REPORT

BEAVER RIDGE WIND SOUND MONITORING

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PREPARED FOR:
BEAVER RIDGE WIND LLC

SUBMITTED BY:
KENNETH KALISKI, P.E., INCE BD. CERT.
SENIOR DIRECTOR

55 Railroad Row
White River Junction, VT 05001
802.295.4999
www.rsginc.com

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1.0 EXECUTIVE SUMMARY

The Beaver Ridge Wind project (the Project) consists of three GE 1.5 MW wind turbines in Freedom, Maine. The project is not subject to the Site Location of Development Act (Site Law), which includes the Maine DEP Chapter 375.10 sound rules (DEP Sound Rules). However, Beaver Ridge Wind retained RSG to measure Project sound emissions in accordance with the methodology contained in the DEP Sound Rules.

A third-party independent sound consultant was retained to review the sound monitoring methodology, observe the monitoring setup, and review the results. A request for proposals made to the four consultants pre-approved by Maine DEP for wind turbine sound reviews resulted in Hessler Associates being retained as the third-party consultant.

The sound monitoring was conducted from November 19 to December 16, 2013. The initial three monitoring sites were:

1) Gerrish – This is the closest residence to the Project that would be considered a protected location under DEP Sound Rules. The residence is approximately 1,300 feet from the closest turbine (Turbine T3).The monitor was set up adjacent to Deer Hill Road.
2) Littlefield – This monitor was set up near the Littlefield residence, about 2,800 feet northeast of Turbine T3.
3) Dave and Maryann (D&M) Bennett – This monitor was set up in a pasture to the west-southwest of the home, about 3,200 feet from Turbine T1.

In addition, a 10-meter meteorological tower was placed in an open area at the Boulier residence to help assess valid sound monitoring periods.

Each of these locations was field reviewed by the third-party consultant, and placed with the consent of the property owner.

After the first week of monitoring, Steve and Carrie (S&C) Bennett requested a monitor be placed on their property. On November 26, 2013 a monitor was set up 315 feet south of the residence, about 2,800 feet northwest of Turbine T1.

Each monitoring system included a sound level meter logging sound levels every 50 milliseconds (ms), an audio recorder, and an anemometer to record wind speed. In addition, the project operator collected wind speed, wind direction, and power output for each turbine on a 10-minute basis.

After the monitoring took place, the data were processed. Each monitoring location had at least 12 valid 10-minute monitoring intervals. The results of the monitoring are shown in Table 1 below. The first column shows the monitor location; the next three columns show the sound levels as determined under the methodology contained in the DEP Sound Rules; and the last two columns show the sound levels

according to the turbine shutdown methodology, which was requested by the third-party sound consultant and which is a commonly used methodology outside of Maine.

TABLE 1: SUMMARY OF SOUND LEVEL RESULTS

Location	Daytime Adjusted Leq (dBA)	Nighttime Adjusted Leq (dBA)	Overall Adjusted Leq (dBA)	Turbine Shutdown Method Leq (dBA)	Turbine Shutdown Method L90 (dBA)
Gerrish	42.7	43.5	42.9	40.7	37.9
Littlefield	35.6	36.4	35.9	33.8	29.6
D&M Bennett	-	29.0	29.0	-	-
S&C Bennett	38.4	35.5	37.4	37.5	32.3

Note: The D&M Bennett monitor did not have any valid daytime monitoring periods or any valid monitoring periods for the turbine shutdown methodology (during these periods the wind turbine sound levels were too low to distinguish Project sound from ambient sound).

Overall, the results show that the Project generated sound levels below 45 dBA at all four monitoring locations using both the Maine DEP and turbine shutdown sound monitoring methods. As discussed in more detail below, the sound levels in Table 1 are conservative because non-turbine sounds (e.g. dog barking, airplane flyovers, birds chirping, etc.) were not filtered out (as provided for in the DEP Sound Rules) unless the monitoring interval exceeded 45 dBA.

2.0 INTRODUCTION

This report provides sound monitoring results conducted at the Beaver Ridge Wind project (the Project) in Freedom, Maine in November and December 2013. The monitoring was conducted in accordance with the Sound Monitoring Protocol dated September 12, 2013 (Appendix D). The purpose of the testing is to measure sound levels from the wind turbines to assess whether the project meets a 45 dBA design goal at nearby residences.

This report includes:

- A primer on the terminology used in this report
- A description of the Project including information about the Project area, turbines, and modeled sound levels
- Measurement methodology
- Measurement results

3.0 TERMINOLOGY USED IN THIS REPORT

Sound is caused by variations in air pressure at a range of frequencies. Sound levels that are detectable by human hearing are defined in the decibel (dB) scale, with 0 dB being the approximate threshold of human hearing, and 135 dB causing pain and permanent damage to the ear.

The decibel scale can be weighted to mimic the human perception of certain frequencies. The most common of these weighting scales is the "A" weighting. It is used most frequently in environmental noise analyses. Sound levels that are weighted by the "A" scale have units of dBA or dB(A).

Sound can be measured in many different ways. Perhaps the simplest way is to take an instantaneous measurement, which gives the sound pressure level at an exact moment in time. The level reading could be 62 dB, but a second later, it could 57 dB. Sound pressure levels are constantly changing. It is for this reason that it makes sense to describe sound levels over time.

Take as an example the sound levels measured over time shown in Figure 1. Instantaneous measurements are shown as a fluctuating grey line. The sound levels that occur during this hypothetical interval can be described statistically. This is done using a variety of "levels" which are described below.

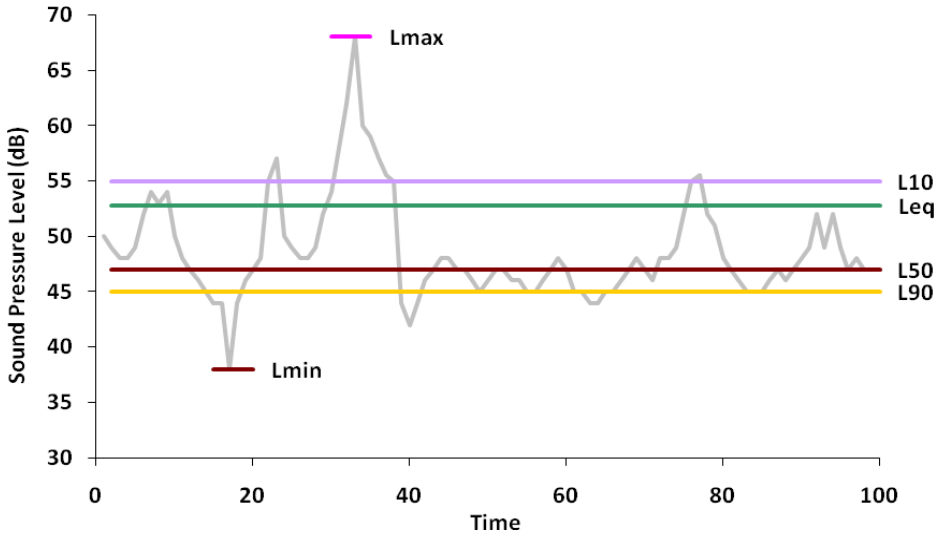

FIGURE 1: EXAMPLE OF DESCRIPTIVE TERMS OF SOUND MEASUREMENT OVER TIME

3.1 | Lmin AND Lmax

Lmin and Lmax are simply the minimum and maximum sound level, respectively, monitored over a period.

3.2 | PERCENTILE SOUND LEVEL - L*n*

L*n* is the sound level exceeded n percent of the time. This type of statistical sound level, also shown in Figure 1, gives us information about the distribution of sound levels. For example, the L10 is the sound level that is exceeded 10 percent of the time, while the L90 is the sound level exceeded 90 percent of the time. The L50 is the median and is exceeded half the time. The L90 is often described as the "residual" level, describing a condition when most short-term contaminating sources are removed.

3.3 | EQUIVALENT AVERAGE SOUND LEVEL - Leq

One of the most common ways of describing noise levels is in terms of the continuous equivalent sound level (Leq). The Leq is the average of the sound pressure over an entire monitoring period and expressed as a decibel:

$$Leq_T = 10 * log_{10}\left(\frac{1}{T}\int_{\theta}^{T} p_A^2(t)dt \Big/ p_0^2\right)$$

where p_0^2 is the squared instantaneous weighted sound pressure signal, as a function of elapsed time t, p_0 is the reference pressure of 20 μPa, and T is the stated time interval.

The monitoring period, T, can be for any amount of time. It could be one second ($Leq_{1\text{-sec}}$), one hour ($Leq_{(1)}$), or 24 hours ($Leq_{(24)}$). Because Leq is a logarithmic function of the average pressure, loud and infrequent sounds have a greater effect on the resulting Leq than quieter and more frequent sounds. For example, in Figure 1, the L50 (median) is about 47 dB, but the Leq is 53 dB. Because it tends to weight the higher sound levels and is representative of sound that takes place over time, the Leq is the most commonly used descriptor in noise standards and regulations, and is the descriptor specified by the DEP Sound Rules.

4.0 PROJECT DESCRIPTION

The Project is located in Freedom, Maine at the eastern terminus of Sibley Road. North Palermo Road is located 1,800 meters (5,900 feet) to the northwest of the Project and the western terminus of Deer Hill Road is located approximately 350 meters (1,150 feet) to the north of Turbine T3. The Project consists of three GE 1.5 SLE turbines arranged from southwest to northeast with 80 meter (262 ft) hub heights. A map showing the project in relation to the surrounding area is shown in Figure 2.

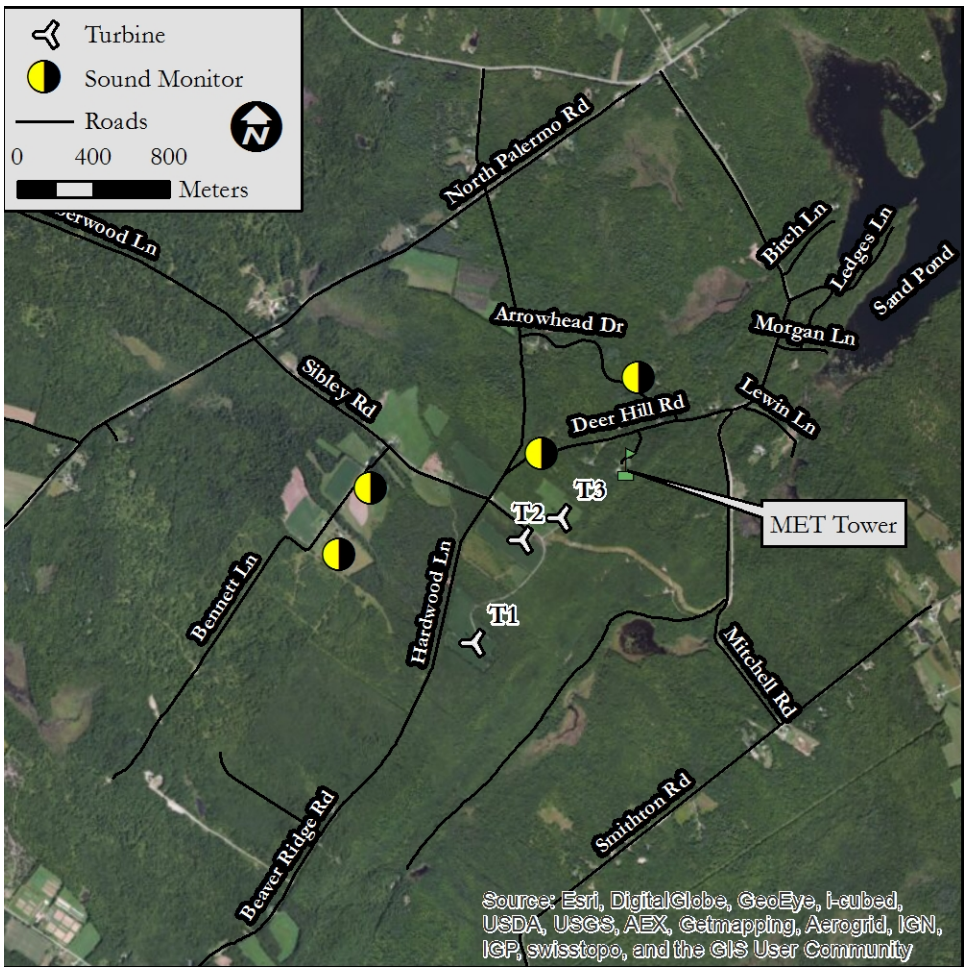

FIGURE 2: PROJECT AREA

5.0 SOUND MONITORING METHODOLOGY

5.1 | THIRD PARTY REVIEW

A Request for Proposals was issued to the four acoustical consulting firms pre-approved by the Maine Department of Environmental Protection to review wind turbine sound studies. One firm could not respond due to DEP contract restrictions. One firm chose not to respond. The two remaining firms responded to the RFP and the low bidder, Hessler Associates, Inc., was chosen. This neutral third-party observer assessed conformance with the noise-monitoring requirements of this protocol.

David Hessler, of Hessler Associates, approved each of the sound monitoring locations and attended the installation of the three primary sound monitors and the meteorological tower listed in the Monitoring Protocol.

David Hessler will file a separate report setting forth his opinion as to the sufficiency of the data collected, and whether the turbine's sound levels were accurately captured at the monitoring locations.

5.2 | SOUND MONITORING PROTOCOL

A Sound Monitoring Protocol, dated September 12, 2013, was established for this study. It laid out the requirements for equipment, location, logistics, and analysis for sound monitoring at Beaver Ridge. The protocol is based on the wind power-specific guidelines in the DEP Sound Rules and was reviewed and approved by the third-party consultant. The protocol is attached as Appendix D.

5.3 | SOUND MONITORING LOGISTICS & EQUIPMENT

Sound monitoring was conducted in accordance with the Sound Monitoring Protocol. At each of the monitoring sites, sound level data were collected using Larson Davis 831, ANSI/IEC Type 1, sound level meters. Each sound level meter was supplemented with an audio recorder, which recorded in .mp3 format using the audio output from the sound level meter.

Microphones were mounted on approximately three-foot to five-foot (1 to 1.5 meter) tall wooden stakes and covered with 7-inch ACO-Pacific weather resistant windscreens. At each location, an anemometer was installed at microphone height to measure wind speed.

At the Boulier residence, one primary and one backup anemometer were installed on a 10-meter mast to help assess valid sound monitoring periods.

5.4 | DATA PROCESSING

Each monitor was set to record, at a minimum, LAf, LAeq, and 1/3 octave band data. LAf and LAeq were recorded at 50 ms intervals at all monitors, while some

monitors recorded 1/3 octave band data at 50 ms intervals and other monitors recorded 1/3 octave band data at 1-minute intervals.

