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ASSESSMENT REPORT - **Project: 17095.01**

Belle River Wind LP
Phase 2 Acoustic Immission Audit

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Executive Summary

Aercoustics Engineering Limited ("Aercoustics") has been retained by Belle River Wind LP to complete the acoustic immission audit requirements outlined in the Renewable Energy Approval ("REA") for the Belle River Wind Power Project ("BRWPP"). BRWPP operates under REA #2765-A4ER2P, issued on January 13, 2016 [1].

As per the REA, five (5) measurement locations are required to be audited over two (2) separate occasions – or "Phases" – of measurement. The five (5) measurement locations chosen for the BRWPP immission audit are: R1126, R1207, R1170, R1469, and R2299. This report summarises the results of Phase 2 of the I-audit testing at all five (5) measurement locations.

The Phase 2 audit campaign for the five (5) measurement locations spanned the following dates:

Location	Monitoring Start Date	Monitoring End Date	Monitoring Duration (weeks)
R1126	September 19, 2019	January 11, 2020	16
R1207	September 19, 2019	January 11, 2020	16
R1170	September 19, 2019	January 11, 2020	16
R1469	February 7, 2019	March 21, 2020	6
R2299	February 7, 2019	March 21, 2020	6

The audit has been completed as per the methodology outlined in Parts D and E5.5 RAM-I (Revised Assessment Methodology) of the "*MECP Compliance Protocol for Wind Turbine Noise*" (Updated April 21, 2017) [2].

Based on the results presented in Section 10.2 of this report, the cumulative sound impact calculated at all five (5) measurement locations complies with the MECP sound level limits at all wind bins having sufficient data for assessment.

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1 Introduction

Aercoustics Engineering Limited ("Aercoustics") has been retained by Belle River Wind LP to complete the immission audit ("I-audit") requirement outlined in Section E of the Renewable Energy Approval ("REA") for the Belle River Wind Power Project ("BRWPP"). BRWPP operates under REA #2765-A4ER2P, issued on January 13, 2016 [1].

Measurements were conducted per the Compliance Protocol for Wind Turbine Noise (the "Protocol") [2]. As per the REA, five (5) measurement locations are required. The measurement locations chosen for the BRWPP immission audit are: R1126, R1207, R1170, R1469, and R2299. This report summarises the results of Phase 2 of the I-audit testing at all BRWPP audit measurement locations.

2 Facility Description

The Belle River Wind Power Project is located in Lakeshore, Ontario. The site is bound by Essex 42 to the north, Highway 401 to the south, Lakeshore Road 111 to the west, and Comber Side Road to the east.

The BRWPP consists of 40 Siemens SWT-113 wind turbines for power generation, with a total nameplate capacity of 100 MW. Each turbine has a hub height of 99.5 meters, a rotor diameter of 113 meters and an individual nameplate capacity of either 3.2MW, 2.772MW, 2.473MW or 2.37MW. The facility operates 24 hours per day, 7 days per week. A Site Plan of the facility and the surrounding area are provided in Appendix A.1.

There are two wind facilities within 10 kilometres of the BRWPP: Comber Wind Farm ("CWF") and Pointe-Aux-Roches Wind Farm ("PARWF"). With respect to the five audit measurement locations, the nearest CWF turbine is Turbine T48, 3.1 km to the south of monitor R1126; the nearest PARWF turbine is Turbine T220, 2.1 km to the north of monitor R1170.

3 Audit Receptor Selection

As per Section E.1(2) of the BRWPP REA, five receptor[1] locations were chosen to execute both phases of the I-audit: R1126, R1207, R1170, R1469, and R2299. Monitoring equipment was erected near each of these receptors for the duration of the Phase 2 monitoring period.

[1] In this report, the term "receptor" refers to the Points of Reception outlined in the REA. The term "monitor" refers to the location of the measurement equipment used to assess the worst-case impact at the associated receptor.

3.1 **Receptor Selection Criteria**

Receptor selection criteria are outlined in REA Section E1 and paraphrased below. "Predicted noise impact" refers to the predicted cumulative impact using the sound model outlined in the noise assessment report [3] (Dokouzian, 2015)[2]. "Primary Turbine" refers to the turbine having the highest predicted impact at a given receptor location. "Downwind" refers to the direction from monitor to primary turbine being within +/-45° of the direction of the prevailing winds.

E1(3): *- Selected receptors should have the highest possible predicted noise impacts*
- Selected receptors should be in the direction of the prevailing winds

The receptors chosen for the BRWPP I-audit are R1126, R1207, R1170, R1469, and R2299. All receptors are situated downwind with respect to the prevailing wind direction. Further details regarding the monitoring position are provided in Section 4.3.

The Receptor Selection Process at the BRWPP was significantly restricted by the BRWPP's close proximity to the two neighbouring wind power projects, CWF and PARWF, and the central location of the BRWPP Transformer. These noise sources limit the locations on the project where the Protocol's requirement for a predicted level below 30 dBA during background measurement can be met.

Further to this, Ontario Highway 401 borders the project to the south, and is a significant source of ambient noise in the area. Noise from Highway 401 was observed to be particularly significant at two (2) measurement locations – R738 and R1141 – which were originally selected for the BRWPP audit campaign and subsequently de-selected. Two new receptors – R1460 and R2299, situated further from the highway – were selected in Fall 2019 for their Phase 1 audit period. Additional information and context regarding the BRWPP receptor selection has been included in Appendix B.

During the receptor selection process, an effort was made to select locations across the entire project as much as possible, and to avoid clusters of measurement locations. The MECP was consulted throughout the receptor selection process and was notified of the final receptors selected prior to the commencement of any measurements.

[2] It is noted that the noise assessment report in [3] included 46 turbines, but only 40 turbines were constructed. As such, the receptor selections for the I-audit measurements in this report were conducted using the predicted sound impact of 40 turbines (as-built), modelled by DNV-GL.

3.1.1 Prevailing Wind Direction

The prevailing wind direction used for receptor selection was determined using historical weather data for the site. This data was filtered to isolate for the conditions during which the facility would generate over 85% power, to match the conditions required to fulfill the filtering requirements of the Protocol. A wind rose showing the historical wind direction at the site is included Figure 1. The predominant wind direction is southwest, specifically 220°.

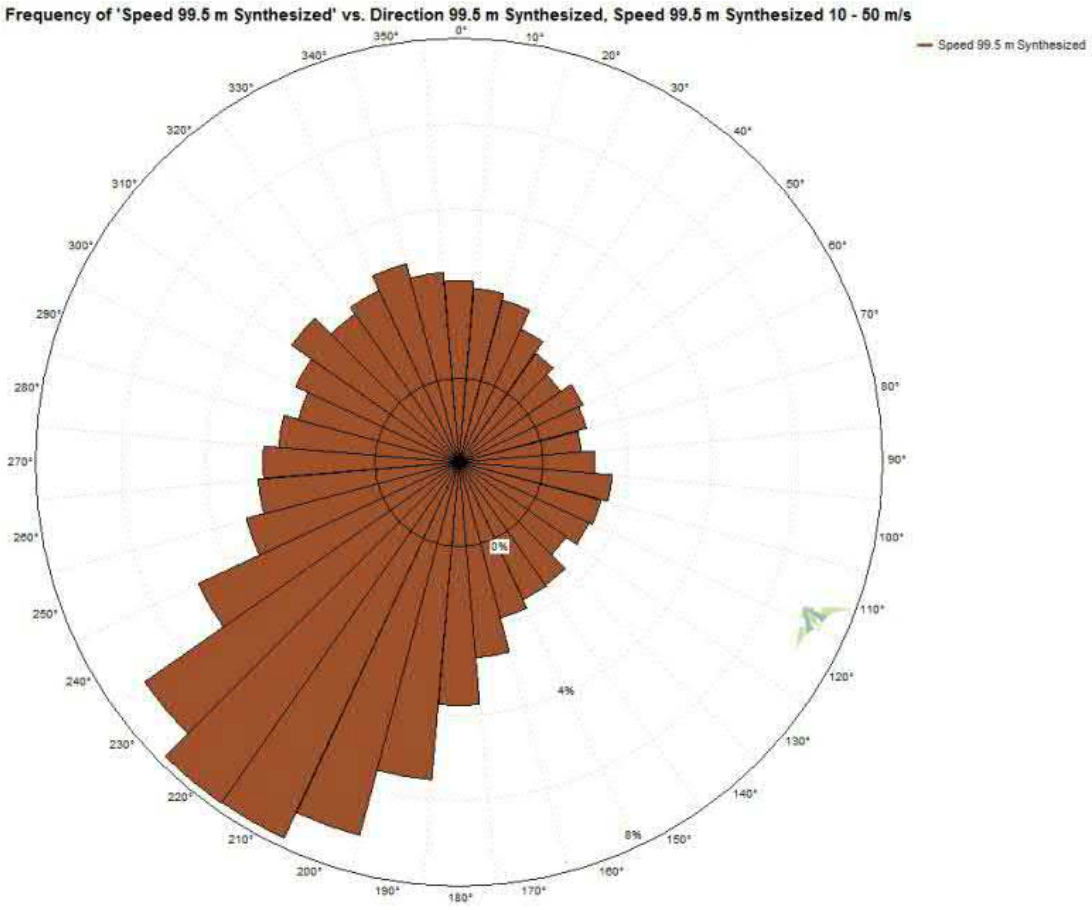


Figure 1: Historical Wind Roses for BRWPP, filtered for hub-height wind speeds above 10 m/s

3.1.2 Receptor Selection Table

Receptors that are participants of BRWPP or that are not located in the predominant downwind direction from the closest turbine were automatically excluded during the receptor selection process, in accordance with the guidance in the BRWPP REA and the Protocol. Receptors excluded for other reasons are summarized in Table 1 below, along with the five locations that were selected. A full summary of the results of the receptor selection process is included in Appendix B. Details regarding the land access permission activities for this project are available upon request.

Table 1: I-Audit Receptor Selection Table

SPL Rank	ID	Height (m)	Distance to Nearest Turbine (m)	Nearest Turbine	Calculated Sound Level (dBA)[1]	Wind Direction[2]	Notes
55	**R1170**	4.5	574	T40	39.2	DW	**Selected -** Monitor located such that predicted third-party impact <30 dBA
111	**R1126**	4.5	626	T50	38.6	DW	**Selected**
112	V2717	4.5	636	T50	38.6	DW	**Excluded** - Redundant with R1126
121	V2485	4.5	569	T14	38.5	DW	Land access denied[3]
128	R1123	4.5	684	T50	38.5	DW	**Excluded** - Redundant with R1126
136	V2484	4.5	568	T14	38.4	DW	Land access denied[3]
137	R1141	4.5	580	T12	38.4	DW	**Initially Selected** and subsequently **De-Selected**[4] due to proximity of Hwy 401.
144	V2763	4.5	733	T50	38.4	DW	**Excluded** - Redundant with R1126
148	V2482	4.5	570	T14	38.3	DW	Land access denied[3]
149	V2689	4.5	633	T12	38.3	DW	**Excluded** - Redundant with R1141
153	V2513	4.5	683	T14	38.3	DW	Land access denied[3]
156	R1125	4.5	720	T50	38.3	DW	**Excluded** - Redundant with R1126
162	V2539	4.5	572	T14	38.2	DW	Land access denied[3]
167	R1138	4.5	675	T12	38.2	DW	**Excluded** - Redundant with R1141
169	V2514	4.5	680	T14	38.2	DW	Land access denied[3]
186	V2515	4.5	681	T14	38.1	DW	Land access denied[3]
199	V2516	4.5	681	T14	38	DW	Land access denied[3]
215	V2517	4.5	683	T14	37.9	DW	Land access denied[3]
226	R738	1.5	568	T58	37.9	DW	**Initially Selected** and subsequently **De-Selected**[4] due to proximity of Hwy 401.
227	**R1207**	1.5	620	T20	37.9	DW	**Selected**

SPL Rank	ID	Height (m)	Distance to Nearest Turbine (m)	Nearest Turbine	Calculated Sound Level (dBA)[1]	Wind Direction[2]	Notes
231	V2518	4.5	686	T14	37.8	DW	Land access denied[3]
247	R737	1.5	634	T58	37.7	DW	**Excluded –** within 2500m of Hwy 401
252	R1140	4.5	685	T12	37.6	DW	**Excluded –** within 2500m of Hwy 401
260	V3051	4.5	754	T215	37.6	DW	**Excluded –** within 2500m of Hwy 401
280	R1124	1.5	627	T50	37.5	DW	**Excluded –** redundant with R1126
325	R733	1.5	552	T57	37.2	DW	**Excluded –** within 2500m of Hwy 401
345	**R2299**	1.5	735	T202	37.1	DW	**Selected**
348	R1225	4.5	642	T51	37	DW	**Excluded –** redundant with R1207
353	**R1469**	1.5	598	T29	37	DW	**Selected**

[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°
[3] Part of sub-divided vacant lot with single land-management authority
[4] Please refer to Appendix B for additional details regarding the Belle River receptor selection process.

4 Audit Measurement Locations

The following section describes the measurement location used for each of the five (5) audit receptors and provides context regarding the ambient acoustic environment observed at the BRWPP.

4.1 Existing Ambient Environment

The ambient acoustical environment measured at the five (5) BRWPP audit locations was observed to be dominated by wind-related noise and distant highway traffic noise. Noise from the nearby rail line and local roadways, as well as overhead aircraft, was also observed at all monitoring locations. Noise from nearby fauna occurred occasionally throughout the beginning of the measurement campaign at R1126, R1207, and R1170. The sources of ambient noise that comprise the ambient acoustical environment at BRWPP are described below.

Data that was found to be influenced significantly by extraneous ambient noise was filtered out either manually by listening analysis or automatically by the transient (LA_{eq}-L_{90}) filter, described in Section 6.1. Whilst this method significantly reduces the number of contaminated intervals included in the analysis, it is acknowledged that not all contaminated data is guaranteed to be removed from the dataset.

4.1.1 Noise from Local Fauna

Noise from fauna refers to noise typically arising from the activity of insects, birds, livestock, or dogs. Noise of this nature may be concentrated at high frequencies (such as crickets chirping) or limited to short-term events (such as dogs barking). Noise from fauna is considered extraneous noise.

Cricket noise was present at the R1126, R1207, and R1170 measurement locations, and was especially prominent in the early fall months from September to November. Insect noise was not observed at the R1469 and R2299 measurement locations, likely due to the Phase 2 noise audit for those locations occurring during a different time of year than the measurements conducted at R1126, R1207, and R1170. There were no other significant sources of fauna noise identified at any of the five (5) audit locations.

Instances of transient extraneous noise from fauna were filtered out either manually by listening analysis or automatically by the transient (LA_{eq}-L_{90}) filter, described in Section 6.1. Periods of steady, high-frequency extraneous noise from fauna were filtered out by excluding high-frequency 1/3rd-octave data, as described in Section 6.3.

4.1.2 Wind-Related Ambient Noise

Wind-related noise is comprised of two sources: self-noise and foliage noise. Self-noise results from wind blowing over objects associated with the monitoring equipment and is similar to what one might observe when wind blows over the ear on a windy day. Self-noise is present in all monitoring campaigns at high wind speeds. Conversely, foliage noise depends on the vegetation in the area surrounding the monitor. Measures to reduce the impact of wind-related noise were employed at the monitor location, as prescribed in the Protocol; a secondary wind screen was installed to reduce self-noise, and the monitoring equipment was located away from trees as much as practically possible. The approximate location and effect of the various sources of wind self-noise are outlined in Table 2.

Table 2: Ambient Noise Sources – Wind Related Ambient Noise

Audit Location	Noise Source	Location of Source	Effect of Source at Audit Location
All Locations	Wind Self Noise	Noise Monitor	Increased sound levels at high wind speeds
R1126	Soybean Crop	Surrounding Monitor	Minimal effect on measured sound levels at low to medium wind speeds, elevated sound levels at high wind speeds
	Deciduous Tree	40 m north	
R1207	No Nearby Large Foliage for Duration of Phase 2 Audit		Little-to-no impact on measured sound levels at low to medium wind speeds. Potential for elevated sound levels at higher wind speeds.
R1170			
R1469	Coniferous Hedge	15 m east	Minimal effect on measured sound levels at low to medium wind speeds, elevated sound levels at high wind speeds
R2299	Coniferous Hedge	42 m northeast	

4.1.3 Traffic Noise

Ontario Highway 401, located between 2.7 and 3.5 km to the south of the BRWPP audit locations, was observed to be a distant ambient noise source at all measurement locations, both through listening and spectral analysis of the measured data. It was noted that the contribution of the noise from Ontario Highway 401 varied with the time of night, day of the week, and most significantly, the wind direction. Removal of the Ontario Highway 401 contamination was not possible due to the continuous nature of the source, and so an effort was made to further filter the dataset to control for the variations caused by wind direction. This was done by adding a downwind filter to the background data set. An additional attempt to reduce the influence of noise from Highway 401 was made by analysing periods where the impact of road traffic noise was observed to be less significant. The time filtering and background wind direction filtering methodologies are described in further detail in Section 6.1.

The location of Highway 401 with respect to the audit locations is outlined in Table 3. Similarly, the locations of local road traffic noise sources, as well as their influence on the measured sound levels, are provided for each measurement location in Table 4.

Table 3: Ambient Noise Sources – ON-401

Audit Location	Noise Source	Location of Source	Effect of Source at Audit Location
R1126	ON-401	2.7 km south	Elevated sound levels, depending on wind direction and time of day
R1207		3.5 km south	
R1170		2.8 km south	
R1469		3.0 km south	
R2299		2.7 km south	

Table 4: Ambient Noise Sources - Local Traffic

Audit Location	Noise Source	Location of Source	Effect of Source at Audit Location
R1126	Myers Road	35 m east	Intermittent high sound levels during local vehicle traffic
R1207	Lakeshore Rd 123	60 m east	
R1170	Lakeshore Rd 129	64 m east	
R1469	Country Rd 31	85 m east	
R2299	Lakeshore Rd 113	115 m east	

4.1.4 Rail Noise

A Canadian Pacific Railway Line, located approximately 2.5 km to the north of the BRWPP audit locations, was observed to be an occasional source of transient contamination at all measurement locations. This was observed during site visits, and through listening and spectral analysis of the measured data. In a similar fashion to the Ontario Highway 401, the contribution of the noise from the Canadian Pacific Railway Line varied with the time of night, day of the week, and wind direction.

Table 5: Ambient Noise Sources - Rail Noise

Audit Location	Noise Source	Location of Source	Effect of Source at Audit Location
R1126	CP Rail Line	2.6 km north	Elevated sound levels during rail activity
R1207		2.0 km north	
R1170		2.8 km north	
R1469		2.5 km north	
R2299		2.6 km north	

4.1.5 Aircraft Noise

The Belle River Wind Farm is situated approximately 24 km to the east of Windsor International Airport. Noise from overhead aircraft was observed occasionally during equipment setup on-site and through listening and spectral analysis of the measurement data. This source of transient contamination was observed to occur less frequently than those mentioned above but had a significant impact on the measured sound levels when present.

Table 6: Ambient Noise Sources - Aircraft Noise

Audit Location	Noise Source	Location of Source	Effect of Source at Audit Location
R1126	Overhead Aircraft	Surrounding BRWPP	Elevated sound levels when aircrafts are overhead and nearby
R1207			
R1170			
R1469			
R2299			

4.2 Influence of COVID-19 on Ambient Acoustical Environment

A state of emergency associated with the emergence of COVID-19 in Ontario was declared on March 17, 2020. Measures were put forth by the Provincial Government in the subsequent days to limit non-essential business and non-essential border crossings into the US. A reduction in road traffic – both on highways and on residential roadways – was observed to follow the implementation of these measures.

Noise from road traffic on Highway 401 had previously been observed as a dominant source of ambient noise at the R1469 and R2299 measurement location, during both the Phase 1 and Phase 2 audit campaigns.

The inclusion of data affected by this reduction in road traffic would not be appropriate in an assessment of compliance, as the ambient environment would no longer be representative of the typical acoustical environment of the BRWPP Receptors. A reduction in ambient noise from road traffic was not observed in the submitted audit data collected at R1469 and R2299, which spans from February 7th, 2020 to March 21st, 2020.

As per Table 7, the data collected for the Phase 2 audit at receptors R1126, R1207, and R1170 was acquired prior to the emergence of COVID-19 and is therefor unaffected.

4.3 Monitoring Location

Table 7 provides specific details of the receptor and monitoring equipment locations. The immediate surroundings of the monitor location are also described below. Photos of the surrounding area and measurement setup are included in Appendix A.

Table 7: Receptor and Monitor Locations

Audit Receptor	Primary Turbine	Measurement Duration	Location	UTM Coordinates [m] (Zone 17T)	Distance to Primary Turbine [m]	Predicted Level (dBA)†
R1126	T50	*September 19, 2019 – January 11, 2020*	*Receptor*	360,951 E 4,680,115 N	626	38.6
			Monitor	360,934 E 4,680,055 N	597	38.7
R1207	T20	*September 19, 2019 – January 11, 2020*	*Receptor*	362,309 E 4,680,743 N	620	37.9
			Monitor	362,270 E 4,680,678 N	557	38.1
R1170	T40	*September 19, 2019 – January 11, 2020*	*Receptor*	366,413 E 4,679,720 N	573	39.3
			Monitor	366,409 E 4,679,616 N	548	39.4
R1469	T29	*February 7, 2020 – March 21, 2020*	*Receptor*	365,067 E 4,679,978 N	599	37.0
			Monitor	365,026 E 4,679,997 N	561	37.0
R2299	T202	*February 7, 2020 – March 21, 2020*	*Receptor*	355,381 E 4,680,360 N	734	37.1
			Monitor	355,304 E 4,680,328 N	656	37.5

† Predicted sound pressure level determined using an as-built sound model created by DNV-GL

5 Measurement Methodology

The acoustic audit was conducted at receptors R1126, R1207, R1170, R1469, and R2299 Measurements and data analyses were conducted per the Protocol. Specific details regarding the methodology are presented in this section.

5.1 Test Equipment

Measurement equipment used for the I-audit campaign, both acoustic and non-acoustic, is detailed below. Equipment specifications and measurement positions comply with MECP Protocol sections *D2 – Instrumentation* and *D3 – Measurement Procedure*, respectively. Each remote monitoring unit is comprised of the following:

- One (1) Type 1 sound level meter, with microphone and pre-amplifier installed at least 5 meters from any large reflecting surfaces at a height of:
    - 4.5 meters for Receptors R1126 and R1170
    - 1.5 meters for Receptors R1207, R1469, and R2299.
- One (1) primary and one (1) secondary windscreen for the microphone. The 1/3 octave band insertion loss of the secondary windscreen has been tested and was accounted for in the measurement analysis.
- One (1) anemometer, installed 10 metres above ground level (“10-m AGL").

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

Table 8: Equipment Details

Monitor	Equipment	Make/Model	Serial Number
R1126	Data Acquisition Card	NI 9234	19A4D82
	Signal Conditioner	PCB 480E09	34592
	Microphone	PCB 377B02	177759
	Pre-Amplifier	PCB 426E01	51463
	Weather Anemometer	Vaisala WXT 520	M0410645[1]
		Vaisala WXT 536	R3250417[2]
R1207	Data Acquisition Card	NI 9234	1AA831C
	Signal Conditioner	PCB 480E09	35342
	Microphone	PCB 377B02	174130
	Pre-Amplifier	PCB 426E01	51461
	Weather Anemometer	Vaisala WXT 536	R1020385
R1170	Data Acquisition Card	NI 9234	ID571FE
	Signal Conditioner	PCB 480E09	33804
	Microphone	PCB 377B02	155181[3]
			163368[4]
	Pre-Amplifier	PCB 426E01	40835[3]
			43344[4]
	Weather Anemometer	Vaisala WXT 520	M0110646
R1469	Data Acquisition Card	NI 9234	1CAF72D
	Signal Conditioner	PCB 480E09	35332
	Microphone	PCB 377B02	150498
	Pre-Amplifier	PCB 426E01	37448
	Weather Anemometer	Vaisala WXT 520	K0630016
R2299	Data Acquisition Card	NI 9234	1CAF757
	Signal Conditioner	PCB 480E09	34205
	Microphone	PCB 377B02	163103
	Pre-Amplifier	PCB 426E01	43047
	Weather Anemometer	Vaisala WXT 520	L3020299

[1] Equipment deployed from September 19, 2019 to November 16, 2019.
[2] Equipment deployed from November 16, 2019 to January 11, 2020.
[3] Equipment deployed from September 19, 2019 to October 30, 2019.
[4] Equipment deployed from October 30, 2019 to January 11, 2020.

Equipment lab calibration follows the guidance provided in Section D2.3 of the Protocol for sound level meters and acoustic calibrators, and Section 6.3 of the IEC 61400-11 Edition 3.0 standard for weather anemometers.

The measurement chain was field calibrated before, during, and after the measurement campaign using a type 4231 Brüel & Kjær acoustic calibrator. Calibration certificates have been included in Appendix F.

5.2 Measurement Parameters

During the measurement campaign, acoustic and weather data were logged simultaneously in one-minute intervals.

Measured acoustic data includes A-weighted overall equivalent sound levels ("LA_{eq}"), 90th percentile statistical levels ("L_{90}")[3], and 1/3rd octave band levels between 20 Hz and 10,000 Hz (inclusive). Raw signal recordings were also stored for listening and post-processing. Measured weather data includes average wind direction, wind speed, temperature, relative humidity, and atmospheric pressure. The maximum and minimum wind speed for each one-minute interval was also stored.

To account for the effect of wind speed on the measured sound level, intervals are sorted into integer wind bins based on their measured 10-m AGL wind speeds. Each wind bin ranges from 0.5 m/s below to 0.5 m/s above each integer wind speed (i.e. the 5 m/s wind bin comprises all intervals having average wind speeds between 4.5 m/s and 5.5 m/s).

6 Assessment Methodology

6.1 Data Reduction and Filtering

Data reduction procedures have been employed to remove invalid and extraneous data points from the measured datasets to form a refined assessment dataset for each measurement location. Specific filters are described below.

For all measurement locations, a measurement interval is excluded if any of the following criteria are not satisfied:

- The interval occurred between 10pm – 5am
- No precipitation was detected within 60 minutes before or after the interval
- The ambient temperature was above -20˚C
- The measured LA_{eq} was no more than 6 dB greater than the L_{90} value

Significant extraneous transient events are often detectable by comparing the LA_{eq} with the L_{90} level for the same interval. At this location, if the measured L_{90} differed from the LA_{eq} by more than 6 dB, the interval was automatically excluded. If necessary, listening tests are conducted to identify contaminated intervals not excluded by the filters listed above.

In order to further reduce the ambient noise contribution from Highway 401, only periods from 12:00 AM - 05:00 AM were analysed. Elevated noise levels were observed at all monitor locations for both Total Noise and Background Noise periods between the 10:00 PM and 05:00 AM time period conventionally prescribed by the Protocol, when compared to the 12:00 AM – 5:00 AM time period used in this assessment. This follows the guidance

[3] L_{90} refers to the sound level that is exceeded for 90% of samples in the measurement interval.

from the Protocol to assess sound levels without extraneous ambient noise, with periods after 12:00 AM having a reduced degree of extraneous ambient noise.

6.2 Manual Exclusion of Data

The application of the filtering methodology outlined in the Protocol and summarized throughout Section 6.1 of this report results in a dataset with significantly less acoustic contamination than is present in the unfiltered dataset. Despite this, it has been found that these automatic filters are not always sufficient to remove all contaminated data intervals. In situations where contamination is suspected in the assessment dataset, listening tests were conducted on the audio recordings to confirm and, if possible, to identify the contamination. Intervals containing significant contamination are manually excluded from the assessment data. This follows the guidance from the Protocol to assess sound levels without extraneous ambient noise.

Data is also manually excluded if it is suspected that any of the measurement equipment is not functioning according to its specification, which may occur during extreme weather conditions such as freezing rain.

6.3 Exclusion of High-Frequency Data – Ambient Contamination

Steady acoustical contamination from nearby insects and wind-related noise is present in the measurement data at R1126, R1207, and R1170[4] at higher acoustical frequencies. Consequently, this high-frequency contamination was removed from the 1/3rd-Octave spectra of each measurement interval, per the guidance provided in Section D5.3 of the Protocol.

The exclusion of this high-frequency data allows for the assessment of measurement intervals which would otherwise be manually invalidated and does so while accounting for the acoustical impact of the relevant wind turbine facilities. The high frequency acoustical contribution from the relevant wind facilities is small – this is because high frequency sound is more easily absorbed by the atmosphere as it propagates across long distances.

The contribution from BRWPP as well as its neighbours at these excluded frequencies was predicted at the affected monitoring locations using the as-built turbine model and was found to be less than 11 dBA at all five (5) monitor locations. This contribution was then added logarithmically to the calculated Turbine-Only sound level at the affected monitor locations as an added measure of conservatism.

[4] Per Section 4.1.1, insect noise was not observed at R1469 nor R2299 during the Phase 2 audit period. Accordingly, no high-frequency data at these monitors were excluded.

6.4 Turbine Power & Wind Direction

Intervals that pass the filtering criteria listed above are sorted into Total Noise[5] or Background periods according to the conditions listed below. If neither Total Noise nor Background conditions are met, the data point is excluded.

- **Total Noise:** All facility turbines within 3 km must be rotating and generating power. The list of turbines within 3 km of a given measurement location is provided below:

Table 9: List of Turbines for Total Noise Condition

Measurement Location	Turbines within 3 km of a Measurement Location
R1126	T08, T11, T12, T14, T15, T20, T26, T30, T50, T51, T53, T62
R1207	T08, T11, T12, T20, T26, T28, T29, T30, T50, T51, T53, T62
R1170	T28, T29, T36, T38, T40, T44, T45, T46, T47, T48, T49, T53, T54, T55, T59
R1469	T26, T28, T29, T30, T36, T38, T40, T44, T45, T46, T47, T53, T54, T55
R2299	T201, T202, T205, T210, T211, T212, T213, T214, T215

- **Background:** Facility turbines must be parked and not generating power such that the predicted impact at the measurement location is less than 30 dBA. The list of turbines to be turned off to achieve this criterion is provided for each measurement location in the table below, in addition to the list of turbines which would achieve the background criterion at all five measurement locations simultaneously.

Table 10: List of Turbines for Background Condition

Measurement Location	Turbines to be parked to achieve <30 dBA at Measurement Location
All Receptors	T08, T11, T20, T26, T28, T29, T30, T36, T38, T40, T44, T45, T46, T47, T48, T49, T50, T51, T52, T53, T54, T55, T58, T59, T62, T202, T205, T210, T211, T212
R1126	T08, T11, T12, T20, T30, T50, T51, T62
R1207	T20, T26, T30, T51
R1170	T26, T28, T29, T30, T36, T38, T40, T44, T45, T46, T47, T48, T49, T51, T52, T53, T54, T55, T57, T58, T59
R1469	T20, T26, T28, T29, T30, T36, T38, T40, T44, T45, T46, T47, T51, T53, T54, T55
R2299	T202, T205, T210, T211, T212

[5] Total Noise refers to the measured sound level with the turbines running prior to the correction for Background sound (i.e. the total sound level of the turbines plus the ambient).

The Protocol also requires additional criteria be met by each Total Noise data point based on the conditions of the nearest turbine to each monitor location. Specifically,

> "*Only downwind data will be considered in the analysis. With reference to the Turbine location, downwind directions are ±45 degrees from the line of sight between the Turbine and receptor/measurement location.*" *{Section D5.2(4)}*

And

> *"Only data when the turbine's electrical output sound power level is approximately equal to or greater than 85% of its rated electrical power output should be included in the analysis. In addition, the turbine should also be operating at approximately 90% or more of its maximum sound power level; (percentage based on energy/logarithmic calculation)." {Section D5.2(5)}*

In situations where the ambient sound level at a monitor location is heavily influenced by the wind direction, a filter is applied to ensure that the Background measurement conditions are representative of those encountered during Total Noise intervals. This was found to be the case at all five (5) measurement locations, which are located to the north of Ontario Highway 401. As such, a downwind filter was applied to the Background dataset to match the Total Noise measurement conditions, which are also filtered for downwind only in accordance with the Protocol.

Based on the E-Audit test results at BRWPP, the project turbines reach 90% of their maximum measured sound power level at a power output significantly below that which corresponds to 85% of the turbine's rated electrical power. Further to this, the power output corresponding to the maximum sound power level is also below that which corresponds to 85% of rated electrical power for all four turbine variants at BRWPP. For these reasons, using the 85% turbine power threshold alone will not effectively capture the worst-case impact at BRWPP, which was found to occur at an operating condition which corresponds to a lower power output.

