Memorandum

Tel: 519.823.1311
Fax: 519.823.1316
RWDI AIR Inc.
650 Woodlawn Road West
Guelph, Ontario, Canada N1K 1B8
Email: solutions@rwdi.com

Date: **July 25, 2014** **RWDI Reference #:** 1400190

To: Denton Miller,
EAAB, MOECC **E-Mail:** denton.miller@ontario.ca

cc: Jenn Tuck,
NextEra Energy Canada **E-Mail:** jennifer.tuck@nexteraenergy.com

From: Ben Coulson **E-Mail:** ben.coulson@rwdi.com

Re: Analysis of Conestogo and Summerhaven Wind Data

Dear Mr. Miller,

Further to our recent discussion on the progress of conducting immission audits at the Conestogo and Summerhaven wind facilities, RWDI has performed additional analysis of our collected wind data in response to requests made by the MOE. We have summarised the data reduction in tables below.

Background

As you are aware, there have been difficulties in collecting the requisite amount of valid data to meet the requirements of the MOE's "Compliance Protocol for Wind Turbine Noise" (Protocol) at these two facilities. Initial evidence conducted by MOE suggested that this sort of testing may take a few weeks to a month to obtain the requisite data points; however, it has taken much longer in practice. We understand that this is not unique to these sites and is being experienced at other facilities. Our reviews suggest that a number of factors may be contributing to this issue including:

1. Regional variability of wind resource between sites;
2. Seasonal variations in winds;
3. Interannual (year-to-year) differences in winds;
4. Local terrain and topography differences;
5. MOE protocol interpretation differences amongst parties (e.g., downwind conditions, audit location); and
6. Instrumentation and setup differences amongst parties.

To date, RWDI has conducted three measurement campaigns at the Conestogo wind facility (spring 2013, fall 2013, spring 2014). The first two campaigns were in direct response to the immission audit conditions of the facility's REA. The third campaign was begun, and remains ongoing at MOE request, to extend the collection of data in an attempt to achieve the requisite data points in the Protocol at all audit locations (i.e. three in total). This additional need continues at one audit location in spite of the MOE indicating that the data collected to date can be considered in aggregate when comparing to the minimum number of data points (the two other audit locations have satisfied the requirement). Given historical data and experience at this site, it is highly unlikely that measurements through the summer period will satisfy the outstanding data needs due to low night-time winds or precipitation during higher winds. RWDI collects data continuously at the audit locations (i.e., 24 hours, 7 days per week).

At Summerhaven, two measurement campaigns have been conducted (i.e., fall 2013, spring 2014) in accordance with the requirements of the facility's REA conditions. Four audit locations were considered at Summerhaven. Although the REA required only three locations, a fourth was voluntary implemented by NextEra in an attempt to mitigate the data collection issues experienced at Conestogo. The most recent spring 2014 campaign remains ongoing, at MOE request, to attempt to collect the minimum number of data points required by the Protocol. One audit location has satisfied the Protocol data requirements to date, largely due to the fact it has turbines on two sides and hence has twice the array of directions that are downwind. RWDI collects data continuously at the audit locations (i.e., 24 hours, 7 days per week).

Methodology

Some details of the MOE Protocol were unclear or raised questions; hence for clarity on methodology, a monitoring plan for each facility was submitted to the MOE in 2013 for review and comment in advance of the immission measurements. The submitted monitoring plan included details on audit locations, data collection procedures, and criteria for valid data based on interpretation of the MOE Protocol and discussions with MOE staff. No comments were received from the MOE, hence it was assumed to be acceptable and monitoring commenced. The MOE did subsequently request that meteorological towers be co-located with the sound level meters for Conestogo after monitoring had begun. Although this approach was not clear in the applicable section of the Protocol, it was addressed in later measurements.

The Protocol is silent on measuring when a turbine is upwind or downwind of a location and what specifics would define these conditions. RWDI was directed by MOE to consider downwind conditions only for turbine operational conditions, but that any direction was acceptable for ambient measurements when the turbines were parked. This request was considered reasonable given a downwind condition would be expected to produce worst-case sound propagation to receptors.

However, the MOE has provided no guidance to date on the range of wind angles that would be considered downwind. The most liberal interpretation would be to consider a 180 degree sector or 90 degrees either side of the turbine-to-receptor line of sight. Originally, RWDI proposed conservative wind sectors that were within about 45 to 50 degrees of the line of sight. More recently, RWDI expanded these wind angles after sensitivity testing revealed it to be critical to collecting some rare high wind conditions (i.e., 6 m/s and up). The expanded angles are considered appropriate and defensible from a meteorological perspective, while still meeting the MOE request for "downwind" measurements. The audit locations and wind sectors are shown in the figures below.

The influence of filtering data points based on limited downwind wind directions is examined herein. The expanded angles are included in this analysis for all data collected to date (hence the results may not match past reports submitted to MOE).

