audit Start Date	Audit End Date	Turbines in Study
R1883	Feb 7, 2022	Mar 1, 2022	T32, T54
V4329	Oct 22, 2022	Nov 24, 2022	T18, T20, T21, T23
X0002	Oct 27, 2022	Nov 7, 2022	T05, T09
X0003	Feb 7, 2022	Mar 1, 2022	T28, T29
X0006	Oct 22, 2022	Nov 17, 2022	T48

If you have any questions or comments, please contact Bruno Subieta at Bruno.Subieta@edp.com or 713-806-2522.

Sincerely,
Nation Rise Wind Farm Limited Partnership

DocuSigned by:
Brad Harmon
CC7AA82CF8B14BB...

Brad Harmon
Director of Asset Management

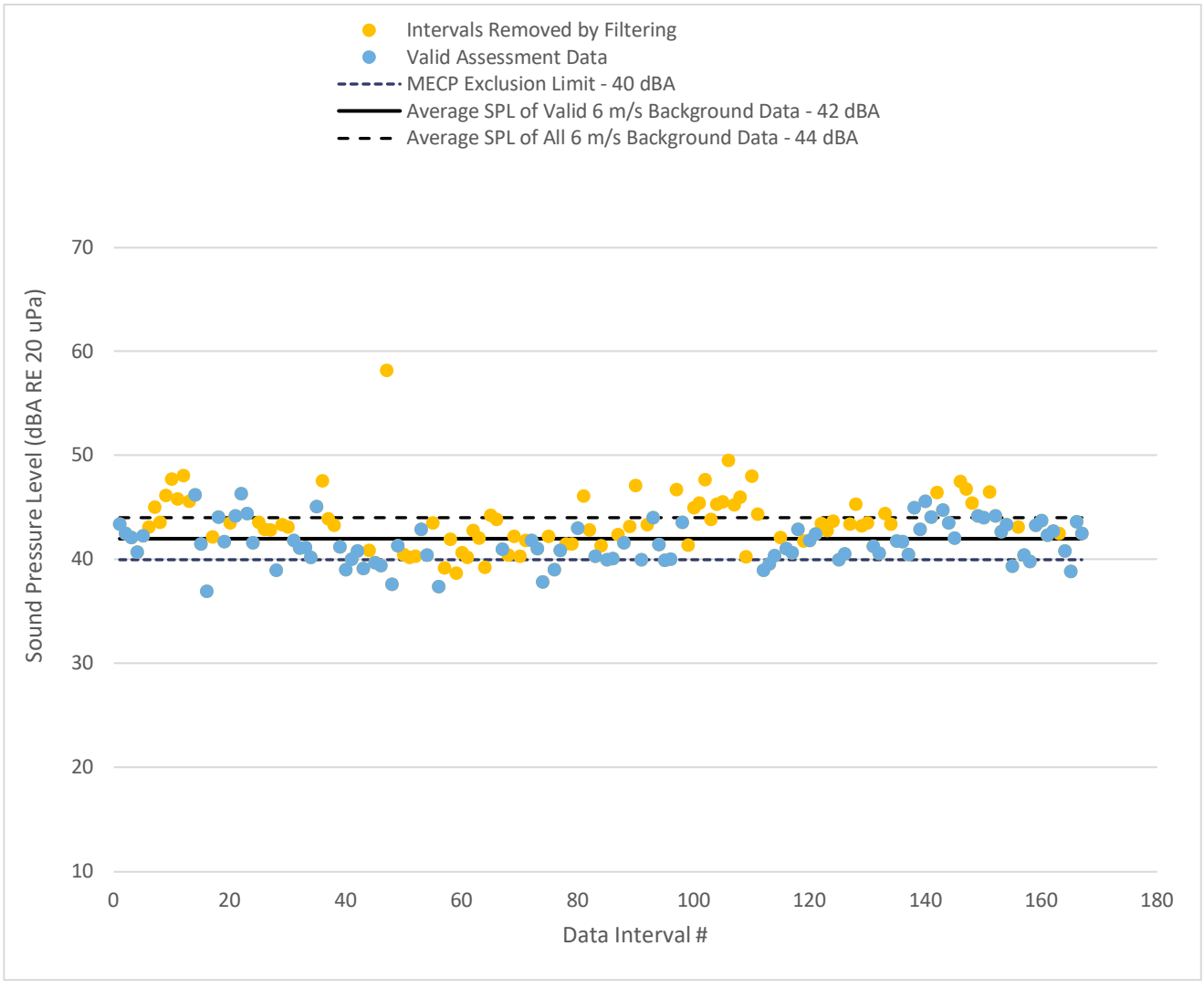
EDP Renewables North America LLC
Corporate Headquarters
1501 McKinney Street, Suite 1300, Houston, TX 77010
For USPS Mail: P.O. Box 3827, Houston, TX 77253
T: 713. 265.0350 | F: 713.583.3630
www.edpr.com/north-america

Appendix F
X0006 Background Sound Level Discussion

The data collected at Receptor X0006 was found to have been influenced significantly by ambient sources as detailed in Section 3.3 of the Report. Figure F1, below, has been included to illustrate the elevated measured Background sound levels in the 6 m/s data wind bin. From Figure F1, it can be seen that the measured Background sound levels regularly exceed the MECP exclusion limit of 40 dBA even after the removal of extraneous noise. The average measured Background sound level in the 6 m/s background wind bin was 44 dBA prior to the application of the filters described in 4.3 of the Report and 42 dBA after the application of filters.

Per Section D6 of the Compliance Protocol for Wind Turbine Noise, the applicable sound level limit in the 6 m/s wind bin is the average background sound level in the assessment windbin without extraneous noise which is 42 dBA.

Figure F1 - X0006 6 m/s Background Data



Appendix G
I-Audit Checklist

Appendix E: I-Audit checklist

Wind Energy Project – Screening Document – Acoustic Audit Report – Immission

Information Required in the Acoustic Audit Report – Immission

Item #	Description	Complete?	Comment
1	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? Section D2.1.1	✓	
2	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)? Section D2.1.3	✓	
3	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? Section D2.3	✓	
4	Was the predictable worst case parameters such as high wind shear and wind direction toward the Receptor considered? Section D3.2	✓	
5	Is there a Wind Rose showing the wind directions at the site? Section D7 (1e)	✓	
6	Did the results cover a wind speed range of at least 4-7 m/s as outlined in section D 3.8.?	✓	RAM-I assessment conducted
7	Was the weather report during the measurement campaign included in the report? Section D7 (1c)	✓	
8	Did the audit state there was compliance with the limits at each wind speed category? Section D6	✓	
9	Are pictures of the noise measurement setup near Point of reception provided? Section D3.3.2 & D3.4	✓	
10	Was there justification of the Receptor location choice(s) prior to commencement of the I-Audit? Section D4.1	✓	
11	Was there sufficient valid data for different wind speeds? Section D5.2 # 3	✓	RAM-I assessment conducted
12	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) Section D3.7	✓	
13	Were all the calculated standard deviations at all relevant integer wind speeds provided? Section D7 (2d)	✓	
14	Compliance statement	✓	
15	All data included in an Excel spreadsheet	✓	
16	If deviations from standard; was justification of the deviations provided	✓	See Section 4.6 of report

End of Report