These data were processed in Microsoft Excel™ using custom programmed VBA routines. Processing of the data is consistent with the required Sound Monitoring Protocol conditions for monitoring, and functions as follows:

1) For each 1-second period, the level of "Short Duration Repetitive Sounds" (SDRS) is assessed by determining the maximum 50 ms LAf, then finding the minimum LAf in the 0.5 seconds prior to and after the maximum. The amplitude modulation level is the difference between the maximum and the average of the two minima. If amplitude modulation is 5 dB or greater for more than five events in a 10-minute period, then a 5 dB penalty is added to that 10-minute LAeq.
2) The unweighted one-second or one-minute 1/3 octave band sound levels are combined to yield 10-minute equivalent sound levels.
3) Each ten-minute period is then assessed to identify tonality. If tonal sound is indicated, then a 5 dB penalty is added to that ten-minute LAeq.[1]
4) **Primary Methodology**: Each 10-minute period is screened to assess whether the data is valid, based on the following meteorological conditions specified by the DEP Sound Rules:
    a. Wind direction (as measured at the wind turbine hub) is within 45 degrees of the geographic center of the nearest five wind turbines[2];
    b. The three turbines are generating above 924 kW, above which the turbines produce their highest sound power level (i.e. the turbines are at their loudest);
    c. The 10-meter anemometer wind speed is less than 6 mph;
    d. There is no precipitation; and
    e. Temperatures are above the rated level for the monitoring equipment.
5) **Secondary Methodology**: As dictated by the DEP Sound Rules, if fewer than 12 10-minute periods meet the meteorological conditions specified above, then the sound levels were evaluated to determine if:
    a. The difference between the LA90 and LA10 during any 10-minute period is less than 5 dBA;
    b. The surface wind speed (10 meter height) (32.8 feet) is 6 mph or less for 80 percent of the measurement period and does not exceed 10 mph at any time, or the turbines are shut down during the monitoring period

[1] In Appendix A, tonality is reported as "Tonal Seconds," the number of seconds in a 10-minute period where the sound spectrum has tonal components. 10-minute periods are assessed for tonality based upon the overall spectrum for the 10-minute period, according to the DEP Sound Rules. Consequently, a 10-minute period could indicate tonal seconds, but the 10-minute Leq is not tonal, and thus is not assigned a tonality penalty. For periods with many tonal sounds, the source of the sound is noted in Appendix A.
[2] In the case of Beaver Ridge Wind, with only three turbines, we used the center of the Project.

and the difference in the observed LA50 after shut down is equal to or greater than 6 dBA; and

c. Observer logs or recorded sound files clearly indicate the dominance of wind turbine sound. (Although not required by the DEP Sound Rules or the monitoring protocol for this report, the Project turbines were operating at maximum sound power during all intervals assessed under the secondary methodology.)

6) **Tertiary Methodology**: Sound levels are also evaluated around 10 planned 10-minute turbine shutdowns. A comparison is made between the L90s during operations in a one-hour period on either side of the shutdown, and the L90 during shutdown. The results are used to determine the extent the above measurement protocol is affected by background sound. This method is not part of the DEP Sound Rules; however, in our experience, it is one of the most commonly used methods outside of Maine and provides a useful comparison to the DEP method.[3]

7) If an exceedance of 45 dBA is found, with any of these methods, then the period is further evaluated to determine if any other sources could have contributed to the sound. Common sources could be snowmobile passbys, airplane flyovers, and biogenic sources (birds, peepers, and insects). Biogenic sources are generally characterized by high frequency tonal sound along with amplitude modulation (bird calls, crickets chirping, etc.). Vehicle passbys are characterized by gradual onset and decline, with tonal changes corresponding with Doppler shifts. Other sounds unrelated to turbine operations may also be present (woodpeckers, animal or human sounds, gusty wind, etc.) Filtering or removing these sounds from a dataset has the effect of lowering the overall sound level.

5.5 | MEASUREMENT LOCATIONS

The protocol specified measurements at three locations: the Gerrish, Littlefield, and David and Maryann (D&M) Bennett residences. After the first week of sound monitoring, a supplementary location was added (at the homeowner's request) at the Steve & Carrie (S&C) Bennett residence. The 10-meter anemometer mast was located at the Boulier residence. Each location is shown in Figure 3 and described further in the subsections below.

Each monitor was placed with the approval of the landowner, at least 25 feet from any structure capable of reflecting sound from the Project, and no greater than 500 feet from the residence. Each location is described in detail below.

[3] For example, *Final Monitoring Protocol: Kingdom Community Wind.* RSG, Inc. April, 23, 2012.

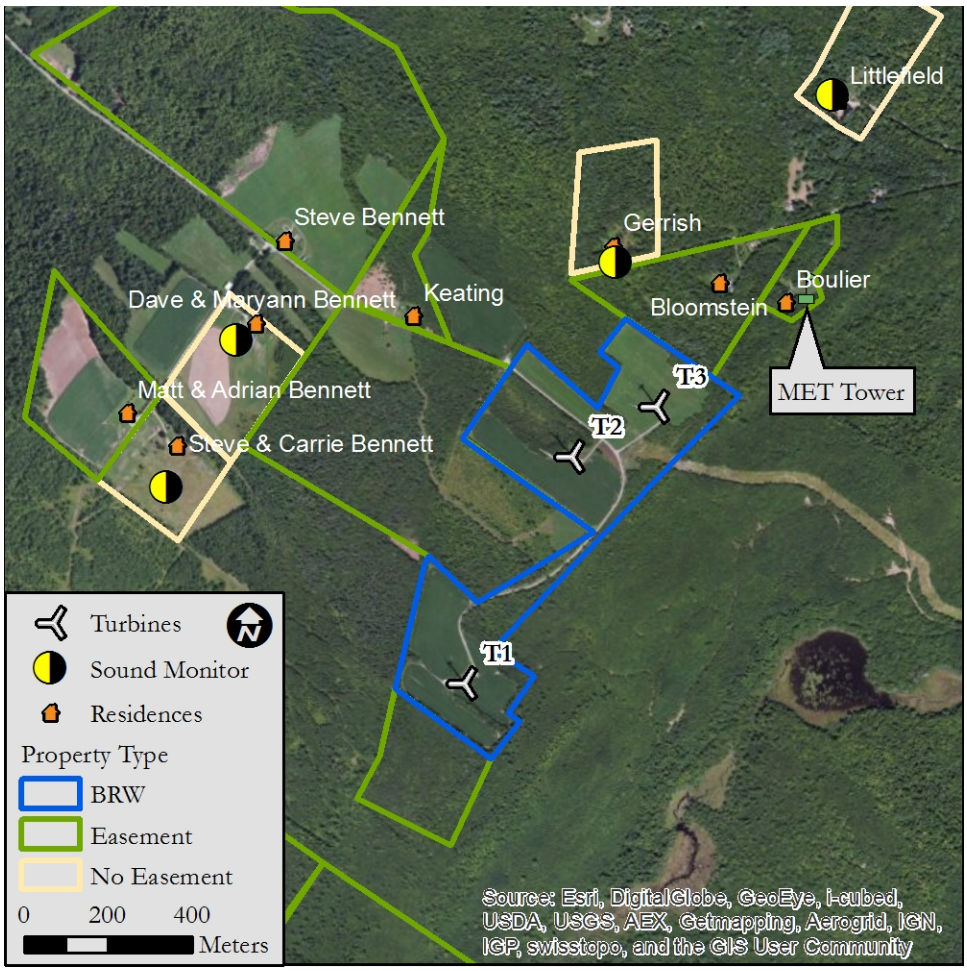

FIGURE 3: MONITORING LOCATIONS

GERRISH

A sound monitoring system was set up approximately 37 meters (120 feet) south of the Gerrish house, about 6 meters (20 feet) east of the driveway and about 8 meters (27 feet) from Deer Hill Road. The nearest turbine, Turbine T3, is about 400 meters (1,300 feet) to the south. A picture of the monitoring setup is shown in Figure 4.

FIGURE 4: GERRISH MONITOR

LITTLEFIELD

The Littlefield monitor was set up about 15 meters (50 feet) north of the home and 850 meters (2,800 feet) from the nearest wind turbine, Turbine T3. There is no picture available for Littlefield.

D&M BENNETT

The sound monitoring system at the D&M Bennett farm was set up at the edge of a pasture, about 60 meters (200 feet) southwest of the house and 975 meters (3,200 feet) from Turbine T1. A picture of the monitoring setup is shown in Figure 5.

The LD831 sound level meter at this location experienced an electronics failure on November 26th. It was replaced on December 6th.

FIGURE 5: D&M BENNETT MONITOR

S&C BENNETT

The sound level monitoring system at S&C Bennett's property was not included in the original Sound Monitoring Protocol. It was added after the sound monitoring began, at the request of Ms. Bennett. The sound monitor was installed on November 26th in the middle of a field, approximately 96 meters (315 feet) south of the residence and approximately 850 meters (2,800 feet) northwest of Turbine T1.

FIGURE 6: S&C BENNETT MONITOR

6.0 SOUND MONITORING RESULTS

The minimum ten-day sound monitoring period was extended to nearly one month to improve the chances of monitoring during valid meteorological periods. The sound monitors ran from November 19 to December 16, 2013.

The Littlefield and Gerrish monitors ran for the entire monitoring period. The D&M Bennett monitor ran for 16 days because of an electronics failure, and the S&C Bennett monitor ran for 20 days. The time history of each sound monitor, including L90 and Leq, the power output of the closest wind turbine, and the 1.5 meter wind speed is shown in Appendix B.

6.1 | PRIMARY METHODOLOGY – HIGH WIND SHEAR

All four sites were analyzed with the primary methodology, which defined a valid period as one with winds downwind from the turbines relative to the receiver, the turbines operating within 1 dB of the maximum sound power, and 10-meter wind speeds less than 6 mph. We found valid periods using this method at all monitoring locations, except the D&M Bennett monitor. The results for each monitor are described below and detailed in Appendix A.

GERRISH

At the Gerrish monitor there were 17 valid periods using the primary methodology, all occurring on the 5th and 6th of December. The overall average of these periods was 42.9 dBA, with no periods requiring application of penalties for either SDRS or tonality. The average of the daytime periods was 42.7 dBA and the average of the nighttime periods was 43.5 dBA.

TABLE 2: VALID PERIODS FOR GERRISH MONITOR - PRIMARY METHODOLOGY

Date/Time	Leq (dBA)	Leq Adjusted for Penalties (dBA)	> 5 SDRS Events?	Tonal?	Seconds > 6 mph
12/5/2013 13:00	42.5	42.5	No	No	17[4]
12/5/2013 13:30	42.8	42.8	No	No	14
12/5/2013 14:10	43.1	43.1	No	No	22
12/5/2013 16:30	42.7	42.7	No	No	0
12/5/2013 16:40	43.1	43.1	No	No	10
12/5/2013 16:50	43.0	43.0[5]	No	No	25
12/5/2013 17:00	42.9	42.9	No	No	16
12/5/2013 17:10	42.2	42.2	No	No	54
12/5/2013 17:40	42.3	42.3	No	No	52
12/5/2013 17:50	42.7	42.7	No	No	87
12/5/2013 18:00	42.7	42.7	No	No	106
12/5/2013 18:50	42.6	42.6	No	No	89
12/5/2013 19:00	42.3	42.3	No	No	84
12/5/2013 19:10	42.9	42.9	No	No	97
12/6/2013 0:40	44.0	44.0	No	No	68
12/6/2013 0:50	44.7	44.7	No	No	93
12/6/2013 1:40	43.6	43.6	No	No	45
Overall Average	42.9	42.9			
Daytime Average	42.7	42.7			
Nighttime Average	43.5	43.5			

[4] 10-meter wind speeds during almost all 10-minute periods exceeded 6 mph for some amount of time. Periods were considered valid for the primary methodology if average wind speeds were below 6 mph.

[5] This period exhibited several dog barks with sound levels up to 65 dBA, which were removed from the data. Without the dog barks removed, the 10-minute Leq for this period is 45.5 dBA.

LITTLEFIELD

At the Littlefield monitor, there were 25 valid periods, occurring on the 6th, 10th, and 13th of December. The overall average of these periods was 35.9 dBA, with no periods requiring application of penalties for either SDRS or tonality. The average of the daytime periods was 35.6 dBA and the average of the nighttime periods was 36.4 dBA.

TABLE 3: VALID PERIODS FOR LITTLEFIELD MONITOR - PRIMARY METHODOLOGY

Date/Time	Leq (dBA)	Leq Adjusted for Penalties (dBA)	> 5 SDRS Events?	Tonal?	Seconds > 6 mph
12/6/2013 1:10	38.2	38.2	No	No	72
12/6/2013 1:20	38.2	38.2	No	No	58
12/6/2013 1:40	37.0	37.0	No	No	45
12/10/2013 5:30	33.7	33.7	No	No	0
12/10/2013 5:40	33.8	33.8	No	No	59
12/10/2013 6:00	35.5	35.5	No	No	38
12/10/2013 6:10	35.0	35.0	No	No	49
12/10/2013 6:20	35.0	35.0	No	No	24
12/10/2013 6:50	41.4	41.4	No	No	23
12/10/2013 7:00	33.4	33.4	No	No	4
12/10/2013 7:10	33.0	33.0	No	No	7
12/10/2013 7:20	33.5	33.5	No	No	3
12/10/2013 7:30	37.1	37.1	No	No	20
12/10/2013 7:40	33.6	33.6	No	No	1
12/10/2013 7:50	38.0	38.0	No	No	1
12/10/2013 8:00	33.5	33.5	No	No	3
12/10/2013 8:10	34.7	34.7	No	No	10
12/10/2013 8:20	34.6	34.6	No	No	19
12/10/2013 8:30	34.5	34.5	No	No	10
12/10/2013 8:40	33.8	33.8	No	No	1
12/10/2013 8:50	36.8	36.8	No	No	0
12/13/2013 8:10	37.7	37.7	No	No	82
12/13/2013 8:20	38.8	38.8	No	No	87
12/13/2013 8:30	36.4	36.4	No	No	47
12/13/2013 9:00	39.7	39.7	No	No	80
Overall Average	35.9	35.9			
Daytime Average	35.6	35.6			
Nighttime Average	36.4	36.4			

S&C BENNETT

At the S&C Bennett monitor, there were seven valid periods using the primary method, all occurring on the 5th of December. Because there were not at least 12 valid periods, the secondary method was also performed at this location. (Results using the secondary method are described in Section 6.2 below.) Periods analyzed using the primary method did not contain greater than five SDRS events and were not tonal.

TABLE 4: VALID PERIODS FOR S&C BENNETT MONITOR - PRIMARY METHODOLOGY

Date/Time	Leq (dBA)	Leq Adjusted for Penalties (dBA)	> 5 SDRS Events ?	Tonal?	Seconds > 6 mph
12/5/2013 11:10[6]	39.4	39.4	No	No	13
12/5/2013 11:40[6]	39.9	39.9	No	No	20
12/5/2013 13:00	36.0	36.0	No	No	17
12/5/2013 13:30	40.0	40.0	No	No	14
12/5/2013 13:40[6]	37.2	37.2	No	No	56
12/5/2013 14:00[6]	38.3	38.3	No	No	53
12/5/2013 14:10	39.1	39.1	No	No	22

D&M BENNETT

At the D&M Bennett monitor, there were no valid periods using the primary method. There were valid periods at neighboring S&C Bennett on 12/5/13, however the D&M Bennett meter was not operating at that time. Therefore, the secondary method was performed at this location. (Results using the secondary method are described in Section 6.2 below.)

6.2 | SECONDARY METHODOLOGY – L90 TO L10 DIFFERENCE

For monitors where fewer than 12 valid periods were found using the primary method, the secondary method was performed. This was necessary for the S&C Bennett and D&M Bennett monitors. For both, the average sound level of the valid periods using both methods is included in the tables below. In both cases, only enough periods were included to reach the 12 period minimum. For D&M Bennett,

[6] For this time period, Turbine T3, the furthest turbine from the monitor, was producing less than 924 kW.

the first 12 valid periods are shown using the secondary method and for S&C Bennett first five valid periods are shown using the secondary method. Consequently, some periods that are shown for S&C Bennett are not shown at D&M Bennett, even if those periods may have been valid.