Figure 1: Conestogo Immission Audit Locations with Original and Expanded Wind Angles

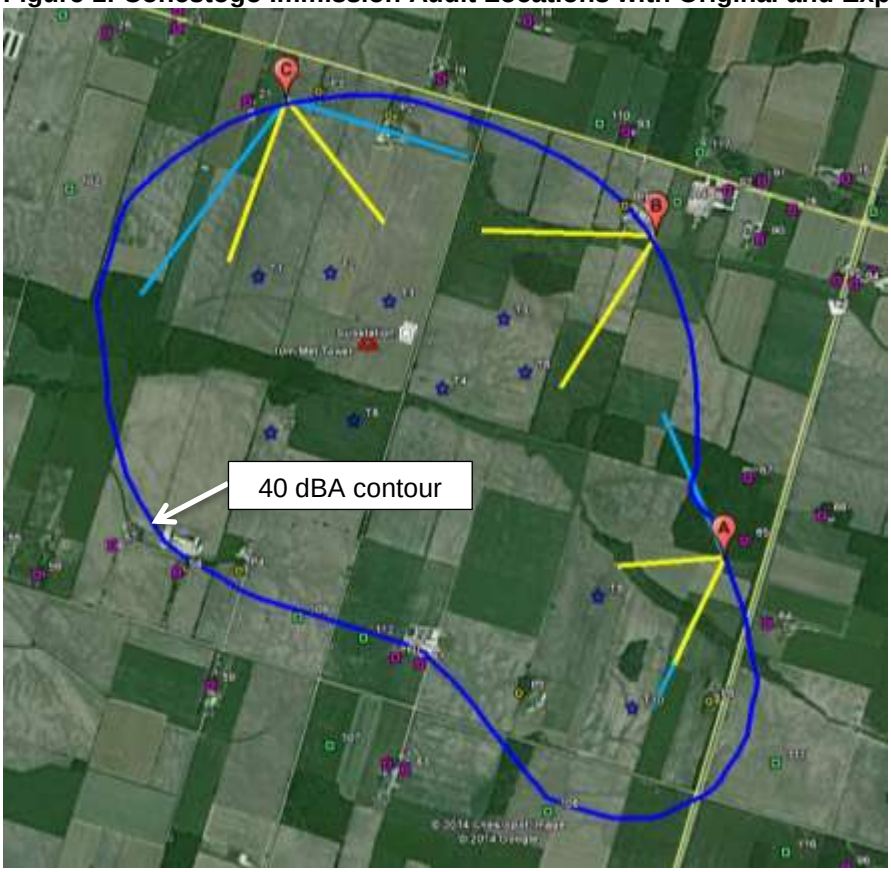
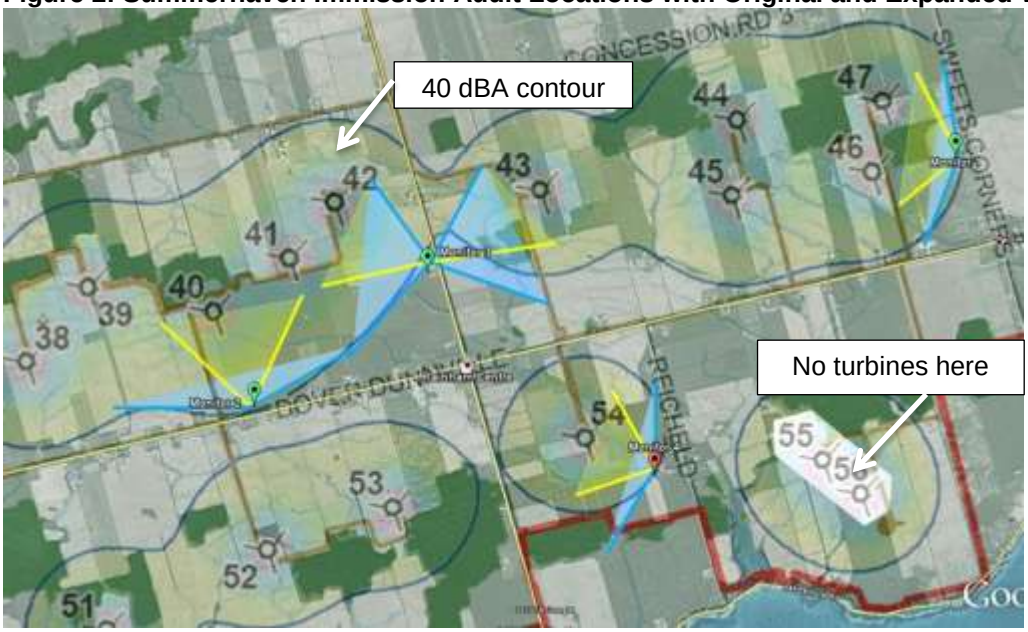


Figure 2: Summerhaven Immission Audit Locations with Original and Expanded Wind Angles



Based on discussions with the MOE, various alternatives to other data filtering criteria included in the Protocol were reviewed. The MOE was unwilling to alter filtering criteria associated with time of day or precipitation. However, the MOE provided a potential variation in criteria to the evaluation of wind gusts in the Protocol that may be considered. We understand that the proposed variation has helped at other sites being monitored by other companies. The variation included two different options that would modify the criteria used in the Protocol such that additional data points may be available under high wind conditions. Our review found that only one of the options produced a consequential change in the number of data points. That influence of the proposed variation is included in the results herein.

Results

The tables below present the influence of different data filters for wind gusts and direction on the cumulative number of valid data points over all measurement campaigns collected at the two facilities. The scenarios are based on discussions and as requested by MOE. Results for the individual campaigns are included in the attachment.