For this reason, as a conservative measure, the 90% sound power condition has been selected to determine the power threshold corresponding to the worst-case impact from the turbine-type closest to each measurement location. Table 11 provides, for each audit location, the closest turbine and its rated power output, as well as the power output corresponding to the 90% sound power condition for the turbine of the same type. This is the power threshold that has been used for filtering this dataset. Details regarding the measured sound power levels of the BRWPP turbines and the 90% sound power calculations are included in Appendix G.

Table 11: 90% Sound Power Criterion for BRWPP Audit Receptors

Audit Location	Closest Turbine	Rated Power Output of Closest Turbine [MW]	BRWPP E-Test Turbine of Same Type	Power Output Corresponding to 90% Sound Power [MW]
R1126	T50	2.37	T40	1.114[1]
R1207	T20			1.114[1]
R1170	T40			1.114[1]
R1469	T29			1.114[1]
R2299	T202	2.772	T53	1.581[2]

[1] Based on the E-test conducted at T40 [6]
[2] Based on the E-test conducted at T53 [7]

6.5 Sample Size Requirements

Section D3.8 of the Protocol requires at least 120 Total Noise intervals and 60 Background intervals in a wind bin for that bin to be deemed complete.

RAM-I analysis, described in Section E5.5 of the Protocol, is employed in cases where insufficient data is collected after an extended monitoring campaign lasting 6-weeks or more. The BRWPP Phase 1 campaign lasted longer than 6-weeks at all monitors and therefore RAM-I analysis was applied. The RAM-I methodologies used in this assessment, in addition to those already mentioned are detailed below. Further details regarding the data analysis methodology are provided in Section 9.1.

Section E5.5(1)

The range of wind bins which may be used to assess compliance is expanded to include a minimum of one of the following conditions:

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)"*

Section E5.5(5)

The RAM-I assessment methodology relaxes the sample size requirements, stating:

> "*The Ministry may accept a reduced number of data points for each wind speed bin with appropriate justification. […] The acceptable number of data points will be influenced by the quality of the data (standard deviation)"*

The threshold of 60 data points for Total Noise measurements and 30 data points for Background measurements is used in this assessment.

6.6 Turbine Operating Conditions

Wind facility SCADA information was provided for the duration of the measurement campaign by the Belle River Wind Power Project. This data was used to verify that the BRWPP wind turbines were operational for Total Noise intervals and parked for Background intervals. The turbine operating conditions were verified by the BRWPP for the duration of the campaign; see Appendix D.

6.7 Contribution from Adjacent Wind Facilities

The nearest wind facility to BRWPP is Pointe-Aux-Roches Wind Farm followed by the Comber Wind Farm. The closest PARWF turbine to a monitoring location is Turbine T220, 2.1 km to the north of monitor R1170. The closest CWF turbine to a monitoring location is Turbine T48, 3.1 km to the southeast of monitor R1126. At these distances, sound impact from both CWF and PARWF is considered to be negligible and thus no contributions from adjacent wind facilities were considered in this study.

7 Sound Level Limits

Sound level limits are set by the MECP and vary based on the classification of the surrounding acoustic environment as well as the measured background sound level (if available). The area surrounding the facility has been deemed in the original Noise Assessment Report to be Class III, having exclusion limits based on 10-m AGL wind speed as noted in Table 12 below.

Table 12: MECP Sound Level Limits for Wind Turbines

Wind speed at 10m height [m/s]	MECP Sound level limit [dBA]
≤ 6	40
7	43

Sections D3.5 and D6 of the Protocol state that in wind bins where the measured background sound levels are greater than the applicable exclusion limits, the sound level limit for that wind bin is the background sound level without extraneous noise sources. In effect, the exclusion limits outline the minimum sound level limit by wind bin, with increases in sound level limit permissible if it can be shown through measurements that the existing background sound level is higher than the exclusion limit. Any complete wind bins where the measured background sound level exceeded the exclusion limit are noted in Table 15.

8 Audit Results

Acoustic and weather data measured during the I-audit campaign are summarized in the following section.

8.1 Weather Conditions

General weather conditions observed in the assessment dataset during the Phase 1 I-audit are summarized in Table 13 for each measurement location.

Table 13: General Weather Conditions – Range of Measured Values

			10-m AGL			*Hub height*
Measurement Location	Minimum or Maximum Value	Atmospheric Pressure [hPa]	Wind Speed [m/s]	Relative Humidity [%]	Temperature [°C]	Wind speed [m/s]
R1126	Minimum	976	2.0	51	-6.8	5.5
	Maximum	1004	11.0	89	21.5	16.3
R1207	Minimum	976	2.1	52	-10.5	5.1
	Maximum	1005	12.1	87	23.3	16.7
R1170	Minimum	976	1.6	50	-6.8	5.7
	Maximum	1004	11.0	85	23.0	16.3
R1469	Minimum	979	1.0	42	-13.0	5.2
	Maximum	1012	12	87	9.7	18.8
R2299	Minimum	979	3.0	41	-11.7	5.2
	Maximum	1005	12	92	15.0	17.3

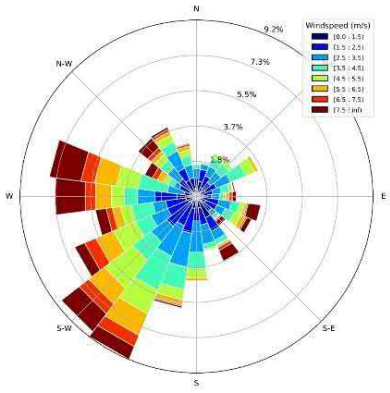
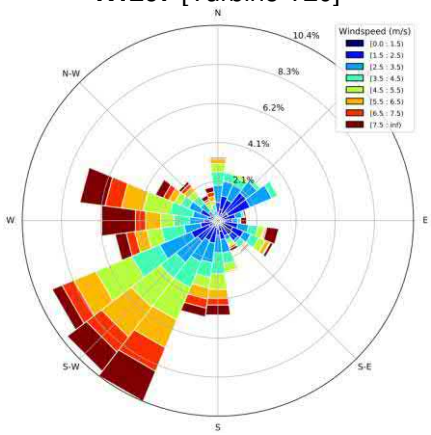
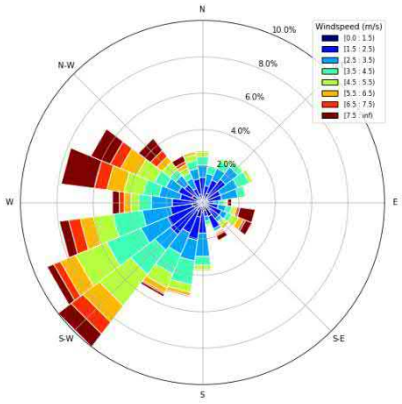
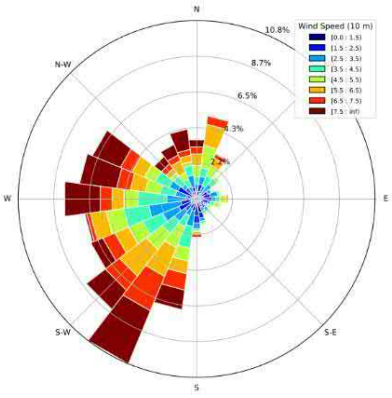
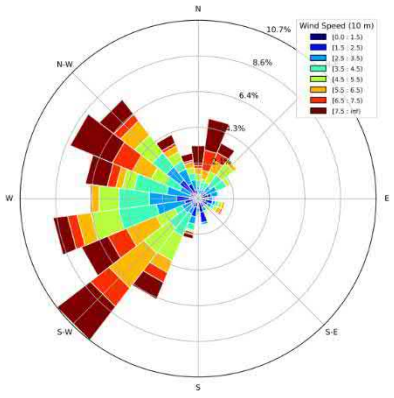
8.2 Wind Direction

A wind rose was created for each measurement location using the yaw angle from the nearest wind turbine and the wind speeds from the 10-m AGL anemometer. As noted in Section 6.5 of this report, RAM-I methodology is being used, and thus all wind speeds from 1-7 m/s 10-m AGL can be used in the assessment.

The wind rose measured across the audit duration at each audit location is provided in Table 14. It is noted that the wind roses for R1469 and R2299 differ from those of R1126, R1207, and R1170 and illustrate a higher prevalence of strong south-westerly winds. This is likely a result of the noise audit at R1469 and R2299 being conducted at a different time of year than the other three (3) audit locations, as per Table 7. The distribution of wind directions observed during the measurement campaign roughly agrees with the historical wind rose (see Section 3.1.1), especially considering that the historical wind rose in Figure 1 is based on hub-height wind speeds, and is filtered for 10 m/s and greater.

Supplementary wind roses for the specific valid Total Noise and Background datasets are included in Appendix E.

Table 14: Measured Wind Rose for all Measurement Locations

<table>
<tr>
<td>
Windspeed (m/s)
[0.0 - 1.5)
[1.5 - 2.5)
[2.5 - 3.5)
[3.5 - 4.5)
[4.5 - 5.5)
[5.5 - 6.5)
[6.5 - 7.5)
[7.5-INF]
Note: The turbine from which the yaw angle information was taken is indicated in brackets for each measurement location.
</td>
<td>
R1126 [Turbine T50]

</td>
</tr>
<tr>
<td>
R1207 [Turbine T20]

</td>
<td>
R1170 [Turbine T40]

</td>
</tr>
<tr>
<td>
R1469 [Turbine T29]

</td>
<td>
R2299 [Turbine T202]

</td>
</tr>
</table>

8.3 **Sound Levels**

Table 15 presents the average measured sound levels at monitor each of the five (5) BRWPP I-Audit measurement locations. Results are separated by wind bin into Total Noise and Background periods.

Table 15: Average Measured Sound Levels at Audit Measurement Locations, RAM-I Analysis

Receptor	Period	Measurement Parameter	I-audit Wind Bins (m/s)						
			1	2	3	4	5	6	7
R1126	*Total Noise*	Number of Samples	0	4	16	124	421	297	150
		Average LAeq [dBA]	-	-	-	41.6	42.2	43.1	45.1
		Standard Deviation [dB]	-	-	-	1.1	1.2	1.3	1.5
	Background	Number of Samples	0	0	21	81	100	102	27
		Average LAeq [dBA]	-	-	-	39.4	40.0	41.3	44.1
		Standard Deviation [dB]	-	-	-	1.9	2.3	2.2	1.2
R1207	*Total Noise*	Number of Samples	0	1	118	513	837	710	332
		Average LAeq [dBA]	-	-	41.0	41.2	41.1	41.8	43.8
		Standard Deviation [dB]	-	-	1.2	1.3	1.5	1.4	1.7
	Background	Number of Samples	0	0	2	67	131	99	49
		Average LAeq [dBA]	-	-	-	35.7	36.3	38.2	40.6
		Standard Deviation [dB]	-	-	-	3.0	2.3	1.9	1.6
R1170	*Total Noise*	Number of Samples	0	53	250	784	780	433	303
		Average LAeq [dBA]	-	41.2	40.8	41.1	41.7	42.8	45.5
		Standard Deviation [dB]	-	1.2	1.2	1.0	1.1	1.2	1.5
	Background	Number of Samples	0	0	26	167	133	58	28
		Average LAeq [dBA]	-	-	36.6	37.5	38.4	41.2	44.6
		Standard Deviation [dB]	-	-	2.9	2.1	2.0	1.5	1.2
R1469	*Total Noise*	Number of Samples	1	5	17	152	437	562	514
		Average LAeq [dBA]	-	-	-	37.3	38.2	39.9	42.2
		Standard Deviation [dB]	-	-	-	1.3	1.4	1.4	1.6
	Background	Number of Samples	0	0	2	10	13	95	52
		Average LAeq [dBA]	-	-	-	30.0†	30.0†	37.9	41.7
		Standard Deviation [dB]	-	-	-	-	-	2.1	1.9
R2299	*Total Noise*	Number of Samples	0	0	3	104	395	569	392
		Average LAeq [dBA]	-	-	-	41.9	42.2	42.4	44.1
		Standard Deviation [dB]	-	-	-	1.7	2.1	1.5	1.5
	Background	Number of Samples	0	0	0	3	48	101	40
		Average LAeq [dBA]	-	-	-	-	40.2	40.7	43.9
		Standard Deviation [dB]	-	-	-	-	2.3	2.3	1.8

"-" *Significantly* fewer than the minimum data counts outlined in 6.5 were attained in this wind bin.
† An assumed ambient sound level of 30 dBA has been used according to Section E5.5.6 of the Protocol. This conservative methodology is being applied to satisfy the minimum data count requirements outlined in Section E5.5.1 of the Protocol.

Visualizations of the assessment datasets for each measurement location are presented in Figure 2 through Figure 6 below.

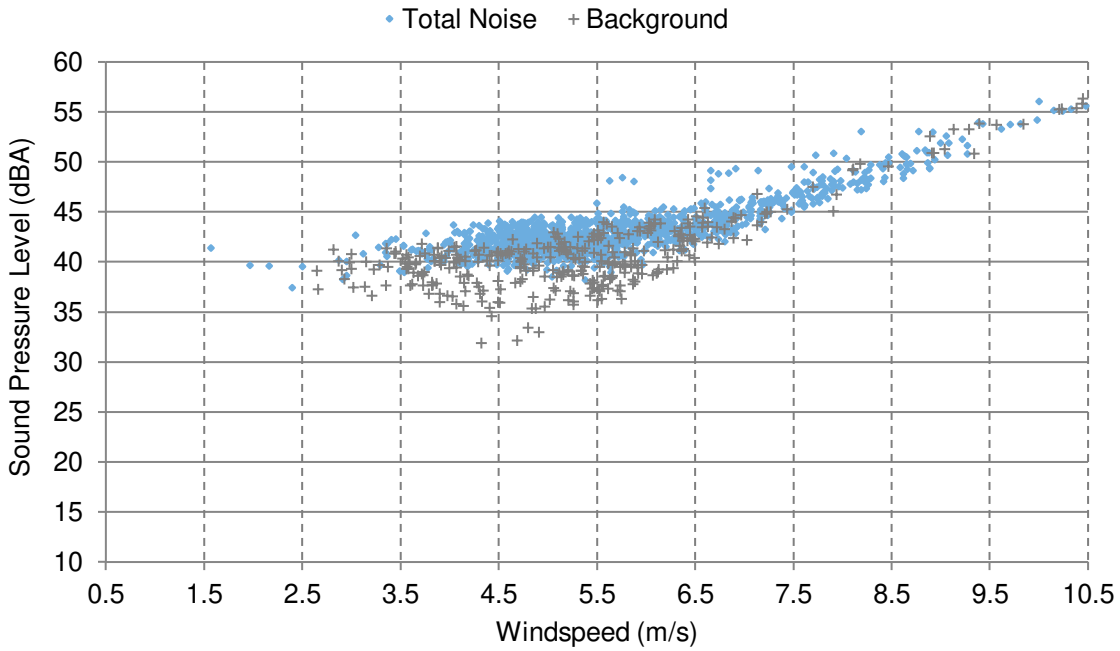


Figure 2: R1126 - Measured Sound Levels for Total Noise and Background vs Wind Speed

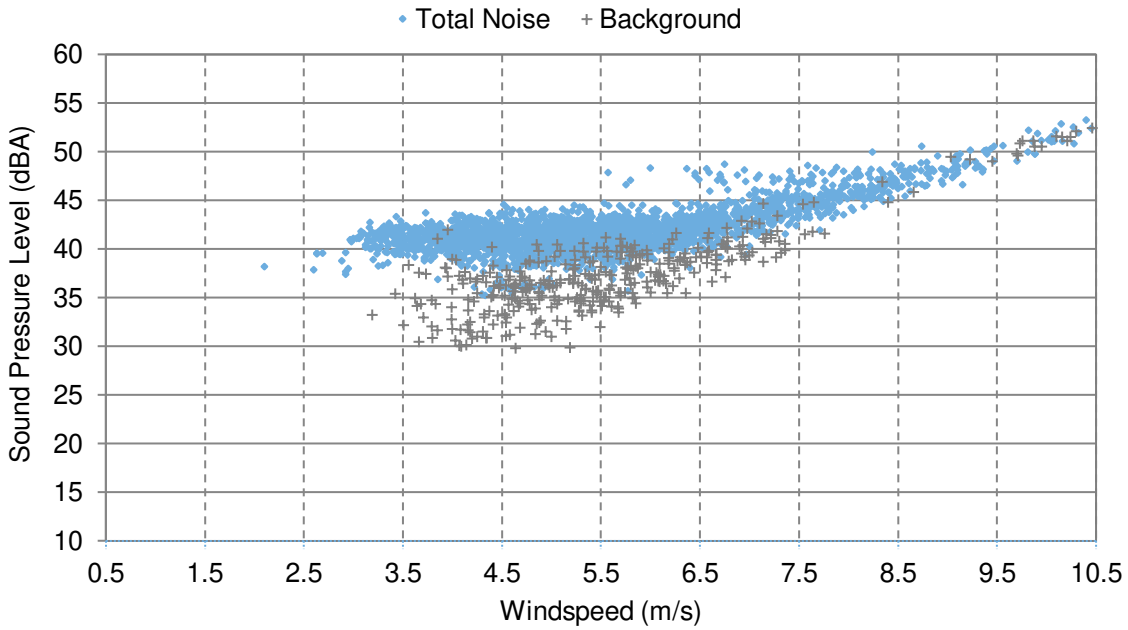


Figure 3: R1207 - Measured Sound Levels for Total Noise and Background vs Wind Speed

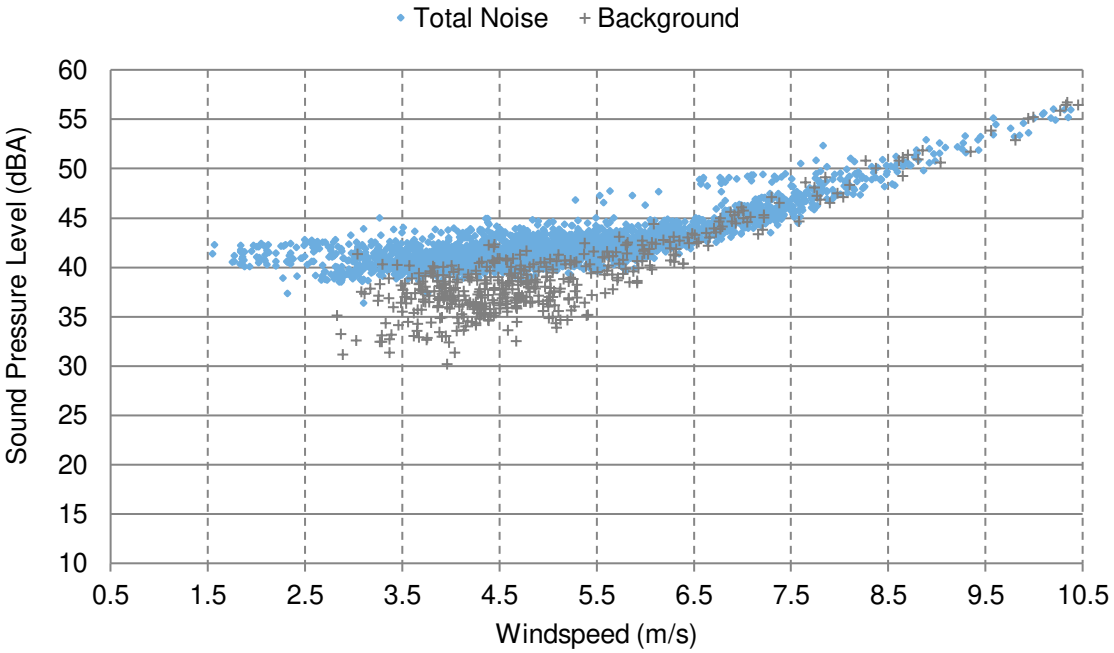


Figure 4: R1170 - Measured Sound Levels for Total Noise and Background vs Wind Speed

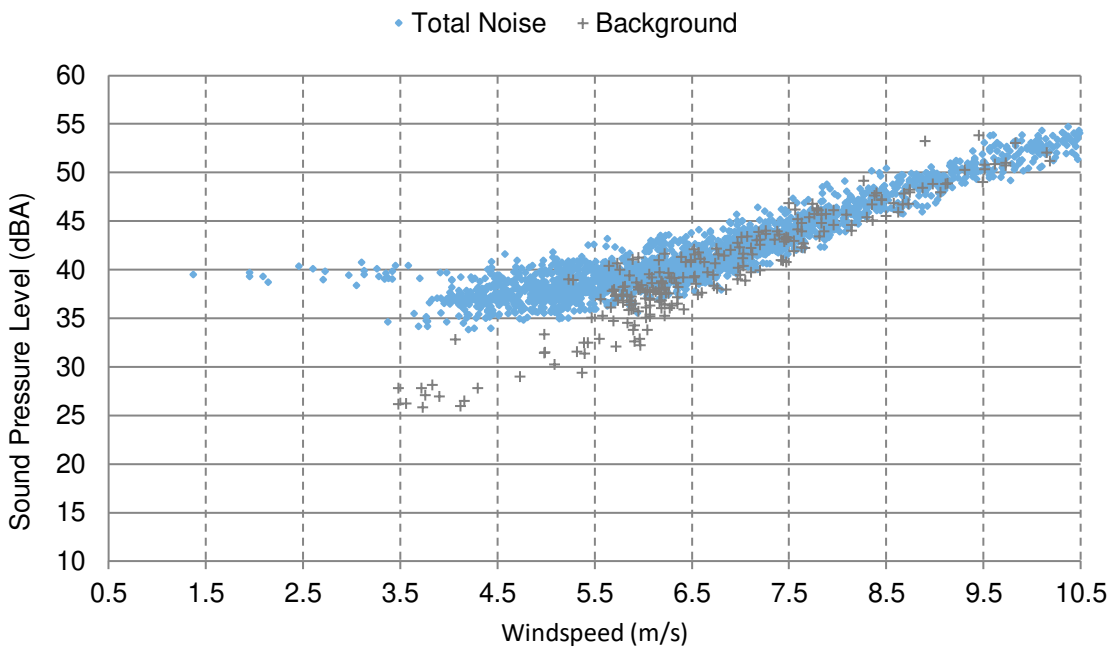


Figure 5: R1469 - Measured Sound Levels for Total Noise and Background vs Wind Speed

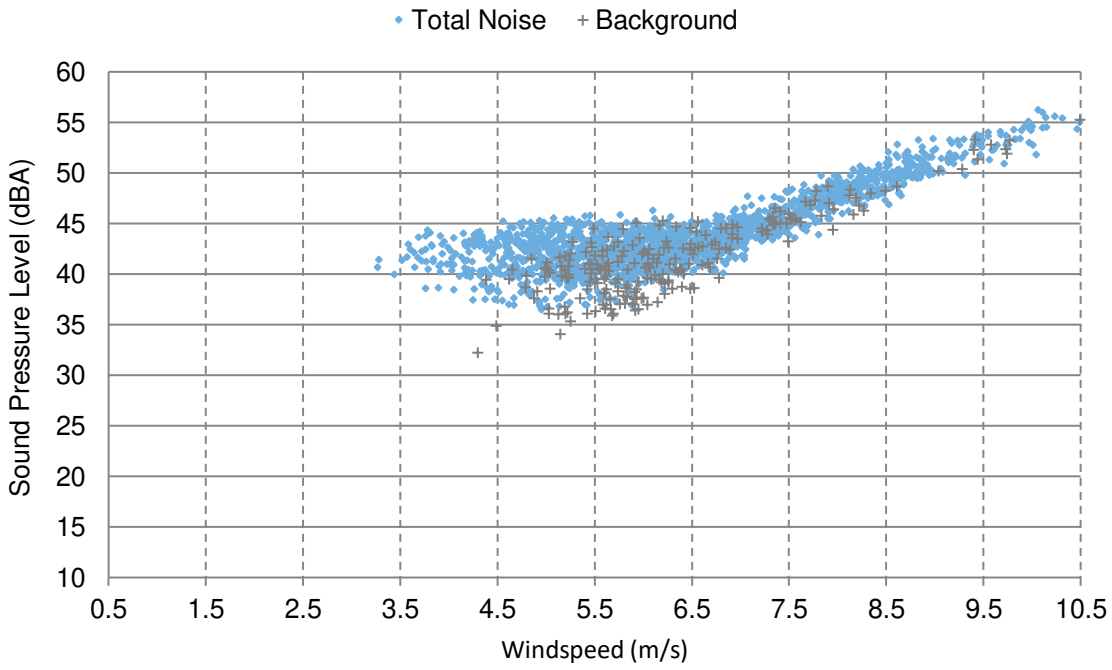


Figure 6: R2299 - Measured Sound Levels for Total Noise and Background vs Wind Speed

9 Discussion

9.1 Analysis Methodology

Interpretation and discussion of the measured sound levels are provided in this section.

9.2 Effect of Filtering

The measurement data was assessed according to Part D of the Protocol with the incorporation of the RAM-I data reduction methodology per Section E5.5 of the Protocol. The effect of each filter on the measurement datasets, as well as the total portion of measurement data excluded from the assessment data, are summarized in Table 16.

Table 16: Effect of Data Filtering on Measurement Dataset

	% Data Excluded				
Data Filter	R1126	R1207	R1170	R1469	R2299
Turbine Power Threshold	82%	77%	78%	70%	80%
Wind Direction	59%	52%	55%	62%	62%
Rain	15%	11%	14%	9%	8%
Temperature	0%	0%	0%	0%	0%
Wind Gust	0%	0%	0%	0%	0%
Transient Contamination	18%	9%	5%	11%	6%
Excluded from Total Noise	98%	95%	96%	96%	97%

Table 16 illustrates the proportion of measurement time during the campaign that did not meet the criteria for worst-case noise impact at each receptor. Data not excluded by automatic or manual filters are used in the assessment of compliance. It is important to note that the data remaining after these filters are applied represents the times when the turbines were generating high power output in a downwind condition without significant transient contamination or inclement environmental conditions (such as rain or low temperature). In other words, this remaining data represents the portion of time that the immission impact from the facility is at its highest for the given monitor location.

10 Assessment of Compliance

The following section presents an assessment of compliance for the BRWPP based on the results of the Phase 1 Immission Audit.

10.1 Tonality Assessment

The tonality analysis results of the Emission audit measurements for T52 [4], T44 [5], T40 [6] and T53 [7] were used as a basis for tones at receptors which were likely to have been generated by the closest turbine rather than an external source.

Based on discussions with Belle River Wind LP., it was determined that to be consistent with Sections 3.8.3 and Section 5.1 of the Compliance protocol, the tonal assessment should be completed using IEC 61400-11 Ed. 3.0, with modifications to adapt the method to immission measurements and the tonal penalty structure taken from ISO 1996-2:2007 Annex C. Namely, Section 5.1 of the compliance protocol states:

> *"If a tonal assessment … indicates a tonal audibility value that exceeds 4 dB, the Ministry will require that a tonal penalty be applied at all Receptors in accordance with the penalties described in Annex C of ISO 1996-2, Reference [2]"{Section D5.1}*

For the tonal assessment, narrowband data was acquired and calculated for each 1-minute interval used in the immission analysis and binned by wind speed. Each minute was analysed in order to detect any tones with tonal audibility values greater than -3 dB at any of the assessed frequencies. Similar to the methodology in IEC 61400-11, a tone would have to be present in at least 20% of the valid measurement intervals to be classified as relevant. This reduces the possibility of intermittent tones related to either the unsteady operation of the turbines, or from other contaminating sources, being attributed to the steady state operation of the turbines. The tonal audibility (L_{ta}) for the most prominent tones in each wind bin were then evaluated to determine if a tonal penalty would be applicable. The penalty structure was taken from ISO1996-2 Annex C: namely that the tonal penalty would be a positive number between 0 dB and 6 dB based on the degree of tonal audibility of the worst-case tone. A tonal penalty is calculated as L_{ta} - 4 dB i.e. a tonal audibility of 6.5 would incur a penalty of 2.5 dBA on the overall Turbine Only level.

A 62 Hz and 78 Hz tone were observed to occasionally be present at receptor all measurement locations, however these tones were not prevalent enough nor prominent enough for a tonal penalty to be applicable. A tonal assessment summary table is provided in Appendix E for each measurement location.

No tonal penalty was found to be applicable at any of the five (5) measurement locations based on detailed tonal audibility analysis.

10.2 **Assessment Tables**

Cumulative Turbine-Only sound levels are presented in the table below for each audit location. The cumulative noise impact in the table is calculated using the data presented in Table 15. Wind bins having insufficient data with which to determine the cumulative sound impact are marked with a "-". The signal-to-noise for each complete wind bin is also presented. The *Cumulative Sound Impact* is the difference between the average Total Noise and Background sound levels from Table 15, unless otherwise noted.

Table 17: R1126 Assessment Table – Cumulative Turbine-only Sound Impact

Audited Receptor	Wind speed at 10-m AGL [m/s]	1	2	3	4	5	6	7
R1126	Cumulative Sound Impact - Receptor Location [dBA]	-	-	-	38	38	38	38
	Signal-to-noise [dB]	-	-	-	2.2†	2.2†	1.8†	1.0†
Background Sound Level [dBA]		-	-	-	39	40	41*	44*
MECP Exclusion Limit [dBA]		40	40	40	40	40	40	43
Compliance? (Y/N)		-	-	-	Y	Y	Y	Y‡

"-" Significantly fewer than the minimum data counts (60 Total Noise / 30 Background) were attained in this wind bin.

* Background sound level is greater than the applicable exclusion limit.

† Signal-to-noise level less than 3 dB (see Table 15). Increased uncertainty in the determination of the Cumulative Sound Impact.

‡ Per Table 15, Background Noise data counts are deficient from the required count of 30 by 3 points in the 7 m/s wind bin. A significant amount of data is available in this wind bin, however, and so the sound levels have been reported and included in the assessment of compliance.

Table 18: R1207 Assessment Table – Cumulative Turbine-only Sound Impact

Audited Receptor	Wind speed at 10-m AGL [m/s]	1	2	3	4	5	6	7
R1207	Cumulative Sound Impact - Receptor Location [dBA]	-	-	-	40	39	39	41
	Signal-to-noise [dB]	-	-	-	5.5	4.7	3.7	3.2
Background Sound Level [dBA]		-	-	-	36	36	38	41
MECP Exclusion Limit [dBA]		40	40	40	40	40	40	43
Compliance? (Y/N)		-	-	-	Y	Y	Y	Y

"-" Significantly fewer than the minimum data counts (60 Total Noise / 30 Background) were attained in this wind bin.

Table 19: R1170 Assessment Table – Cumulative Turbine-only Sound Impact

Audited Receptor	Wind speed at 10-m AGL [m/s]	1	2	3	4	5	6	7
R1170	Cumulative Sound Impact - Receptor Location [dBA]	-	-	39	39	39	38	38
	Signal-to-noise [dB]	-	-	4.2	3.6	3.4	1.6†	0.9†
Background Sound Level [dBA]		-	-	37	38	38	41*	45*
MECP Exclusion Limit [dBA]		40	40	40	40	40	40	43
Compliance? (Y/N)		-	-	Y‡	Y	Y	Y	Y‡

"-" Significantly fewer than the minimum data counts (60 Total Noise / 30 Background) were attained in this wind bin.

* Background sound level is greater than the applicable exclusion limit.

† Signal-to-noise level less than 3 dB (see Table 15). Increased uncertainty in the determination of the Cumulative Sound Impact.

‡ Per Table 15, Background Noise data counts are deficient from the required count of 30 by 4 in the 3 m/s wind bin, and by 2 in the 7 m/s wind bin. A significant amount of data is available in these wind bins, however, and so the sound levels have been reported and included in the assessment of compliance.

Table 20: R1469 Assessment Table – Cumulative Turbine-only Sound Impact

Audited Receptor	Wind speed at 10-m AGL [m/s]	1	2	3	4	5	6	7
R1469	Cumulative Sound Impact - Receptor Location [dBA]	-	-	-	36	38	36	33
	Signal-to-noise [dB]	-	-	-	7.3	8.2	2.0†	0.5†
Background Sound Level [dBA]		-	-	-	30‡	30‡	38	42
MECP Exclusion Limit [dBA]		40	40	40	40	40	40	43
Compliance? (Y/N)		-	-	-	Y	Y	Y	Y

"-" Significantly fewer than the minimum data counts (60 Total Noise / 30 Background) were attained in this wind bin.