Details of the analysis of valid periods are shown in Appendix A.

S&C BENNETT

The first five valid periods found using the secondary method are shown in Table 5. The daytime and nighttime valid period average using periods from both methods is 37.0 dBA without adjustments and 37.4 dBA with adjustments. The nighttime average is 34.3 dBA unadjusted and 35.5 dBA adjusted and the daytime average is 38.4 dBA both adjusted and unadjusted. There was one period with greater than five SDRS events, but no periods were tonal. The SDRS events were confirmed as turbine-caused with audio recordings.

TABLE 5: VALID PERIODS FOR S&C BENNETT MONITOR - SECONDARY METHODOLOGY

Date/Time	Leq (dBA)	Leq Adjusted for Penalties (dBA)	> 5 SDRS Events?	Tonal?	Seconds > 6 mph
11/30/2013 22:30	34.3	34.3	No	No	0
12/3/2013 18:40	36.9	36.9	No	No	4
12/3/2013 19:00	35.1	35.1	No	No	25
12/3/2013 19:10	34.8	34.8	No	No	11
12/3/2013 19:20	32.8	37.8	Yes	No	26
Overall Average (Combined Methods)	37.0	37.4			
Daytime Average (Combined Methods)	38.4	38.4			
Nighttime Average (Combined Methods)	34.3	35.5			

The first twelve valid periods using the secondary method are shown in Table 6. The overall valid period average sound level is 28.5 dBA unadjusted and 29.0 dBA adjusted.[7] There were no daytime valid periods, so the nighttime average is the same as the overall. There was one period with greater than five SDRS events, but no tonal periods. The SDRS events were confirmed as turbine-caused with audio recordings.

TABLE 6: VALID PERIODS FOR D&M BENNETT MONITOR - SECONDARY METHODOLOGY

Date/Time	Leq (dBA)	Leq Adjusted for Penalties (dBA)	> 5 AM Events?	Tonal?	Seconds > 6 mph
11/20/2013 20:10	27.8	27.8	No	No	1
11/20/2013 20:20	28.2	33.2	Yes	No	13
11/20/2013 20:30	28.9	28.9	No	No	6
11/20/2013 21:50	25.4	25.4	No	No	3
11/20/2013 22:00	26.9	26.9	No	No	14
11/20/2013 22:10	24.8	24.8	No	No	4
12/8/2013 2:00	30.1	30.1	No	No	0
12/8/2013 4:00	28.4	28.4	No	No	0
12/10/2013 3:40	27.4	27.4	No	No	0
12/11/2013 1:10	32.2	32.2	No	No	0
12/11/2013 1:20	31.1	31.1	No	No	8
12/11/2013 1:30	31.2	31.2	No	No	27
Overall Average	28.5	29.0			
Daytime Average	-	-			
Nighttime Average	28.5	29.0			

6.3 | TERTIARY METHODOLOGY – TURBINE SHUTDOWNS

At the request of the third-party acoustical consultant and in addition to the monitoring methodologies contained in the DEP Sound Rules, the Protocol called for up to 10 turbine shutdowns for 10 minutes each. This allowed for a direct comparison of operational and background sound levels as a way of assessing the turbine-only sound level. That is, the 10-minute "background" sound level is

[7] Sound levels measured at the D&M Bennett monitor are lower than those measured at the nearby S&C Bennett monitor because the D&M Bennett monitor is partially shielded from the Project by intervening terrain and foliage. At the D&M Bennett monitoring location, the rotor of T1 is partially obscured by foliage, the rotor of T2 is partially obscured by foliage and the ridgeline on which the Project is located, and T3 is completely obscured from view.

logarithmically subtracted from the one-hour "turbine+background" sound level to yield a calculated "turbine-only" sound level.

The shutdown periods shown are those where either the period before or after the shutdown exhibited prominent turbine sound and minimal contamination[8] from other sound sources. Gerrish, Littlefield, and S&C Bennett had at least one valid period that did not show significant contamination, but D&M Bennett did not show any valid periods under this method due to low wind turbine sound relative to background. The results for the former three monitoring locations are shown below and detailed in Appendix C.

GERRISH

The Gerrish monitor exhibited the most uncontaminated shutdown periods of all the monitors, with either the period before or after the shutdown being useable for seven of the ten periods. The average of the L90 turbine-only periods was 37.9 dBA, ranging from 34.6 to 41.6 dBA. This is in contrast to the turbine+background equivalent level of 42 dBA, a difference of 4.1 dB. The equivalent (Leq) turbine+background level is what would be assessed for compliance with the DEP Sound Rules. While in most cases, the hour before and after the shutdown was not considered valid using the primary Maine DEP method, the turbine+background levels are similar to the average levels found by the primary method because the turbines were operating at maximum sound power levels during those periods. The difference between the turbine-only equivalent level and the turbine+background equivalent level is 1.2 dB.

[8] Contamination would include sound from machinery, cars, wind, animals, airplane overflights, and vegetation.

TABLE 7: VALID SHUTDOWNS AT GERRISH MONITOR – TERTIARY METHODOLOGY

Shutdown Period				Hour Before				Hour After			
Date/Time		Background Sound Level (dBA)		Sound Level (dBA)				Sound Level (dBA)			
				Turbine + Background		Turbine Only		Turbine + Background		Turbine Only	
Beginning	End	Leq	L90	Leq	L90	Leq	L90	Leq	L90	Leq	L90
11/23/13 22:18	11/23/13 22:34	31.7	26.0	42.7	37.0	42.3	36.6	40.0	37.4	39.3	37.1
12/5/13 15:47[9]	12/5/13 16:04	34.0	27.9	40.1	36.1	38.9	35.4	42.9	41.8	42.3	41.6
12/6/13 0:05	12/6/13 0:20	40.1	37.3	43.7	42.3	41.2	40.6	44.1	41.8	41.9	39.9
12/7/13 14:50	12/7/13 15:03	41.1	35.4	44.0	40.5	NP	38.9	41.5	39.1	NP	36.6
12/10/13 20:53	12/10/13 21:11	36.7	32.6	41.4	36.7	39.7	34.6	44.3	38.6	43.4	37.3
12/12/13 6:30	12/12/13 6:44	34.0	29.6	38.2	31.4	36.1	NP	42.3	38.0	41.7	37.3
12/13/13 8:59	12/13/13 9:14	34.9	37.1	37.6	40.8	NP	38.4	42.3	41.1	41.5	38.9

NP = Turbines not prominent

Valid Shutdown Averages	**Leq**	**L90**
Turbine + Background	42.0	39.3
Turbine-Only	**40.7**	**37.9**

LITTLEFIELD

At the Littlefield monitor there were two shutdown periods with minimal contamination from other sources. The average of the L90 turbine-only periods was 29.6 dBA, 6.3 dB below the average equivalent turbine+background level of 35.9 dBA. The turbine+background equivalent level is 2.1 dB above the turbine-only equivalent level.

[9] Dog barks and vehicle noise were filtered out of the hour preceding and following this shutdown period.

TABLE 8: VALID SHUTDOWNS AT LITTLEFIELD MONITOR – TERTIARY METHODOLOGY

Shutdown Period				Hour Before				Hour After			
Date/Time		Baclground Sound Level (dBA)		Sound Level (dBA)				Sound Level (dBA)			
				Turbine + Background		Turbine Only		Turbine + Background		Turbine Only	
Beginning	End	Leq	L90	Leq	L90	Leq	L90	Leq	L90	Leq	L90
11/23/13 22:19	11/23/13 22:33	27.2	21.5	30.2	28.0	27.2	26.9	33.7	28.4	32.6	27.4
12/13/13 8:59	12/13/13 9:10	39.6	34.0	38.7	34.6	NP	NP	43.8	37.3	41.6	34.6

Valid Shutdown Averages	**Leq**	**L90**
Turbine + Background	35.9	31.2
Turbine-Only	**33.8**	**29.6**

NP = Turbines not prominent

S&C BENNETT

There were three shutdown periods at the S&C Bennett monitor with prominent turbine noise before or after the curtailment. The turbine-only L90 ranged from 31.5 to 33.2 dBA with an average of 32.3 dBA. This is 6.9 dB below the turbine+background equivalent level. The turbine+background equivalent level is 1.7 dB above the turbine-only equivalent level.

TABLE 9: VALID SHUTDOWNS AT S&C BENNETT MONITOR – TERTIARY METHODOLOGY

Shutdown Period				Hour Before				Hour After			
Date/Time		Background Sound Level (dBA)		Sound Level (dBA)				Sound Level (dBA)			
				Turbine + Background		Turbine Only		Turbine + Background		Turbine Only	
Beginning	End	Leq	L90	Leq	L90	Leq	L90	Leq	L90	Leq	L90
12/5/13 15:49	12/5/13 16:04	31.3	28.6	33.9	31.1	NP	NP	35.4	33.3	33.3	31.5
12/6/13 0:07	12/6/13 0:21	34.1	29.9	35.2	31.9	NP	NP	40.6	34.9	39.5	33.2
12/7/13 14:55	12/7/13 15:04	37.2	31.7	41.7	35.0	39.7	32.3	39.3	33.2	NP	NP

Valid Shutdown Averages	**Leq**	**L90**
Turbine + Background	39.2	34.4
Turbine Only	**37.5**	**32.3**

NP = Turbines not prominent

7.0 SUMMARY AND CONCLUSIONS

Sound monitoring was conducted at the Beaver Ridge Wind Farm in Freedom, Maine in November and December 2013. The purpose of the testing was to measure sound levels from the wind turbines to assess whether the project meets a 45 dBA sound level at nearby residences.

The monitoring followed a protocol written by RSG that was based on the DEP Sound Rules. It was reviewed and agreed to by a third-party consultant. This consultant was one of four pre-approved by the Maine DEP to review noise studies for wind farm applications.

Sound monitors were placed at three locations on November 19, 2013, with a fourth added after the first week. Monitoring was extended from the two weeks in the protocol to four weeks to increase the chances that worst-case meteorological conditions would occur.

Three methodologies were used to assess the sound level. The primary methodology was to use valid periods only under the worst-case meteorological conditions, where the receiver is downwind of the wind turbines, wind speeds at 10 meters are less than 6 mph, and the turbines are operating within 1 dB of their maximum sound power. If fewer than 12 valid periods were found using this method, then a secondary methodology was used until there are a total of 12 valid periods. This secondary methodology included times when the turbines were operating within 1 dB of their maximum sound power, the difference between the L90 and L10 was less than 5 dB, and recordings indicated that the primary source of sound were the wind turbines. Both methods were conducted according to the wind-power specific monitoring requirements contained in the DEP Sound Rules.

The results of the sound monitoring are as follows:

1) At the Gerrish property, which is the closest residence at which sound would be regulated under the DEP Sound Rules, the overall sound level was 42.9 dBA. The daytime sound level was 42.7 dBA and the nighttime was 43.5 dBA.
2) At the Littlefield property, the overall sound level was 35.9 dBA. The daytime sound level was 35.6 dBA and the nighttime was 36.4 dBA
3) At the S&C Bennett property, the overall sound level was 37.4 dBA, with a daytime level of 38.4 dBA and a nighttime level of 35.5 dBA.
4) At the D&M Bennett property, the nighttime sound level was 29.0 dBA. There were no daytime valid periods.
5) These levels may include non-turbine–caused sounds such as dogs barking, birds, distant machinery and traffic, wind "pops[10]," airplanes, etc. These

[10] Wind "pops" are sounds made by wind interaction with the microphone.

sounds were not eliminated from the data, so long as periods were not above 45 dBA.

In addition to the monitoring methodologies contained in the DEP Sound Rules, the wind turbines were shut down for 10-minutes on 10 separate occasions when they were operating at 924 kW or greater. This background sound level was then subtracted from the sound level one hour before and after the shutdown. The resulting turbine-only sound levels are described below:

1) At the Gerrish property, there were seven shutdown periods where turbine noise was sufficiently prominent, for a total of 13 valid one-hour periods. The turbine-only sound levels were 37.9 dBA L90 and 40.7 dBA Leq.
2) At the Littlefield property, there were two shutdown periods where turbine noise was sufficiently prominent, with a total of three valid one-hour periods. These periods averaged 29.6 dBA L90 and 33.8 dBA Leq.
3) At the S&C Bennett property, there were three shutdown periods where turbine noise was sufficiently prominent, with a total of three valid one-hour periods. These periods averaged 32.3 dBA L90 and 37.5 dBA Leq.
4) There were no periods with sufficient signal to noise ratio at the D&M Bennett Monitor.

The results show that the Beaver Ridge Wind project operates at sound levels below 45 dBA at all monitoring locations under the primary and secondary analysis methods. These results were confirmed by the turbine shutdown method, which is more commonly used outside of Maine for wind turbine compliance monitoring.

APPENDIX A: DETAILED VALID PERIOD INFORMATION

Each set of tables in Appendix A describe results for valid monitoring periods at each site, for both the primary and secondary methods, where applicable. Leq and Leq adjusted for penalties are shown, along with L10, L90, average and maximum wind speed, temperature, and turbine direction and orientation. The number of SDRS events are shown, and where greater than 4 events, a note explains the cause of the event. The number of tonal seconds are shown. However, a tonal penalty is only assessed where the 10-minute Leq is tonal. No 10-minute period was penalized for tonality. Where there are many tonal seconds, we reviewed the source of the sound and noted the source on the table.