Audit location B is not presented for Conestogo since it has satisfied the requisite number of cumulative data points without modification to the current Protocol requirements. Audit location 4 is not presented for Summerhaven since it currently has the fewest number of available data points and would not add to outcome of this analysis or the compliance discussion.

Table 1: Conestogo Location A

Data	# of Data Points with Turbine On (min. 120 required)				# of Data Points with Turbine Off (min. 60 required)				Percentage of Minimum Number of Points				Percentage of Minimum Number of Points			
	4m/s	5m/s	6m/s	7m/s	4m/s	5m/s	6m/s	7m/s	4m/s	5m/s	6m/s	7m/s	4m/s	5m/s	6m/s	7m/s
(A) Total Available Valid Points	7161	3370	1368	375	540	275	132	84	5968%	2808%	1140%	313%	900%	458%	220%	140%
(B) After Applying Original Gust Filter to (A)	4226	1809	542	137	458	210	73	51	3522%	1508%	452%	114%	763%	350%	122%	85%
(C) After Applying Proposed Gust Filter to (A)	4565	2000	639	195	483	235	93	63	3804%	1667%	533%	163%	805%	392%	155%	105%
(D) After Applying Downwind Wind Direction Condition to (B)	1508	640	325	118	n/a - direction independent for off condition				1257%	533%	271%	98%	n/a - direction independent for off condition			
(E) After Applying Downwind Wind Direction Condition to (C)	1596	693	371	162	n/a - direction independent for off condition				1330%	578%	309%	135%	n/a - direction independent for off condition			

Table 2: Conestogo Location C

Data	# of Data Points with Turbine On (min. 120 required)				# of Data Points with Turbine Off (min. 60 required)				Percentage of Minimum Number of Points				Percentage of Minimum Number of Points			
	4m/s	5m/s	6m/s	7m/s	4m/s	5m/s	6m/s	7m/s	4m/s	5m/s	6m/s	7m/s	4m/s	5m/s	6m/s	7m/s
(A) Total Available Valid Points	9505	6208	3160	1669	1026	845	395	243	7921%	5173%	2633%	1391%	1710%	1408%	658%	405%
(B) After Applying Original Gust Filter to (A)	6886	4418	1810	811	984	753	289	158	5738%	3682%	1508%	676%	1640%	1255%	482%	263%
(C) After Applying Proposed Gust Filter to (A)	7061	4692	2112	1036	1018	836	388	243	5884%	3910%	1760%	863%	1697%	1393%	647%	405%
(D) After Applying Downwind Wind Direction Condition to (B)	3279	2110	857	406	n/a - direction independent for off condition				2733%	1758%	714%	338%	n/a - direction independent for off condition			
(E) After Applying Downwind Wind Direction Condition to (C)	3317	2171	935	489	n/a - direction independent for off condition				2764%	1809%	779%	408%	n/a - direction independent for off condition			

Table 3: Summerhaven Location 1

Data	# of Data Points with Turbine On (min. 120 required)				# of Data Points with Turbine Off (min. 60 required)				Percentage of Minimum Number of Points				Percentage of Minimum Number of Points			
	4m/s	5m/s	6m/s	7m/s	4m/s	5m/s	6m/s	7m/s	4m/s	5m/s	6m/s	7m/s	4m/s	5m/s	6m/s	7m/s
(A) Total Available Valid Points	5002	2616	1764	1189	757	437	139	17	4168%	2180%	1470%	991%	1262%	728%	232%	28%
(B) After Applying Original Gust Filter to (A)	4726	2352	1538	944	620	326	72	10	3938%	1960%	1282%	787%	1033%	543%	120%	17%
(C) After Applying Proposed Gust Filter to (A)	4861	2486	1639	1031	652	386	130	15	4051%	2072%	1366%	859%	1087%	643%	217%	25%
(D) After Applying Downwind Wind Direction Condition to (B)	3068	1348	887	559	n/a - direction independent for off condition				2557%	1123%	739%	466%	n/a - direction independent for off condition			
(E) After Applying Downwind Wind Direction Condition to (C)	3182	1448	956	613	n/a - direction independent for off condition				2652%	1207%	797%	511%	n/a - direction independent for off condition			

Table 4: Summerhaven Location 2

Data	# of Data Points with Turbine On (min. 120 required)				# of Data Points with Turbine Off (min. 60 required)				Percentage of Minimum Number of Points				Percentage of Minimum Number of Points			
	4m/s	5m/s	6m/s	7m/s	4m/s	5m/s	6m/s	7m/s	4m/s	5m/s	6m/s	7m/s	4m/s	5m/s	6m/s	7m/s
(A) Total Available Valid Points	9466	5703	2522	1259	1240	783	273	57	7888%	4753%	2102%	1049%	2067%	1305%	455%	95%
(B) After Applying Original Gust Filter to (A)	9302	5394	2233	996	1227	735	228	41	7752%	4495%	1861%	830%	2045%	1225%	380%	68%
(C) After Applying Proposed Gust Filter to (A)	9444	5586	2402	1110	1228	746	240	46	7870%	4655%	2002%	925%	2047%	1243%	400%	77%
(D) After Applying Downwind Wind Direction Condition to (B)	5719	2831	856	307	n/a - direction independent for off condition				4766%	2359%	713%	256%	n/a - direction independent for off condition			
(E) After Applying Downwind Wind Direction Condition to (C)	5775	2922	921	348	n/a - direction independent for off condition				4813%	2435%	768%	290%	n/a - direction independent for off condition			