† Signal-to-noise level less than 3 dB (see Table 15). Increased uncertainty in the determination of the Cumulative Sound Impact.

‡ An assumed ambient sound level of 30 dBA has been used according to Section E5.5.6 of the Protocol. This conservative methodology is being applied to satisfy the minimum data count requirements outlined in Section E5.5.1 of the Protocol.

Table 21: R2299 Assessment Table – Cumulative Turbine-only Sound Impact

Audited Receptor	Wind speed at 10-m AGL [m/s]	1	2	3	4	5	6	7
R2299	Cumulative Sound Impact - Receptor Location [dBA]	-	-	-	-	38	37	32
	Signal-to-noise [dB]	-	-	-	-	2.1†	1.6†	0.2†
Background Sound Level [dBA]		-	-	-	-	40	41*	44*
MECP Exclusion Limit [dBA]		40	40	40	40	40	40	43
Compliance? (Y/N)		-	-	-	-	Y	Y	Y

"-" Significantly fewer than the minimum data counts (60 Total Noise / 30 Background) were attained in this wind bin.

* Background sound level is greater than the applicable exclusion limit.

† Signal-to-noise level less than 3 dB (see Table 15). Increased uncertainty in the determination of the Cumulative Sound Impact.

10.3 **Assessment of Compliance**

Based on the results presented in Section 10.2, the cumulative sound impact calculated at all five (5) measurement locations complies with the MECP sound level limits at all wind bins having sufficient data for assessment.

11 Conclusion

Aercoustics Engineering Limited has completed the Phase 2 immission audit outlined in Condition E the Renewable Energy Approval #2765-A4ER2P for the Belle River Wind Power Project. Testing was conducted in accordance with the methodology outlined in Part D and Part E of the MECP Compliance Protocol for Wind Turbine Noise. Compliance has been demonstrated at all five (5) audit locations.

12 References

[1] M. Keyvani, P.Eng., "Renewable Energy Approval #2765-A4ER2P", Ontario Ministry of the Environment, Toronto, ON, January 13, 2016.

[2] Ministry of the Environment and Climate Change, *"Compliance Protocol for Wind Turbine Noise"*, Ontario Ministry of the Environment, Toronto, ON, April 21, 2017.

[3] S. Dokouzian, A. Nercessian and A. Danaitis, "Belle River Wind Project Renewable Energy Approval Application – Noise Impact Assessment" DNV-GL, Ottawa, ON, November 27, 2015.

[4] P. Ashtiani, A. Denison and S. Sanchez, "Belle River Wind Power Project – Turbine T52 – IEC 61400-11 Edition 3.0 Measurement Report", Aercoustics Engineering Ltd., Mississauga, ON, 4 January 2019.

[5] P. Ashtiani, A. Denison and N. Tam, "Belle River Wind Power Project – Turbine T44 – IEC 61400-11 Edition 3.0 Measurement Report", Aercoustics Engineering Ltd., Mississauga, ON, 21 May 2019.

[6] P. Ashtiani, A. Denison and A. Davidson, "Belle River Wind Power Project – Turbine T40 – IEC 61400-11 Edition 3.0 Measurement Report", Aercoustics Engineering Ltd., Mississauga, ON, 26 November 2018.

[7] P. Ashtiani, A. Denison and A. Davidson, "Belle River Wind Power Project – Turbine T53 – IEC 61400-11 Edition 3.0 Measurement Report", Aercoustics Engineering Ltd., Mississauga, ON, 21 May 2019.

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Appendix A
Location Details



Legend

- Rail Line
- Ontario HWY 401
- Receptor Locations
- Campaign Monitor
- De-Selected Monitor

Belle River Turbines

- Turbines Not Built
- Turbines Built
- Transformer

Third Party Turbines

- Comber
- Comber Transformer
- PAR
- PAR Transformer

N

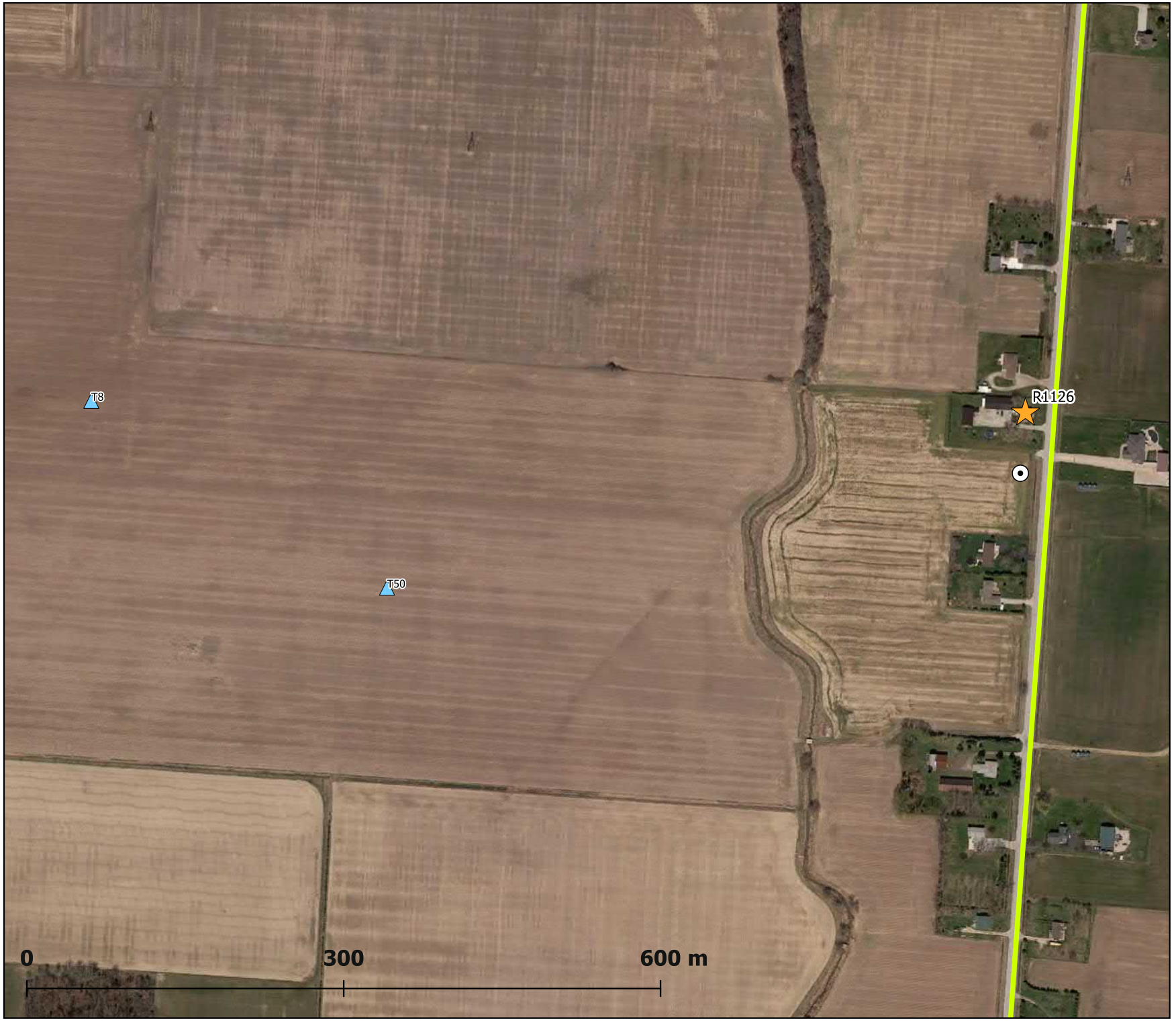
Project ID:	17095.01
Drawn by:	MWJ
Reveiwed by:	KC
Date:	Aug 5, 2020
Revision:	1
Scale:	As Indicated

Belle River Wind Power Project
Phase 2 I-Audit Report

Appendix A.1

Site Plan Overview

aercoustics



Legend

- Campaign Receptor
- Turbines - Built
- Monitor Locations
- Myers Rd

N

Project ID:	17095.01
Drawn by:	MWJ
Reveiwed by:	KC
Date:	Aug 5, 2020
Revision:	1
Scale:	As Indicated

Belle River Wind Power Project
Phase 2 I-Audit Report

Appendix A.2.i

R1126
Monitor and Receptor Location

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Project ID:	17095.01
Drawn by:	MWJ
Reveiwed by:	KC
Date:	Aug 5, 2020
Revision:	1
Scale:	NA

Belle River Wind Power Project
Phase 2 I-Audit Report

Appendix A.2.ii

R1126
Monitor to T50

aercoustics



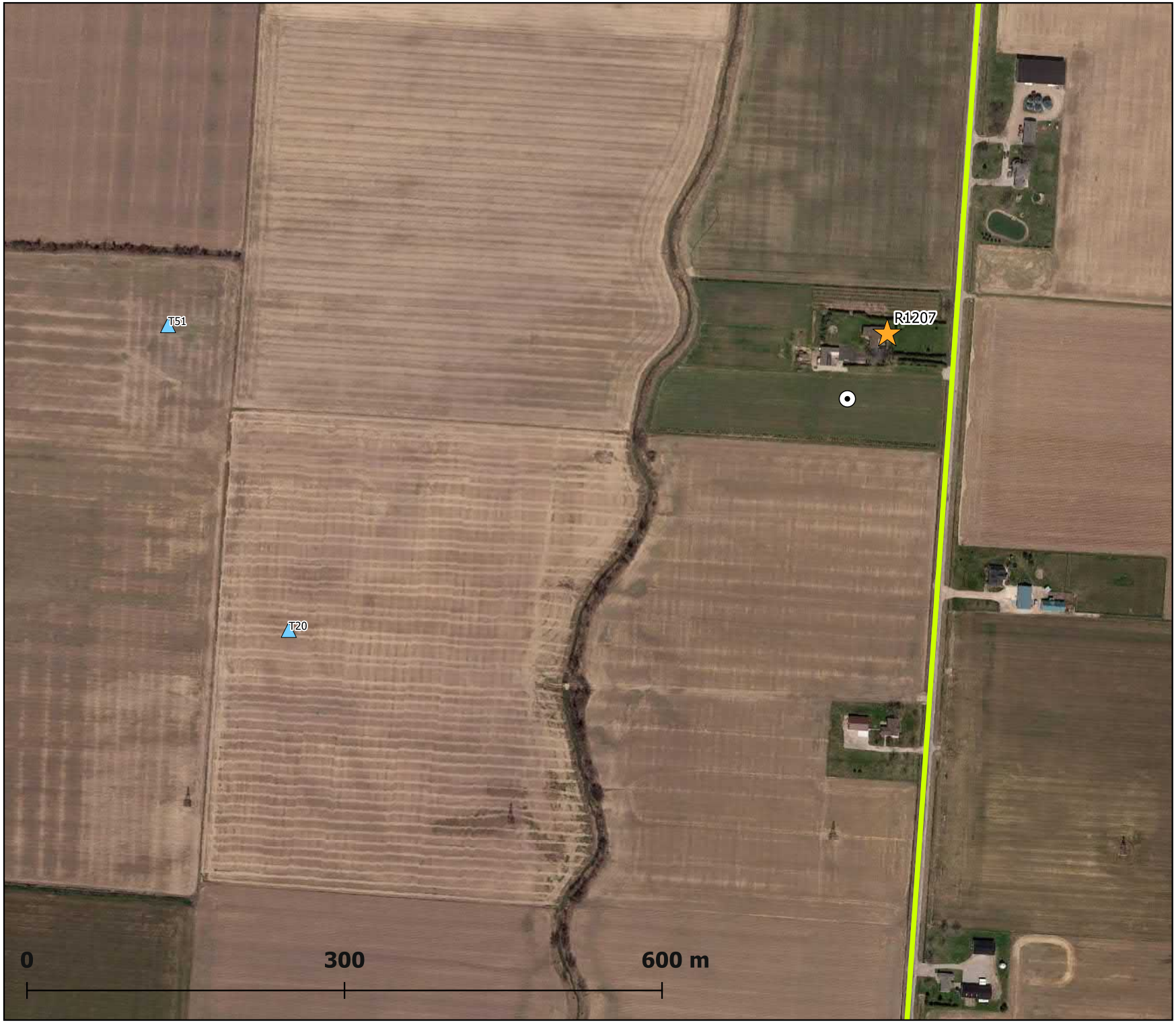
Project ID:	17095.01
Drawn by:	MWJ
Reveiwed by:	KC
Date:	Aug 5, 2020
Revision:	1
Scale:	NA

Belle River Wind Power Project
Phase 2 I-Audit Report

Appendix A.2.iii

R1126
Monitor to Receptor

aercoustics



Legend

- Campaign Receptor
- Turbines - Built
- Monitor Locations
- Lakeshore Rd 123

N

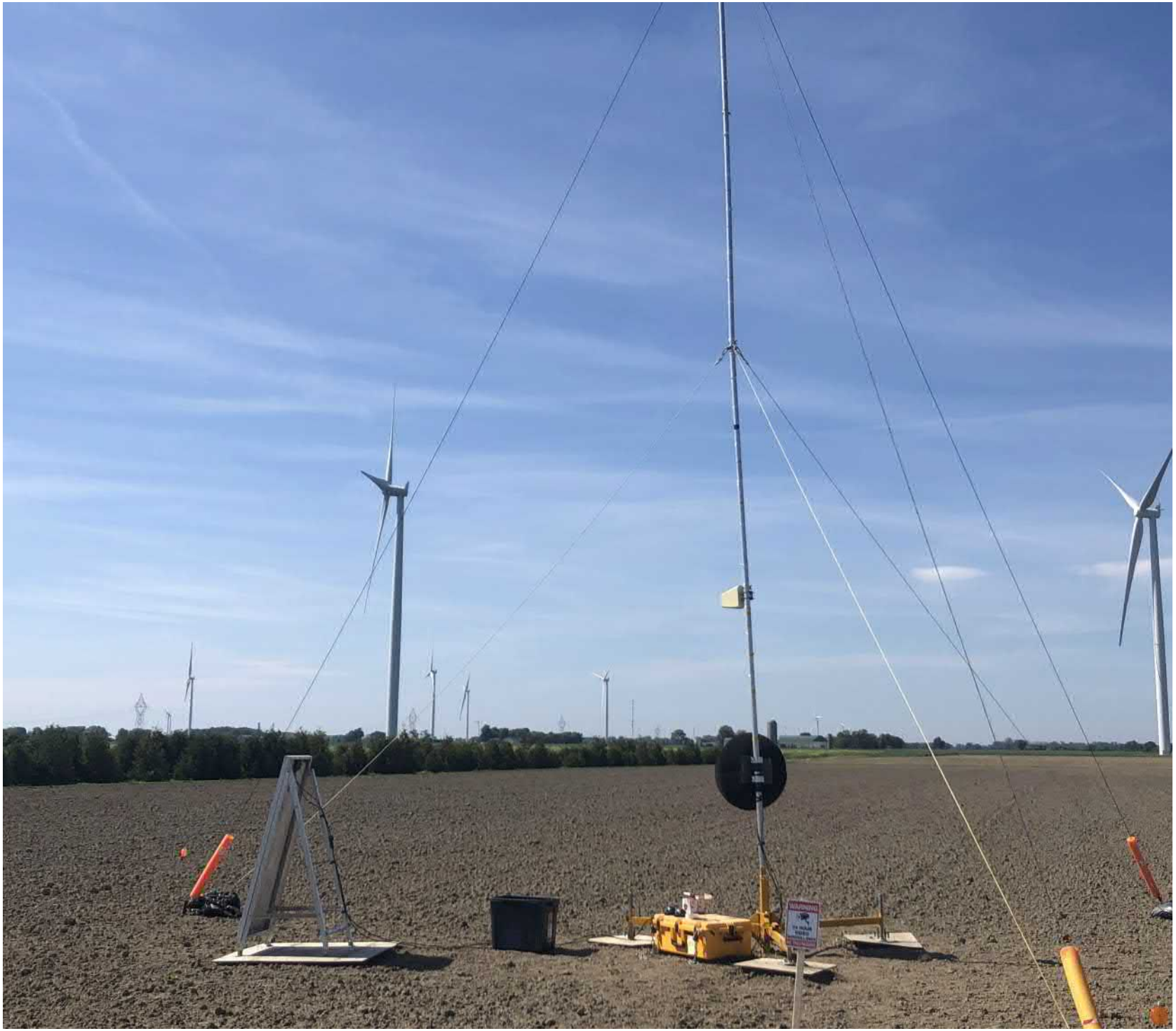
Project ID:	17095.01
Drawn by:	MWJ
Reveiwed by:	KC
Date:	Aug 5, 2020
Revision:	1
Scale:	As Indicated

Belle River Wind Power Project
Phase 2 I-Audit Report

Appendix A.3.i

R1207
Monitor and Receptor Location

aercoustics



Project ID:	17095.01
Drawn by:	MWJ
Reveiwed by:	KC
Date:	Aug 5, 2020
Revision:	1
Scale:	NA

Belle River Wind Power Project
Phase 2 I-Audit Report

Appendix A.3.ii

R1207
Monitor to T20

aercoustics



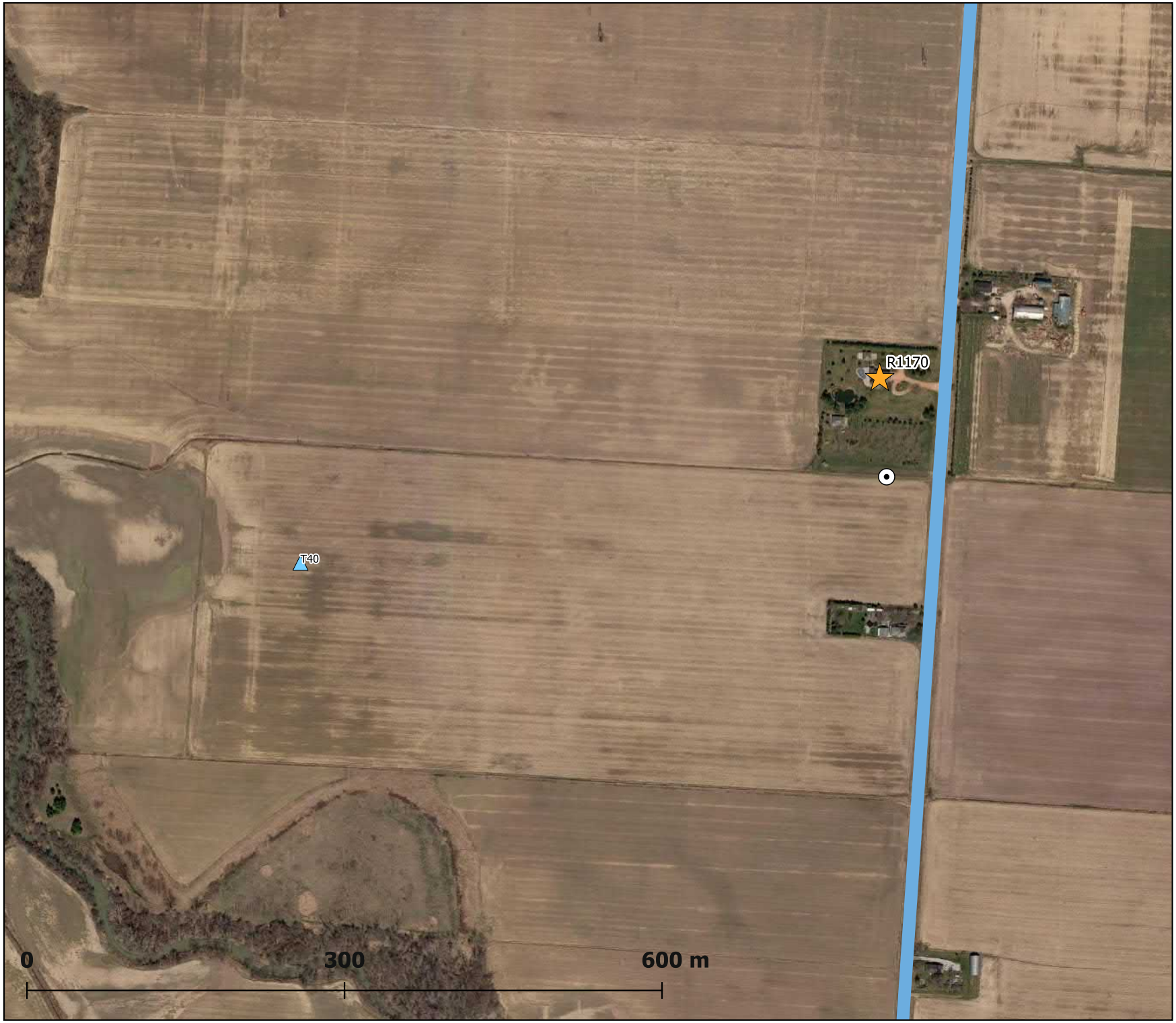
Project ID:	17095.01
Drawn by:	MWJ
Reveiwed by:	KC
Date:	Aug 5, 2020
Revision:	1
Scale:	NA

Belle River Wind Power Project
Phase 2 I-Audit Report

Appendix A.3.iii

R1207
Monitor to Receptor

aercoustics



Legend

- Campaign Receptor
- Turbines - Built
- Monitor Locations
- Lakeshore Rd 129

N

Project ID:	17095.01
Drawn by:	MWJ
Reveiwed by:	KC
Date:	Aug 5, 2020
Revision:	1
Scale:	As Indicated

Belle River Wind Power Project
Phase 2 I-Audit Report

Appendix A.4.i

R1170
Monitor and Receptor Location

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Project ID:	17095.01
Drawn by:	MWJ
Reveiwed by:	KC
Date:	Aug 5, 2020
Revision:	1
Scale:	NA

Belle River Wind Power Project
Phase 2 I-Audit Report

Appendix A.4.ii

R1170
Monitor to T40

aercoustics



Project ID:	17095.01
Drawn by:	MWJ
Reveiwed by:	KC
Date:	Aug 5, 2020
Revision:	1
Scale:	NA

Belle River Wind Power Project
Phase 2 I-Audit Report

Appendix A.4.iii

R1170
Monitor to Receptor

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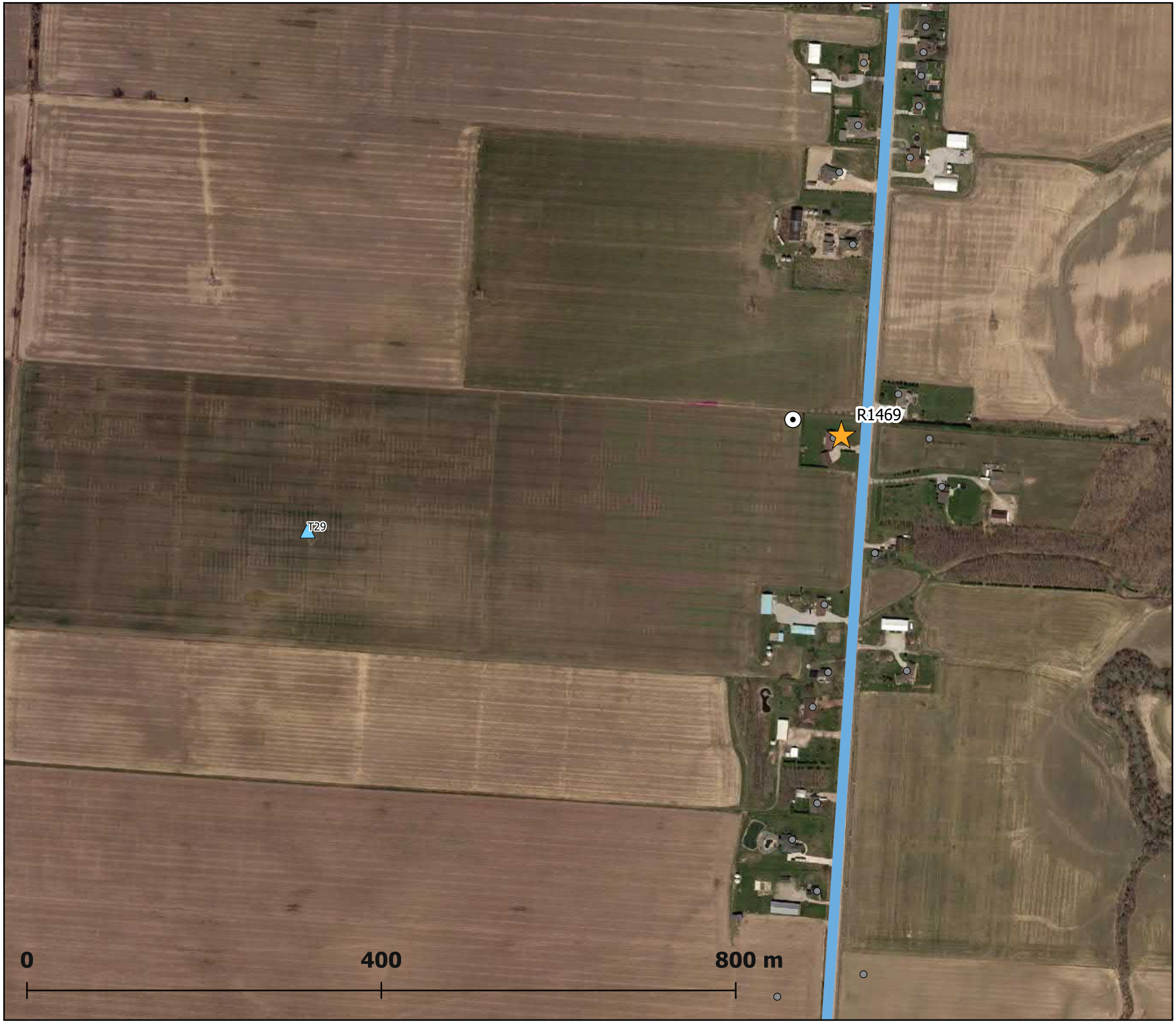

Legend

- Campaign Receptor
- Turbines - Built
- Monitor Locations
- County Road 31

N

Project ID:	17095.01
Drawn by:	MWJ
Reveiwed by:	KC
Date:	Aug 5, 2020
Revision:	1
Scale:	As Indicated

Belle River Wind Power Project
Phase 2 I-Audit Report

Appendix A.5.i

R1469
Monitor and Receptor Location

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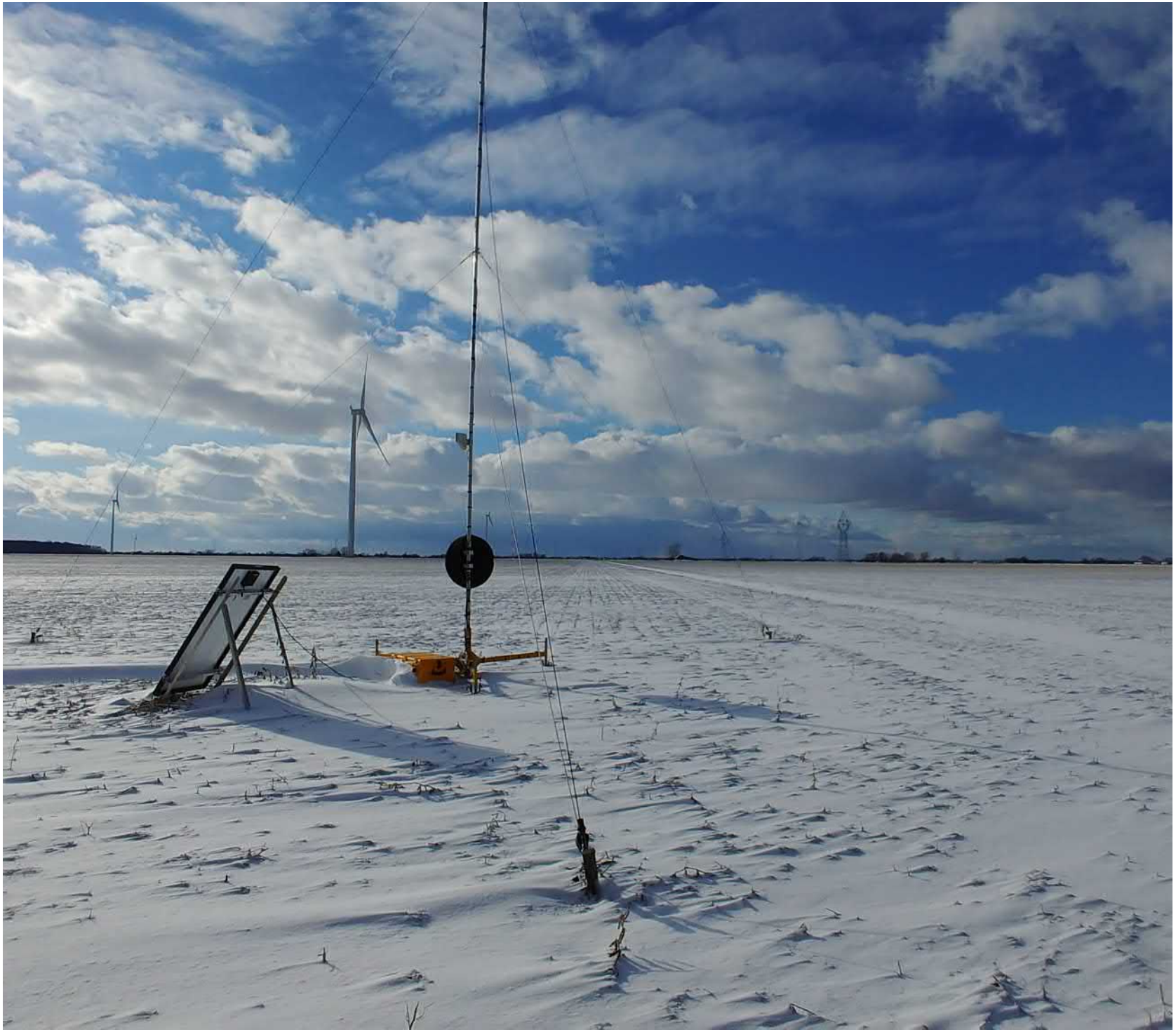

Project ID:	17095.01
Drawn by:	MWJ
Reveiwed by:	KC
Date:	Aug 5, 2020
Revision:	1
Scale:	NA

Belle River Wind Power Project
Phase 2 I-Audit Report

Appendix A.5.ii

R1469
Monitor to T29

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Project ID:	17095.01
Drawn by:	MWJ
Reveiwed by:	KC
Date:	Aug 5, 2020
Revision:	1
Scale:	NA

Belle River Wind Power Project
Phase 2 I-Audit Report

Appendix A.5.iii

R1469
Monitor to Receptor

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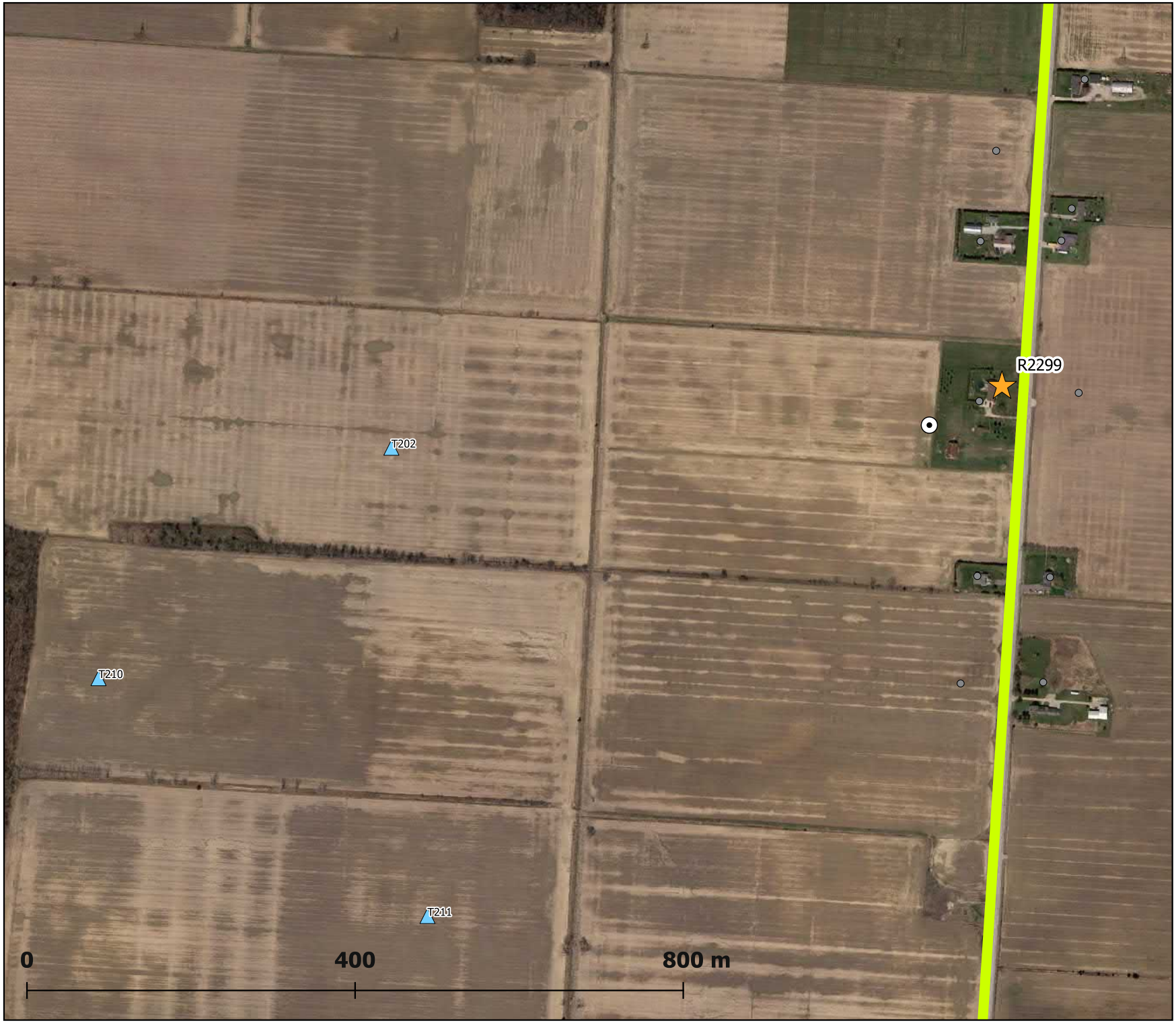

Legend

- Campaign Receptor
- Turbines - Built
- Monitor Locations
- Lakeshore Road 113

N

Project ID:	17095.01
Drawn by:	MWJ
Reveiwed by:	KC
Date:	Aug 5, 2020
Revision:	1
Scale:	As Indicated

Belle River Wind Power Project
Phase 2 I-Audit Report

Appendix A.6.i

R2299
Monitor and Receptor Location

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Project ID:	17095.01
Drawn by:	MWJ
Reveiwed by:	KC
Date:	Aug 5, 2020
Revision:	1
Scale:	NA

Belle River Wind Power Project
Phase 2 I-Audit Report

Appendix A.6.ii

R2299
Monitor to T202

aercoustics



Project ID:	17095.01
Drawn by:	MWJ
Reveiwed by:	KC
Date:	Aug 5, 2020
Revision:	1
Scale:	NA

Belle River Wind Power Project
Phase 2 I-Audit Report

Appendix A.6.iii

R2299
Monitor to Receptor

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Appendix B
Receptor Selection Details

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Appendix B – Receptor Selection Details

As per the REA, five (5) measurement locations are required to be conducted on two (2) separate occasions, or "Phases" of measurement.