TABLE A 1: GERRISH MONITOR - VALID PERIOD DETAILED INFORMATION CHART 1

Date/Time		12/5/13 13:00	12/5/13 13:30	12/5/13 14:10	12/5/13 16:30	12/5/13 16:40	12/5/13 16:50	12/5/13 17:00	12/5/13 17:10	12/5/13 17:40
Notes			Tonality due to birds	Tonality due to birds			4 WT Caused AM Events			
Analysis Method		Primary	Primary	Primary	Primary	Primary	Primary	Primary	Primary	Primary
Leq (dBA)		42.5	42.8	43.1	42.7	43.1	43.0	42.9	42.2	42.3
Adjusted Leq (dBA)		42.5	42.8	43.1	42.7	43.1	43.0	42.9	42.2	42.3
L10 (dBA)		43.5	43.7	43.8	43.7	43.9	43.9	43.6	43.1	43.2
L90 (dBA)		41.0	41.5	40.9	41.4	41.9	41.7	41.7	41.2	41.2
L10 - L90 (dB)		2.5	2.2	2.9	2.3	2.0	2.2	1.9	1.9	2.0
AM > 4 dB		4	2	4	3	3	9	2	1	1
Tonal Seconds		0	180	300	0	0	60	0	0	0
Average Wind Speed (m/s)		0.4	0.5	0.4	0.3	0.4	0.8	0.9	1.5	1.2
Maximum Wind Speed (m/s)		3.8	4.1	4.3	2.5	5.6	4.3	4.2	5.5	5.2
Temperature (Celsius)		3.1	3.1	3.5	3.5	3.7	3.9	4.0	4.1	4.5
T3	Turbine Output (kW)	959	1001	1117	1270	1355	1196	1291	1293	1479
	Turbine Direction (deg)	137	146	138	156	152	152	154	150	155
T2	Turbine Output (kW)	941	1045	950	1223	1377	1325	1298	1344	1500
	Turbine Direction (deg)	131	138	133	147	147	146	146	146	149
T1	Turbine Output (kW)	1279	1456	1374	1500	1455	1381	1434	1425	1498
	Turbine Direction (deg)	130	139	133	149	145	145	147	147	147

TABLE A 2: GERRISH MONITOR - VALID PERIOD DETAILED INFORMATION CHART 2

Date/Time		12/5/13 17:50	12/5/13 18:00	12/5/13 18:50	12/5/13 19:00	12/5/13 19:10	12/6/13 0:40	12/6/13 0:50	12/6/13 1:40
Notes						1 WT AM Event			
Analysis Method		Primary	Primary	Primary	Primary	Primary	Primary	Primary	Primary
Leq (dBA)		42.7	42.7	42.6	42.3	42.9	44.0	44.7	43.6
Adjusted Leq (dBA)		42.7	42.7	42.6	42.3	42.9	44.0	44.7	43.6
L10 (dBA)		43.6	43.6	43.4	43.0	43.7	44.9	45.6	44.6
L90 (dBA)		41.5	41.5	41.5	41.3	41.4	42.6	43.5	42.0
L10 - L90 (dB)		2.1	2.1	1.9	1.7	2.3	2.3	2.1	2.6
AM > 4 dB		2	3	1	1	9	4	3	3
Tonal Seconds		0	0	0	0	0	60	0	0
Average Wind Speed (m/s)		1.5	2.0	1.7	1.5	1.7	1.7	1.9	1.2
Maximum Wind Speed (m/s)		5.3	4.6	5.2	6.8	5.4	4.3	6.8	4.8
Temperature (Celsius)		4.5	4.6	5.1	5.2	5.2	7.7	8.0	8.5
T3	Turbine Output (kW)	1316	1346	1443	1178	1166	952	1197	1065
	Turbine Direction (deg)	160	155	161	161	165	181	182	210
T2	Turbine Output (kW)	1374	1327	1450	1140	1198	1033	1202	1373
	Turbine Direction (deg)	151	151	153	155	153	173	177	203
T1	Turbine Output (kW)	1463	1456	1496	1224	1267	1281	1413	1088
	Turbine Direction (deg)	150	150	150	152	154	174	178	206

TABLE A 3: LITTLEFIELD MONITOR - VALID PERIOD DETAILED INFORMATION CHART 1

Date/Time		12/6/13 1:10	12/6/13 1:20	12/6/13 1:40	12/10/13 5:30	12/10/13 5:40	12/10/13 6:00	12/10/13 6:10	12/10/13 6:20	12/10/13 6:50
Notes							AM Due to Animals in Shed,	AM Not WT Caused		AM not WT Caused
Analysis Method		Primary	Primary	Primary	Primary	Primary	Primary	Primary	Primary	Primary
Leq (dBA)		38.2	38.2	37.0	33.7	33.8	35.5	35.0	35.0	41.4
Adjusted Leq (dBA)		38.2	38.2	37.0	33.7	33.8	35.5	35.0	35.0	41.4
L10 (dBA)		39.2	39.5	37.7	35.4	36.1	37.0	36.6	36.7	41.8
L90 (dBA)		36.7	36.4	35.9	31.2	30.6	31.9	32.9	32.4	33.0
L10 - L90 (dB)		2.5	3.1	1.8	4.2	5.5	5.1	3.7	4.3	8.8
AM > 4 dB		0	2	1	2	3	16	5	2	16
Tonal Seconds		0	0	3	26	8	42	31	47	32
Average Wind Speed (m/s)		1.7	1.6	1.2	0.1	0.6	0.6	0.6	0.4	0.2
Maximum Wind Speed (m/s)		5.7	4.9	4.8	2.3	5.5	4.8	5.9	3.8	3.9
Temperature (Celsius)		8.2	8.4	8.5	-2.3	-1.9	-1.1	-1.0	-0.9	-1.3
T3	Turbine Output (kW)	1226	1043	1065	938	1280	1348	1310	1064	1369
	Turbine Direction (deg)	195	201	210	240	247	255	253	251	249
T2	Turbine Output (kW)	1323	1337	1373	1362	1373	1364	1318	1121	1374
	Turbine Direction (deg)	194	196	203	234	239	246	247	245	239
T1	Turbine Output (kW)	1449	1340	1088	1417	1439	1432	1336	1130	1361
	Turbine Direction (deg)	192	196	206	235	241	248	248	246	242

TABLE A 4: LITTLEFIELD MONITOR - VALID PERIOD DETAILED INFORMATION CHART 2

Date/Time		12/10/13 7:00	12/10/13 7:10	12/10/13 7:20	12/10/13 7:30	12/10/13 7:40	12/10/13 7:50	12/10/13 8:00	12/10/13 8:10	12/10/13 8:20
Notes		AM Not WT Caused			AM Not WT Caused		AM, Tonality Not WT Caused		AM Not WT Caused	AM Not WT Caused
Analysis Method		Primary	Primary	Primary	Primary	Primary	Primary	Primary	Primary	Primary
Leq (dBA)		33.4	33.0	33.5	37.1	33.6	38.0	33.5	34.7	34.6
Adjusted Leq (dBA)		33.4	33.0	33.5	37.1	33.6	38.0	33.5	34.7	34.6
L10 (dBA)		35.0	34.6	35.1	40.1	34.8	40.7	35.2	36.5	36.5
L90 (dBA)		31.2	31.0	31.2	33.0	32.1	32.8	31.6	31.2	31.7
L10 - L90 (dB)		3.8	3.6	3.9	7.1	2.7	7.9	3.6	5.3	4.8
AM > 4 dB		23	1	2	32	1	12	1	11	7
Tonal Seconds		5	14	19	25	8	100	14	82	31
Average Wind Speed (m/s)		0.1	0.1	0.1	0.3	0.2	0.1	0.1	0.2	0.2
Maximum Wind Speed (m/s)		3.0	3.0	3.0	3.8	3.3	2.8	3.0	3.9	3.6
Temperature (Celsius)		-1.0	-0.9	-0.7	-0.6	-0.4	-0.3	-0.4	-0.4	-0.3
T3	Turbine Output (kW)	1417	1449	1344	1322	1349	1350	1395	1335	1272
	Turbine Direction (deg)	248	250	250	250	254	254	253	253	254
T2	Turbine Output (kW)	1407	1450	1347	1326	1336	1331	1390	1328	1223
	Turbine Direction (deg)	242	245	245	245	248	247	245	244	244
T1	Turbine Output (kW)	1414	1466	1332	1368	1325	1317	1378	1382	1203
	Turbine Direction (deg)	244	248	245	248	250	249	247	246	248

TABLE A 5: LITTLEFIELD MONITOR - VALID PERIOD DETAILED INFORMATION CHART 3

Date/Time		12/10/13 8:30	12/10/13 8:40	12/10/13 8:50	12/13/13 8:10	12/13/13 8:20	12/13/13 8:30	12/13/13 9:00
Notes		AM Not WT Caused	AM Not WT Caused	AM Not WT Caused	AM Not WT Caused	AM Not WT Caused	AM Not WT Caused	AM Not WT Caused
Analysis Method		Primary	Primary	Primary	Primary	Primary	Primary	Primary
Leq (dBA)		34.5	33.8	36.8	37.7	38.8	36.4	39.7
Adjusted Leq (dBA)		34.5	33.8	36.8	37.7	38.8	36.4	39.7
L10 (dBA)		35.9	35.1	38.3	39.2	41.7	38.0	43.2
L90 (dBA)		31.8	31.9	33.2	35.1	34.3	34.0	33.9
L10 - L90 (dB)		4.1	3.2	5.1	4.1	7.4	4.0	9.3
AM > 4 dB		32	13	39	8	6	21	7
Tonal Seconds		12	11	70	38	47	32	0
Average Wind Speed (m/s)		0.2	0.1	0.0	1.1	1.4	1.1	1.4
Maximum Wind Speed (m/s)		4.6	2.8	0.0	5.8	5.7	5.7	6.3
Temperature (Celsius)		-0.4	-0.4	-0.4	-9.4	-8.3	-7.1	-5.3
T3	Turbine Output (kW)	1227	1263	1134	1280	1169	930	1011
	Turbine Direction (deg)	252	251	253	236	236	236	238
T2	Turbine Output (kW)	1275	1282	1159	1532	1516	1449	1227
	Turbine Direction (deg)	245	243	246	231	228	230	233
T1	Turbine Output (kW)	1257	1301	1224	1531	1525	1510	1219
	Turbine Direction (deg)	244	245	249	234	234	232	233

TABLE A 6: D&M BENNETT MONITOR - VALID PERIOD DETAILED INFORMATION

Date/Time		11/20/13 20:10	11/20/13 20:20	11/20/13 20:30	11/20/13 21:50	11/20/13 22:00	11/20/13 22:10	12/8/13 2:00	12/8/13 4:00	12/10/13 3:40	12/11/13 1:10	12/11/13 1:20	12/11/13 1:30
Notes		AM Not WT Caused	6 WT AM Events				AM Not WT Caused	AM Not WT Caused					
Analysis Method		Secondary	Secondary	Secondary	Secondary	Secondary	Secondary	Secondary	Secondary	Secondary	Secondary	Secondary	Secondary
Leq (dBA)		27.8	28.2	28.9	25.4	26.9	24.8	30.1	28.4	27.4	32.2	31.1	31.2
Adjusted Leq (dBA)		27.8	33.2	28.9	25.4	26.9	24.8	30.1	28.4	27.4	32.2	31.1	31.2
L10 (dBA)		29.0	29.9	30.6	26.6	28.9	25.9	31.9	29.7	28.3	34.0	33.1	33.4
L90 (dBA)		25.8	25.8	26.7	23.7	24.2	23.3	27.6	26.8	26.3	29.1	28.3	28.7
L10 - L90 (dB)		3.2	4.1	3.9	2.9	4.7	2.6	4.3	2.9	2.0	4.9	4.8	4.7
AM > 4 dB		9	13	2	2	5	16	8	0	1	2	1	0
Tonal Seconds		53	74	24	6	30	9	60	0	0	0	0	0
Average Wind Speed (m/s)		1.6	1.7	1.6	1.4	1.6	1.4	0.0	0.0	0.1	0.0	0.4	0.9
Maximum Wind Speed (m/s)		2.8	3.4	3.3	3.1	3.5	3.4	0.0	0.0	2.7	0.5	3.9	3.7
Temperature (Celsius)		-3.3	-3.3	-3.1	-3.6	-3.6	-3.6	-8.1	-8.7	-3.6	-9.6	-9.5	-9.5
T1	Turbine Output (kW)	1221	1258	1193	1102	1272	1348	1375	1277	1142	1257	1282	1396
	Turbine Orientation (deg)	327	328	330	330	329	330	281	279	259	268	269	268
T2	Turbine Output (kW)	974	1028	1046	998	1153	1134	1134	973	944	1048	1141	1249
	Turbine Orientation (deg)	318	320	321	321	321	323	277	277	258	266	270	267
T3	Turbine Output (kW)	668	1043	1084	984	1123	1192	1152	876	913	1046	1114	1116
	Turbine Orientation (deg)	339	339	341	342	341	341	284	283	267	272	274	271

TABLE A 7: S&C BENNETT MONITOR - VALID PERIOD DETAILED INFORMATION

Date/Time		11/30/13 22:30	12/3/13 18:40	12/3/13 19:00	12/3/13 19:10	12/3/13 19:20	12/5/13 11:10	12/5/13 11:40	12/5/13 13:00	12/5/13 13:30	12/5/13 13:40	12/5/13 14:00	12/5/13 14:10
Notes		10-minute Leq spectrum not tonal	3 WT AM Counts	2 WT AM Events	1 WT AM Event	AM due to WT	AM Not WT Caused	AM Not WT Caused	AM Not WT Caused	AM Not WT Caused, Tonality Due to Birds	AM Not WT Caused	AM Not WT Caused	AM Not WT Caused
Analysis Method		Secondary	Secondary	Secondary	Secondary	Secondary	Primary	Primary	Primary	Primary	Primary	Primary	Primary
Leq (dBA)		34.3	36.9	35.1	34.8	32.8	39.4	39.9	36.0	40.0	37.2	38.3	39.1
Adjusted Leq (dBA)		34.3	36.9	35.1	34.8	37.8	39.4	39.9	36.0	40.0	37.2	38.3	39.1
L10 (dBA)		35.5	38.9	37.2	36.8	33.9	41.3	42.5	37.8	41.8	38.9	39.8	40.6
L90 (dBA)		32.5	34.0	32.3	32.1	31.0	36.6	36.8	33.4	35.3	34.8	35.5	34.2
L10 - L90 (dB)		3.0	4.9	4.9	4.7	2.9	4.7	5.7	4.4	6.5	4.1	4.3	6.4
AM > 4 dB		0	41	22	11	13	7	5	3	69	5	3	4
Tonal Seconds		240	0	0	0	0	0	0	0	180	0	0	0
Average Wind Speed (m/s)		0.0	1.2	1.4	1.3	1.4	0.5	0.3	0.4	0.5	1.0	0.8	0.4
Maximum Wind Speed (m/s)		0.0	4.0	3.7	3.2	4.5	3.8	4.0	3.8	4.1	5.2	6.2	4.3
Temperature (Celsius)		NA	-0.1	-0.3	-0.4	-0.6	1.2	1.7	3.1	3.1	3.3	3.5	3.5
T1	Turbine Production (kW)	1202	1123	1290	1231	1185	1005	998	1279	1456	1383	1202	1374
	Turbine Orientation (deg)	180	318	321	320	318	128	126	130	139	135	135	133
T2	Turbine Production (kW)	981	940	1113	1061	1086	988	973	941	1045	932	957	950
	Turbine Orientation (deg)	177	319	322	318	318	129	127	131	138	134	135	133
T3	Turbine Production (kW)	0	851	1014	1058	981	865	866	959	1001	830	911	1117
	Turbine Orientation (deg)	55	320	326	324	320	137	137	137	146	140	143	138

APPENDIX B: TIME HISTORY GRAPHS

Time history of 10-minute Leq and L90, 1.5 meter wind speed, and output of the closest turbines are shown below. Grey bars show nighttime hours. Washed out colors indicate periods of precipitation.