Table 5: Summerhaven Location 3

Data	# of Data Points with Turbine On (min. 120 required)				# of Data Points with Turbine Off (min. 60 required)				Percentage of Minimum Number of Points				Percentage of Minimum Number of Points			
	4m/s	5m/s	6m/s	7m/s	4m/s	5m/s	6m/s	7m/s	4m/s	5m/s	6m/s	7m/s	4m/s	5m/s	6m/s	7m/s
(A) Total Available Valid Points	7457	4767	2718	1357	1011	692	384	179	6214%	3973%	2265%	1131%	1685%	1153%	640%	298%
(B) After Applying Original Gust Filter to (A)	7362	4557	2532	1188	1010	682	369	169	6135%	3798%	2110%	990%	1683%	1137%	615%	282%
(C) After Applying Proposed Gust Filter to (A)	7402	4661	2636	1270	1010	685	370	171	6168%	3884%	2197%	1058%	1683%	1142%	617%	285%
(D) After Applying Downwind Wind Direction Condition to (B)	5016	3122	1646	790	n/a - direction independent for off condition				4180%	2602%	1372%	658%	n/a - direction independent for off condition			
(E) After Applying Downwind Wind Direction Condition to (C)	5053	3189	1710	840	n/a - direction independent for off condition				4211%	2658%	1425%	700%	n/a - direction independent for off condition			

Glossary

(A) Total valid points after excluding readings within 1 hr of rain, manual exclusions for meter downtime, wind speed binning, and time exclusions

(B) Valid readings after applying original MOE protocol gust filter (+/-2 m/s)

(C) Valid readings after applying MOE proposed filter below
- the maximum wind speed will differ from the average by no more than 2 m/s (parked)
- the minimum wind speed will differ from the average by no more than 2 m/s (operational)

(D) & (E) Valid readings after applying expanded wind direction filter (measurement station downwind of turbines)

Discussion

Given the limited number of potential data points at the higher wind conditions (i.e., 6 and 7 m/s), it is necessary to combine the results from all measurement campaigns in order to approach the Protocol requirements at most locations. Potential data points are more limited for the “off” turbine conditions since turbines are only parked when appropriate wind conditions are forecast to occur. Such forecasts are difficult since operating protocols at these facilities typically require several days’ notice for shut-downs when forecast accuracy tends to be less reliable.

Comparing scenarios B and C in Tables 1 to 5 shows the influence of the different wind gustiness filter criteria examined. The Conestogo locations show a notable reduction in valid data points from the total available (i.e., scenario A in the tables) with the application of either filter (i.e., scenario B and C), on the order of 30-40%. However, the Summerhaven locations show a less significant reduction (i.e., typically 5-15%) suggesting it is less prone to wind gusts.

More data points are consistently available for the MOE's proposed wind gustiness criteria (i.e., scenario C) compared to the original (i.e., scenario B). However, the improvement in available data points is typically only about 5-10%. Scenarios A, B, and C are independent of any consideration of wind direction.

Reviewing scenarios D and E, which apply the downwind wind direction filters for the expanded wind angles, there is a far more notable reduction in available data points compared to wind gustiness. The wind direction filter reduces the available data points by 40-50% consistently at each audit location. This parameter has proven to be very influential in assessing valid data points at these facilities, yet the Protocol is silent on aspects associated with wind direction. RWDI has received direction from the MOE in this regard (i.e., applying downwind conditions for turbine "on" conditions, but no direction on how to do so). This concern could have considerable influence on attaining the minimum number of data points required in the Protocol and may be a reason why there is wide variability in the amount of monitoring time needed at different facilities.

Based on a review of cumulative data, Tables 1 to 5 demonstrate that the two facilities are missing the minimum data points at only 7 m/s and only for a few audit locations. At 7 m/s the required sound level limit is 43 dBA at a receptor, versus 40 dBA at 6 m/s and below. If turbine sound emissions were the same at 6 and 7 m/s, assessment at 6 m/s would be considered worst-case due to the stricter sound level limit. In other words, if turbine sound contributions at a receptor could reasonably be expected to be the same at both wind speeds, the 6 m/s case would be most conservative for compliance assessment.

The wind turbines used at these facilities are Siemens SWT-2.3-101 and SWT-2.221-101 (Conestogo), and SWT-2.221-101 and SWT-2.221-93 (Summerhaven). The manufacturer data for the turbines indicates that the sound power level is constant at all wind speeds of interest to the Protocol (i.e., 4 to 7 m/s). As a result, turbine sound contributions at receptors would be expected to be approximately the same for all wind speeds (i.e., some minor variations of 0.1 to 0.3 dB may occur due to varying propagation conditions). Compliance at 4 to 6 m/s wind speeds would be worst-case for these facilities and the 7 m/s condition could be ignored. Furthermore, in practice for immission testing, ambient sound levels would tend to be lowest at 4 m/s, so turbines with constant or near constant sound power levels would demonstrate their clearest compliance at lower wind speeds.