During the initial audit measurement campaign, conducted in Spring 2019, the five measurement locations selected were R1126, R1207, R1170, R1141, and R738. Of these five (5) measurement locations, only three (3) were able to collect complete datasets. The other two (2) locations – R1141 and R738 – were impacted significantly by noise from the nearby Ontario Highway 401, which was situated less than a kilometer from the two affected receptors.

In consultation with the MECP, Receptors R1141 and R738 were not reselected for a subsequent measurement campaign. Instead, two new measurement locations were selected. A buffer of 2500 m from the highway was applied during the selection of the two revised measurement locations. This setback is consistent with that of R1126, R1207, and R1170, where the contribution of Highway 401 was observed to be less significant than was observed at R1141 and R738.

These two new measurement locations – R1469 and R2299 – were visited for the first time in the Fall of 2019, which represented the second audit campaign for Receptors R1126, R1207, and R1170.

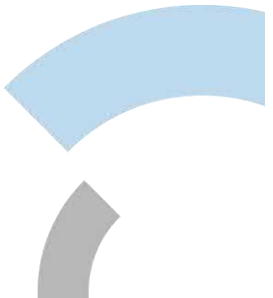
The audit campaigns carried out at BRWPP since the start of the Spring 2019 measurement campaign are outlined in Table B1 below. The monitoring phase indicated for each location represents whether this is the first or second period over which the location has been audited. The full receptor selection table is provided in Table B2.

Table B1: I-Audit Campaign Summary – Phase 1 and Phase 2

Monitoring Phase	Monitoring Season	Location	Measurement Status
Phase 1	Spring 2019	R1126	Complete
		R1207	Complete
		R1170	Complete
		R738	Audit incomplete – location de-selected
		R1141	Audit incomplete – location de-selected
	Fall 2019	R1469	Complete
		R2299	Complete
Phase 2	Fall 2019	R1126	Complete
		R1207	Complete
		R1170	Complete
	Spring 2020	R1469	Complete
		R2299	Complete

Table B2: Receptors Sorted by Sound Level

SPL Rank	Point of Reception ID	Participating / Predicted Third-Party impact (dBA)	Height (m)	Distance to Nearest Turbine (m)	Nearest Turbine	Predicted Overall Impact (dBA)	Wind Direction	Excluded / Potential	Notes
1	V3230	0.0	4.5	97	T213	49.4	UW	Excluded	Participating
2	V3055	0.0	4.5	359	T214	43.6	UW	Excluded	Participating
3	R1162	33.8	4.5	458	T53	41.4	**DW**	Excluded	Participating
4	R1161	32.4	1.5	483	T53	40.2	**DW**	Excluded	Participating
5	R1111	38.5	4.5	730	T55	40	**DW**	Excluded	Third-party + Belle River Transformer impact over 30 dBA
6	R766	36.4	4.5	570	T48	39.9	CW	Excluded	Crosswind
7	V3053	14.3	4.5	587	T215	39.9	CW	Excluded	Crosswind
8	V2788	37.6	4.5	747	T48	39.9	CW	Excluded	Crosswind
9	R211	39.0	4.5	931	T15	39.9	CW	Excluded	Crosswind
10	R1171	30.2	7.5	569	T40	39.8	CW	Excluded	Crosswind
11	V3302	0.0	4.5	551	T210	39.7	CW	Excluded	Crosswind
12	V2810	29.7	4.5	598	T45	39.7	CW	Excluded	Crosswind
13	V2793	30.3	4.5	561	T59	39.7	**DW**	Excluded	Participating
14	R742	30.3	4.5	550	T49	39.6	**DW**	Excluded	Third-party + Belle River Transformer impact over 30 dBA
15	R741	30.8	7.5	622	T59	39.6	**DW**	Excluded	Third-party + Belle River Transformer impact over 30 dBA
16	R2311	14.2	4.5	636	T215	39.6	CW	Excluded	Crosswind
17	R206	38.9	4.5	1070	T15	39.6	CW	Excluded	Crosswind
18	V2794	30.1	4.5	447	T49	39.6	CW	Excluded	Crosswind
19	R736	31.2	7.5	674	T58	39.5	**DW**	Excluded	Third-party + Belle River Transformer impact over 30 dBA
20	R214	37.8	4.5	689	T15	39.5	CW	Excluded	Crosswind
21	R1110	37.8	4.5	715	T55	39.5	CW	Excluded	Crosswind
22	R767	36.5	4.5	748	T58	39.5	UW	Excluded	Upwind
23	R213	38.1	4.5	752	T15	39.5	CW	Excluded	Crosswind
24	R210	38.4	4.5	887	T15	39.5	CW	Excluded	Crosswind
25	R181	39.1	4.5	1462	T15	39.5	CW	Excluded	Crosswind
26	R714	34.3	4.5	602	T52	39.5	**DW**	Excluded	Participating
27	R2108	0.0	4.5	554	T214	39.4	UW	Excluded	Upwind



SPL Rank	Point of Reception ID	Participating / Predicted Third-Party impact (dBA)	Height (m)	Distance to Nearest Turbine (m)	Nearest Turbine	Predicted Overall Impact (dBA)	Wind Direction	Excluded / Potential	Notes
28	R735	31.3	7.5	578	T57	39.4	CW	Excluded	Crosswind
29	V2712	36.8	4.5	584	T15	39.4	CW	Excluded	Crosswind
30	V2817	37.0	4.5	605	T55	39.4	**DW**	Excluded	Third-party + Belle River Transformer impact over 30 dBA
31	V3379	30.4	4.5	618	T59	39.4	**DW**	Excluded	Third-party + Belle River Transformer impact over 30 dBA
32	R2313	14.1	4.5	624	T215	39.4	CW	Excluded	Crosswind
33	R2312	14.0	4.5	656	T215	39.4	CW	Excluded	Crosswind
34	V3216	9.1	4.5	704	T212	39.4	CW	Excluded	Crosswind
35	V2734	37.8	4.5	741	T15	39.4	CW	Excluded	Crosswind
36	R207	38.6	4.5	971	T15	39.4	CW	Excluded	Crosswind
37	V2610	38.6	4.5	996	T15	39.4	CW	Excluded	Crosswind
38	V2609	38.6	4.5	1021	T15	39.4	CW	Excluded	Crosswind
39	R205	38.6	4.5	1049	T15	39.4	CW	Excluded	Crosswind
40	V3363	38.7	4.5	1158	T15	39.4	CW	Excluded	Crosswind
41	R175	38.7	4.5	1182	T15	39.4	CW	Excluded	Crosswind
42	R176	38.8	4.5	1255	T15	39.4	CW	Excluded	Crosswind
43	V2825	29.7	4.5	551	T40	39.4	CW	Excluded	Crosswind
44	V2772	30.5	4.5	552	T49	39.3	UW	Excluded	Upwind
45	R1172	29.5	4.5	573	T45	39.3	CW	Excluded	Crosswind
46	V2792	30.4	4.5	576	T58	39.3	CW	Excluded	Crosswind
47	R739	31.0	7.5	635	T58	39.3	**DW**	Excluded	Third-party + Belle River Transformer impact over 30 dBA
48	V2786	36.4	4.5	737	T58	39.3	UW	Excluded	Upwind
49	R177	38.8	4.5	1373	T15	39.3	CW	Excluded	Crosswind
50	R1169	30.2	4.5	561	T44	39.3	CW	Excluded	Crosswind
51	R2510	29.6	4.5	573	T45	39.3	UW	Excluded	Upwind
52	V2791	30.5	4.5	542	T58	39.3	**DW**	Excluded	Participating
53	V3215	10.4	4.5	709	T211	39.3	**DW**	Excluded	Participating
54	R740	30.4	4.5	573	T58	39.2	CW	Excluded	Crosswind
55	**R1170**	30.1	**4.5**	**574**	**T40**	**39.2**	**DW**	**Selected**	**Selected** **Note: monitor was located such that the predicted third-party/transformer impact is less than 30 dBA**
56	V2777	33.0	4.5	599	T52	39.2	CW	Excluded	Crosswind
57	R1121	25.6	7.5	644	T51	39.2	UW	Excluded	Upwind

SPL Rank	Point of Reception ID	Participating / Predicted Third-Party impact (dBA)	Height (m)	Distance to Nearest Turbine (m)	Nearest Turbine	Predicted Overall Impact (dBA)	Wind Direction	Excluded / Potential	Notes
58	V3217	13.9	4.5	711	T215	39.2	CW	Excluded	Crosswind
59	R2309	9.0	4.5	740	T212	39.2	CW	Excluded	Crosswind
60	V3054	13.8	4.5	751	T212	39.2	CW	Excluded	Crosswind
61	R768	36.5	4.5	762	T58	39.2	UW	Excluded	Upwind
62	V2926	38.9	4.5	1745	T36	39.2	CW	Excluded	Crosswind
63	V2768	26.0	4.5	554	T20	39.2	CW	Excluded	Crosswind
64	V2495	30.0	4.5	561	T12	39.1	UW	Excluded	Upwind
65	V2492	30.3	4.5	609	T12	39.1	UW	Excluded	Upwind
66	V2790	30.8	4.5	683	T57	39.1	CW	Excluded	Crosswind
67	V2778	30.6	4.5	729	T58	39.1	**DW**	Excluded	Third-party + Belle River Transformer impact over 30 dBA
68	R1175	29.8	4.5	643	T45	39.1	UW	Excluded	Upwind
69	R1157	34.0	1.5	547	T15	39.1	CW	Excluded	Crosswind
70	V2496	29.8	4.5	562	T12	39	UW	Excluded	Upwind
71	R763	31.5	4.5	569	T48	39	UW	Excluded	Upwind
72	V2491	30.4	4.5	602	T14	39	**DW**	Excluded	Third-party + Belle River Transformer impact over 30 dBA
73	V2580	25.1	4.5	615	T51	39	UW	Excluded	Upwind
74	V2814	30.2	4.5	645	T46	39	**DW**	Excluded	Third-party + Belle River Transformer impact over 30 dBA
75	V2749	33.3	4.5	695	T26	39	**DW**	Excluded	Third-party + Belle River Transformer impact over 30 dBA
76	R2310	14.0	4.5	796	T212	39	CW	Excluded	Crosswind
77	R770	36.9	4.5	873	T58	39	CW	Excluded	Crosswind
78	R1503	34.7	7.5	768	T38	39	UW	Excluded	Upwind
79	R1205	26.5	4.5	576	T20	38.9	CW	Excluded	Crosswind
80	V2490	30.3	4.5	598	T14	38.9	**DW**	Excluded	Third-party + Belle River Transformer impact over 30 dBA
81	R734	30.8	4.5	604	T57	38.9	**DW**	Excluded	Third-party + Belle River Transformer impact over 30 dBA
82	V2836	29.8	4.5	669	T45	38.9	UW	Excluded	Upwind
83	R2302	10.4	4.5	670	T205	38.9	UW	Excluded	Upwind
84	V2751	36.8	4.5	738	T54	38.9	CW	Excluded	Crosswind
85	V2747	36.6	4.5	773	BR_sub	38.9	UW	Excluded	Upwind
86	R1108	37.4	4.5	873	T55	38.9	CW	Excluded	Crosswind
87	V2944	38.5	4.5	1445	T54	38.9	UW	Excluded	Upwind
88	V2721	26.6	4.5	560	T50	38.9	CW	Excluded	Crosswind
89	V2816	30.3	4.5	639	T40	38.9	**DW**	Excluded	Participating

SPL Rank	Point of Reception ID	Participating / Predicted Third-Party impact (dBA)	Height (m)	Distance to Nearest Turbine (m)	Nearest Turbine	Predicted Overall Impact (dBA)	Wind Direction	Excluded / Potential	Notes
90	V2822	30.9	4.5	587	T47	38.9	**DW**	Excluded`	Participating
91	R2314	14.1	1.5	542	T215	38.9	UW	Excluded	Upwind
92	R1128	26.5	4.5	571	T50	38.8	CW	Excluded	Crosswind
93	V2489	30.2	4.5	589	T14	38.8	**DW**	Excluded	Third-party + Belle River Transformer impact over 30 dBA
94	R1206	26.3	4.5	596	T30	38.8	UW	Excluded	Upwind
95	V2497	29.8	4.5	601	T12	38.8	UW	Excluded	Upwind
96	R2300	10.6	4.5	644	T205	38.8	CW	Excluded	Crosswind
97	V2923	38.4	4.5	1645	T36	38.8	CW	Excluded	Crosswind
98	V2722	26.3	4.5	572	T50	38.8	**DW**	Excluded	Participating
99	V2737	25.9	4.5	564	T30	38.8	CW	Excluded	Crosswind
100	V2487	30.1	4.5	576	T14	38.7	**DW**	Excluded	Third-party + Belle River Transformer impact over 30 dBA
101	V2488	30.2	4.5	582	T14	38.7	**DW**	Excluded	Third-party + Belle River Transformer impact over 30 dBA
102	V2732	34.7	4.5	594	T15	38.7	**DW**	Excluded	Third-party + Belle River Transformer impact over 30 dBA
103	R1155	35.1	4.5	598	T15	38.7	**DW**	Excluded	Third-party + Belle River Transformer impact over 30 dBA
104	R1131	27.1	4.5	606	T50	38.7	CW	Excluded	Crosswind
105	V2510	29.7	4.5	626	T12	38.7	UW	Excluded	Upwind
106	V2769	25.5	4.5	692	T51	38.7	UW	Excluded	Upwind
107	V2834	35.3	4.5	734	T52	38.7	**DW**	Excluded	Third-party + Belle River Transformer impact over 30 dBA
108	R1109	37.6	1.5	862	T55	38.7	CW	Excluded	Crosswind
109	V2782	30.8	4.5	533	T57	38.7	**DW**	Excluded	Participating
110	V2486	30.1	4.5	572	T14	38.6	**DW**	Excluded	Third-party + Belle River Transformer impact over 30 dBA
111	**R1126**	26.2	**4.5**	**626**	**T50**	**38.6**	**DW**	**Selected**	**Selected**
112	V2717	26.0	4.5	636	T50	38.6	**DW**	Excluded	Excluded: Redundant with R1126
113	V2511	29.7	4.5	652	T12	38.6	UW	Excluded	Upwind
114	R1505	33.7	4.5	694	T36	38.6	CW	Excluded	Crosswind
115	V2818	33.8	4.5	728	T36	38.6	CW	Excluded	Crosswind
116	R1498	35.0	4.5	746	T38	38.6	CW	Excluded	Crosswind
117	R1501	34.8	4.5	763	T38	38.6	CW	Excluded	Crosswind
118	R1165	37.2	4.5	1018	T55	38.6	CW	Excluded	Crosswind
119	R1500	34.4	4.5	695	T38	38.6	CW	Excluded	Crosswind
120	R1504	34.2	4.5	780	T54	38.6	**DW**	Excluded	Participating

SPL Rank	Point of Reception ID	Participating / Predicted Third-Party impact (dBA)	Height (m)	Distance to Nearest Turbine (m)	Nearest Turbine	Predicted Overall Impact (dBA)	Wind Direction	Excluded / Potential	Notes
121	V2485	30.0	4.5	569	T14	38.5	**DW**	Excluded	Land access denied, part of sub-divided vacant lot
122	R1132	27.3	4.5	648	T50	38.5	CW	Excluded	Crosswind
123	R2315	13.1	4.5	661	T215	38.5	UW	Excluded	Upwind
124	V2711	27.6	4.5	664	T62	38.5	CW	Excluded	Crosswind
125	V2744	26.9	4.5	667	T20	38.5	CW	Excluded	Crosswind
126	R1173	30.0	4.5	669	T40	38.5	CW	Excluded	Crosswind
127	V2578	34.6	4.5	681	T38	38.5	CW	Excluded	Crosswind
128	R1123	25.9	4.5	684	T50	38.5	**DW**	Excluded	Excluded: Redundant with R1126
129	V2603	33.6	4.5	703	T36	38.5	CW	Excluded	Crosswind
130	V2564	35.3	4.5	795	T38	38.5	CW	Excluded	Crosswind
131	V2762	35.6	4.5	802	BR_sub	38.5	CW	Excluded	Crosswind
132	R1495	35.4	4.5	810	T38	38.5	CW	Excluded	Crosswind
133	R1492	35.2	7.5	842	BR_sub	38.5	CW	Excluded	Crosswind
134	R715	32.4	1.5	576	T52	38.5	**DW**	Excluded	Third-party + Belle River Transformer impact over 30 dBA
135	V2815	31.5	4.5	543	T55	38.5	CW	Excluded	Crosswind
136	V2484	30.0	4.5	568	T14	38.4	**DW**	Excluded	Land access denied, part of sub-divided vacant lot
137	**R1141**	29.4	**4.5**	**580**	**T12**	**38.4**	**DW**	**No longer selected**	**Initially selected and subsequently de-selected due to impact from the 401**
138	R731	31.4	7.5	628	T57	38.4	**DW**	Excluded	Third-party + Belle River Transformer impact over 30 dBA
139	V3213	0.0	4.5	654	T202	38.4	CW	Excluded	Crosswind
140	V2512	29.7	4.5	678	T12	38.4	UW	Excluded	Upwind
141	R2426	30.9	4.5	692	T38	38.4	CW	Excluded	Crosswind
142	R1176	30.0	4.5	708	T46	38.4	CW	Excluded	Crosswind
143	V2565	33.8	4.5	714	T54	38.4	CW	Excluded	Crosswind
144	V2763	26.0	4.5	733	T50	38.4	**DW**	Excluded	Excluded: Redundant with R1126
145	R1494	35.5	4.5	801	BR_sub	38.4	CW	Excluded	Crosswind
146	V2781	35.6	4.5	816	T58	38.4	CW	Excluded	Crosswind
147	R732	30.9	4.5	552	T57	38.3	**DW**	Excluded	Third-party + Belle River Transformer impact over 30 dBA
148	V2482	29.9	4.5	570	T14	38.3	**DW**	Excluded	Land access denied, part of sub-divided vacant lot
149	V2689	29.0	4.5	633	T12	38.3	**DW**	Excluded	Excluded: Within 2500 meters of the 401
150	R1477	33.2	4.5	649	T29	38.3	CW	Excluded	Crosswind
151	V2774	32.1	4.5	655	T48	38.3	UW	Excluded	Upwind

SPL Rank	Point of Reception ID	Participating / Predicted Third-Party impact (dBA)	Height (m)	Distance to Nearest Turbine (m)	Nearest Turbine	Predicted Overall Impact (dBA)	Wind Direction	Excluded / Potential	Notes
152	R1154	35.0	4.5	680	T15	38.3	**DW**	Excluded	Third-party + Belle River Transformer impact over 30 dBA
153	V2513	29.6	4.5	683	T14	38.3	**DW**	Excluded	Land access denied, part of sub-divided vacant lot
154	V2813	29.4	4.5	714	T45	38.3	CW	Excluded	Crosswind
155	V2829	31.1	4.5	715	T38	38.3	CW	Excluded	Crosswind
156	R1125	26.2	4.5	720	T50	38.3	**DW**	Excluded	Excluded: Redundant with R1126
157	V2761	35.4	4.5	788	BR_sub	38.3	**DW**	Excluded	Third-party + Belle River Transformer impact over 30 dBA
158	R1491	35.3	4.5	797	BR_sub	38.3	CW	Excluded	Crosswind
159	R1382	37.8	4.5	1552	T36	38.3	CW	Excluded	Crosswind
160	V2731	34.1	4.5	636	T15	38.3	**DW**	Excluded	Participating
161	V2831	33.5	4.5	714	T36	38.3	CW	Excluded	Crosswind
162	V2539	29.9	4.5	572	T14	38.2	**DW**	Excluded	Land access denied, part of sub-divided vacant lot
163	R1474	32.1	4.5	606	T29	38.2	CW	Excluded	Crosswind
164	R1107	30.8	4.5	630	T55	38.2	CW	Excluded	Crosswind
165	R1118	25.0	4.5	654	T51	38.2	CW	Excluded	Crosswind
166	V3056	0.0	4.5	660	T214	38.2	UW	Excluded	Upwind
167	R1138	28.8	4.5	675	T12	38.2	**DW**	Excluded	Excluded: Within 2500 meters of the 401
168	R1130	27.1	4.5	677	T50	38.2	CW	Excluded	Crosswind
169	V2514	29.5	4.5	680	T14	38.2	**DW**	Excluded	Land access denied, part of sub-divided vacant lot
170	R1478	33.4	4.5	703	T29	38.2	CW	Excluded	Crosswind
171	V2590	31.5	4.5	712	T44	38.2	CW	Excluded	Crosswind
172	R2514	33.7	4.5	715	T54	38.2	CW	Excluded	Crosswind
173	V2759	34.1	4.5	748	T29	38.2	CW	Excluded	Crosswind
174	R1112	36.0	4.5	762	T55	38.2	**DW**	Excluded	Third-party + Belle River Transformer impact over 30 dBA
175	R1489	35.2	4.5	798	BR_sub	38.2	CW	Excluded	Crosswind
176	R1493	34.9	4.5	808	T38	38.2	CW	Excluded	Crosswind
177	V2760	35.0	4.5	866	BR_sub	38.2	**DW**	Excluded	Third-party + Belle River Transformer impact over 30 dBA
178	V2557	34.7	4.5	885	T29	38.2	CW	Excluded	Crosswind
179	R1383	37.6	4.5	1509	T36	38.2	CW	Excluded	Crosswind
180	R461	37.2	1.5	1457	T28	38.2	**DW**	Excluded	Third-party + Belle River Transformer impact over 30 dBA
181	R822	28.8	4.5	550	T206	38.1	CW	Excluded	Crosswind
182	V2538	29.8	4.5	576	T14	38.1	CW	Excluded	Crosswind
183	R1208	25.1	4.5	594	T30	38.1	CW	Excluded	Crosswind

SPL Rank	Point of Reception ID	Participating / Predicted Third-Party impact (dBA)	Height (m)	Distance to Nearest Turbine (m)	Nearest Turbine	Predicted Overall Impact (dBA)	Wind Direction	Excluded / Potential	Notes
184	V2757	24.5	4.5	599	T51	38.1	CW	Excluded	Crosswind
185	V3206	11.1	4.5	647	T205	38.1	CW	Excluded	Crosswind
186	V2515	29.5	4.5	681	T14	38.1	**DW**	Excluded	Land access denied, part of sub-divided vacant lot
187	V2820	31.8	4.5	703	T36	38.1	**DW**	Excluded	Third-party + Belle River Transformer impact over 30 dBA
188	R1487	34.9	4.5	838	BR_sub	38.1	CW	Excluded	Crosswind
189	R1484	35.0	4.5	839	BR_sub	38.1	**DW**	Excluded	Third-party + Belle River Transformer impact over 30 dBA
190	R1386	37.3	4.5	1361	T36	38.1	CW	Excluded	Crosswind
191	R212	37.0	1.5	861	T15	38.1	CW	Excluded	Crosswind
192	R1508	33.7	4.5	731	T54	38.1	CW	Excluded	Crosswind
193	V2765	26.9	4.5	683	T50	38.1	CW	Excluded	Crosswind
194	R730	31.0	4.5	577	T57	38	**DW**	Excluded	Third-party + Belle River Transformer impact over 30 dBA
195	V2537	29.7	4.5	582	T14	38	CW	Excluded	Crosswind
196	R761	30.0	4.5	623	T49	38	CW	Excluded	Crosswind
197	R1471	31.6	4.5	643	T29	38	CW	Excluded	Crosswind
198	V3048	16.3	4.5	666	T215	38	UW	Excluded	Upwind
199	V2516	29.4	4.5	681	T14	38	**DW**	Excluded	Land access denied, part of sub-divided vacant lot
200	V2698	27.4	4.5	689	T11	38	UW	Excluded	Upwind
201	R1467	30.7	7.5	689	T29	38	**DW**	Excluded	Third-party + Belle River Transformer impact over 30 dBA
202	V2582	33.0	4.5	693	T48	38	UW	Excluded	Upwind
203	V2811	32.3	4.5	722	T55	38	CW	Excluded	Crosswind
204	V2571	33.4	4.5	780	T40	38	UW	Excluded	Upwind
205	V2809	33.5	4.5	787	T40	38	UW	Excluded	Upwind
206	R1480	34.1	4.5	873	T40	38	UW	Excluded	Upwind
207	R1385	37.3	4.5	1420	T36	38	CW	Excluded	Crosswind
208	R1369	37.4	7.5	1673	T36	38	CW	Excluded	Crosswind
209	R1507	33.4	4.5	746	T36	38	UW	Excluded	Upwind
210	R1119	22.8	1.5	594	T51	38	UW	Excluded	Upwind
211	V2536	29.7	4.5	589	T14	37.9	CW	Excluded	Crosswind
212	V2823	32.7	4.5	621	T47	37.9	CW	Excluded	Crosswind
213	R760	30.0	4.5	638	T49	37.9	CW	Excluded	Crosswind
214	V2718	25.0	4.5	675	T51	37.9	CW	Excluded	Crosswind
215	V2517	29.4	4.5	683	T14	37.9	**DW**	Excluded	Land access denied, part of sub-divided vacant lot

SPL Rank	Point of Reception ID	Participating / Predicted Third-Party impact (dBA)	Height (m)	Distance to Nearest Turbine (m)	Nearest Turbine	Predicted Overall Impact (dBA)	Wind Direction	Excluded / Potential	Notes
216	V3049	20.3	4.5	723	T215	37.9	CW	Excluded	Crosswind
217	V3050	20.3	4.5	727	T215	37.9	CW	Excluded	Crosswind
218	R1152	34.5	4.5	738	T15	37.9	**DW**	Excluded	Third-party + Belle River Transformer impact over 30 dBA
219	R1134	27.7	4.5	758	T62	37.9	CW	Excluded	Crosswind
220	V2812	34.9	4.5	807	T55	37.9	CW	Excluded	Crosswind
221	V2830	34.6	4.5	878	BR_sub	37.9	CW	Excluded	Crosswind
222	R1481	34.2	4.5	897	T40	37.9	UW	Excluded	Upwind
223	R1482	34.2	4.5	901	T40	37.9	UW	Excluded	Upwind
224	R1483	34.3	4.5	936	BR_sub	37.9	**DW**	Excluded	Third-party + Belle River Transformer impact over 30 dBA
225	V2483	37.1	4.5	1828	T8	37.9	CW	Excluded	Crosswind
226	**R738**	28.3	**1.5**	**568**	**T58**	**37.9**	**DW**	**Selected**	**Initially selected and subsequently de-selected due to impact from the 401**
227	**R1207**	23.8	**1.5**	**620**	**T20**	**37.9**	**DW**	**Selected**	**Selected**
228	R1163	31.5	1.5	660	T26	37.9	DW	Excluded	Third-party + Belle River Transformer impact over 30 dBA
229	R1367	37.5	1.5	1848	T36	37.9	CW	Excluded	Crosswind
230	V2535	29.6	4.5	597	T14	37.8	CW	Excluded	Land access denied, part of subdivided vacant lot
231	V2518	29.3	4.5	686	T14	37.8	DW	Excluded	Land access denied, part of subdivided vacant lot
232	V2743	34.3	4.5	750	T15	37.8	DW	Excluded	Third-party + Belle River Transformer impact over 30 dBA
233	V2754	35.0	4.5	914	T53	37.8	UW	Excluded	Upwind
234	R1127	24.2	1.5	569	T50	37.8	CW	Excluded	Crosswind
235	R2301	7.8	1.5	726	T205	37.8	CW	Excluded	Crosswind
236	V2534	29.6	4.5	607	T14	37.7	CW	Excluded	Land access denied, part of subdivided vacant lot
237	R1117	24.8	4.5	659	T51	37.7	CW	Excluded	Crosswind
238	V2758	31.1	4.5	704	T28	37.7	CW	Excluded	Crosswind
239	R1470	31.1	4.5	719	T29	37.7	CW	Excluded	Crosswind
240	V2874	34.8	4.5	728	T14	37.7	UW	Excluded	Upwind
241	V2701	32.5	4.5	798	T12	37.7	CW	Excluded	Crosswind
242	R1509	33.5	4.5	809	T36	37.7	UW	Excluded	Upwind
243	R1396	36.6	4.5	1246	T36	37.7	CW	Excluded	Crosswind
244	V2752	36.7	4.5	1972	T53	37.7	UW	Excluded	Upwind
245	R764	29.4	1.5	592	T48	37.7	UW	Excluded	Upwind