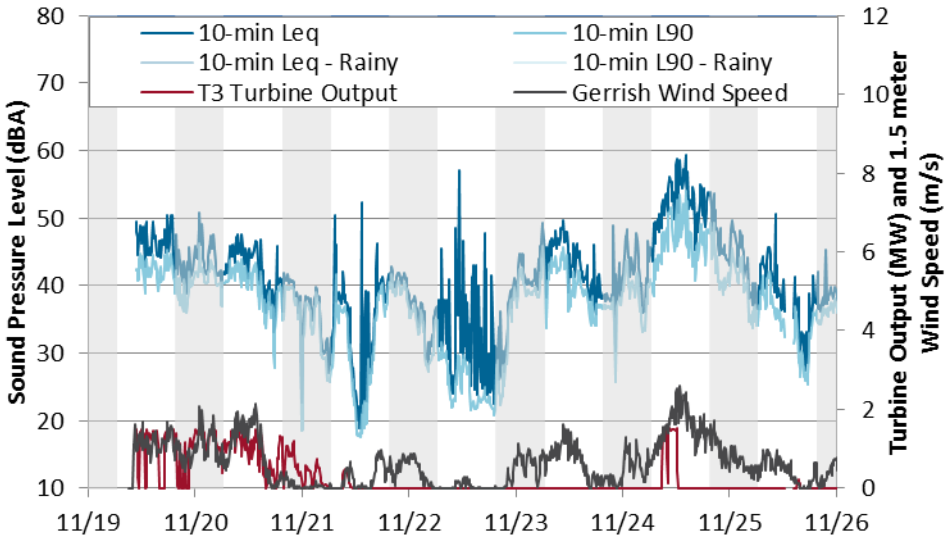

FIGURE B 1: GERRISH MONITOR - SOUND LEVEL TIME HISTORY CHART 1

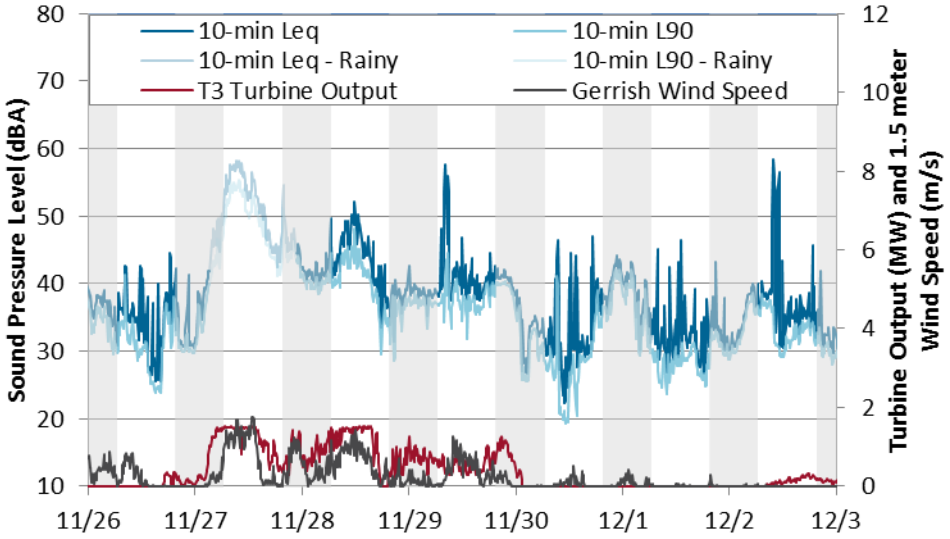

FIGURE B 2: GERRISH MONITOR - SOUND LEVEL TIME HISTORY CHART 2

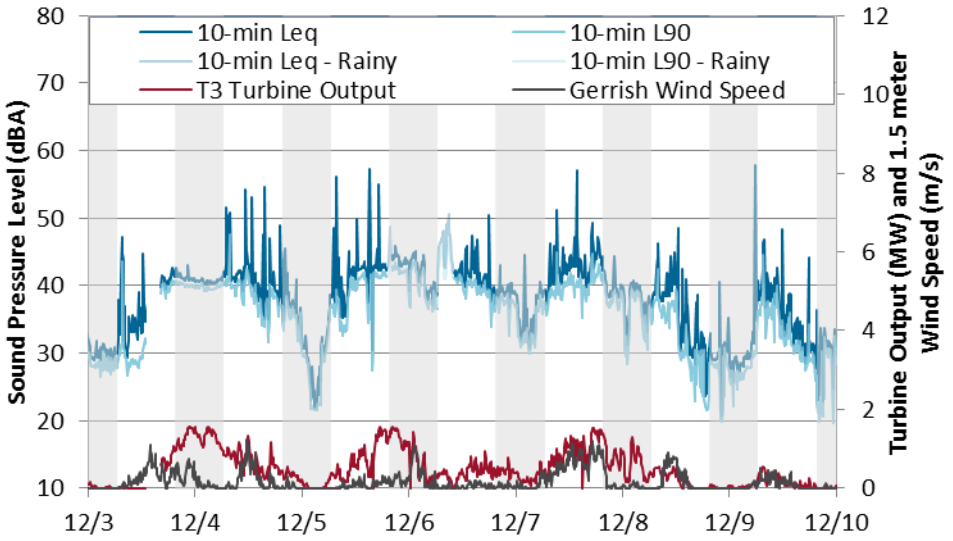

FIGURE B 3: GERRISH MONITOR - SOUND LEVEL TIME HISTORY CHART 3

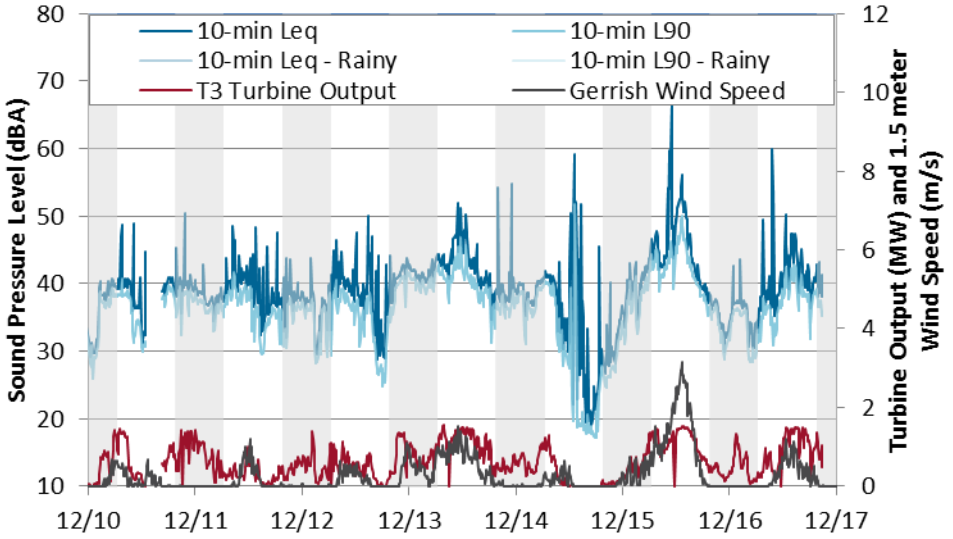

FIGURE B 4: GERRISH MONITOR - SOUND LEVEL TIME HISTORY CHART 4

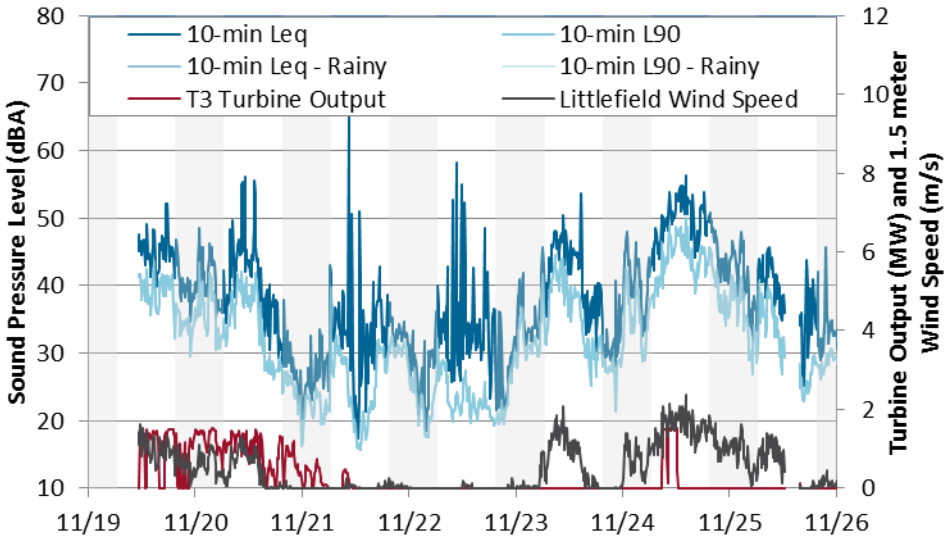

FIGURE B 5: LITTLEFIELD MONITOR - SOUND LEVEL TIME HISTORY CHART 1

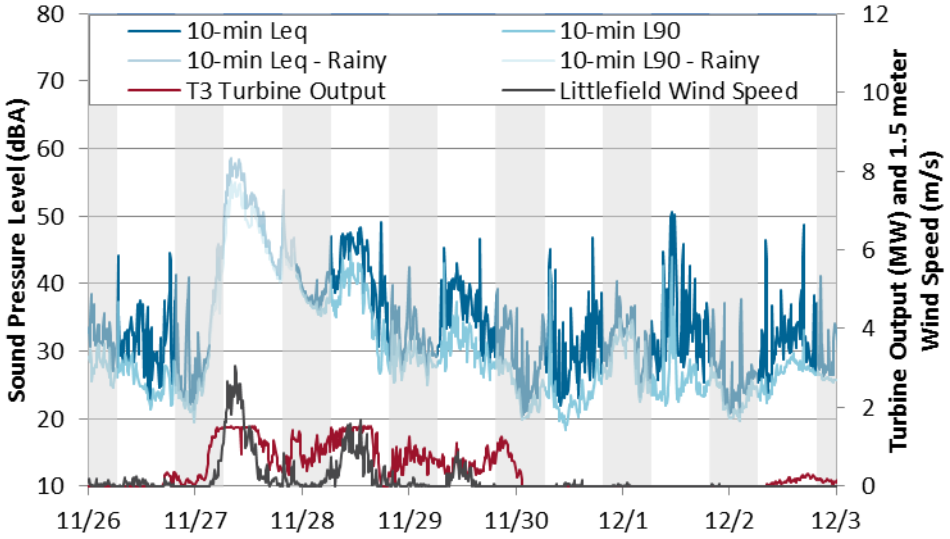

FIGURE B 6: LITTLEFIELD MONITOR - SOUND LEVEL TIME HISTORY CHART 2

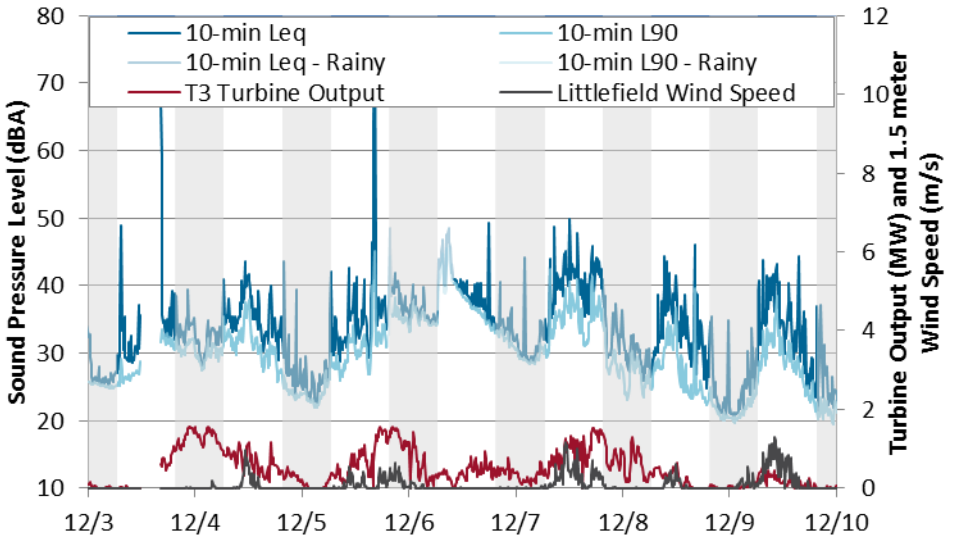

FIGURE B 7: LITTLEFIELD MONITOR - SOUND LEVEL TIME HISTORY CHART 3

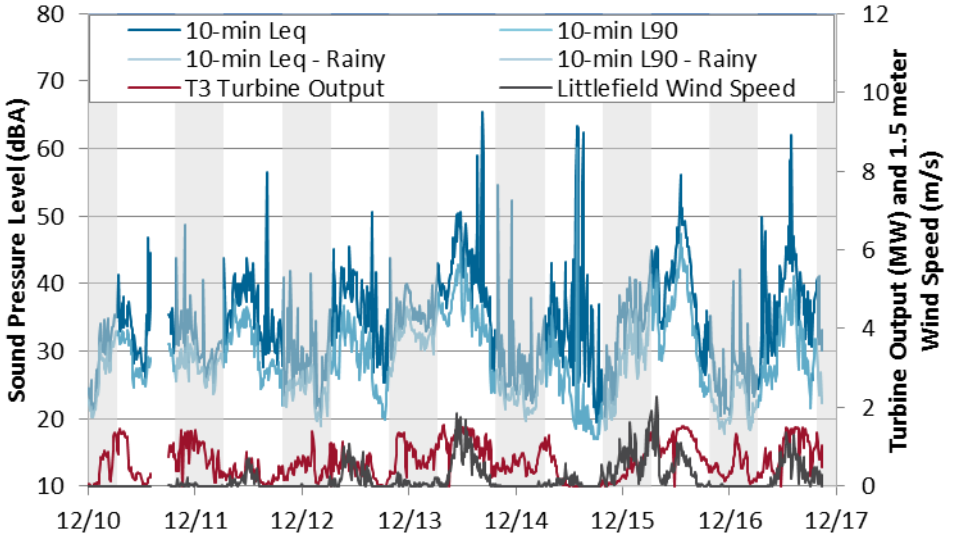

FIGURE B 8: LITTLEFIELD MONITOR - SOUND LEVEL TIME HISTORY CHART 4

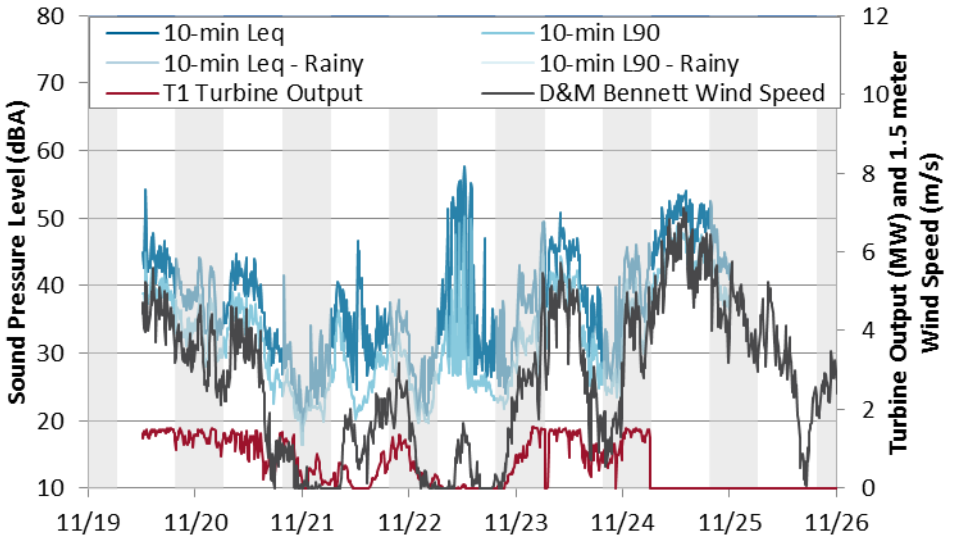

FIGURE B 9: D&M BENNETT MONITOR - SOUND LEVEL TIME HISTORY CHART 1

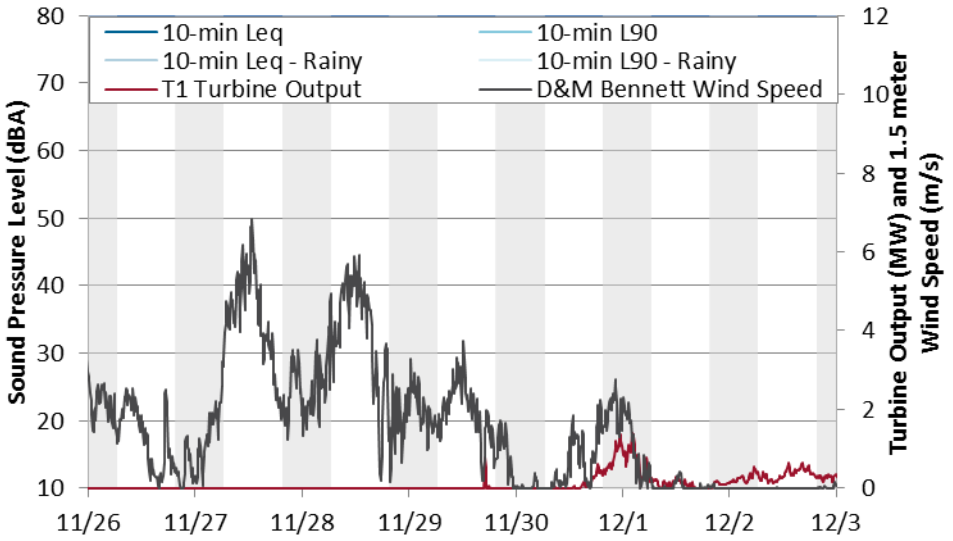

FIGURE B 10: D&M BENNETT MONITOR - SOUND LEVEL TIME HISTORY CHART 2

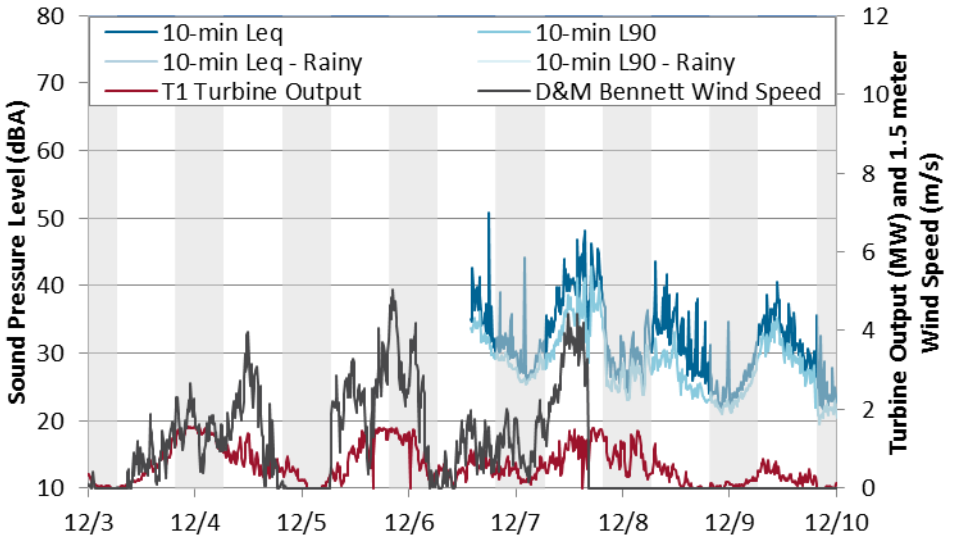