When cumulative data points are considered for all measurement campaigns and worst-case compliance conditions are considered (i.e., 6 m/s and below), the required data points are achieved at both facilities. Additional data collection at either facility is not expected to change any assessment of compliance and more becomes an exercise in meeting an unnecessary data collection standard.

Conclusions

Based on our review of the monitoring data collected to date at Conestogo and Summerhaven over all measurement campaigns, the following conclusions can be drawn:

1. The monitoring conducted to date satisfies the intent of MOE protocol and is technically defensible.
2. The influence of the wind gustiness filter has limited influence on the available valid data points.

3. The MOE's proposed change to the wind gustiness filter criteria increases valid data points by approximately 5-10%.
4. Wind direction considerations have a substantial influence on valid data points, in some cases reducing the available data set by more than 50% when only "downwind" measurements are allowed when turbines are operational.
5. Consistent guidance from the MOE is required on how wind direction should be considered in the application of the Protocol, particularly given the Protocol is silent on how wind direction is considered.
6. When cumulative data is considered over all measurement campaigns, the minimum number of data points required by the Protocol is achieved at all wind speeds excepting the 7 m/s condition for a few locations.
7. Given the turbines at these facilities have a constant sound power level, the 7 m/s wind speed is not the limiting case for compliance and should not be necessary in making a compliance statement.
8. In practice, for constant or near constant turbine sound power emissions over the Protocol wind speeds of interest, the most reliable compliance scenario is expected to be the low wind speeds (e.g., 4 and 5 m/s) when ambient noise is lowest.

Given the above conclusions, we feel a compliance statement can be made based on the work conducted to date. We request that MOE approve the monitoring data collected to date as sufficient so that additional unnecessary monitoring can cease at both Conestogo and Summerhaven.

We recommend that the Protocol be updated or that appropriate formal guidance to all operators is provided by MOE to resolve some lingering uncertainties associated with the data collection for immission testing. Such updates would help to ensure consistency amongst parties, prevent wasted resources, and produce a more robust and reliable result. Guidance is particularly needed on wind direction. The inclusion of the "intent" of certain data filter restrictions would also be useful so that issues like turbine sound power levels or local winds can be evaluated in site-specific circumstances.

Respectfully submitted,

Ben Coulson, M.A.Sc., P.Eng.
Project Director, Associate

BJC/klm

ATTACHMENTS

Cumulative Data for Conestogo Receptor A

Data	# of Data Points with Turbine On (min. 120 required)				# of Data Points with Turbine Off (min. 60 required)				Percentage of Minimum Number of Points				Percentage of Minimum Number of Points			
	4m/s	5m/s	6m/s	7m/s	4m/s	5m/s	6m/s	7m/s	4m/s	5m/s	6m/s	7m/s	4m/s	5m/s	6m/s	7m/s
(A) Total Available Valid Points	7161	3370	1368	375	540	275	132	84	5968%	2808%	1140%	313%	900%	458%	220%	140%
(B) After Applying Original Gust Filter to (A)	4226	1809	542	137	458	210	73	51	3522%	1508%	452%	114%	763%	350%	122%	85%
(C) After Applying Proposed Gust Filter to (A)	4565	2000	639	195	483	235	93	63	3804%	1667%	533%	163%	805%	392%	155%	105%
(D) After Applying Downwind Wind Direction Condition to (B)	1508	640	325	118	n/a - direction independent for off condition				1257%	533%	271%	98%	n/a - direction independent for off condition			
(E) After Applying Downwind Wind Direction Condition to (C)	1596	693	371	162	n/a - direction independent for off condition				1330%	578%	309%	135%	n/a - direction independent for off condition			

Data Summary for Conestogo Receptor A (Spring 2013)

Data	# of Data Points with Turbine On (min. 120 required)				# of Data Points with Turbine Off (min. 60 required)			
	4m/s	5m/s	6m/s	7m/s	4m/s	5m/s	6m/s	7m/s
(A) Total Available Valid Points	3303	1864	763	73	0	3	31	46
(B) After Applying Original Gust Filter to (A)	1209	784	226	30	0	3	30	46
(C) After Applying Proposed Gust Filter to (A)	1212	805	229	32	0	3	30	46
(D) After Applying Downwind Wind Direction Condition to (B)	160	143	117	24	n/a - direction independent for off condition			
(E) After Applying Downwind Wind Direction Condition to (C)	162	152	120	25	n/a - direction independent for off condition			

Data Summary for Conestogo Receptor A (Fall 2013)

Data	# of Data Points with Turbine On (min. 120 required)				# of Data Points with Turbine Off (min. 60 required)			
	4m/s	5m/s	6m/s	7m/s	4m/s	5m/s	6m/s	7m/s
(A) Total Available Valid Points	1998	720	293	166	217	69	1	0
(B) After Applying Original Gust Filter to (A)	1528	452	115	22	195	61	0	0
(C) After Applying Proposed Gust Filter to (A)	1698	544	170	53	199	65	1	0
(D) After Applying Downwind Wind Direction Condition to (B)	453	104	61	16	n/a - direction independent for off condition			
(E) After Applying Downwind Wind Direction Condition to (C)	523	136	89	38	n/a - direction independent for off condition			

Data Summary for Conestogo Receptor A (Spring 2014)