SPL Rank	Point of Reception ID	Participating / Predicted Third-Party impact (dBA)	Height (m)	Distance to Nearest Turbine (m)	Nearest Turbine	Predicted Overall Impact (dBA)	Wind Direction	Excluded / Potential	Notes
246	R1129	24.7	1.5	595	T50	37.7	CW	Excluded	Crosswind
247	R737	28.4	1.5	634	T58	37.7	DW	Excluded	Excluded: Within 2500 meters of the 401
248	R1174	28.0	1.5	669	T45	37.7	UW	Excluded	Upwind
249	R1368	37.3	1.5	1814	T36	37.7	CW	Excluded	Crosswind
250	V2533	29.5	4.5	619	T14	37.6	CW	Excluded	Land access denied, part of subdivided vacant lot
251	R759	29.7	4.5	674	T49	37.6	CW	Excluded	Crosswind
252	R1140	29.5	4.5	685	T12	37.6	DW	Excluded	Excluded: Within 2500 meters of the 401
253	V2519	29.3	4.5	691	T14	37.6	CW	Excluded	Land access denied, part of subdivided vacant lot
254	R2515	31.1	4.5	698	T40	37.6	CW	Excluded	Crosswind
255	R1145	31.8	4.5	708	T12	37.6	CW	Excluded	Crosswind
256	V2586	31.0	4.5	710	T29	37.6	DW	Excluded	Third-party + Belle River Transformer impact over 30 dBA
257	R2513	30.3	4.5	713	T29	37.6	DW	Excluded	Third-party + Belle River Transformer impact over 30 dBA
258	V2771	30.7	4.5	714	T55	37.6	CW	Excluded	Crosswind
259	V2694	32.0	4.5	732	T12	37.6	CW	Excluded	Crosswind
260	V3051	19.9	4.5	754	T215	37.6	DW	Excluded	Excluded: Within 2500 meters of the 401
261	V2783	34.7	4.5	785	T57	37.6	UW	Excluded	Upwind
262	V2785	34.2	4.5	832	T52	37.6	DW	Excluded	Third-party + Belle River Transformer impact over 30 dBA
263	V2838	31.8	4.5	839	T55	37.6	CW	Excluded	Crosswind
264	R394	36.3	4.5	1486	T48	37.6	UW	Excluded	Upwind
265	R782	34.3	1.5	723	T58	37.6	UW	Excluded	Upwind
266	R2303	7.1	1.5	770	T211	37.6	CW	Excluded	Crosswind
267	R209	36.5	1.5	917	T15	37.6	CW	Excluded	Crosswind
268	R208	36.5	1.5	949	T15	37.6	CW	Excluded	Crosswind
269	R1177	28.2	1.5	630	T46	37.6	UW	Excluded	Upwind
270	R821	22.2	4.5	669	T219	37.5	CW	Excluded	Crosswind
271	V2577	30.4	4.5	679	T12	37.5	CW	Excluded	Crosswind
272	V2736	30.0	4.5	690	T12	37.5	CW	Excluded	Crosswind
273	V2520	29.2	4.5	697	T14	37.5	CW	Excluded	Crosswind
274	R1267	21.4	4.5	749	T219	37.5	CW	Excluded	Crosswind
275	R1203	28.0	4.5	751	T20	37.5	CW	Excluded	Crosswind
276	R2293	21.4	4.5	775	T219	37.5	CW	Excluded	Crosswind
277	R1511	33.7	4.5	798	T54	37.5	CW	Excluded	Crosswind

SPL Rank	Point of Reception ID	Participating / Predicted Third-Party impact (dBA)	Height (m)	Distance to Nearest Turbine (m)	Nearest Turbine	Predicted Overall Impact (dBA)	Wind Direction	Excluded / Potential	Notes
278	V2601	32.7	4.5	816	T55	37.5	CW	Excluded	Crosswind
279	V2827	34.6	4.5	901	T55	37.5	CW	Excluded	Crosswind
280	R1124	23.9	1.5	627	T50	37.5	DW	Excluded	Excluded: Redundant with R1126
281	R769	35.2	1.5	854	T58	37.5	CW	Excluded	Crosswind
282	R174	36.7	1.5	1188	T15	37.5	CW	Excluded	Crosswind
283	R1001	17.6	4.5	611	T205	37.5	DW	Excluded	Participating
284	V2740	30.0	4.5	567	T28	37.5	CW	Potential	Crosswind
285	R1280	30.0	4.5	583	T28	37.4	CW	Potential	Crosswind
286	R1279	30.0	4.5	595	T28	37.4	CW	Potential	Crosswind
287	R1299	29.9	4.5	595	T28	37.4	CW	Potential	Crosswind
288	R1275	30.0	4.5	611	T28	37.4	CW	Excluded	Crosswind
289	R1411	30.0	4.5	628	T28	37.4	CW	Excluded	Crosswind
290	V2532	29.4	4.5	631	T14	37.4	CW	Excluded	Crosswind
291	V2690	32.6	4.5	635	T14	37.4	UW	Excluded	Upwind
292	V2521	29.2	4.5	704	T14	37.4	CW	Excluded	Crosswind
293	R2334	22.1	4.5	717	T219	37.4	CW	Excluded	Crosswind
294	V2819	33.3	4.5	720	T36	37.4	CW	Excluded	Crosswind
295	V2775	33.0	4.5	730	T47	37.4	CW	Excluded	Crosswind
296	V3091	33.2	4.5	859	T15	37.4	DW	Excluded	Third-party + Belle River Transformer impact over 30 dBA
297	R440	36.3	4.5	1494	T28	37.4	DW	Excluded	Third-party + Belle River Transformer impact over 30 dBA
298	R468	36.2	7.5	1496	T28	37.4	DW	Excluded	Third-party + Belle River Transformer impact over 30 dBA
299	R1502	32.6	1.5	704	T38	37.4	UW	Excluded	Upwind
300	R1281	30.0	4.5	584	T28	37.3	CW	Potential	Crosswind
301	V2531	29.3	4.5	645	T14	37.3	CW	Excluded	Land access denied, part of subdivided vacant lot
302	R1116	24.8	4.5	689	T51	37.3	CW	Excluded	Crosswind
303	V2551	29.0	4.5	713	T14	37.3	CW	Excluded	Land access denied, part of subdivided vacant lot
304	R758	29.7	4.5	757	T49	37.3	CW	Excluded	Crosswind
305	R1202	28.5	4.5	801	T26	37.3	CW	Excluded	Crosswind
306	R1146	32.7	4.5	862	T12	37.3	CW	Excluded	Crosswind
307	V2789	34.6	4.5	1015	T48	37.3	UW	Excluded	Upwind
308	R396	35.2	4.5	1190	T48	37.3	UW	Excluded	Upwind
309	R775	34.6	1.5	673	T15	37.3	CW	Excluded	Crosswind

SPL Rank	Point of Reception ID	Participating / Predicted Third-Party impact (dBA)	Height (m)	Distance to Nearest Turbine (m)	Nearest Turbine	Predicted Overall Impact (dBA)	Wind Direction	Excluded / Potential	Notes
310	R1167	29.6	1.5	675	T44	37.3	CW	Excluded	Crosswind
311	R1499	33.0	1.5	687	T38	37.3	CW	Excluded	Crosswind
312	R1122	23.7	1.5	737	T20	37.3	UW	Excluded	Upwind
313	R1284	30.1	4.5	593	T28	37.2	DW	Excluded	Third-party + Belle River Transformer impact over 30 dBA
314	R823	29.3	4.5	637	T206	37.2	CW	Excluded	Crosswind
315	V2530	29.2	4.5	660	T14	37.2	CW	Excluded	Land access denied, part of subdivided vacant lot
316	V3207	18.9	4.5	667	T205	37.2	CW	Excluded	Crosswind
317	R269	30.0	7.5	715	T206	37.2	CW	Excluded	Crosswind
318	V2552	29.0	4.5	722	T14	37.2	CW	Excluded	Land access denied, part of subdivided vacant lot
319	V2779	34.3	4.5	762	T57	37.2	UW	Excluded	Upwind
320	V2566	31.8	4.5	773	T12	37.2	CW	Excluded	Crosswind
321	V2764	28.3	4.5	807	T20	37.2	CW	Excluded	Crosswind
322	R1512	33.5	4.5	871	T36	37.2	UW	Excluded	Upwind
323	V2824	34.5	4.5	881	T47	37.2	CW	Excluded	Crosswind
324	R1113	35.5	4.5	1044	T55	37.2	DW	Excluded	Third-party + Belle River Transformer impact over 30 dBA
325	R733	28.4	1.5	552	T57	37.2	DW	Excluded	Excluded: Within 2500 meters of the 401
326	R1475	31.0	1.5	601	T29	37.2	CW	Excluded	Crosswind
327	R1497	33.8	1.5	761	T38	37.2	CW	Excluded	Crosswind
328	R1472	30.4	1.5	586	T29	37.2	CW	Excluded	Crosswind
329	R1301	30.1	4.5	597	T28	37.1	DW	Excluded	Third-party + Belle River Transformer impact over 30 dBA
330	V2770	31.1	4.5	654	T57	37.1	DW	Excluded	Third-party + Belle River Transformer impact over 30 dBA
331	R1273	30.1	4.5	693	T28	37.1	CW	Excluded	Crosswind
332	R1115	24.6	4.5	695	T51	37.1	CW	Excluded	Crosswind
333	V2729	24.8	4.5	710	T51	37.1	CW	Excluded	Crosswind
334	V2802	31.0	4.5	728	T57	37.1	DW	Excluded	Third-party + Belle River Transformer impact over 30 dBA
335	V2553	28.9	4.5	733	T14	37.1	CW	Excluded	Land access denied, part of subdivided vacant lot
336	R2306	15.9	4.5	768	T215	37.1	UW	Excluded	Upwind
337	V2581	29.8	4.5	783	T49	37.1	CW	Excluded	Crosswind
338	V2617	35.5	4.5	1067	T36	37.1	CW	Excluded	Crosswind
339	V2883	35.8	4.5	1437	T28	37.1	DW	Excluded	Third-party + Belle River Transformer impact over 30 dBA
340	R1156	34.3	1.5	691	T15	37.1	CW	Excluded	Crosswind
341	R1135	26.0	1.5	693	T62	37.1	CW	Excluded	Crosswind

SPL Rank	Point of Reception ID	Participating / Predicted Third-Party impact (dBA)	Height (m)	Distance to Nearest Turbine (m)	Nearest Turbine	Predicted Overall Impact (dBA)	Wind Direction	Excluded / Potential	Notes
342	R1120	23.0	1.5	717	T51	37.1	UW	Excluded	Upwind
343	R1496	33.5	1.5	722	T38	37.1	CW	Excluded	Crosswind
344	R1506	31.9	1.5	733	T36	37.1	CW	Excluded	Crosswind
345	**R2299**	8.1	**1.5**	**735**	**T202**	**37.1**	**DW**	**Selected**	**Selected**
346	R442	36.1	1.5	1429	T28	37.1	DW	Excluded	Third-party + Belle River Transformer impact over 30 dBA
347	V3071	28.3	4.5	628	T206	37.1	CW	Excluded	Crosswind
348	R1225	22.6	4.5	642	T51	37	DW	Excluded	Excluded: Redundant with R1207
349	V3058	29.1	4.5	659	T206	37	CW	Excluded	Crosswind
350	R1276	30.1	4.5	674	T28	37	CW	Excluded	Crosswind
351	V2548	29.0	4.5	676	T14	37	CW	Excluded	Crosswind
352	V2554	28.8	4.5	745	T14	37	CW	Excluded	Crosswind
353	**R1469**	29.6	**1.5**	**598**	**T29**	**37**	**DW**	**Selected**	**Selected**
354	R762	27.8	1.5	612	T49	37	CW	Excluded	Crosswind
355	R1139	27.3	1.5	616	T12	37	DW	Excluded	Excluded: Within 2500 meters of the 401
356	R1476	31.6	1.5	650	T29	37	CW	Excluded	Crosswind
357	R1168	29.3	1.5	709	T44	37	CW	Excluded	Crosswind
358	R1137	26.2	1.5	715	T62	37	CW	Excluded	Crosswind
359	R716	33.7	1.5	757	T52	37	DW	Excluded	Third-party + Belle River Transformer impact over 30 dBA
360	R1486	34.2	1.5	786	BR_sub	37	DW	Excluded	Third-party + Belle River Transformer impact over 30 dBA
361	R1488	34.3	1.5	774	BR_sub	37	CW	Excluded	Crosswind

aercoustics

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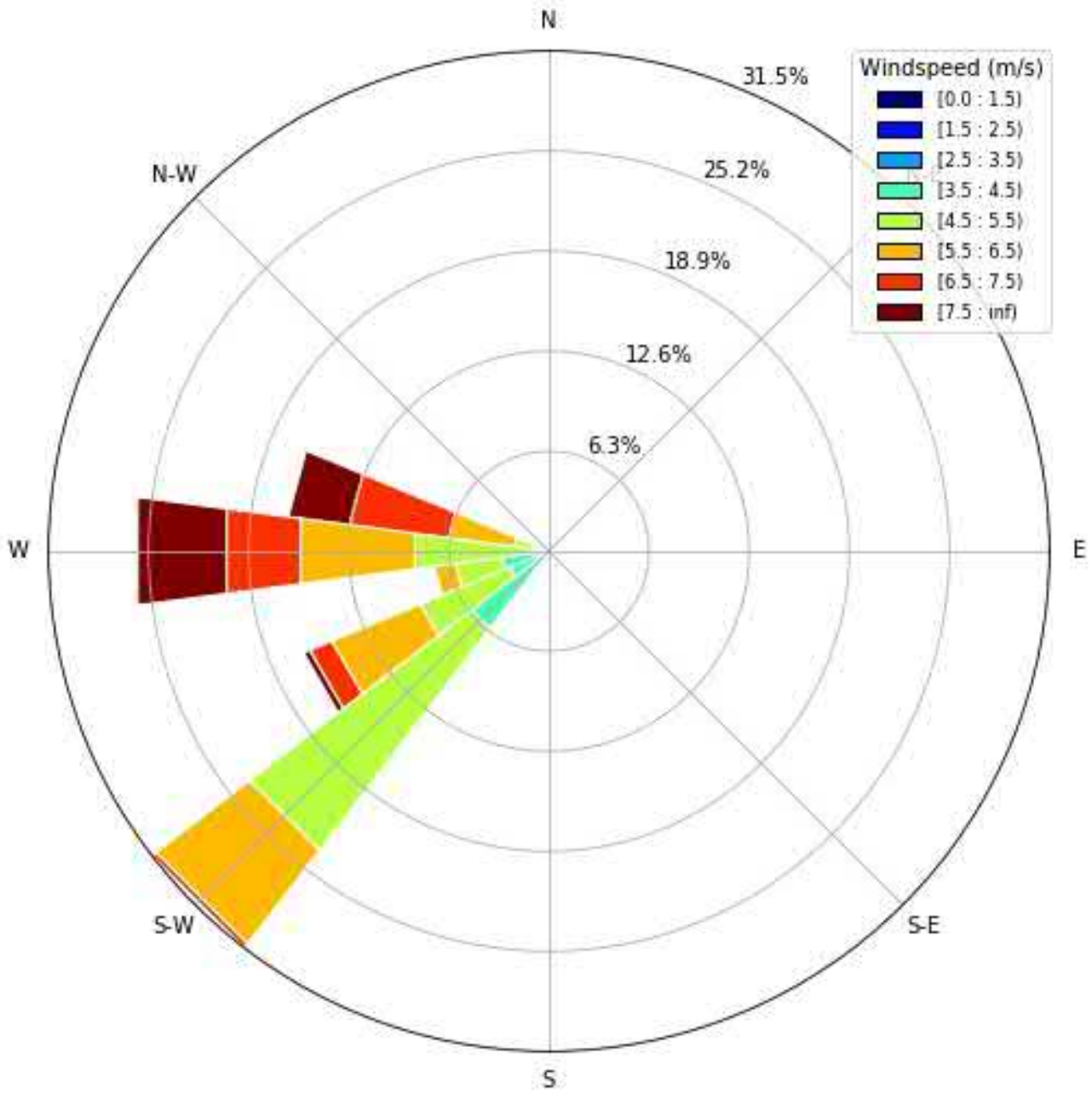
Appendix C
Wind Roses



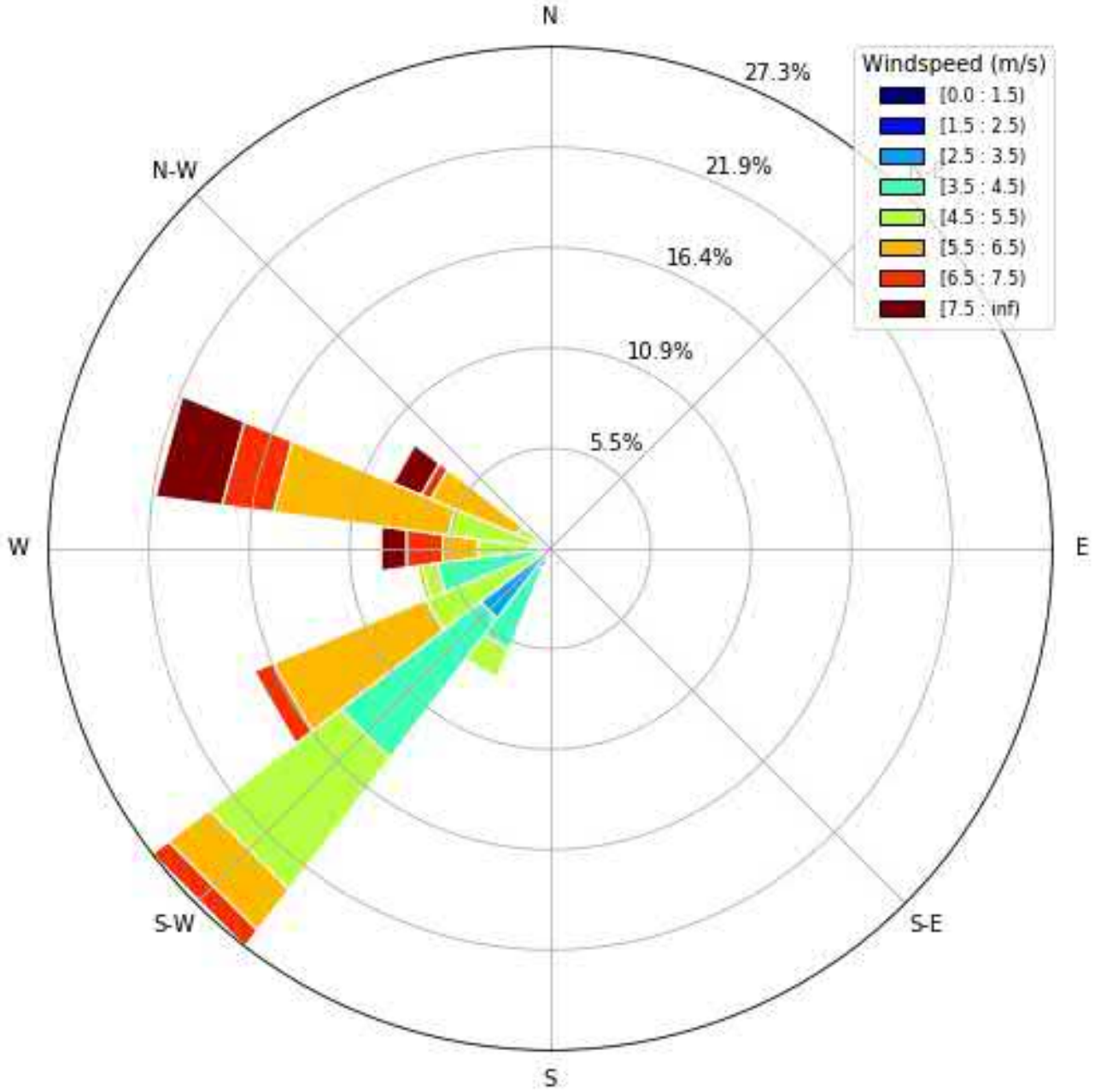
Project ID:	17095.01
Drawn by:	MWJ
Reveiwed by:	KC
Date:	Aug 5, 2020
Revision:	1
Scale:	NA

Belle River Wind Power Project
Phase 2 I-Audit Report

Appendix C.1.i

R1126
Supplementary Wind Rose
based on Assessment Data
Total Noise

aercoustics



Project ID:	17095.01
Drawn by:	MWJ
Reveiwed by:	KC
Date:	Aug 5, 2020
Revision:	1
Scale:	NA

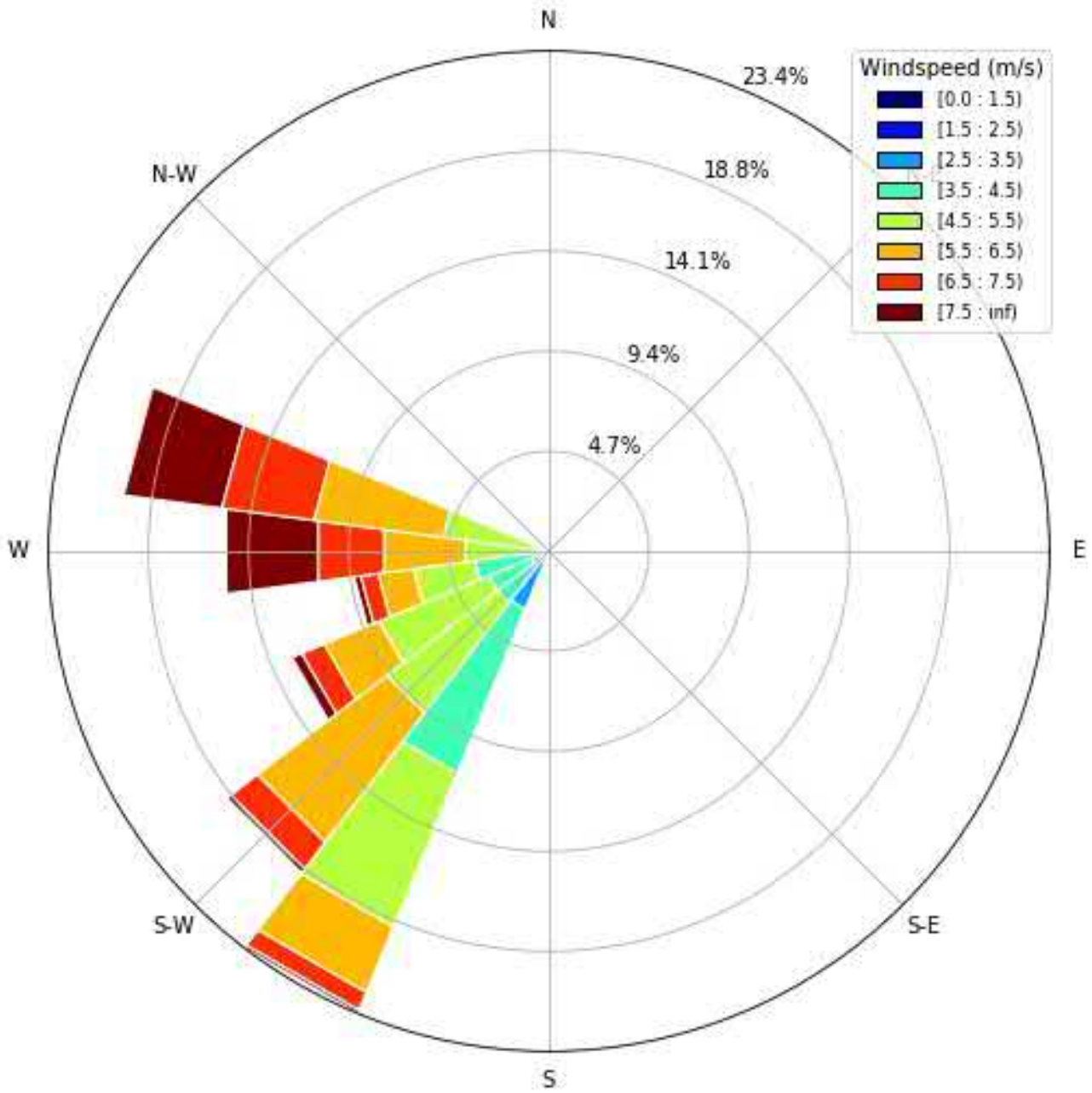
Belle River Wind Power Project
Phase 2 I-Audit Report

Appendix C.1.ii

R1126
Supplementary Wind Rose
based on Assessment Data

Background Noise

aercoustics



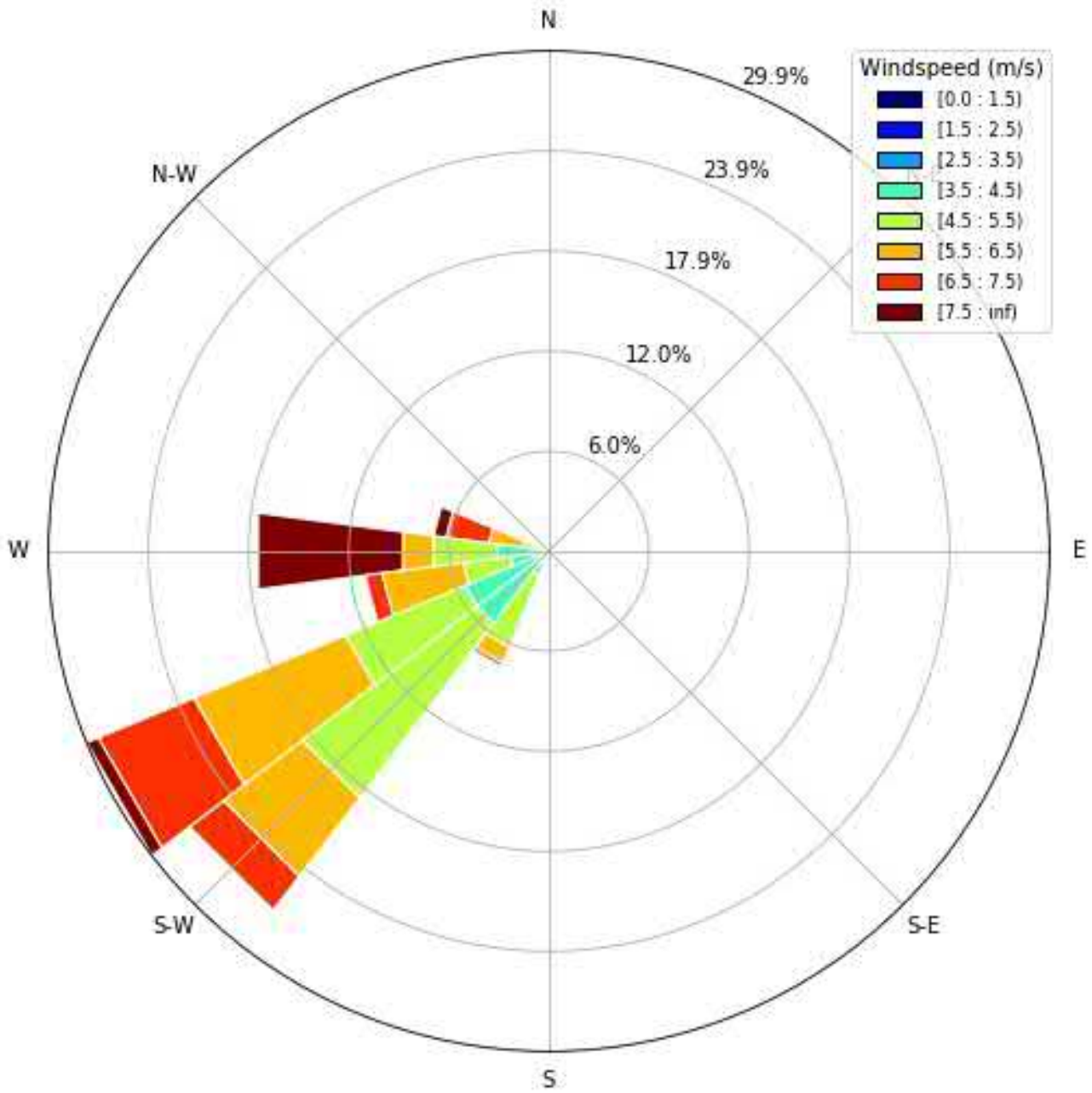
Project ID:	17095.01
Drawn by:	MWJ
Reveiwed by:	KC
Date:	Aug 5, 2020
Revision:	1
Scale:	NA

Belle River Wind Power Project
Phase 2 I-Audit Report

Appendix C.2.i

R1207
Supplementary Wind Rose
based on Assessment Data
Total Noise

aercoustics



Project ID:	17095.01
Drawn by:	MWJ
Reveiwed by:	KC
Date:	Aug 5, 2020
Revision:	1
Scale:	NA

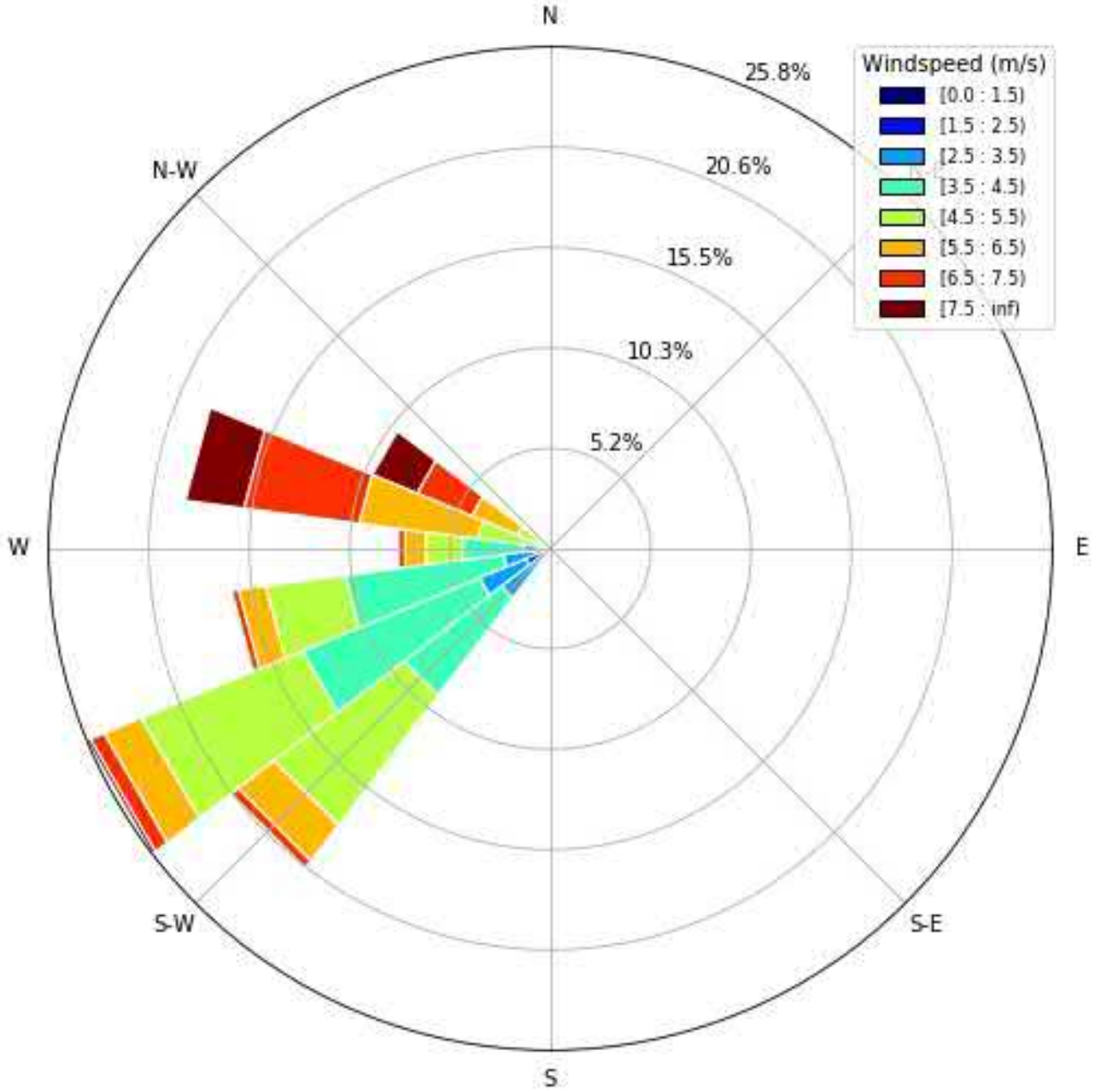
Belle River Wind Power Project
Phase 2 I-Audit Report