FIGURE B 11: D&M BENNETT MONITOR - SOUND LEVEL TIME HISTORY CHART 3

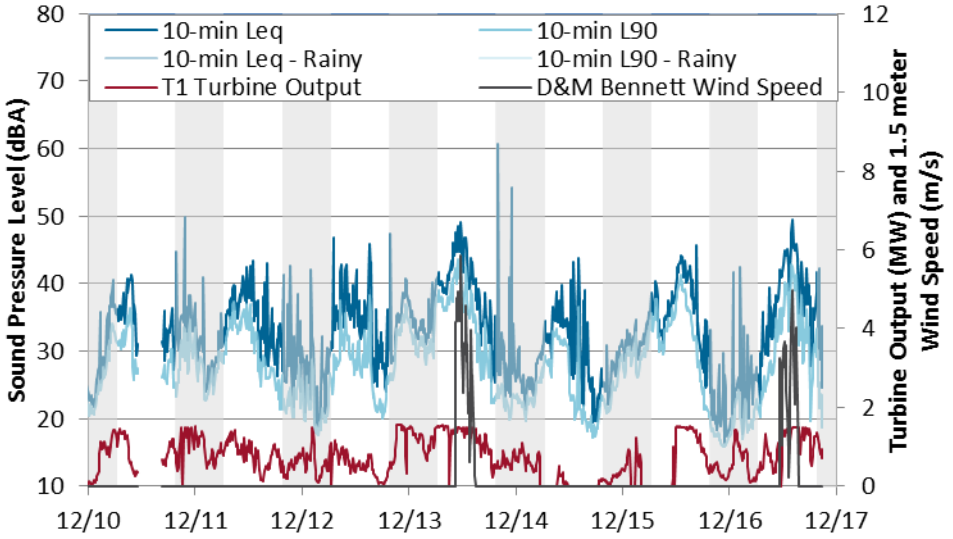

FIGURE B 12: D&M BENNETT MONITOR - SOUND LEVEL TIME HISTORY CHART 4

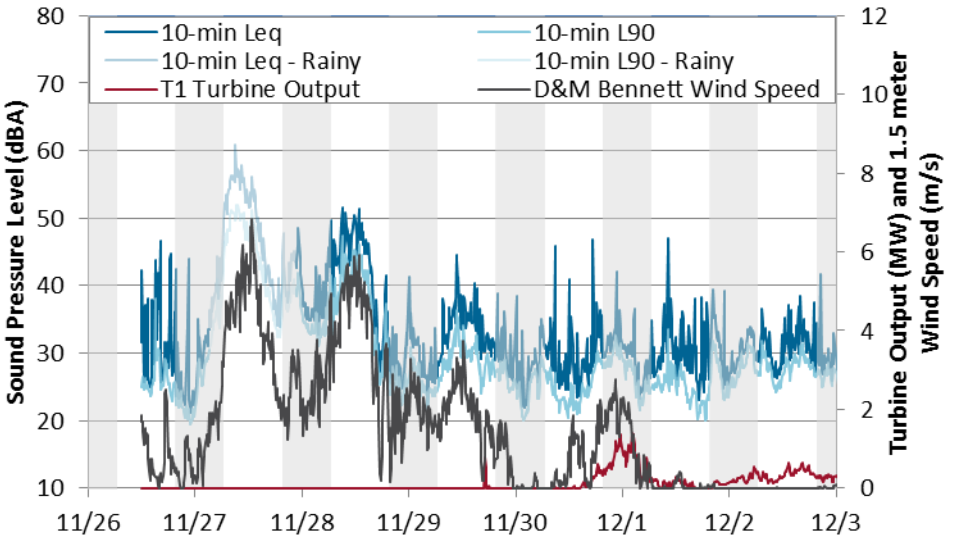

FIGURE B 13: S&C BENNETT MONITOR - SOUND LEVEL TIME HISTORY CHART 1

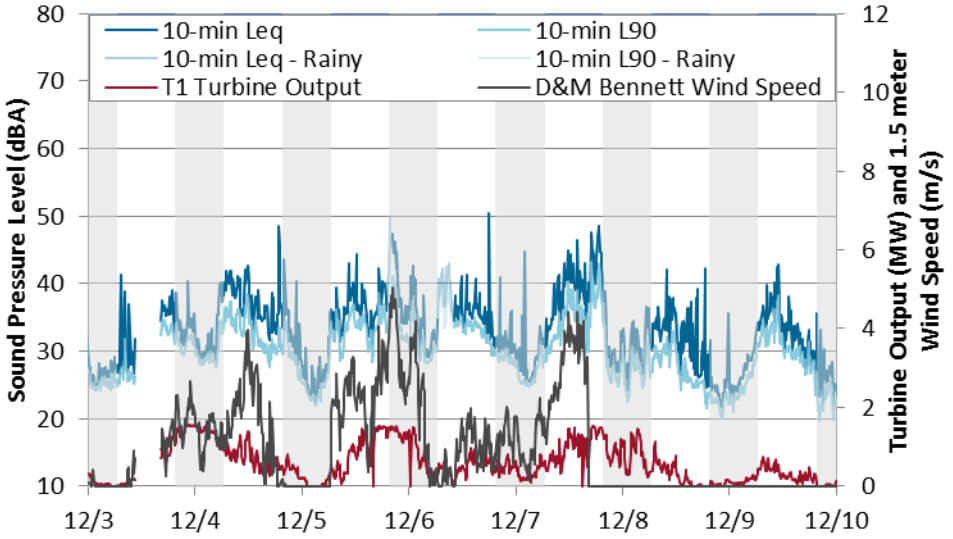

FIGURE B 14: S&C BENNETT MONITOR - SOUND LEVEL TIME HISTORY CHART 2

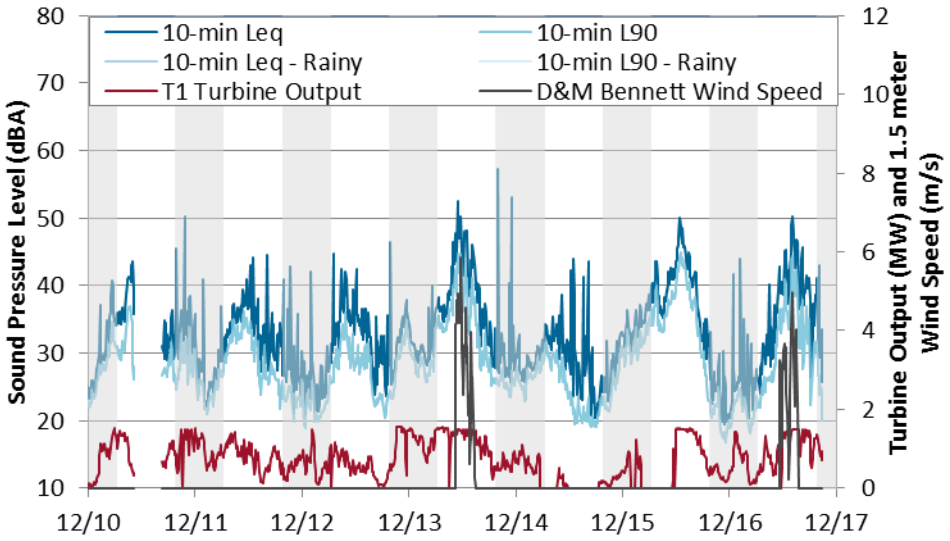

FIGURE B 15: S&C BENNETT MONITOR - SOUND LEVEL TIME HISTORY CHART 3

APPENDIX C: TURBINE SHUTDOWN TIME HISTORIES

1-second sound levels for the period of about 1-hour before, during, and 1-hour after each valid shutdown is shown below. Valid shutdowns are where we can detect a change in sound levels due to the shutdown. Turbines sounds were indistinguishable at D&M Bennett for all shutdown periods, but three graphs were included at this location for demonstration purposes.

In most cases, the shutdown period is obvious by viewing the change in sound level. Where it is not obvious, the shutdown occurs during a 10-minute period in the center of the graph.