Data	# of Data Points with Turbine On (min. 120 required)				# of Data Points with Turbine Off (min. 60 required)			
	4m/s	5m/s	6m/s	7m/s	4m/s	5m/s	6m/s	7m/s
(A) Total Available Valid Points	1860	786	312	136	323	203	100	38
(B) After Applying Original Gust Filter to (A)	1489	573	201	85	263	146	43	5
(C) After Applying Proposed Gust Filter to (A)	1655	651	240	110	284	167	62	17
(D) After Applying Downwind Wind Direction Condition to (B)	895	393	147	78	n/a - direction independent for off condition			
(E) After Applying Downwind Wind Direction Condition to (C)	911	405	162	99	n/a - direction independent for off condition			

Glossary

(A) Total valid points after excluding readings within 1 hr of rain, manual exclusions for meter downtime, wind speed binning, and time exclusions
(B) Valid readings after applying original MOE protocol gust filter (+/-2 m/s)
(C) Valid readings after applying MOE proposed filter below
- the maximum wind speed will differ from the average by no more than 2 m/s (parked)
- the minimum wind speed will differ from the average by no more than 2 m/s (operational)
(D) & (E) Valid readings after applying expanded wind direction filter (measurement station downwind of turbine(s))

Cumulative Data for Conestogo Receptor C

Data	# of Data Points with Turbine On (min. 120 required)				# of Data Points with Turbine Off (min. 60 required)				Percentage of Minimum Number of Points				Percentage of Minimum Number of Points			
	4m/s	5m/s	6m/s	7m/s	4m/s	5m/s	6m/s	7m/s	4m/s	5m/s	6m/s	7m/s	4m/s	5m/s	6m/s	7m/s
(A) Total Available Valid Points	9505	6208	3160	1669	1026	845	395	243	7921%	5173%	2633%	1391%	1710%	1408%	658%	405%
(B) After Applying Original Gust Filter to (A)	6886	4418	1810	811	984	753	289	158	5738%	3682%	1508%	676%	1640%	1255%	482%	263%
(C) After Applying Proposed Gust Filter to (A)	7061	4692	2112	1036	1018	836	388	243	5884%	3910%	1760%	863%	1697%	1393%	647%	405%
(D) After Applying Downwind Wind Direction Condition to (B)	3279	2110	857	406	n/a - direction independent for off condition				2733%	1758%	714%	338%	n/a - direction independent for off condition			
(E) After Applying Downwind Wind Direction Condition to (C)	3317	2171	935	489	n/a - direction independent for off condition				2764%	1809%	779%	408%	n/a - direction independent for off condition			

Data Summary for Conestogo Receptor C (Spring 2013)

Data	# of Data Points with Turbine On (min. 120 required)				# of Data Points with Turbine Off (min. 60 required)			
	4m/s	5m/s	6m/s	7m/s	4m/s	5m/s	6m/s	7m/s
(A) Total Available Valid Points	3604	1974	971	236	0	3	31	47
(B) After Applying Original Gust Filter to (A)	1273	725	281	73	0	3	29	46
(C) After Applying Proposed Gust Filter to (A)	1277	748	286	78	0	3	29	47
(D) After Applying Downwind Wind Direction Condition to (B)	728	272	81	41	n/a - direction independent for off condition			
(E) After Applying Downwind Wind Direction Condition to (C)	728	275	83	44	n/a - direction independent for off condition			

Data Summary for Conestogo Receptor C (Fall 2013)

Data	# of Data Points with Turbine On (min. 120 required)				# of Data Points with Turbine Off (min. 60 required)			
	4m/s	5m/s	6m/s	7m/s	4m/s	5m/s	6m/s	7m/s
(A) Total Available Valid Points	2277	1364	698	431	493	419	58	1
(B) After Applying Original Gust Filter to (A)	2093	1057	412	236	485	408	51	1
(C) After Applying Proposed Gust Filter to (A)	2195	1162	510	282	485	410	53	1
(D) After Applying Downwind Wind Direction Condition to (B)	914	324	66	14	n/a - direction independent for off condition			
(E) After Applying Downwind Wind Direction Condition to (C)	926	335	74	16	n/a - direction independent for off condition			

Data Summary for Conestogo Receptor C (Spring 2014)

Data	# of Data Points with Turbine On (min. 120 required)				# of Data Points with Turbine Off (min. 60 required)			
	4m/s	5m/s	6m/s	7m/s	4m/s	5m/s	6m/s	7m/s
(A) Total Available Valid Points	3624	2870	1491	1002	533	423	306	195
(B) After Applying Original Gust Filter to (A)	3520	2636	1117	502	499	342	209	111
(C) After Applying Proposed Gust Filter to (A)	3589	2782	1316	676	533	423	306	195
(D) After Applying Downwind Wind Direction Condition to (B)	1637	1514	710	351	n/a - direction independent for off condition			
(E) After Applying Downwind Wind Direction Condition to (C)	1663	1561	778	429	n/a - direction independent for off condition			

Glossary

(A) Total valid points after excluding readings within 1 hr of rain, manual exclusions for meter downtime, wind speed binning, and time exclusions

(B) Valid readings after applying original MOE protocol gust filter (+/-2 m/s)

(C) Valid readings after applying MOE proposed filter below

- the maximum wind speed will differ from the average by no more than 2 m/s (parked)
- the minimum wind speed will differ from the average by no more than 2 m/s (operational)