Appendix C.2.ii

R1207
Supplementary Wind Rose
based on Assessment Data

Background Noise

aercoustics



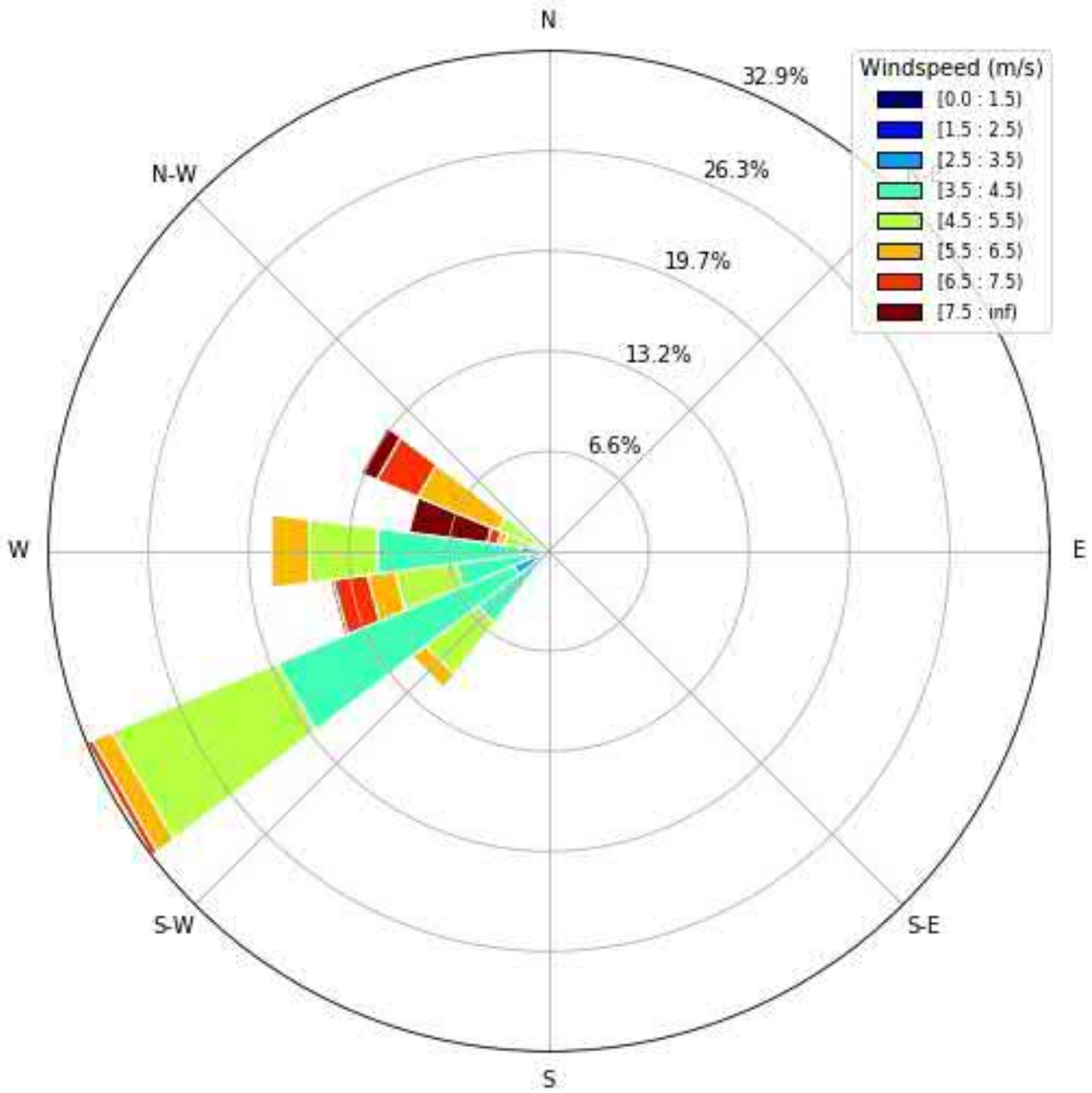
Project ID:	17095.01
Drawn by:	MWJ
Reveiwed by:	KC
Date:	Aug 5, 2020
Revision:	1
Scale:	NA

Belle River Wind Power Project
Phase 2 I-Audit Report

Appendix C.3.i

R1170
Supplementary Wind Rose
based on Assessment Data
Total Noise

aercoustics



Project ID:	17095.01
Drawn by:	MWJ
Reveiwed by:	KC
Date:	Aug 5, 2020
Revision:	1
Scale:	NA

Belle River Wind Power Project
Phase 2 I-Audit Report

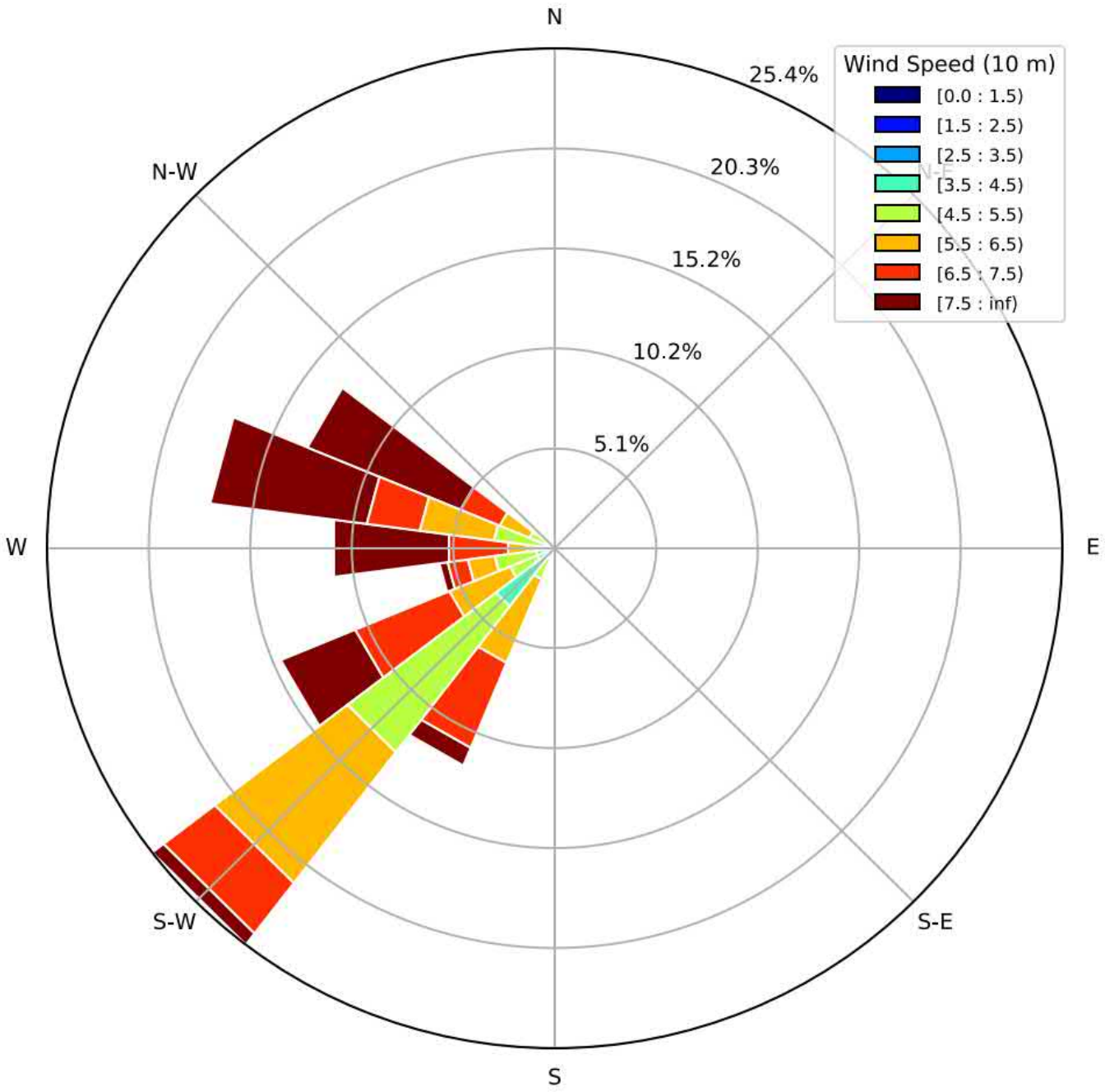
Appendix C.3.ii

R1170

Supplementary Wind Rose
based on Assessment Data

Background Noise

aercoustics



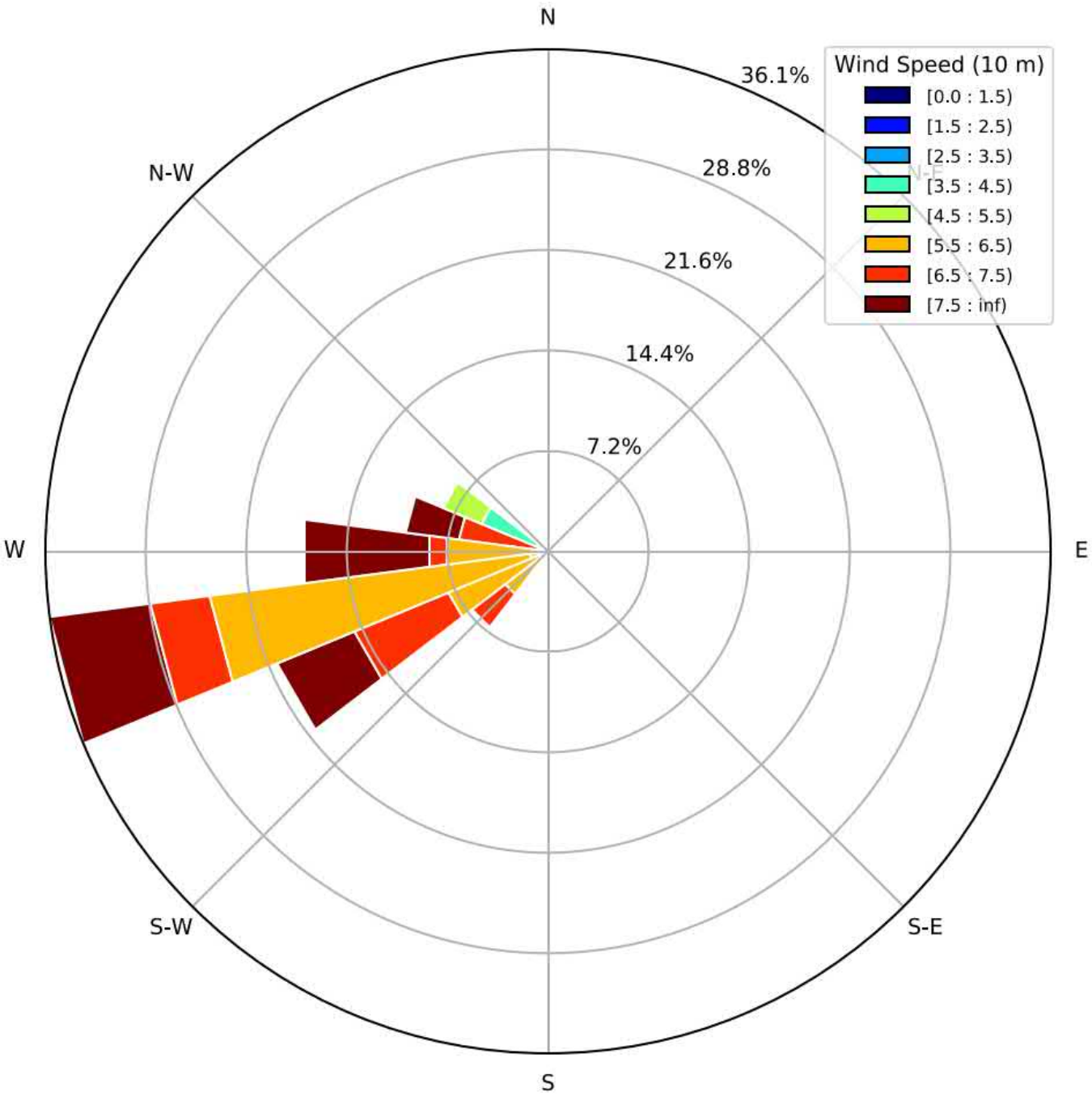
Project ID:	17095.01
Drawn by:	MWJ
Reveiwed by:	KC
Date:	Aug 5, 2020
Revision:	1
Scale:	NA

Belle River Wind Power Project
Phase 2 I-Audit Report

Appendix C.4.i

R1469
Supplementary Wind Rose
based on Assessment Data
Total Noise

aercoustics



Project ID:	17095.01
Drawn by:	MWJ
Reveiwed by:	KC
Date:	Aug 5, 2020
Revision:	1
Scale:	NA

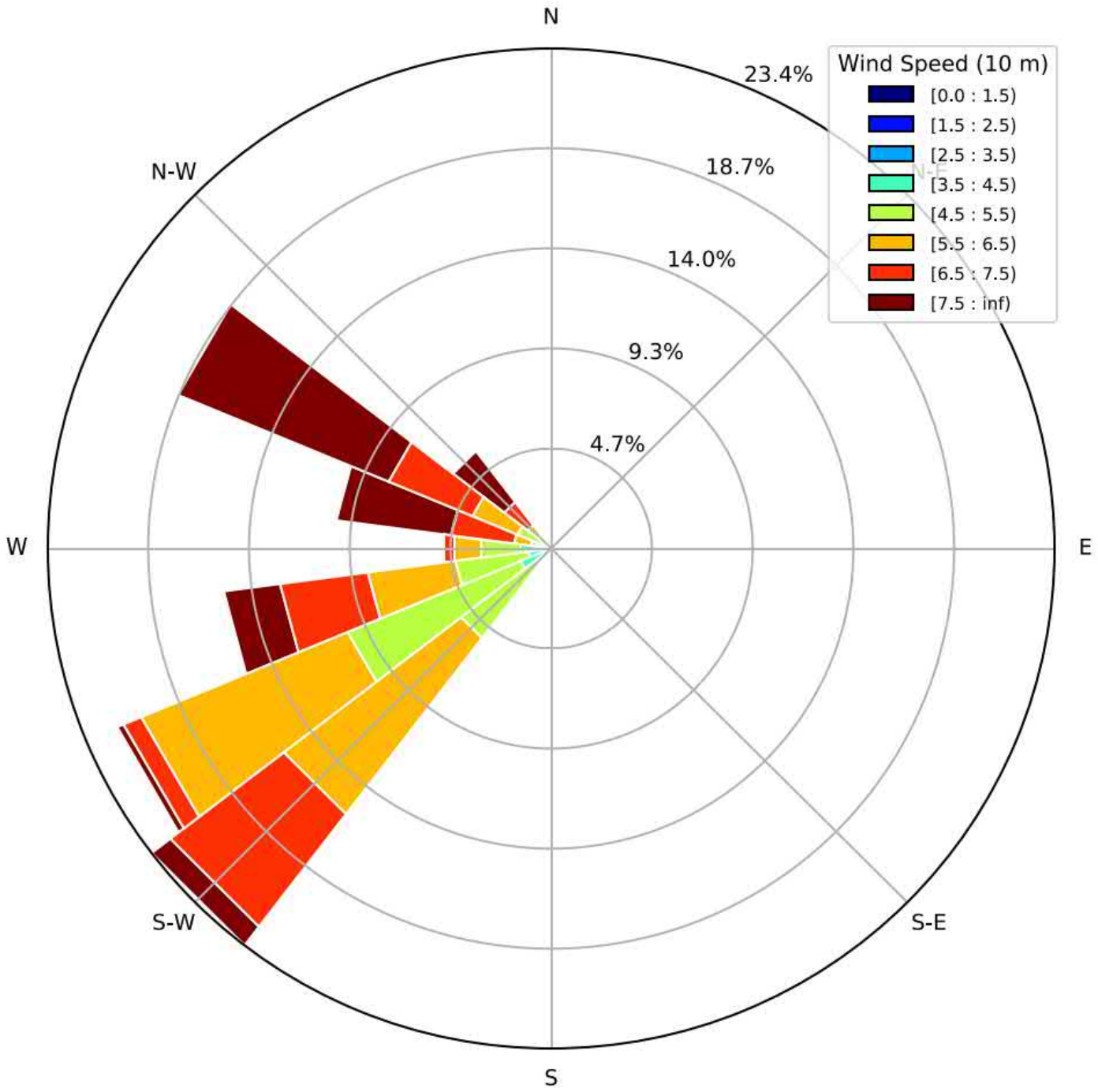
Belle River Wind Power Project
Phase 2 I-Audit Report

Appendix C.4.ii

R1469
Supplementary Wind Rose
based on Assessment Data

Background Noise

aercoustics



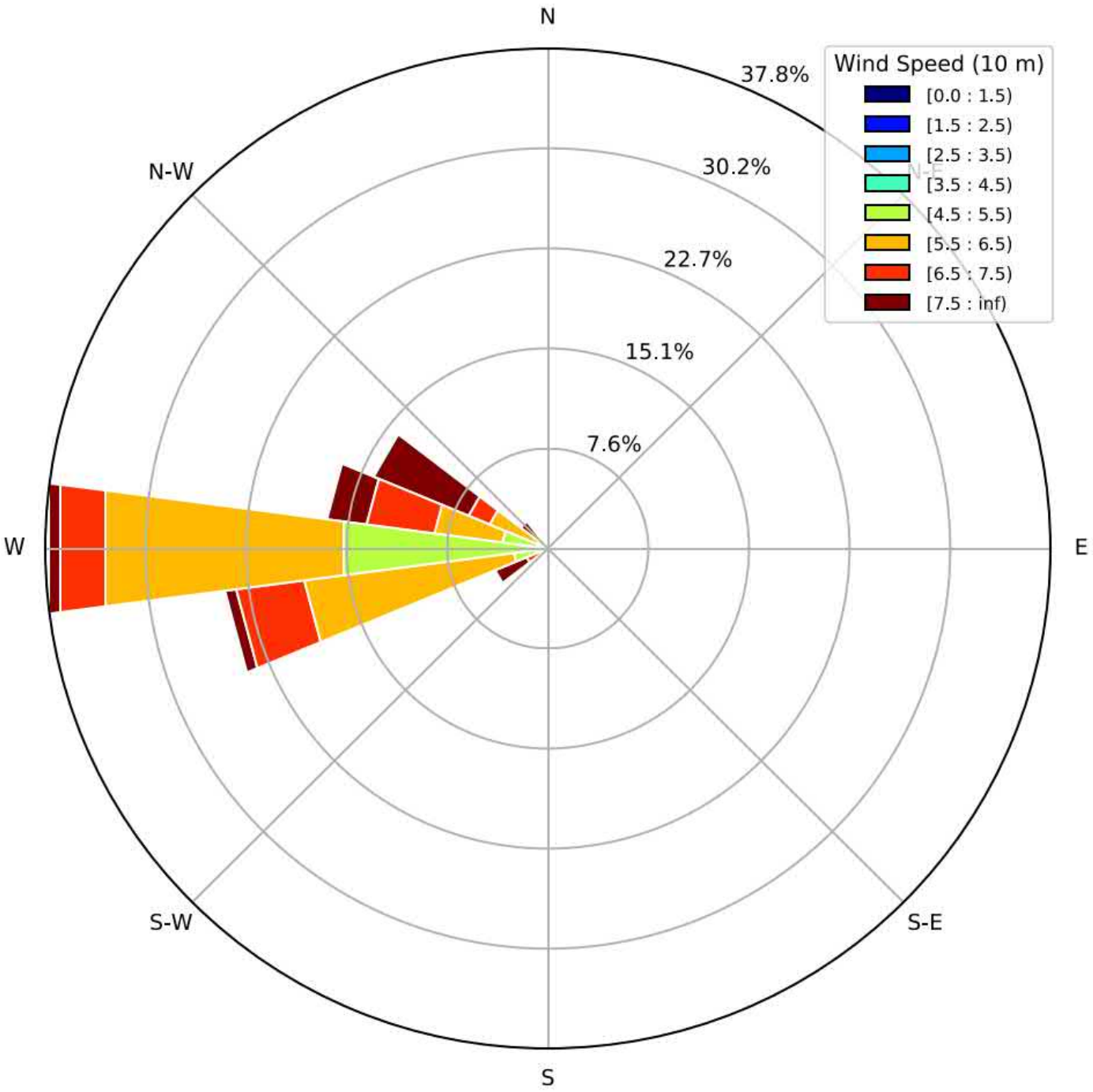
Project ID:	17095.01
Drawn by:	MWJ
Reveiwed by:	KC
Date:	Aug 5, 2020
Revision:	1
Scale:	NA

Belle River Wind Power Project
Phase 2 I-Audit Report

Appendix C.5.i

R2299
Supplementary Wind Rose
based on Assessment Data
Total Noise

aercoustics



Project ID:	17095.01
Drawn by:	MWJ
Reveiwed by:	KC
Date:	Aug 5, 2020
Revision:	1
Scale:	NA

Belle River Wind Power Project
Phase 2 I-Audit Report

Appendix C.5.ii

R2299

Supplementary Wind Rose
based on Assessment Data

Background Noise

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aercoustics.com

Appendix D
Turbine Operational Statement from Operator

SP Belle River Wind LP
2050 Derry Road West
2nd Floor
Mississauga, ON L5N 0B9
www.belleriverwind.com

January 21, 2020

Director, Environmental Approvals Access and Service
Integration Branch Ministry of Environment
2 St. St Clair Avenue West, Floor 12A
Toronto ON M4V 1L5

Subject: SP Belle River Wind LP Renewable Energy Approval Number 2765-A4ER2P Condition Receptor "Phase 1 Receptor I-Audit".

Dear Director

Please accept this letter as confirmation that all turbines tested during the fall audit of 2019 acoustics measurement campaign conducted by Aercoustics LTD. From September 9, 2019 to January 11, 2020 were operating normally for the duration of the campaign, with the exception of specific time periods during which the turbines were placed in remote owner stop to facilitate ambient noise measurements.

The turbines placed in remote owner stop for ambient measurements are as follows:

T8, T11, T20, T26, T28, T29, T30, T36, T38, T40, T44, T45, T46, T47, T48, T49, T50, T51, T52, T53, T54, T55, T58, T59, T62, T202, T205, T210, T211, T212

Sincerely,

Jonathan Miranda
Facility Manager
Belle River Wind Project
C: 289-407-8387

Operations & Maintenance Building Belle River
1624 Lakeshore road 125
Belle River Ontario, N0R 1A0
Canada

SP Belle River Wind LP
2050 Derry Road West
2nd Floor
Mississauga, ON L5N 0B9
www.belleriverwind.com

June 4, 2020

Director, Environmental Approvals Access and Service
Integration Branch Ministry of Environment
2 St. St Clair Avenue West, Floor 12A
Toronto ON M4V 1L5

Subject: SP Belle River Wind LP Renewable Energy Approval Number 2765-A4ER2P Condition Receptor "Phase 1 Receptor I-Audit".

Dear Director

"Please accept this letter as confirmation that all turbines tested during the spring audit of 2020 acoustics measurement campaign conducted by Aercoustics LTD. From February 7, 2020 until March 21, 2020 were operating normally for the duration of the campaign, with the exception of specific time periods during which the turbines were placed in remote owner stop to facilitate ambient noise measurements.

The turbines placed in remote owner stop for ambient measurements were as follows:

T20, T26, T28, T29, T30, T36, T38, T40, T44, T45, T46, T47, T51, T53, T54, T55, T202, T205, T210, T211, T212

Sincerely,

Jonathan Miranda
Facility Manager
Belle River Wind Project
C: 289-407-8387

Operations & Maintenance Building Belle River
1624 Lakeshore road 125
Belle River Ontario, N0R 1A0
Canada

aercoustics

Aercoustics Engineering Ltd.
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aercoustics.com

Appendix E
Tonality Assessment

Appendix E - Tonality Assessment Summary

Project: Belle River Wind Power Project - 2nd Acoustic Immission Audit R1126

Report ID: 17095.01

Created on: 2020-08-06

R1126 62 Hz Tonality Summary - IEC 61400-11 Edition 3.0 Analysis							
Wind Speed (m/s)	Data Count	Tone Count	Tonal Presence (%)	Turbine ONLY (dBA)	MECP Sound Level Limit (dBA)	Average Tonal Audability (dB)	Applicable Tonal Penalty (dB)
0	0	0	**	*	40	**	**
1	0	0	**	*	40	**	**
2	4	1	25%	*	40	-3.3	0.0
3	16	15	94%	*	40	2.1	0.0
4	124	76	61%	38	40	1.9	0.0
5	421	247	59%	38	40	1.8	0.0
6	297	186	63%	38	40	0.9	0.0
7	150	124	83%	38	40	-1.6	0.0

* Insufficient amount of data points as per RAM-I protocol

** No tonal data points at wind speed

R1126 78 Hz Tonality Summary - IEC 61400-11 Edition 3.0 Analysis							
Wind Speed (m/s)	Data Count	Tone Count	Tonal Presence (%)	Turbine ONLY (dBA)	MECP Sound Level Limit (dBA)	Average Tonal Audability (dB)	Applicable Tonal Penalty (dB)
0	0	0	**	*	40	**	**
1	0	0	**	*	40	**	**
2	4	1	25%	*	40	-3.3	0.0
3	16	15	94%	*	40	2.1	0.0
4	124	75	60%	38	40	1.9	0.0
5	421	248	59%	38	40	1.8	0.0
6	297	183	62%	38	40	1.0	0.0
7	150	124	83%	38	40	-1.7	0.0

* Insufficient amount of data points as per RAM-I protocol

** No tonal data points at wind speed

R1207 62 Hz Tonality Summary - IEC 61400-11 Edition 3.0 Analysis							
Wind Speed (m/s)	Data Count	Tone Count	Tonal Presence (%)	Turbine ONLY (dBA)	MECP Sound Level Limit (dBA)	Average Tonal Audability (dB)	Applicable Tonal Penalty (dB)
0	0	0	**	*	40	**	**
1	0	0	**	*	40	**	**
2	1	0	0%	*	40	**	**
3	118	39	33%	40	40	-1.2	0.0
4	513	308	60%	40	40	-1.0	0.0
5	837	631	75%	39	40	-0.3	0.0
6	710	489	69%	39	40	-1.9	0.0
7	332	104	31%	41	40	-3.3	0.0

* Insufficient amount of data points as per RAM-I protocol
** No tonal data points at wind speed

R1207 78 Hz Tonality Summary - IEC 61400-11 Edition 3.0 Analysis							
Wind Speed (m/s)	Data Count	Tone Count	Tonal Presence (%)	Turbine ONLY (dBA)	MECP Sound Level Limit (dBA)	Average Tonal Audability (dB)	Applicable Tonal Penalty (dB)
0	0	0	**	*	40	**	**
1	0	0	**	*	40	**	**
2	1	0	0%	*	40	**	**
3	118	39	33%	40	40	-1.2	0.0
4	513	302	59%	40	40	-1.2	0.0
5	837	616	74%	39	40	-0.8	0.0
6	710	475	67%	39	40	-2.2	0.0
7	332	99	30%	41	40	-3.8	0.0

* Insufficient amount of data points as per RAM-I protocol
** No tonal data points at wind speed

R1170 62 Hz Tonality Summary - IEC 61400-11 Edition 3.0 Analysis							
Wind Speed (m/s)	Data Count	Tone Count	Tonal Presence (%)	Turbine ONLY (dBA)	MECP Sound Level Limit (dBA)	Average Tonal Audability (dB)	Applicable Tonal Penalty (dB)
0	0	0	**	*	40	**	**
1	0	0	**	*	40	**	**
2	53	3	6%	*	40	3.4	0.0
3	250	133	53%	39	40	0.5	0.0
4	784	389	50%	39	40	-0.2	0.0
5	780	356	46%	39	40	-1.0	0.0
6	433	203	47%	38	40	-2.4	0.0
7	303	142	47%	38	40	-4.2	0.0

* Insufficient amount of data points as per RAM-I protocol
** No tonal data points at wind speed

R1170 78 Hz Tonality Summary - IEC 61400-11 Edition 3.0 Analysis							
Wind Speed (m/s)	Data Count	Tone Count	Tonal Presence (%)	Turbine ONLY (dBA)	MECP Sound Level Limit (dBA)	Average Tonal Audability (dB)	Applicable Tonal Penalty (dB)
0	0	0	**	*	40	**	**
1	0	0	**	*	40	**	**
2	53	3	6%	*	40	3.4	0.0
3	250	133	53%	39	40	0.5	0.0
4	784	387	49%	39	40	-0.2	0.0
5	780	353	45%	39	40	-1.0	0.0
6	433	200	46%	38	40	-2.4	0.0
7	303	141	47%	38	40	-4.2	0.0

* Insufficient amount of data points as per RAM-I protocol
** No tonal data points at wind speed

R1469 62 Hz Tonality Summary - IEC 61400-11 Edition 3.0 Analysis							
Wind Speed (m/s)	Data Count	Tone Count	Tonal Presence (%)	Turbine ONLY (dBA)	MECP Sound Level Limit (dBA)	Average Tonal Audability (dB)	Applicable Tonal Penalty (dB)
0	0	0	**	*	40	**	**
1	1	1	**	*	40	0.8	0.0
2	5	5	100%	*	40	1.7	0.0
3	17	17	100%	*	40	1.9	0.0
4	152	151	99%	36	40	3.0	0.0
5	437	428	98%	38	40	1.6	0.0
6	562	535	95%	36	40	0.3	0.0
7	514	436	85%	33	40	-0.5	0.0

* Insufficient amount of data points as per RAM-I protocol
** No tonal data points at wind speed

R1469 78 Hz Tonality Summary - IEC 61400-11 Edition 3.0 Analysis							
Wind Speed (m/s)	Data Count	Tone Count	Tonal Presence (%)	Turbine ONLY (dBA)	MECP Sound Level Limit (dBA)	Average Tonal Audability (dB)	Applicable Tonal Penalty (dB)
0	0	0	**	*	40	**	**
1	1	1	100%	*	40	0.8	0.0
2	5	5	100%	*	40	1.7	0.0
3	17	17	100%	*	40	1.9	0.0
4	152	151	99%	36	40	3.0	0.0
5	437	428	98%	38	40	1.6	0.0
6	562	534	95%	36	40	0.2	0.0
7	514	438	85%	33	40	-0.6	0.0

* Insufficient amount of data points as per RAM-I protocol
** No tonal data points at wind speed

R2299 62 Hz Tonality Summary - IEC 61400-11 Edition 3.0 Analysis							
Wind Speed (m/s)	Data Count	Tone Count	Tonal Presence (%)	Turbine ONLY (dBA)	MECP Sound Level Limit (dBA)	Average Tonal Audability (dB)	Applicable Tonal Penalty (dB)
0	0	0	**	*	40	**	**
1	0	0	**	*	40	**	**
2	0	0	**	*	40	**	**
3	3	3	100%	*	40	2.3	0.0
4	104	83	80%	40	40	-0.5	0.0
5	395	296	75%	38	40	-2.4	0.0
6	569	420	74%	37	40	-2.2	0.0
7	392	240	61%	32	40	-2.5	0.0

* Insufficient amount of data points as per RAM-I protocol
** No tonal data points at wind speed

R2299 78 Hz Tonality Summary - IEC 61400-11 Edition 3.0 Analysis							
Wind Speed (m/s)	Data Count	Tone Count	Tonal Presence (%)	Turbine ONLY (dBA)	MECP Sound Level Limit (dBA)	Average Tonal Audability (dB)	Applicable Tonal Penalty (dB)
0	0	0	**	*	40	**	**
1	0	0	**	*	40	**	**
2	0	0	**	*	40	**	**
3	3	3	100%	*	40	2.3	0.0
4	104	82	79%	40	40	-0.5	0.0
5	395	296	75%	38	40	-2.4	0.0
6	569	425	75%	37	40	-2.2	0.0
7	392	243	62%	32	40	-2.4	0.0

* Insufficient amount of data points as per RAM-I protocol
** No tonal data points at wind speed

aercoustics

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

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

Appendix F
Calibration Certificates

Calibration Certificates –

Details are disclosed in the table below regarding the calibration of the equipment used for the Phase 2 I-Audit campaign at R1126. 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 preamplifier, and 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 Calibrated [YYYY-MM-DD]	Measurement Interval	Confirmation of Validity for Measurement Interval?
Sound Level Meter	NI 9234	19A4D6B	2019-08-26	Sept 19 – Jan 11	Yes
Microphone/ Pre-amplifier Pair	PCB 377B02	132194	2019-05-16	Sept 19 – Jan 11	Yes
Microphone	PCB 377B02	177759	2019-05-16	Sept 19 – Jan 11	Yes
Pre-amplifier	PCB 426E01	51463	2019-05-16	Sept 19 – Jan 11	Yes
Signal Conditioner	PCB 480E09	34592	2019-05-09	Sept 19 – Jan 11	Yes
Weather Anemometer	Vaisala WXT520	M0410645	2019-07-25	Sept 19 – Nov 16	Yes
Weather Anemometer	Vaisala WXT536	R3250417	2019-08-09	Nov 16 – Jan 11	Yes

Compliant Calibration Certificate

NATIONAL INSTRUMENTS
CALIBRATED
SN/ID 19A4D82
DATE: 26-AUG-2019
DUE: 26-AUG-2020
ni.com/calibration

Certificate Number:	6126156.1	**OE Number:**	21733250
Date Printed:	26-AUG-2019	**Page:**	1 of 14
Customer:	Aercoustics Engineering LTD (CA) 1004 Middlegate Road Suite 1100 ONTARIO MISSISSAUGA, L4Y 0G1 CANADA		
Manufacturer:	National Instruments	**Model:**	NI 9234
Serial Number:	19A4D82		
Part Number:	195551B-01L	**Description:**	MODULE ASSY,NI 9234, 4 AI CONFIGURABLE
Calibration Date:	26-AUG-2019	**Issued Date:**	26-AUG-2019
Procedure Name:	NI 9234	**Recommended Calibration Due:**	26-AUG-2020
Procedure Version:	3.6.1.0	**Verification Results:**	As Found: Passed As Left: Passed
Lab Technician:	Rodolfo Maldonado	**Calibration Executive Version:**	4.6.2.0
		Driver Info:	NI-DAQmx:17.6.0
Temperature:	23.0° C	**Humidity:**	42.8% 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.