FIGURE C 1: GERRISH MONITOR - NOVEMBER 23, 2013 SHUTDOWN

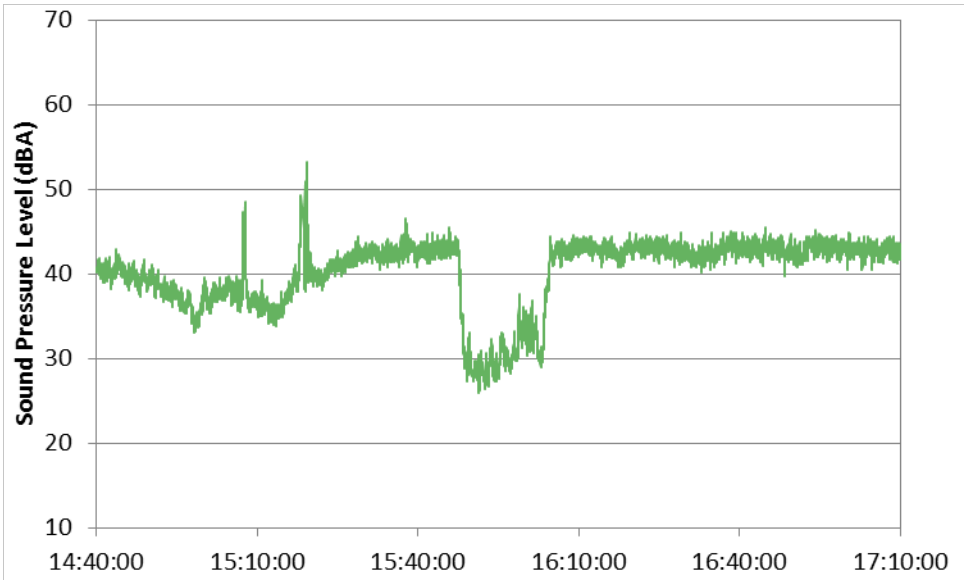

FIGURE C 2: GERRISH MONITOR - DECEMBER 5, 2013 SHUTDOWN

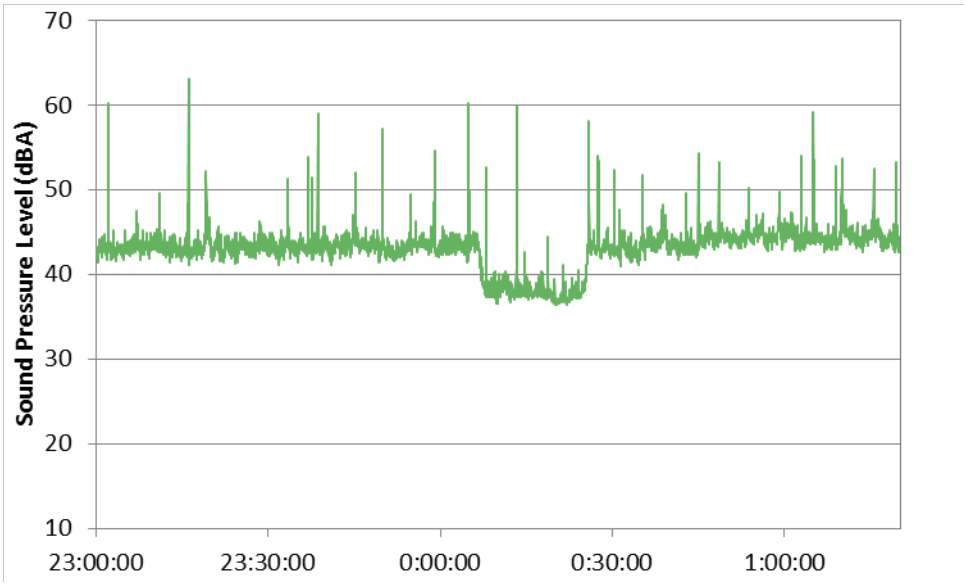

FIGURE C 3: GERRISH MONITOR - DECEMBER 6, 2013 SHUTDOWN

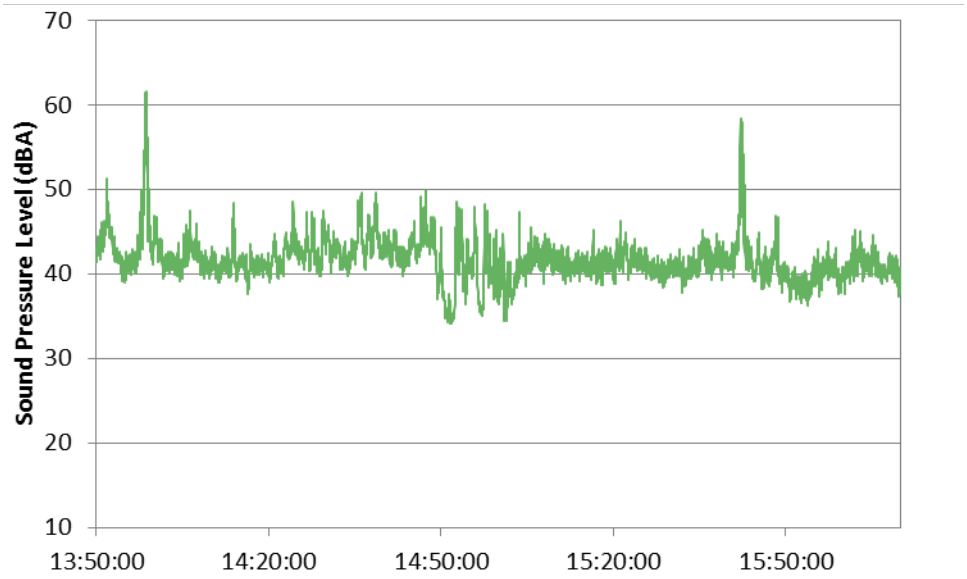

FIGURE C 4: GERRISH MONITOR - DECEMBER 7, 2013 SHUTDOWN

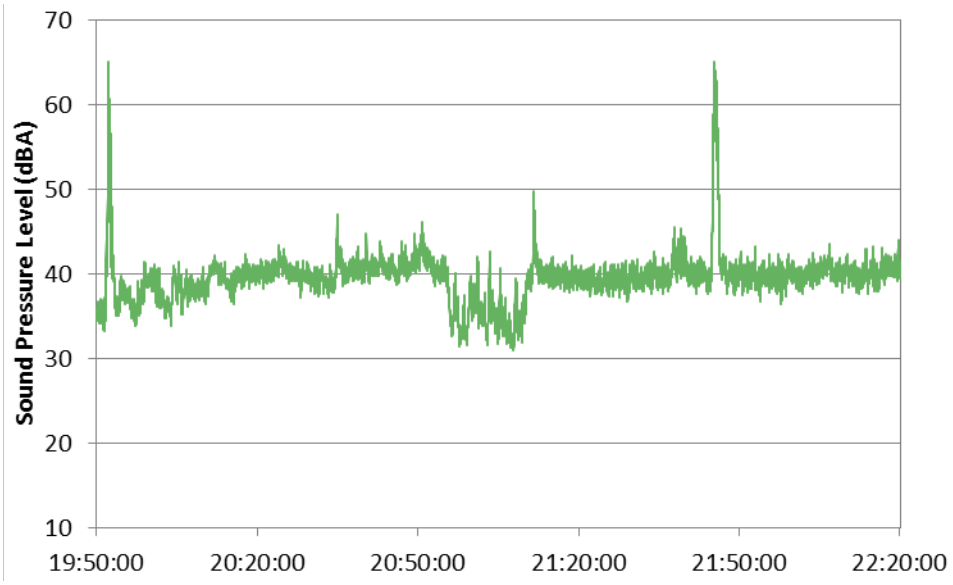

FIGURE C 5: GERRISH MONITOR - DECEMBER 10, 2013 SHUTDOWN

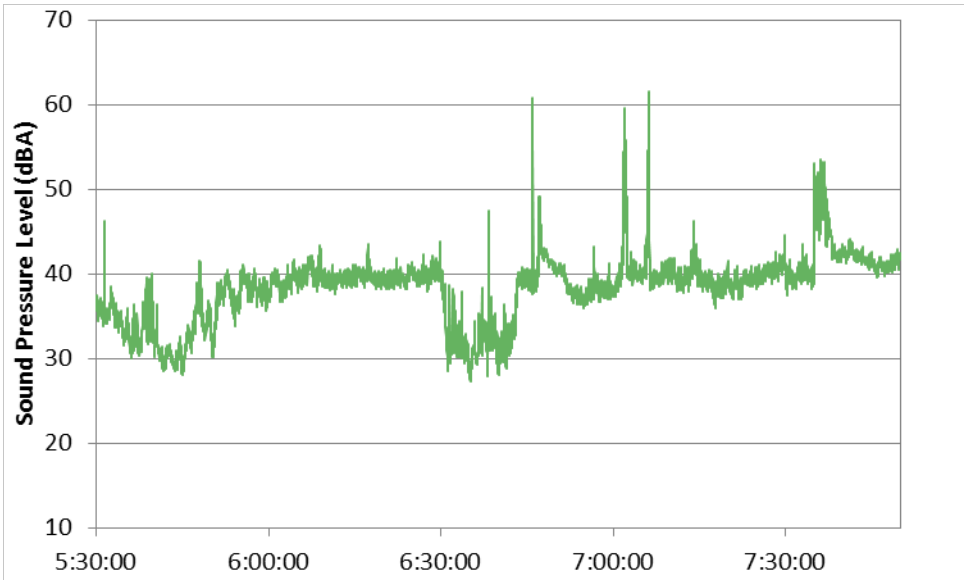

FIGURE C 6: GERRISH MONITOR - DECEMBER 12, 2013 SHUTDOWN

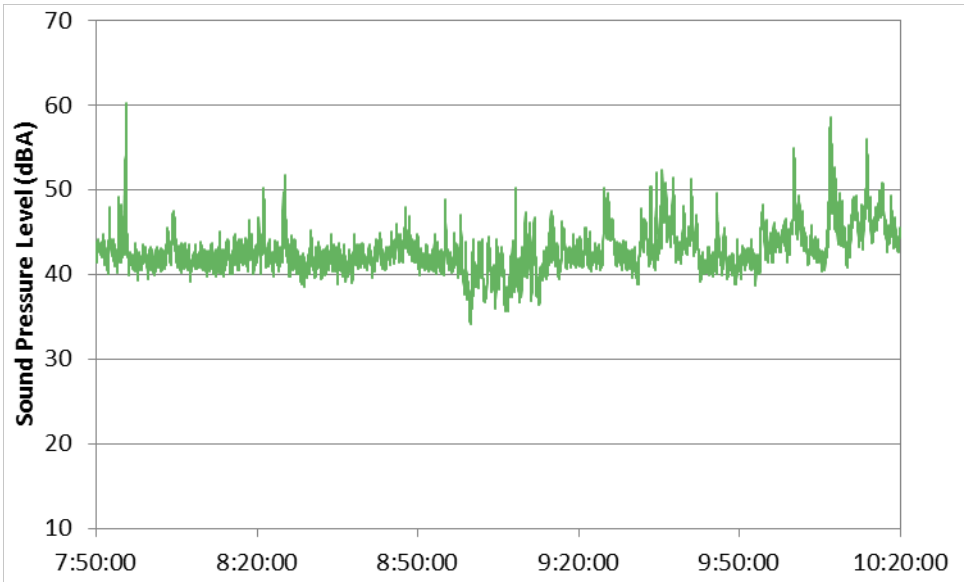

FIGURE C 7: GERRISH MONITOR - DECEMBER 13, 2013 SHUTDOWN

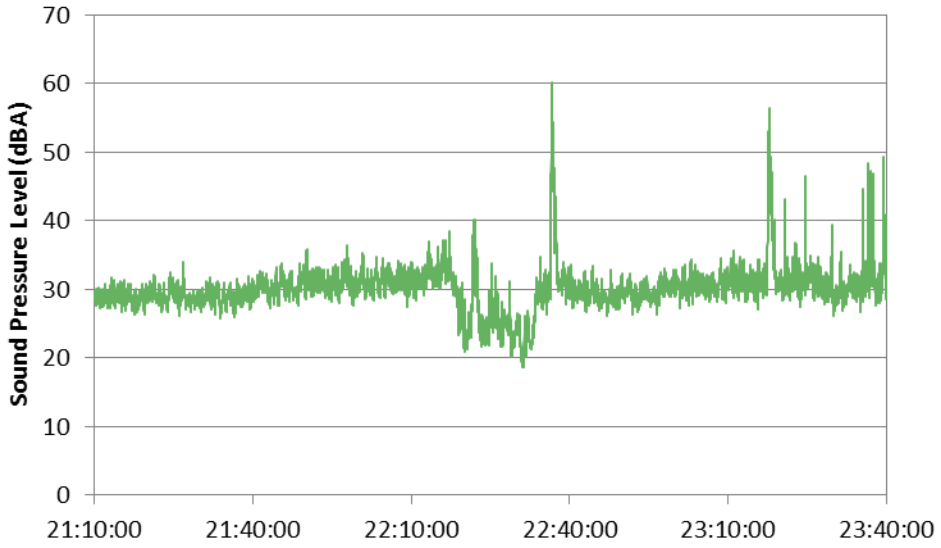

FIGURE C 8: LITTLEFIELD MONITOR - NOVEMBER 23, 2013 SHUTDOWN

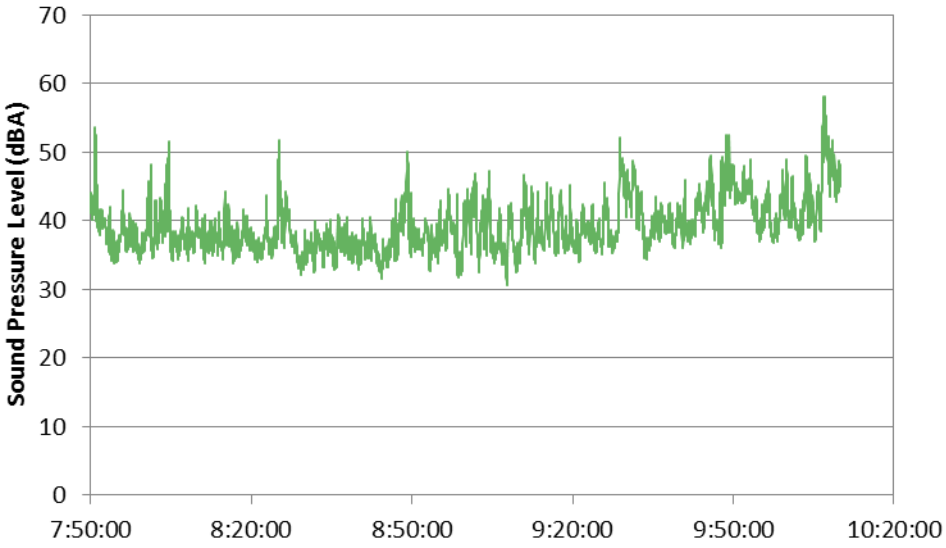

FIGURE C 9: LITTLEFIELD MONITOR - DECEMBER 13, 2013 SHUTDOWN

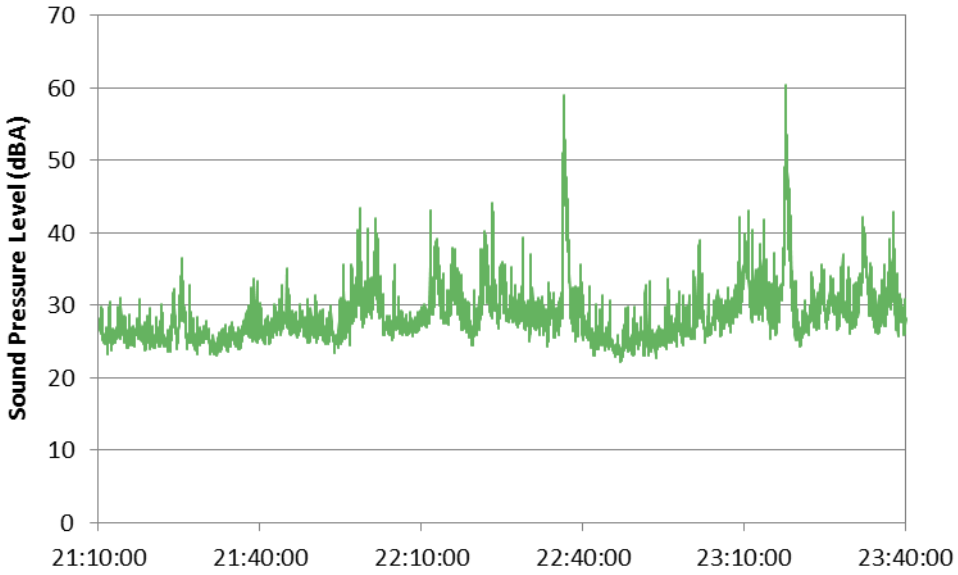

FIGURE C 10: D&M BENNETT MONITOR - NOVEMBER 23, 2013 SHUTDOWN

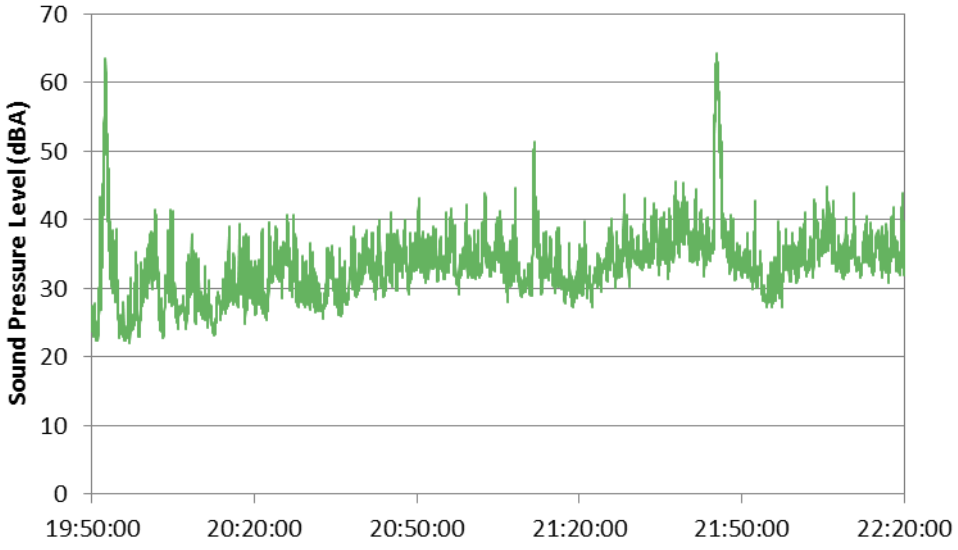

FIGURE C 11: D&M BENNETT MONITOR - DECEMBER 10, 2013 SHUTDOWN

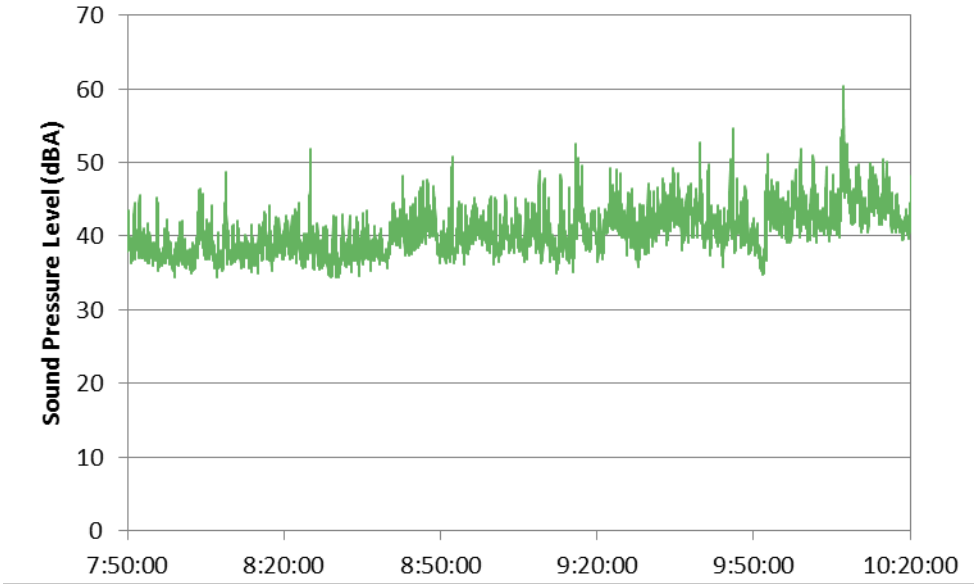

FIGURE C 12: D&M BENNETT MONITOR - DECEMBER 13, 2013 SHUTDOWN

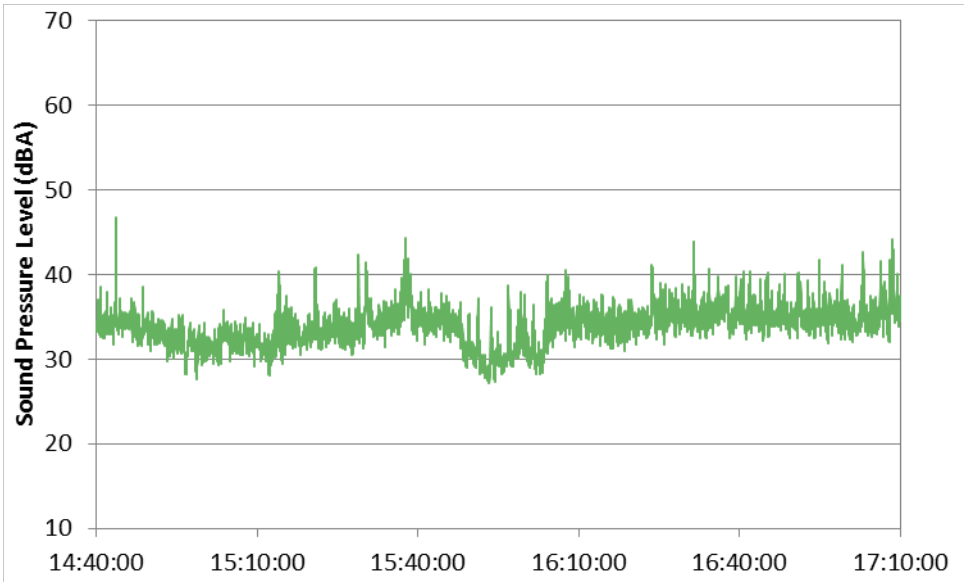

FIGURE C 13: S&C BENNETT MONITOR - DECEMBER 5, 2013 SHUTDOWN

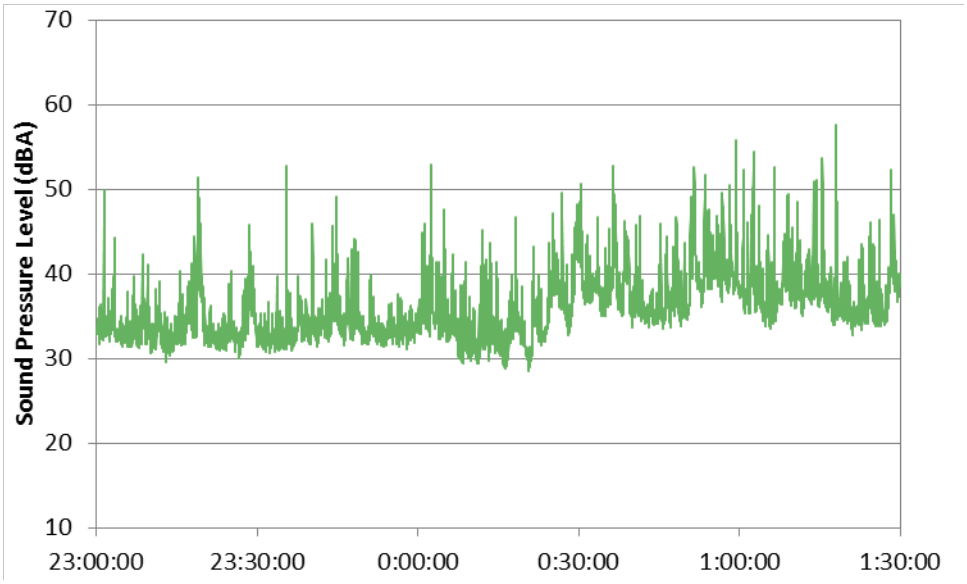

FIGURE C 14: S&C BENNETT MONITOR - DECEMBER 6, 2013 SHUTDOWN

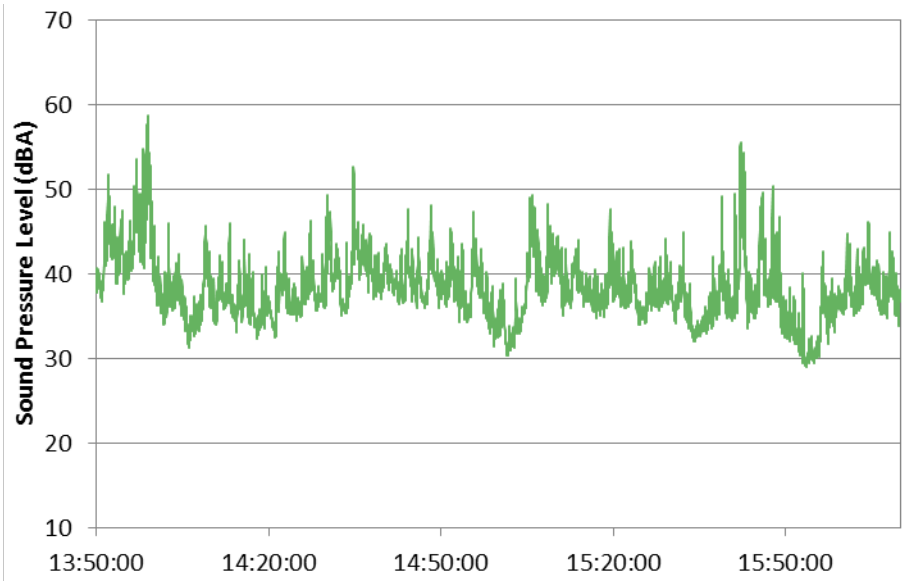

FIGURE C 15: S&C BENNETT MONITOR - DECEMBER 7, 2013 SHUTDOWN

APPENDIX D: SOUND MONITORING PROTOCOL

Sound Monitoring Protocol
Beaver Ridge Wind Farm
Freedom, Maine

12 September 2013

1. INTRODUCTION

The Beaver Ridge Wind Farm operates three GE 1.5 sle wind turbines in Freedom, Maine. This protocol is designed to measure sound levels from operational wind turbines to assess whether the project meets a 45 dBA design goal at nearby protected locations.

2. THIRD-PARTY REVIEW

A neutral third-party observer, Hessler Associates, Inc., will be used to assess conformance with the noise-monitoring requirements of this protocol. The third party's role shall include review of the placement of microphones at the monitored locations, as well as review of the data collected. The third party will file a report within 30 days of the completion of the draft report setting forth his opinion as to the sufficiency of the data collected, and whether the turbine's sound levels were accurately captured at the monitoring locations.

3. MEASUREMENT LOCATIONS

For the purposes of this protocol, a protected location is defined as anywhere on a residential property, within the property line and no greater than 500 feet from the residence on that property.

Three protected locations have been identified for this study. These are identified by property owner, and are shown on Figure 1. The locations are:

1) Bennett – in the field, 500 feet east of the home, approximately 2,500 feet from Turbine 2.
2) Gerrish – in a cleared area near the home, approximately 2,000 feet north-northwest of Turbine 3
3) Littlefield – in a cleared area near the home, approximately 2,900 feet north-northeast of Turbine 3

In addition, a 10 meter met tower will be installed, to be located in a cleared area, on the Boulier property. This is not marked, but is just south of Bloomstein.

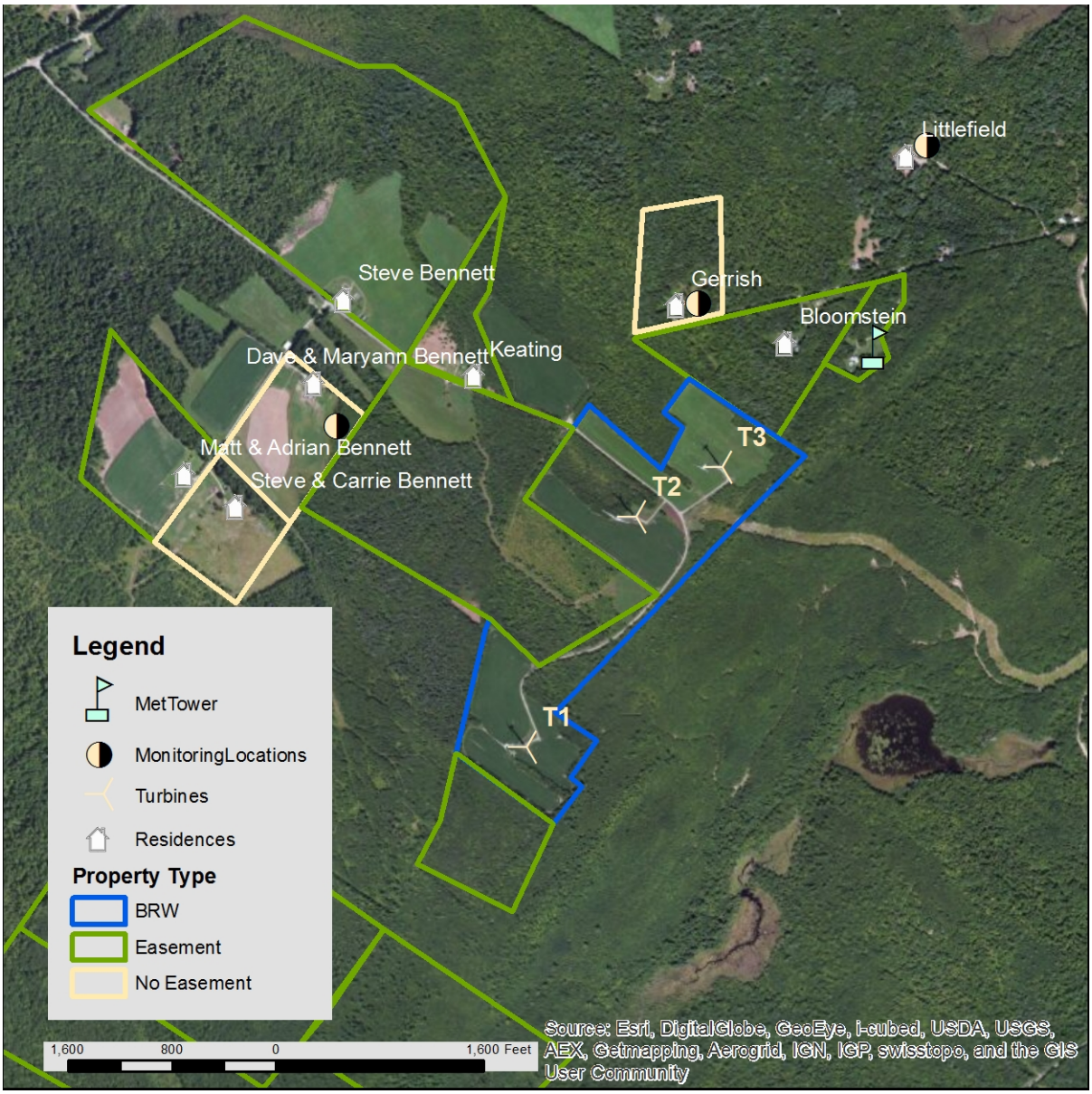

Figure 1: Proposed monitoring locations

4. MONITORING PROTOCOL

Each monitoring period shall be a continuous period at least two weeks in duration, and meant to capture the specific conditions set forth in the DEP Chapter 375 10.I(8) Rules. These include:

4.1 Measurement equipment