(D) & (E) Valid readings after applying expanded wind direction filter (measurement station downwind of turbine(s))

Cumulative Data for Summerhaven Location 1

Data	# of Data Points with Turbine On (min. 120 required)				# of Data Points with Turbine Off (min. 60 required)				Percentage of Minimum Number of Points				Percentage of Minimum Number of Points			
	4m/s	5m/s	6m/s	7m/s	4m/s	5m/s	6m/s	7m/s	4m/s	5m/s	6m/s	7m/s	4m/s	5m/s	6m/s	7m/s
(A) Total Available Valid Points	5002	2616	1764	1189	757	437	139	17	4168%	2180%	1470%	991%	1262%	728%	232%	28%
(B) After Applying Original Gust Filter to (A)	4726	2352	1538	944	620	326	72	10	3938%	1960%	1282%	787%	1033%	543%	120%	17%
(C) After Applying Proposed Gust Filter to (A)	4861	2486	1639	1031	652	386	130	15	4051%	2072%	1366%	859%	1087%	643%	217%	25%
(D) After Applying Downwind Wind Direction Condition to (B)	3068	1348	887	559	n/a - direction independent for off condition				2557%	1123%	739%	466%	n/a - direction independent for off condition			
(E) After Applying Downwind Wind Direction Condition to (C)	3182	1448	956	613	n/a - direction independent for off condition				2652%	1207%	797%	511%	n/a - direction independent for off condition			

Data Summary for Summerhaven Location 1 (Fall 2013)

Data	# of Data Points with Turbine On (min. 120 required)				# of Data Points with Turbine Off (min. 60 required)			
	4m/s	5m/s	6m/s	7m/s	4m/s	5m/s	6m/s	7m/s
(A) Total Available Valid Points	2230	1215	875	588	202	194	78	7
(B) After Applying Original Gust Filter to (A)	2069	1054	742	452	114	121	24	3
(C) After Applying Proposed Gust Filter to (A)	2161	1130	805	508	133	173	78	7
(D) After Applying Downwind Wind Direction Condition to (B)	1779	775	436	290	n/a - direction independent for off condition			
(E) After Applying Downwind Wind Direction Condition to (C)	1871	845	485	331	n/a - direction independent for off condition			

Data Summary for Summerhaven Location 1 (Spring 2014)

Data	# of Data Points with Turbine On (min. 120 required)				# of Data Points with Turbine Off (min. 60 required)			
	4m/s	5m/s	6m/s	7m/s	4m/s	5m/s	6m/s	7m/s
(A) Total Available Valid Points	2772	1401	889	601	555	243	61	10
(B) After Applying Original Gust Filter to (A)	2657	1298	796	492	506	205	48	7
(C) After Applying Proposed Gust Filter to (A)	2700	1356	834	523	519	213	52	8
(D) After Applying Downwind Wind Direction Condition to (B)	1289	573	451	269	n/a - direction independent for off condition			
(E) After Applying Downwind Wind Direction Condition to (C)	1311	603	471	282	n/a - direction independent for off condition			

Glossary

(A) Total valid points after excluding readings within 1 hr of rain, manual exclusions for meter downtime, wind speed binning, and time exclusions

(B) Valid readings after applying original MOE protocol gust filter (+/-2 m/s)

(C) Valid readings after applying MOE proposed filter below

- the maximum wind speed will differ from the average by no more than 2 m/s (parked)
- the minimum wind speed will differ from the average by no more than 2 m/s (operational)

(D) & (E) Valid readings after applying expanded wind direction filter (measurement station downwind of turbine(s))

Cumulative Data for Summerhaven Location 2

Data	# of Data Points with Turbine On (min. 120 required)				# of Data Points with Turbine Off (min. 60 required)				Percentage of Minimum Number of Points				Percentage of Minimum Number of Points			
	4m/s	5m/s	6m/s	7m/s	4m/s	5m/s	6m/s	7m/s	4m/s	5m/s	6m/s	7m/s	4m/s	5m/s	6m/s	7m/s
(A) Total Available Valid Points	9466	5703	2522	1259	1240	783	273	57	7888%	4753%	2102%	1049%	2067%	1305%	455%	95%
(B) After Applying Original Gust Filter to (A)	9302	5394	2233	996	1227	735	228	41	7752%	4495%	1861%	830%	2045%	1225%	380%	68%
(C) After Applying Proposed Gust Filter to (A)	9444	5586	2402	1110	1228	746	240	46	7870%	4655%	2002%	925%	2047%	1243%	400%	77%
(D) After Applying Downwind Wind Direction Condition to (B)	5719	2831	856	307	n/a - direction independent for off condition				4766%	2359%	713%	256%	n/a - direction independent for off condition			
(E) After Applying Downwind Wind Direction Condition to (C)	5775	2922	921	348	n/a - direction independent for off condition				4813%	2435%	768%	290%	n/a - direction independent for off condition			

Data Summary for Summerhaven Location 2 (Fall 2013)