Ted Talley
Technical Manager

National Instruments Calibration Services Austin
Building A
11500 N MoPac Expwy
AUSTIN, TX 78759-3504
USA
Tel: (800) 531-5066

NATIONAL INSTRUMENTS™

CERTIFICATE of CALIBRATION

Make : PCB Piezotronics

Reference # : 157209

Model : 378B02

Customer : Aercoustics Engineering Ltd
Mississauga, ON

Descr. : Microphone System 1/2" Free Field

Serial # : 132194

P. Order : 2019.05.16C

Asset # : 01163

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 Quality System 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 : May 16, 2019

By : Petro Onasko

Cal. Due : May 16, 2021

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

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CERTIFICATE of CALIBRATION

Make :	PCB Piezotronics	Reference # :	157112
Model :	480E09	Customer :	Aercoustics Engineering Ltd Mississauga, ON
Descr. :	Conditioning Amplifier		
Serial # :	00034592	P. Order :	2019.05.08C
Asset # :	01043		

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 Quality System 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 : May 09, 2019 By : Petro Onasko

Cal. Due : May 09, 2021

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

Standards used : J-255 J-301 J-512

Navair Technologies

REPAIR AND CALIBRATION TRACEABLE TO NRC AND NIST

6375 Dixie Rd. Mississauga, ON, L5T 2E7
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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: 19.US2.06532 **Date of issue:** July 25, 2019

Type: Vaisala Weather Transmitter, WXT520 **Serial number:** M0410645

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: July 24, 2019 **Anemometer calibrated:** July 25, 2019

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] = 1.01710 · U [m/s] + 0.07250

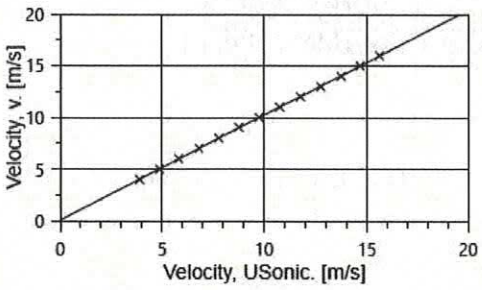
Standard uncertainty, slope: 0.00234 **Standard uncertainty, offset:** 0.34260

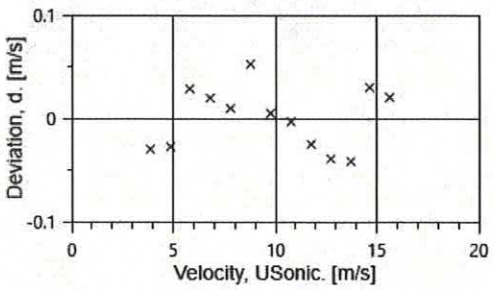
Covariance: -0.0000553 (m/s)²/m/s **Coefficient of correlation:** ρ = 0.999970

Absolute maximum deviation: 0.053 m/s at 9.048 m/s

Barometric pressure: 1007.0 hPa **Relative humidity:** 43.1%

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]
2	9.26	27.6	31.2	3.996	3.8867	-0.030	0.023
4	14.54	27.6	31.2	5.008	4.8793	-0.028	0.026
6	20.99	27.6	31.2	6.017	5.8167	0.029	0.030
8	28.56	27.6	31.2	7.019	6.8100	0.020	0.034
10	37.20	27.6	31.2	8.010	7.7950	0.010	0.038
12	47.47	27.6	31.2	9.048	8.7733	0.053	0.043
13-last	58.09	27.6	31.2	10.010	9.7655	0.005	0.047
11	70.49	27.6	31.2	11.027	10.7733	-0.003	0.051
9	83.83	27.6	31.2	12.026	11.7767	-0.025	0.056
7	98.14	27.6	31.2	13.012	12.7600	-0.039	0.060
5	113.82	27.6	31.2	14.013	13.7467	-0.042	0.064
3	130.89	27.6	31.2	15.027	14.6733	0.030	0.069
1-first	148.39	27.5	31.2	15.999	15.6383	0.021	0.073





EQUIPMENT USED

Serial Number	Description
Njord2	Wind tunnel, blockage factor = 1.0035
13924	Control cup anemometer
-	Mounting tube, D = 19 mm
TT003	Summit Electronics, 1XPT100, 0-10V Output, wind tunnel temp.
TP001	PR Electronics 5102, 0-10V Output, differential pressure box temp.
DP008	Setra Model 239, 0-1inWC, differential pressure transducer
HY002	Dwyer RHP-2D20, 0-10V Output, humidity transmitter
BP003	Setra M278, 0-5VDC Output, 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.

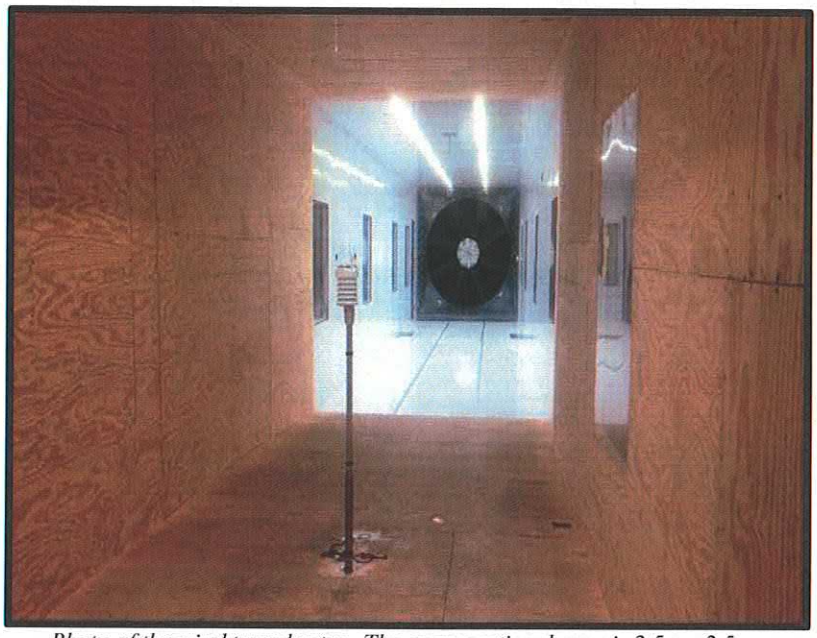


Photo of the wind tunnel setup. The cross-sectional area is 2.5m x 2.5m.

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 calibrated at the 90° position.

Certificate number: 19.US2.06532

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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

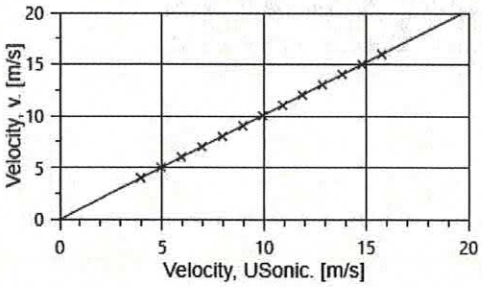
Certificate number: 19.US2.06529 **Date of issue:** July 25, 2019
Type: Vaisala Weather Transmitter, WXT520 **Serial number:** M0410645
Manufacturer: Vaisala, Oyj, Pl 26, FIN-00421 Helsinki, Finland
Client: Aercoustics Engineering Ltd., 1004 Middlegate RD, Suite 1100, S.Tower, Mississauga, ON L4Y 1M4, Canada

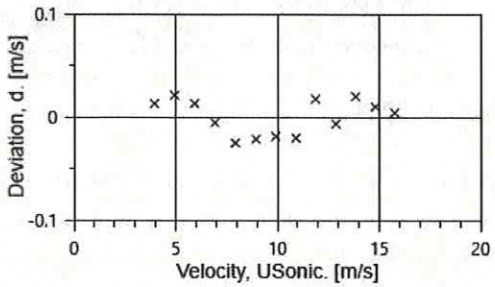
Anemometer received: July 24, 2019 **Anemometer calibrated:** July 25, 2019
Calibrated by: MEJ **Procedure:** MEASNET, IEC 61400-12-1:2017 Annex F
Certificate prepared by: EJF **Approved by:** Calibration engineer, EJF

Calibration equation obtained: v [m/s] = 1.01604 · U [m/s] + -0.04297

Standard uncertainty, slope: 0.00133 **Standard uncertainty, offset:** -0.33175
Covariance: -0.0000180 (m/s)²/m/s **Coefficient of correlation:** ρ = 0.999990
Absolute maximum deviation: -0.025 m/s at 8.009 m/s
Barometric pressure: 1007.1 hPa **Relative humidity:** 43.2%

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]
2	9.24	27.5	31.1	3.990	3.9567	0.013	0.023
4	14.55	27.5	31.2	5.007	4.9500	0.021	0.026
6	20.92	27.5	31.2	6.005	5.9400	0.013	0.030
8	28.53	27.5	31.2	7.013	6.9500	-0.006	0.034
10	37.21	27.5	31.2	8.009	7.9500	-0.025	0.038
12	47.36	27.5	31.2	9.036	8.9567	-0.022	0.043
13-last	58.27	27.5	31.2	10.023	9.9259	-0.019	0.047
11	70.54	27.5	31.2	11.028	10.9167	-0.020	0.051
9	84.05	27.5	31.2	12.038	11.8733	0.017	0.056
7	98.47	27.5	31.2	13.030	12.8733	-0.007	0.060
5	114.25	27.5	31.2	14.036	13.8367	0.020	0.064
3	130.67	27.5	31.2	15.011	14.8067	0.010	0.068
1-first	148.17	27.4	31.1	15.984	15.7700	0.004	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
TT003	Summit Electronics, 1XPT100, 0-10V Output, wind tunnel temp.
TP001	PR Electronics 5102, 0-10V Output, differential pressure box temp.
DP008	Setra Model 239, 0-1inWC, differential pressure transducer
HY002	Dwyer RHP-2D20, 0-10V Output, humidity transmitter
BP003	Setra M278, 0-5VDC Output, 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 calibrated at the 0° position.

Certificate number: 19.US2.06529

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VAISALA

#1432

Test report no. H31-19320133

TEST REPORT

Product family	WXT530 series
Product type	WXT536
Order code	6B1B2A4B1A1B
Serial number	R3250417
Manufacturer	Vaisala Oyj, Finland
Test date	9 August 2019

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

Test results

Test	Result	Lower limit	Upper limit	Unit
Rain response	375	345	575	mV
Zero wind speed	0	0	0.4	m/s
Pressure difference	-0.22	-1	1	hPa
Temperature difference	0.38	-2	2	°C
Humidity difference	-0.79	-10	10	%RH
Heating current	0.7	0.6	0.8	A
Current (service port)	1.18	0.5	2	mA
Communication (service port)	pass	PASS	PASS	-
Current (main port)	0.83	0.5	2	mA
Communication (main port)	pass	PASS	PASS	-

Ambient conditions / Humidity 48.43 ±5 %RH, Temperature 24.6 ±1 °C, Pressure 1002.29 ±1 hPa.

Signature

Technician

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

VAISALA

Calibration sheet no. H31-19320134

CALIBRATION SHEET

Instrument	WXTPTU
Serial number	R2910065
Manufacturer	Vaisala Oyj, Finland
Test date	11 July 2019

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

Calibration results

Test phase of calibration process	Reference value	Observed value	Difference*	Uncertainty**
Pressure	1084.1	1084.1	0	± 0.4 hPa
Pressure	904.9	904.9	0	± 0.4 hPa
Pressure	798.9	798.9	0	± 0.4 hPa
Pressure	599.2	599.2	0	± 0.4 hPa
Temperature	59.7	59.7	0	± 0.2 °C
Temperature	-5.9	-5.9	0	± 0.2 °C
Temperature	-32.7	-32.8	-0.1	± 0.2 °C
Temperature	24.9	24.9	0	± 0.2 °C
Temperature	-52.8	-52.8	0	± 0.2 °C
Relative humidity	29.3	29.3	0	± 2 %RH
Relative humidity	58.5	58.5	0	± 2 %RH
Relative humidity	92.4	92.4	0	± 3 %RH

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

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

Signature



Technician

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

Calibration Certificates –

Details are disclosed in the table below regarding the calibration of the equipment used for the Phase 2 I-Audit campaign at R1207. 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 preamplifier, and 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 Calibrated [YYYY-MM-DD]	Measurement Interval	Confirmation of Validity for Measurement Interval?
Sound Level Meter	NI 9234	1AA831C	2019-07-22	Sept 19 – Jan 11	Yes
Microphone/ Pre-amplifier Pair	PCB 377B02	132192	2019-06-28	Sept 19 – Jan 11	Yes
Microphone	PCB 377B02	174130	2019-06-28	Sept 19 – Jan 11	Yes
Pre-amplifier	PCB 426E01	51461	2019-06-28	Sept 19 – Jan 11	Yes
Signal Conditioner	PCB 480E09	35342	2019-06-27	Sept 19 – Jan 11	Yes
Weather Anemometer	Vaisala WXT536	R1020385	2019-03-05	Sept 19 – Jan 11	Yes

Compliant Calibration Certificate

Template Revision: Feb2018

Certificate Number:	6095071.1	**OE Number:**	21719015
Date Printed:	22-JUL-2019	**Page:**	1 of 14
Customer:	Aercoustics Engineering LTD (CA) 1004 Middlegate Rd No 1100 ONTARIO MISSISSAUGA, L4Y 1M4 CANADA		
Manufacturer:	National Instruments	**Model:**	NI 9234
Serial Number:	1AA831C		
Part Number:	195551B-01L	**Description:**	MODULE ASSY,NI 9234, 4 AI CONFIGURABLE
Calibration Date:	22-JUL-2019	**Recommended Calibration Due:**	22-JUL-2020
Procedure Name:	NI 9234	**Verification Results:**	As Found: Passed As Left: Passed
Procedure Version:	3.6.1.0	**Calibration Executive Version:**	4.6.2.0
Lab Technician:	Rachel McKinnon	**Driver Info:**	NI-DAQmx:17.6.0
Temperature:	23.0° C	**Humidity:**	43.4% RH

NATIONAL INSTRUMENTS
CALIBRATED
SN/ID 1AA831C
DATE: 22-JUL-2019
DUE: 22-JUL-2020
ni.com/calibration

The data found in this certificate must be interpreted as:

As Found The calibration data of the unit as received by National Instruments.

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 Z540.1-1994 (R2002) requirements.

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%. The uncertainty is calculated at time of calibration and does not include the object long-term stability and different environmental and operational conditions.

Results are reviewed to establish where any measurement results exceeded the manufacturer's specifications. Measured values greater than the Manufacturer's specification limits are marked as 'Failed', measured values within the Manufacturer's specifications are marked as 'Passed'.

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 E-mail customer.service@NI.com**

Ted Talley
Technical Manager

National Instruments Calibration Services Austin
Building A
11500 N MoPac Expwy
AUSTIN, TX 78759-3504
USA
Tel: (800) 531-5066

NATIONAL INSTRUMENTS

CERTIFICATE of CALIBRATION

Make :	PCB Piezotronics	Reference # :	157710
Model :	378B02	Customer :	Aercoustics Engineering Ltd Mississauga, ON
Descr. :	Microphone System 1/2" Free Field		
Serial # :	132192	P. Order :	2019.06.26C
Asset # :	01161		

Cal. status : Received in spec's, no adjustment made.
Preamp System with Mic 377B02 s/n 174130

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 Quality System 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 28, 2019 By : Petro Onasko

Cal. Due : Jun 28, 2021

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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CERTIFICATE of CALIBRATION

Make :	PCB Piezotronics	Reference # :	157718
Model :	480E09	Customer :	Aercoustics Engineering Ltd Mississauga, ON
Descr. :	Conditioning Amplifier		
Serial # :	00035342	P. Order :	2019.06.26C
Asset # :	01229		

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 Quality System 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 27, 2019 By : Petro Onasko

Cal. Due : Jun 27, 2021

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

Standards used : J-255 J-301 J-512

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VAISALA

#145

Test report no. H31-19100074

TEST REPORT

Product family	WXT530 series
Product type	WXT536
Order code	6B1B2A4B1A1B
Serial number	R1020385
Manufacturer	Vaisala Oyj, Finland
Test date	5 March 2019

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

Test results

Test	Result	Lower limit	Upper limit	Unit
Rain response	382	345	575	mV
Zero wind speed	0	0	0.4	m/s
Pressure difference	-0.17	-1	1	hPa
Temperature difference	0.03	-2	2	°C
Humidity difference	-1.13	-10	10	%RH
Heating current	0.71	0.6	0.8	A
Current (service port)	1.04	0.5	2	mA
Communication (service port)	pass	PASS	PASS	-
Current (main port)	0.7	0.5	2	mA
Communication (main port)	pass	PASS	PASS	-

Ambient conditions / Humidity 13.08 ±5 %RH, Temperature 23.03 ±1 °C, Pressure 979.56 ±1 hPa.

Signature

Technician

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Domicile Vantaa, Finland | VAT FI01244162 | Business ID 0124416-2

VAISALA

Calibration sheet no. H31-19100075

CALIBRATION SHEET

Instrument	WXTPTU
Serial number	R0350180
Manufacturer	Vaisala Oyj, Finland
Test date	21 January 2019

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

Calibration results

Test phase of calibration process	Reference value	Observed value	Difference*	Uncertainty**
Pressure	1085.8	1085.8	0	± 0.4 hPa
Pressure	901.1	901.2	0.1	± 0.4 hPa
Pressure	795.5	795.6	0.1	± 0.4 hPa
Pressure	596.3	596.3	0	± 0.4 hPa
Temperature	59.7	59.7	0	± 0.2 °C
Temperature	-5.7	-5.7	0	± 0.2 °C
Temperature	-32.2	-32.2	0	± 0.2 °C
Temperature	24.6	24.6	0	± 0.2 °C
Temperature	-51.9	-51.9	0	± 0.2 °C
Relative humidity	29.6	29.6	0	± 2 %RH
Relative humidity	57.7	57.7	0	± 2 %RH
Relative humidity	91.3	91.3	0	± 3 %RH

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

Traceability

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

Signature

Technician

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Calibration Certificates –

Details are disclosed in the table below regarding the calibration of the equipment used for the Phase 2 I-Audit campaign at R1170. 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 preamplifier, and 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 Calibrated [YYYY-MM-DD]	Measurement Interval	Confirmation of Validity for Measurement Interval?
Sound Level Meter	NI 9234	1D571FE	2019-07-10	Sept 19 – Jan 11	Yes
Microphone/ Pre-amplifier Pair	PCB 377B02	122654	2019-06-28	Sept 19 – Oct 29	Yes
Microphone	PCB 377B02	155181	2019-06-28	Sept 19 – Oct 29	Yes
Pre-amplifier	PCB 426E01	40835	2019-06-28	Sept 19 – Oct 29	Yes
Microphone/ Pre-amplifier Pair	PCB 377B02	124740	2019-09-05	Oct 29 – Jan 11	Yes
Microphone	PCB 377B02	163368	2019-09-05	Oct 29 – Jan 11	Yes
Pre-amplifier	PCB 426E01	43344	2019-09-05	Oct 29 – Jan 11	Yes
Signal Conditioner	PCB 480E09	33804	2019-06-27	Sept 19 – Jan 11	Yes
Weather Anemometer	Vaisala WXT520	M0410646	2019-08-29	Sept 19 – Jan 11	Yes

Compliant Calibration Certificate

Template Revision: Feb2018

Certificate Number:	6084320.1	**OE Number:**	21713479
Date Printed:	10-JUL-2019	**Page:**	1 of 14
Customer:	Aercoustics Engineering LTD (CA) 1004 Middlegate Road Suite 1100 ONTARIO MISSISSAUGA, L4Y 0G1 CANADA		
Manufacturer:	National Instruments	**Model:**	NI 9234
Serial Number:	1D571FE		
Part Number:	195551C-01L	**Description:**	MODULE ASSY,NI 9234, 4 AI CONFIGURABLE
Calibration Date:	10-JUL-2019	**Recommended Calibration Due:**	10-JUL-2020
Procedure Name:	NI 9234	**Verification Results:**	As Found: Passed As Left: Passed
Procedure Version:	3.6.1.0	**Calibration Executive Version:**	4.6.2.0
Lab Technician:	Carlos Perez	**Driver Info:**	NI-DAQmx:17.6.0
Temperature:	23.0° C	**Humidity:**	44.8% RH

NATIONAL INSTRUMENTS
CALIBRATED
S/N/ID 1D571FE
DATE 10-JUL-2019
DUE 10-JUL-2020
ni.com/calibration

The data found in this certificate must be interpreted as:

As Found The calibration data of the unit as received by National Instruments.

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 Z540.1-1994 (R2002) requirements.

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%. The uncertainty is calculated at time of calibration and does not include the object long-term stability and different environmental and operational conditions.

Results are reviewed to establish where any measurement results exceeded the manufacturer's specifications. Measured values greater than the Manufacturer's specification limits are marked as 'Failed', measured values within the Manufacturer's specifications are marked as 'Passed'.

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 E-mail customer.service@NI.com**

Ted Talley
Technical Manager

National Instruments Calibration Services Austin
Building A
11500 N MoPac Expwy
AUSTIN, TX 78759-3504
USA
Tel: (800) 531-5066

NATIONAL INSTRUMENTS

CERTIFICATE of CALIBRATION

Make :	PCB Piezotronics	Reference # :	157705
Model :	378B02	Customer :	Aercoustics Engineering Ltd Mississauga, ON
Descr. :	Microphone System 1/2" Free Field		
Serial # :	122654	P. Order :	2019.06.26C
Asset # :	00810		

Cal. status : Received in spec's, no adjustment made.
Preamp System with Mic 377B02 s/n 155181

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 Quality System 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 28, 2019 By : Petro Onasko

Cal. Due : Jun 28, 2021

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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CERTIFICATE of CALIBRATION

Make :	PCB Piezotronics	Reference # :	158601
Model :	378B02	Customer :	Aercoustics Engineering Ltd Mississauga, ON
Descr. :	Microphone System 1/2" Free Field		
Serial # :	124740	P. Order :	2019.09.03C
Asset # :	00760		

Cal. status : Received in spec's, no adjustment made.
Preamp System with Mic 377B02 s/n 163368

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 Quality System 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 : Sep 05, 2019 By : Petro Onasko

Cal. Due : Sep 05, 2021

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

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

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CERTIFICATE of CALIBRATION

Make :	PCB Piezotronics	Reference # :	157714
Model :	480E09	Customer :	Aercoustics Engineering Ltd Mississauga, ON
Descr. :	Conditioning Amplifier		
Serial # :	00033804	P. Order :	2019.06.26C
Asset # :	00763		

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 Quality System 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 27, 2019 By : Petro Onasko

Cal. Due : Jun 27, 2021

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

Standards used : J-255 J-301 J-512

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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: 19.US2.07598 **Date of issue:** August 29, 2019

Type: Vaisala Weather Transmitter, WXT520 **Serial number:** M0410646

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: August 26, 2019 **Anemometer calibrated:** August 28, 2019

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] = 1.01843 · U [m/s] + 0.01022

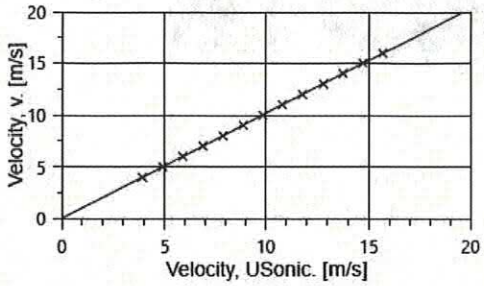
Standard uncertainty, slope: 0.00149 **Standard uncertainty, offset:** 1.55662

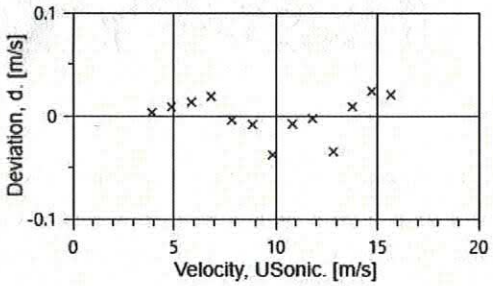
Covariance: -0.0000226 (m/s)²/m/s **Coefficient of correlation:** $\rho = 0.999988$

Absolute maximum deviation: -0.038 m/s at 10.013 m/s

Barometric pressure: 999.4 hPa **Relative humidity:** 43.1%

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]
2	9.21	25.4	31.2	3.985	3.9000	0.003	0.023
4	14.51	25.5	31.2	5.002	4.8931	0.009	0.026
6	20.96	25.5	31.2	6.012	5.8800	0.013	0.030
8	28.54	25.5	31.2	7.015	6.8600	0.019	0.034
10	37.25	25.5	31.2	8.014	7.8633	-0.004	0.038
12	47.37	25.5	31.3	9.039	8.8733	-0.008	0.043
13-last	58.13	25.5	31.3	10.013	9.8586	-0.038	0.047
11	70.43	25.5	31.3	11.022	10.8200	-0.008	0.051
9	83.74	25.5	31.2	12.018	11.7933	-0.003	0.056
7	98.47	25.5	31.2	13.032	12.8200	-0.035	0.060
5	114.17	25.5	31.2	14.032	13.7600	0.009	0.064
3	130.90	25.4	31.2	15.025	14.7200	0.024	0.068
1-first	148.32	25.4	31.2	15.993	15.6733	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
TT003	Summit Electronics, 1XPT100, 0-10V Output, wind tunnel temp.
TP001	PR Electronics 5102, 0-10V Output, differential pressure box temp.
DP008	Setra Model 239, 0-1inWC, differential pressure transducer
HY002	Dwyer RHP-2D20, 0-10V Output, humidity transmitter
BP003	Setra M278, 0-5VDC Output, 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.

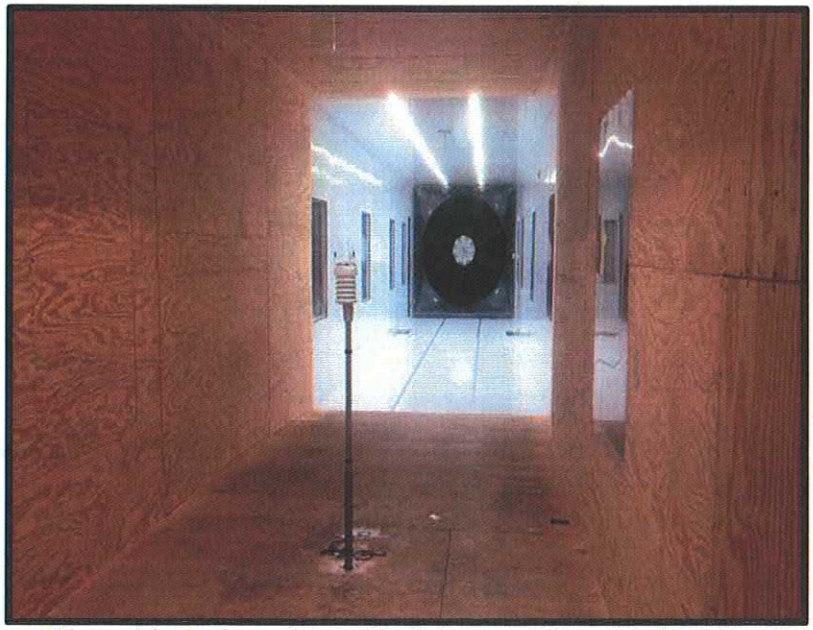


Photo of the wind tunnel setup. The cross-sectional area is 2.5m x 2.5m.

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 positioned at 0° during the calibration.

Certificate number: 19.US2.07598

The results on this certificate relate only to the serial number listed.
All calibrations are done in the "As Left" condition unless otherwise noted.
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CERTIFICATE FOR CALIBRATION OF SONIC ANEMOMETER

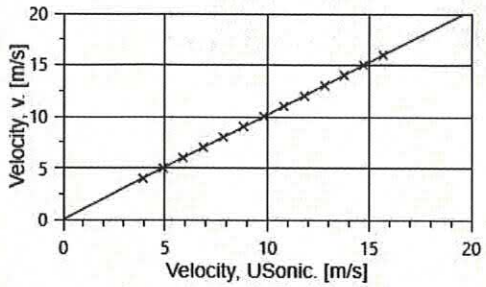
Certificate number: 19.US2.07597 **Date of issue:** August 29, 2019
Type: Vaisala Weather Transmitter, WXT520 **Serial number:** M0410646
Manufacturer: Vaisala, Oyj, Pl 26, FIN-00421 Helsinki, Finland
Client: Aercoustics Engineering Ltd., 1004 Middlegate RD, Suite 1100, S.Tower, Mississauga, ON L4Y 1M4, Canada

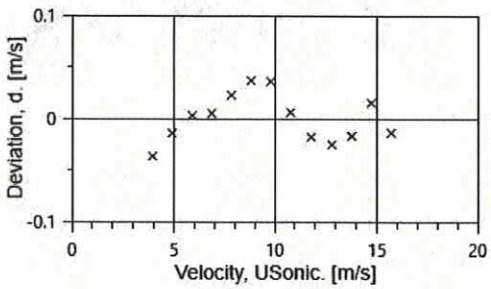
Anemometer received: August 26, 2019 **Anemometer calibrated:** August 28, 2019
Calibrated by: MEJ **Procedure:** MEASNET, IEC 61400-12-1:2017 Annex F
Certificate prepared by: EJF **Approved by:** Calibration engineer, EJF

Calibration equation obtained: v [m/s] = 1.01743 · U [m/s] + 0.02061

Standard uncertainty, slope: 0.00179 **Standard uncertainty, offset:** 0.92876
Covariance: -0.0000327 (m/s)²/m/s **Coefficient of correlation:** ρ = 0.999982
Absolute maximum deviation: 0.037 m/s at 9.031 m/s
Barometric pressure: 999.3 hPa **Relative humidity:** 42.8%

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]
2	9.21	25.6	31.3	3.986	3.9333	-0.037	0.023
4	14.48	25.7	31.3	4.999	4.9069	-0.014	0.026
6	20.93	25.7	31.3	6.009	5.8833	0.003	0.030
8	28.45	25.7	31.3	7.007	6.8617	0.005	0.034
10	37.31	25.7	31.3	8.023	7.8433	0.023	0.039
12	47.26	25.7	31.3	9.031	8.8200	0.037	0.043
13-last	58.31	25.7	31.3	10.031	9.8034	0.036	0.047
11	70.26	25.7	31.3	11.012	10.7967	0.006	0.051
9	83.60	25.7	31.3	12.012	11.8033	-0.018	0.056
7	98.35	25.7	31.3	13.029	12.8100	-0.025	0.060
5	113.89	25.7	31.3	14.020	13.7767	-0.017	0.064
3	130.64	25.6	31.3	15.016	14.7233	0.015	0.068
1-first	148.05	25.6	31.3	15.984	15.7033	-0.014	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
TT003	Summit Electronics, 1XPT100, 0-10V Output, wind tunnel temp.
TP001	PR Electronics 5102, 0-10V Output, differential pressure box temp.
DP008	Setra Model 239, 0-1inWC, differential pressure transducer
HY002	Dwyer RHP-2D20, 0-10V Output, humidity transmitter
BP003	Setra M278, 0-5VDC Output, 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.

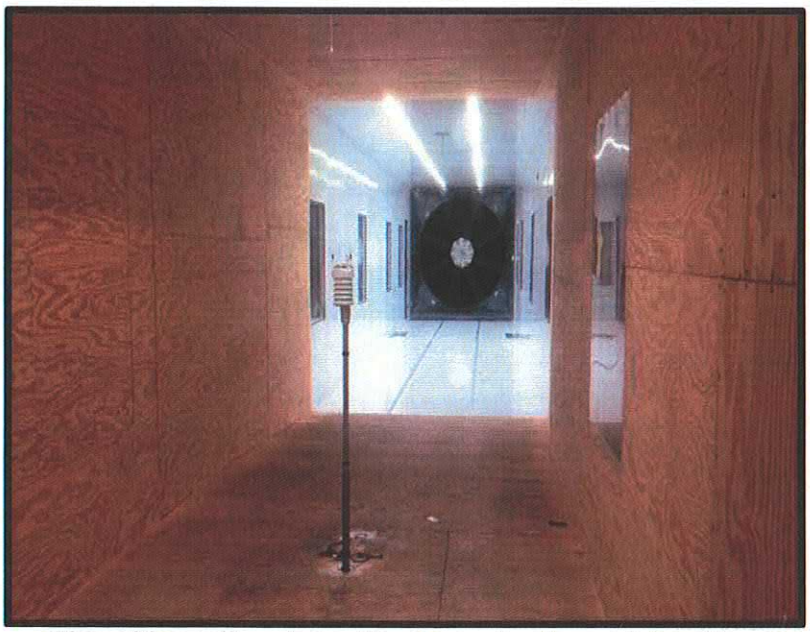


Photo of the wind tunnel setup. The cross-sectional area is 2.5m x 2.5m.

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 positioned at 90° during the calibration.

Certificate number: 19.US2.07597

The results on this certificate relate only to the serial number listed.
All calibrations are done in the "As Left" condition unless otherwise noted.
This certificate must not be reproduced, except in full, without the approval of SOG Wind Engineering LLC

Calibration Certificates –

Details are disclosed in the table below regarding the calibration of the equipment used for the Phase 2 I-Audit campaign at R1469. 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 preamplifier, and 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 Calibrated [YYYY-MM-DD]	Measurement Interval	Confirmation of Validity for Measurement Interval?
Sound Level Meter	NI 9234	1CAF72D	2019-07-22	Feb 7 – March 21	Yes
Microphone/Pre-Amplifier Pair	PCB 377B02	118498	2019-07-26	Feb 7 – March 21	Yes
Microphone	PCB 377B02	150498	2019-07-26	Feb 7 – March 21	Yes
Pre-amplifier	PCB 426E01	37448	2019-07-26	Feb 7 – March 21	Yes
Signal Conditioner	PCB 480E09	35332	2018-07-25	Feb 7 – March 21	Yes
Weather Anemometer	Vaisala WXT520	K0630016	2018-09-27	Feb 7 – March 21	Yes

Compliant Calibration Certificate

Template Revision: Feb2018

Certificate Number:	6095062.1	**OE Number:**	21719015
Date Printed:	22-JUL-2019	**Page:**	1 of 14
Customer:	Aercoustics Engineering LTD (CA) 1004 Middlegate Rd No 1100 ONTARIO MISSISSAUGA, L4Y 1M4 CANADA		
Manufacturer:	National Instruments	**Model:**	NI 9234
Serial Number:	1CAF72D		
Part Number:	195551C-01L	**Description:**	MODULE ASSY,NI 9234, 4 AI CONFIGURABLE
Calibration Date:	22-JUL-2019	**Recommended Calibration Due:**	22-JUL-2020
Procedure Name:	NI 9234	**Verification Results:**	As Found: Passed As Left: Passed
Procedure Version:	3.6.1.0	**Calibration Executive Version:**	4.6.2.0
Lab Technician:	Rachel McKinnon	**Driver Info:**	NI-DAQmx:17.6.0
Temperature:	23.1° C	**Humidity:**	44.4% RH

NATIONAL INSTRUMENTS
CALIBRATED
S/N/ID 1CAF72D
DATE 22-JUL-2019
DUE 22-JUL-2020
ni.com/calibration

The data found in this certificate must be interpreted as:

As Found The calibration data of the unit as received by National Instruments.

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 Z540.1-1994 (R2002) requirements.

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%. The uncertainty is calculated at time of calibration and does not include the object long-term stability and different environmental and operational conditions.

Results are reviewed to establish where any measurement results exceeded the manufacturer's specifications. Measured values greater than the Manufacturer's specification limits are marked as 'Failed', measured values within the Manufacturer's specifications are marked as 'Passed'.

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 E-mail customer.service@NI.com**

Ted Talley
Technical Manager

National Instruments Calibration Services Austin
Building A
11500 N MoPac Expwy
AUSTIN, TX 78759-3504
USA
Tel: (800) 531-5066

NATIONAL INSTRUMENTS

CERTIFICATE of CALIBRATION

Make : PCB Piezotronics

Reference # : 158130

Model : 378B02

Customer : Aercoustics Engineering Ltd
Mississauga, ON

Descr. : Microphone System 1/2" Free Field

Serial # : 118498

P. Order : 2019.07.24C

Asset # : 00234

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 Quality System 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 : Jul 26, 2019

By :

Cal. Due : Jul 26, 2021

Petro Onasko

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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CERTIFICATE of CALIBRATION

Make :	PCB Piezotronics	Reference # :	153405
Model :	480E09	Customer :	Aercoustics Engineering Ltd Mississauga, ON
Descr. :	Conditioning Amplifier		
Serial # :	00035332	P. Order :	2018.07.18C
Asset # :	01197		

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-9001-2008 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 : Jul 25, 2018 By : Petro Onasko

Cal. Due : Jul 25, 2020

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

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

Navair Technologies

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CERTIFICATE FOR CALIBRATION OF SONIC ANEMOMETER

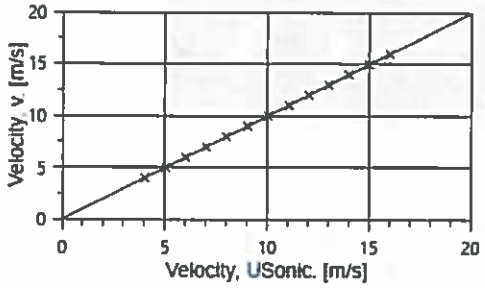
Certificate number: 18.US1.05008 **Date of issue:** September 28, 2018
Type: Vaisala Weather Transmitter, WXT520 **Serial number:** K0630016
Manufacturer: Vaisala, Oyj, Pl 26, FIN-00421 Helsinki, Finland
Client: Aercoustics Engineering Ltd., 1004 Middlegate RD, Suite 1100, S.Tower, Mississauga, ON L4Y 1M4, Canada

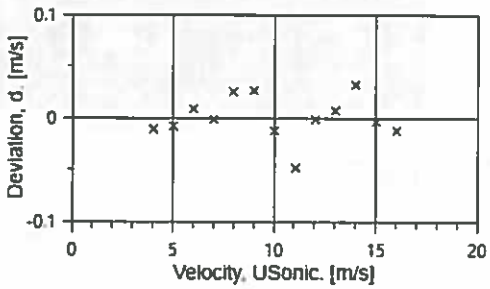
Anemometer received: September 25, 2018 **Anemometer calibrated:** September 27, 2018
Calibrated by: MEJ **Procedure:** MEASNET, IEC 61400-12-1:2017 Annex F
Certificate prepared by: EJF **Approved by:** Calibration engineer, EJF

Calibration equation obtained: v [m/s] = 0.99600 · f [m/s] + -0.01530

Standard uncertainty, slope: 0.00163 **Standard uncertainty, offset:** -1.13705
Covariance: -0.0000265 (m/s)²/m/s **Coefficient of correlation:** $\rho = 0.999985$
Absolute maximum deviation: -0.048 m/s at 10.969 m/s
Barometric pressure: 1006.5 hPa **Relative humidity:** 49.0%

Succession	Velocity pressure, q. [Pa]	Temperature in wind tunnel [°C]	d.p. box [°C]	Wind velocity, v. [m/s]	Anemometer Output, f. [m/s]	Deviation, d. [m/s]	Uncertainty u_c (k=2) [m/s]
2	9.23	25.6	26.7	3.978	4.0200	-0.011	0.020
4	14.47	25.7	26.7	4.981	5.0241	-0.008	0.023
6	20.81	25.7	26.7	5.973	6.0033	0.009	0.026
8	28.35	25.7	26.7	6.972	7.0167	-0.002	0.029
10	37.09	25.7	26.7	7.974	7.9967	0.025	0.033
12	47.19	25.7	26.7	8.995	9.0200	0.026	0.037
13-last	57.82	25.7	26.7	9.956	10.0241	-0.012	0.041
11	70.17	25.7	26.7	10.969	11.0767	-0.048	0.045
9	83.56	25.7	26.7	11.970	12.0350	-0.001	0.049
7	97.94	25.7	26.7	12.960	13.0200	0.007	0.053
5	113.70	25.7	26.7	13.964	14.0033	0.032	0.057
3	129.99	25.6	26.7	14.931	15.0100	-0.004	0.061
1-first	148.17	25.6	26.7	15.941	16.0333	-0.012	0.065





AC-1746

EQUIPMENT USED

Serial Number	Description
Njord1	Wind tunnel, blockage factor = 1.0035
2254	Control cup anemometer
-	Mounting tube, D = 19 mm
TT002	Summit Electronics, 1XPT100, 0-10V Output, wind tunnel temp.
TP001	PR Electronics 5102, 0-10V Output, differential pressure box temp.
DP005	Setra Model 239, 0-1inWC, differential pressure transducer
HY003	Dwyer RHP-2D20, 0-10V Output, humidity transmitter
BP003	Setra M278, 0-5VDC Output, barometer
PL8	Pitot tube
XB002	Computer Board, 16 bit A/D data acquisition board
9PRZRW1	PC dedicated to data acquisition

Traceable calibrations of the equipment are carried out by external accredited institutions: Atlantic Scale, Essco Calibration Labs & Furness Controls. A real-time analysis module within the data acquisition software detects pulse frequency.



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 calibrated at 0°.

Certificate number: 18.US1.05008

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CERTIFICATE FOR CALIBRATION OF SONIC ANEMOMETER

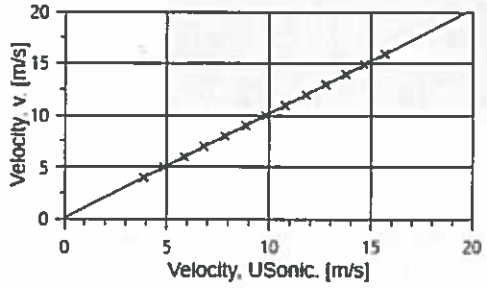
Certificate number: 18.US1.05009 **Date of issue:** September 28, 2018
Type: Vaisala Weather Transmitter, WXT520 **Serial number:** K0630016
Manufacturer: Vaisala, Oyj, Pl 26, FIN-00421 Helsinki, Finland
Client: Aercoustics Engineering Ltd., 1004 Middlegate RD, Suite 1100, S.Tower, Mississauga, ON L4Y 1M4, Canada

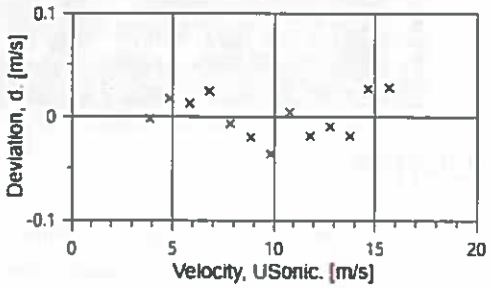
Anemometer received: September 25, 2018 **Anemometer calibrated:** September 27, 2018
Calibrated by: MEJ **Procedure:** MEASNET, IEC 61400-12-1:2017 Annex F
Certificate prepared by: EJF **Approved by:** Calibration engineer, EJF

Calibration equation obtained: v [m/s] = 1.01021 · f [m/s] + 0.06780

Standard uncertainty, slope: 0.00161 **Standard uncertainty, offset:** 0.25078
Covariance: -0.0000258 (m/s)²/m/s **Coefficient of correlation:** ρ = 0.999986
Absolute maximum deviation: -0.036 m/s at 9.966 m/s
Barometric pressure: 1006.6 hPa **Relative humidity:** 48.7%

Succession	Velocity pressure, q. [Pa]	Temperature in wind tunnel [°C]	Temperature in d.p. box [°C]	Wind velocity, v. [m/s]	Anemometer Output, f. [m/s]	Deviation, d. [m/s]	Uncertainty u_c (k=2) [m/s]
2	9.23	25.7	26.7	3.978	3.8733	-0.002	0.020
4	14.46	25.8	26.7	4.979	4.8448	0.017	0.023
6	20.81	25.8	26.7	5.974	5.8333	0.013	0.026
8	28.37	25.8	26.7	6.975	6.8133	0.024	0.029
10	37.11	25.8	26.7	7.977	7.8367	-0.007	0.033
12	47.15	25.7	26.7	8.991	8.8533	-0.020	0.037
13-last	57.93	25.7	26.6	9.966	9.8345	-0.036	0.041
11	70.12	25.7	26.7	10.965	10.7833	0.004	0.045
9	83.59	25.7	26.7	11.973	11.8033	-0.019	0.049
7	98.00	25.7	26.7	12.965	12.7767	-0.009	0.053
5	113.49	25.7	26.7	13.953	13.7633	-0.019	0.057
3	129.60	25.7	26.7	14.911	14.6667	0.027	0.061
1-first	148.11	25.7	26.7	15.939	15.6833	0.028	0.065





AC-1746

EQUIPMENT USED

Serial Number	Description
Njord1	Wind tunnel, blockage factor = 1.0035
2254	Control cup anemometer
-	Mounting tube, D = 19 mm
TT002	Summit Electronics, 1XPT100, 0-10V Output, wind tunnel temp.
TP001	PR Electronics 5102, 0-10V Output, differential pressure box temp.
DP005	Setra Model 239, 0-1inWC, differential pressure transducer
HY003	Dwyer RHP-2D20, 0-10V Output, humidity transmitter
BP003	Setra M278, 0-5VDC Output, barometer
PL8	Pitot tube
XB002	Computer Board, 16 bit A/D data acquisition board
9PRZRW1	PC dedicated to data acquisition

Traceable calibrations of the equipment are carried out by external accredited institutions: Atlantic Scale, Essco Calibration Labs & Furness Controls. A real-time analysis module within the data acquisition software detects pulse frequency.

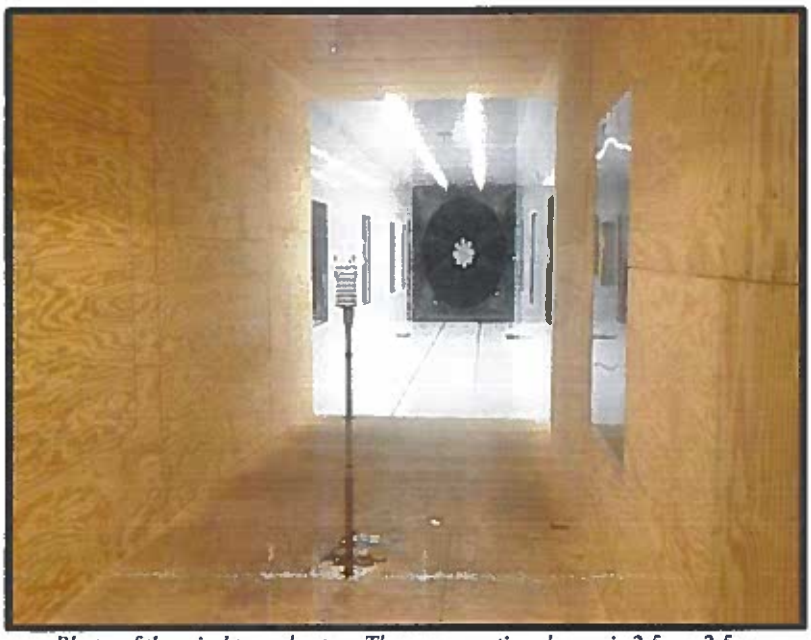


Photo of the wind tunnel setup. The cross-sectional area is 2.5m x 2.5m.

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 calibrated at 90°.

Certificate number: 18.US1.05009

All calibrations are done in the "As Left" condition unless otherwise noted.
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Calibration Certificates –

Details are disclosed in the table below regarding the calibration of the equipment used for the Phase 2 I-Audit campaign at R2299. 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 preamplifier, and 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 Calibrated [YYYY-MM-DD]	Measurement Interval	Confirmation of Validity for Measurement Interval?
Sound Level Meter	NI 9234	1CAF757	2019-06-27	Feb 7 – March 21	Yes
Microphone/Pre-Amplifier Pair	PCB 377B02	124690	2019-06-28	Feb 7 – March 21	Yes
Microphone	PCB 377B02	163103	2019-06-28	Feb 7 – March 21	Yes
Pre-amplifier	PCB 426E01	43047	2019-06-28	Feb 7 – March 21	Yes
Signal Conditioner	PCB 480E09	34205	2019-06-18	Feb 7 – March 21	Yes
Weather Anemometer	Vaisala WXT520	L3020299	2019-07-08	Feb 7 – March 21	Yes

Compliant Calibration Certificate

Template Revision: Feb2018

Certificate Number:	6073295.1	**OE Number:**	21702351
Date Printed:	27-JUN-2019	**Page:**	1 of 14
Customer:	Aercoustics Engineering LTD (CA) 1004 Middlegate Road Suite 1100 ONTARIO MISSISSAUGA, L4Y 0G1 CANADA		
Manufacturer:	National Instruments	**Model:**	NI 9234
Serial Number:	1CAF757		
Part Number:	195551C-01L	**Description:**	MODULE ASSY,NI 9234, 4 AI CONFIGURABLE
Calibration Date:	27-JUN-2019	**Recommended Calibration Due:**	27-JUN-2020
Procedure Name:	NI 9234	**Verification Results:**	As Found: Passed As Left: Passed
Procedure Version:	3.6.1.0	**Calibration Executive Version:**	4.6.2.0
Lab Technician:	Rogelio Gaytan	**Driver Info:**	NI-DAQmx:17.6.0
Temperature:	23.0° C	**Humidity:**	44.9% RH

NATIONAL INSTRUMENTS
CALIBRATED
SN/ID 1CAF757
DATE 27-JUN-2019
DUE 27-JUN-2020
ni.com/calibration

The data found in this certificate must be interpreted as:

As Found The calibration data of the unit as received by National Instruments.

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 Z540.1-1994 (R2002) requirements.

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%. The uncertainty is calculated at time of calibration and does not include the object long-term stability and different environmental and operational conditions.

Results are reviewed to establish where any measurement results exceeded the manufacturer's specifications. Measured values greater than the Manufacturer's specification limits are marked as 'Failed', measured values within the Manufacturer's specifications are marked as 'Passed'.

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 E-mail customer.service@NI.com**



Ted Talley
Technical Manager

National Instruments Calibration Services Austin
Building A
11500 N MoPac Expwy
AUSTIN, TX 78759-3504
USA
Tel: (800) 531-5066

NATIONAL INSTRUMENTS

CERTIFICATE of CALIBRATION

Make :	PCB Piezotronics	Reference # :	157706
Model :	378B02	Customer :	Aercoustics Engineering Ltd Mississauga, ON
Descr. :	Microphone System 1/2" Free Field		
Serial # :	124690	P. Order :	2019.06.26C
Asset # :	00771		

Cal. status : Received in spec's, no adjustment made.
Preamp System with Mic 377B02 s/n 163103

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 Quality System 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 28, 2019 By : Petro Onasko

Cal. Due : Jun 28, 2021

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

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

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CERTIFICATE of CALIBRATION

Make :	PCB Piezotronics	Reference # :	157554
Model :	480E09	Customer :	Aercoustics Engineering Ltd Mississauga, ON
Descr. :	Conditioning Amplifier		
Serial # :	00034205	P. Order :	2019.06.14C
Asset # :	00908		

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 Quality System 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 18, 2019 By : Petro Onasko

Cal. Due : Jun 18, 2021

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

Standards used : J-233 J-255 J-367 J-512

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CERTIFICATE FOR CALIBRATION OF SONIC ANEMOMETER

Certificate number: 19.US2.06157 **Date of issue:** July 08, 2019

Type: Vaisala Weather Transmitter, WXT520 **Serial number:** L3020299

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: July 11, 2019 **Anemometer calibrated:** July 08, 2019

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] = 0.99633 · U [m/s] + -0.05302

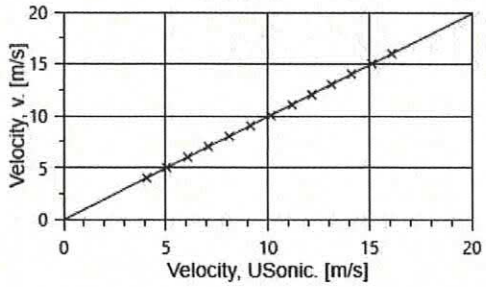
Standard uncertainty, slope: 0.00194 **Standard uncertainty, offset:** -0.39371

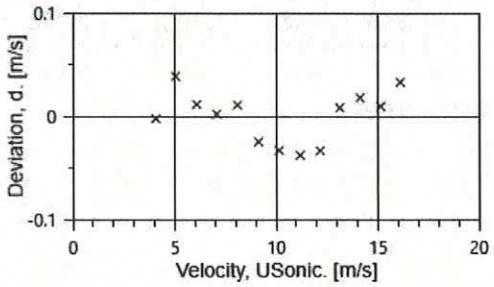
Covariance: -0.0000378 (m/s)²/m/s **Coefficient of correlation:** ρ = 0.999979

Absolute maximum deviation: 0.039 m/s at 5.005 m/s

Barometric pressure: 1004.3 hPa **Relative humidity:** 49.0%

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]
2	9.35	24.5	28.5	4.000	4.0700	-0.003	0.023
4	14.64	24.6	28.5	5.005	5.0379	0.039	0.026
6	21.13	24.6	28.5	6.013	6.0767	0.011	0.030
8	28.74	24.6	28.4	7.013	7.0900	0.002	0.034
10	37.62	24.6	28.6	8.025	8.0967	0.011	0.038
12	47.73	24.6	28.7	9.039	9.1500	-0.025	0.043
13-last	58.83	24.6	28.7	10.035	10.1586	-0.033	0.047
11	71.48	24.6	28.7	11.061	11.1933	-0.038	0.051
9	84.67	24.6	28.4	12.039	12.1700	-0.033	0.056
7	99.33	24.6	28.5	13.040	13.1333	0.008	0.060
5	115.14	24.6	28.5	14.040	14.1267	0.018	0.064
3	132.22	24.5	28.6	15.044	15.1433	0.010	0.069
1-first	150.03	24.5	28.6	16.024	16.1033	0.033	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
TT003	Summit Electronics, 1XPT100, 0-10V Output, wind tunnel temp.
TP001	PR Electronics 5102, 0-10V Output, differential pressure box temp.
DP008	Setra Model 239, 0-1inWC, differential pressure transducer
HY002	Dwyer RHP-2D20, 0-10V Output, humidity transmitter
BP003	Setra M278, 0-5VDC Output, 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.

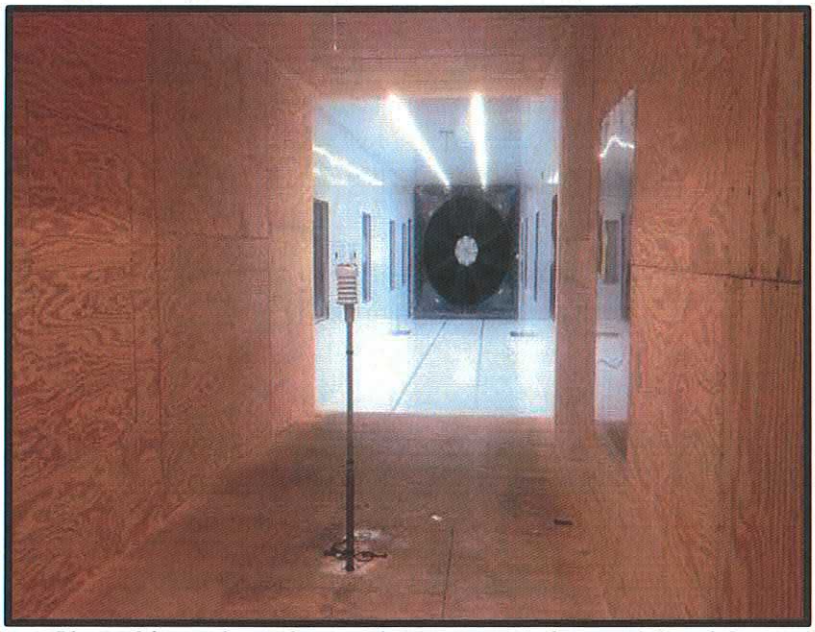


Photo of the wind tunnel setup. The cross-sectional area is 2.5m x 2.5m.

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 positioned at the 0° orientation during calibration.

Certificate number: 19.US2.06157

This certificate must not be reproduced, except in full, without the approval of SOH Wind Engineering LLC

SOH Wind Engineering LLC

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CERTIFICATE FOR CALIBRATION OF SONIC ANEMOMETER

Certificate number: 19.US2.06158 **Date of issue:** July 08, 2019

Type: Vaisala Weather Transmitter, WXT520 **Serial number:** L3020299

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: July 11, 2019 **Anemometer calibrated:** July 08, 2019

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] = 1.00930 · U [m/s] + 0.13558

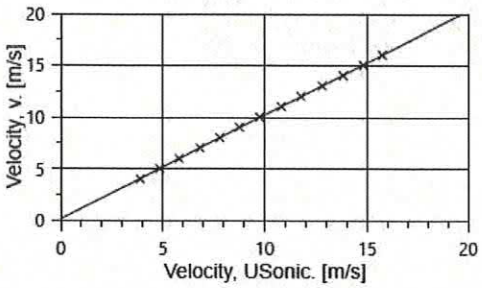
Standard uncertainty, slope: 0.00221 **Standard uncertainty, offset:** 0.17289

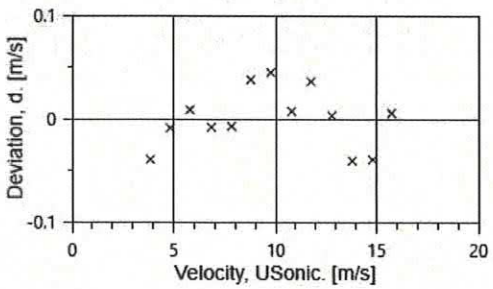
Covariance: -0.0000490 (m/s)²/m/s **Coefficient of correlation:** ρ = 0.999973

Absolute maximum deviation: 0.045 m/s at 10.033 m/s

Barometric pressure: 1004.3 hPa **Relative humidity:** 48.4%

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]
2	9.37	24.7	28.5	4.005	3.8733	-0.039	0.023
4	14.68	24.8	28.4	5.013	4.8414	-0.009	0.026
6	21.01	24.8	28.2	5.998	5.8000	0.009	0.030
8	28.81	24.8	28.1	7.024	6.8333	-0.008	0.034
10	37.60	24.8	27.8	8.025	7.8233	-0.007	0.038
12	47.62	24.8	27.7	9.032	8.7767	0.038	0.043
13-last	58.77	24.8	27.7	10.033	9.7621	0.045	0.047
11	71.28	24.8	27.8	11.050	10.8067	0.007	0.051
9	84.69	24.8	28.0	12.045	11.7633	0.036	0.056
7	99.51	24.8	28.1	13.056	12.7983	0.003	0.060
5	115.14	24.8	28.3	14.044	13.8200	-0.041	0.064
3	132.19	24.7	28.4	15.047	14.8133	-0.040	0.069
1-first	150.07	24.7	28.8	16.031	15.7433	0.006	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
TT003	Summit Electronics, 1XPT100, 0-10V Output, wind tunnel temp.
TP001	PR Electronics 5102, 0-10V Output, differential pressure box temp.
DP008	Setra Model 239, 0-1inWC, differential pressure transducer
HY002	Dwyer RHP-2D20, 0-10V Output, humidity transmitter
BP003	Setra M278, 0-5VDC Output, 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.

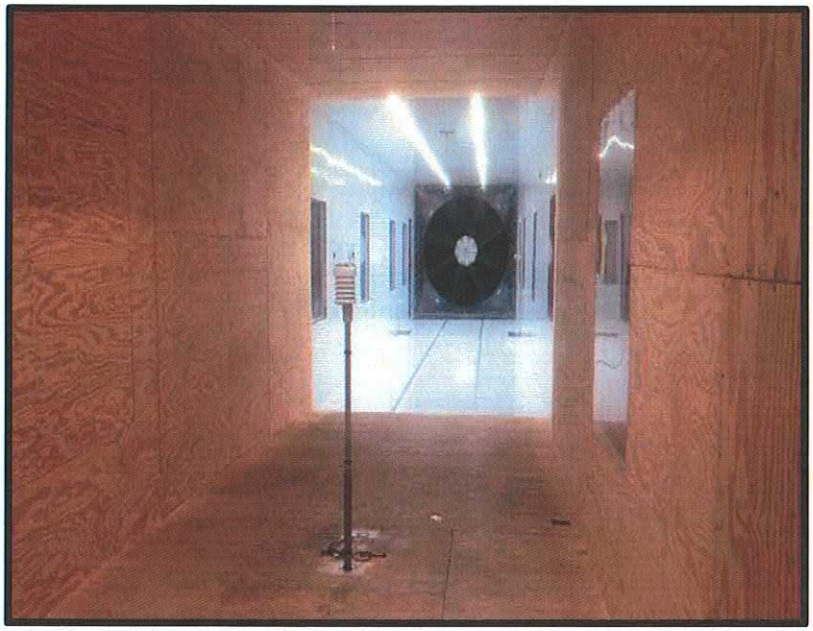


Photo of the wind tunnel setup. The cross-sectional area is 2.5m x 2.5m.

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 positioned at the 90° orientation during calibration.

Certificate number: 19.US2.06158

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Appendix G
Power Thresholds for 90% Sound Power

Appendix G - Power Thresholds for 90% Sound Power

Project: Belle River Wind Power Project - 2nd Acoustic Immission Audit

Report ID: 17095.01

Created on: 30/01/2020

*Wind bins for interpolation are highlighted in light blue

Table G.1: BRWPP 3.2 MW Turbine - Measured Power and Sound Power

T52 (3.2 MW) E-Audit Test Results Summary [4]													
IEC 61400-11 Test	7	7.5	8	8.5	9	9.5	10	10.5	11	11.5	12	12.5	13
Power (kW)	#N/A	#N/A	1487	1788	2089	2388	2687	2881	3075	3131	3186	3193	3199
SPL (dBA)	#N/A	#N/A	103.6	105.1	105.8	105.8	105.7	105.6	105.5	105.4	105.3	105.2	105.1

Table G.2: BRWPP 2.473 MW Turbine - Measured Power and Sound Power

T44 (2.473 MW) E-Audit Test Results Summary [5]													
IEC 61400-11 Test	7	7.5	8	8.5	9	9.5	10	10.5	11	11.5	12	12.5	13
Power (kW)	990	1226	1461	1708	1954	2136	2317	2382	2447	2459	2470	#N/A	#N/A
SPL (dBA)	100.8	101.7	101.9	101.9	101.7	101.7	101.6	101.6	101.7	101.8	102.1	#N/A	#N/A

*Outside reportable range but sufficient data was collected

Table G.3: BRWPP 2.37 MW Turbine - Measured Power and Sound Power

T40 (2.37 MW) E-Audit Test Results Summary [6]													
IEC 61400-11 Test	7	7.5	8	8.5	9	9.5	10	10.5	11	11.5	12	12.5	13
Power (kW)	987	1215	1443	1671	1899	2061	2222	2283	2344	2356	2367	#N/A	#N/A
SPL (dBA)	100.5	101.5	101.2	101.1	101.0	100.8	100.9	101.0	100.9	101.3	101.2	#N/A	#N/A

Table G.3: BRWPP 2.772 MW Turbine - Measured Power and Sound Power

T53 (2.773 MW) E-Audit Test Results Summary [7]													
IEC 61400-11 Test	7	7.5	8	8.5	9	9.5	10	10.5	11	11.5	12	12.5	13
Power (kW)	#N/A	1238	1484	1770	2055	2294	2533	2631	2728	2748	2768	2770	#N/A
SPL (dBA)	#N/A	102.3	103.7	104.3	104.4	104.3	104.2	103.9	103.8	104.0	103.6	103.8	#N/A

Table G.4: Power Thresholds for 90% Sound Power

	maximum sound	90% sound power	electrical power at	percentage of rated
3.2 MW	105.8	105.4	1914	60%
2.473 MW	102.1	101.6	1191	48%
2.37 MW	101.5	101.1	1113	47%
2.773 MW	104.4	103.9	1581	57%

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Appendix H
I-Audit Checklist

Appendix H7: 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.?	✓	
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	✓	
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	✓	To ensure conservative results, 90% Sound Power filter was used in place of 85% Power filter: See Section 6.3 and Appendix G for justification.