Data	# of Data Points with Turbine On (min. 120 required)				# of Data Points with Turbine Off (min. 60 required)			
	4m/s	5m/s	6m/s	7m/s	4m/s	5m/s	6m/s	7m/s
(A) Total Available Valid Points	5069	3123	1528	658	360	392	117	26
(B) After Applying Original Gust Filter to (A)	4927	2871	1333	478	351	370	102	17
(C) After Applying Proposed Gust Filter to (A)	5048	3023	1447	549	352	374	107	20
(D) After Applying Downwind Wind Direction Condition to (B)	3155	1491	565	185	n/a - direction independent for off condition			
(E) After Applying Downwind Wind Direction Condition to (C)	3197	1563	612	213	n/a - direction independent for off condition			

Data Summary for Summerhaven Location 2 (Spring 2014)

Data	# of Data Points with Turbine On (min. 120 required)				# of Data Points with Turbine Off (min. 60 required)			
	4m/s	5m/s	6m/s	7m/s	4m/s	5m/s	6m/s	7m/s
(A) Total Available Valid Points	4397	2580	994	601	880	391	156	31
(B) After Applying Original Gust Filter to (A)	4375	2523	900	518	876	365	126	24
(C) After Applying Proposed Gust Filter to (A)	4396	2563	955	561	876	372	133	26
(D) After Applying Downwind Wind Direction Condition to (B)	2564	1340	291	122	n/a - direction independent for off condition			
(E) After Applying Downwind Wind Direction Condition to (C)	2578	1359	309	135	n/a - direction independent for off condition			

Glossary

(A) Total valid points after excluding readings within 1 hr of rain, manual exclusions for meter downtime, wind speed binning, and time exclusions

(B) Valid readings after applying original MOE protocol gust filter (+/-2 m/s)

(C) Valid readings after applying MOE proposed filter below

- the maximum wind speed will differ from the average by no more than 2 m/s (parked)
- the minimum wind speed will differ from the average by no more than 2 m/s (operational)

(D) & (E) Valid readings after applying expanded wind direction filter (measurement station downwind of turbine(s))

Cumulative Data for Summerhaven Location 3

Data	# of Data Points with Turbine On (min. 120 required)				# of Data Points with Turbine Off (min. 60 required)				Percentage of Minimum Number of Points				Percentage of Minimum Number of Points			
	4m/s	5m/s	6m/s	7m/s	4m/s	5m/s	6m/s	7m/s	4m/s	5m/s	6m/s	7m/s	4m/s	5m/s	6m/s	7m/s
(A) Total Available Valid Points	7457	4767	2718	1357	1011	692	384	179	6214%	3973%	2265%	1131%	1685%	1153%	640%	298%
(B) After Applying Original Gust Filter to (A)	7362	4557	2532	1188	1010	682	369	169	6135%	3798%	2110%	990%	1683%	1137%	615%	282%
(C) After Applying Proposed Gust Filter to (A)	7402	4661	2636	1270	1010	685	370	171	6168%	3884%	2197%	1058%	1683%	1142%	617%	285%
(D) After Applying Downwind Wind Direction Condition to (B)	5016	3122	1646	790	n/a - direction independent for off condition				4180%	2602%	1372%	658%	n/a - direction independent for off condition			
(E) After Applying Downwind Wind Direction Condition to (C)	5053	3189	1710	840	n/a - direction independent for off condition				4211%	2658%	1425%	700%	n/a - direction independent for off condition			

Data Summary for Summerhaven Location 3 (Fall 2013)

Data	# of Data Points with Turbine On (min. 120 required)				# of Data Points with Turbine Off (min. 60 required)			
	4m/s	5m/s	6m/s	7m/s	4m/s	5m/s	6m/s	7m/s
(A) Total Available Valid Points	3501	2117	1107	623	254	303	128	23
(B) After Applying Original Gust Filter to (A)	3483	2040	1029	505	253	296	120	16
(C) After Applying Proposed Gust Filter to (A)	3495	2097	1088	563	253	298	121	16
(D) After Applying Downwind Wind Direction Condition to (B)	2464	1407	722	362	n/a - direction independent for off condition			
(E) After Applying Downwind Wind Direction Condition to (C)	2476	1432	754	393	n/a - direction independent for off condition			

Data Summary for Summerhaven Location 3 (Spring 2014)

Data	# of Data Points with Turbine On (min. 120 required)				# of Data Points with Turbine Off (min. 60 required)			
	4m/s	5m/s	6m/s	7m/s	4m/s	5m/s	6m/s	7m/s
(A) Total Available Valid Points	3956	2650	1611	734	757	389	256	156
(B) After Applying Original Gust Filter to (A)	3879	2517	1503	683	757	386	249	153
(C) After Applying Proposed Gust Filter to (A)	3907	2564	1548	707	757	387	249	155
(D) After Applying Downwind Wind Direction Condition to (B)	2552	1715	924	428	n/a - direction independent for off condition			
(E) After Applying Downwind Wind Direction Condition to (C)	2577	1757	956	447	n/a - direction independent for off condition			

Glossary

(A) Total valid points after excluding readings within 1 hr of rain, manual exclusions for meter downtime, wind speed binning, and time exclusions

(B) Valid readings after applying original MOE protocol gust filter (+/-2 m/s)

(C) Valid readings after applying MOE proposed filter below

- the maximum wind speed will differ from the average by no more than 2 m/s (parked)
- the minimum wind speed will differ from the average by no more than 2 m/s (operational)

(D) & (E) Valid readings after applying expanded wind direction filter (measurement station downwind of turbine(s))