- Sound level meters used shall meet all of the Type 1 performance requirements of American National Standard Specifications for Sound Level Meters, ANSI S1.4, ANSI S1.11, and S1.43.

- The acoustical calibrator used shall meet the requirements of American National Standard Specification for Acoustical Calibrators, ANSI S1.40.
- The microphone windscreen used shall be 7 inch foam or better.
- The anemometer on the 10 meter met tower will have a minimum manufacturer specified accuracy of ±1 mph providing data in one second intervals.
- Audio recording devices shall be time stamped. Audio recording and compliance data collection shall occur through the same microphone/sound meter.

4.2 Equipment Calibration

- The sound level meter shall have been calibrated by a laboratory within 12 months of the measurement.
- Field calibrations shall be recorded before and after each measurement period.
- Anemometers shall be calibrated annually by the manufacturer to maintain stated specification.

4.3 Location criteria

- To the greatest extent possible, compliance measurement locations shall be at the center of unobstructed areas that are maintained free of vegetation and other structures or material that is greater than 2 feet in height for a 75-foot radius around the sound and audio monitoring equipment.
- To the greatest extent possible, meteorological measurement locations shall be at the center of open flat terrain, inclusive of grass and a few isolated obstacles less than 6 feet in height for a 250-foot radius around the anemometer location. The meteorological data measurement location need not be coincident with the sound and audio measurement location provided there is no greater than a 5 mile separation between the data collection points and the measurement locations have similar characterization, i.e. same side of the mountain ridge, etc.
- Meteorological measurements of wind speed and direction shall be collected using anemometers at a 10-meter height (32.8 feet) above the ground. Results shall be reported, based on 1-second integration intervals, and shall be reported synchronously with hub level and sound level measurements at 10-minute measurement intervals. The wind speed average and maximum shall be reported.
- The sound microphone shall be positioned at a height of approximately 4 to 5 feet above the ground, and oriented in accordance with the manufacturer's recommendations.
- When possible, measurement locations should be at least 50 feet from any sound source other than the wind energy development's power generating sources.

4.4 Compliance measurements

- Measurement shall be obtained during weather conditions when the wind turbine sound is most clearly noticeable, generally when the measurement location is downwind of the wind energy development and maximum surface wind speeds < 6 miles per hour (mph) with concurrent turbine hub-elevation wind speeds sufficient to generate the maximum

continuous rated sound power from the nearest wind turbines to the measurement location. A downwind location is defined as within 45^0 of the direction between a specific measurement location and the acoustic center of the five nearest wind turbines. A wider wind direction may be used if the frequency of downwind conditions warrant.

- In some circumstances, it may not be feasible to meet the wind speed and operations criteria due to terrain features or limited elevation change between the wind turbines and monitoring locations. In these cases, measurement periods are acceptable if the following conditions are met:
  - The difference between the L_{A90} and L_{A10} during any 10-minute period is less than 5 dBA; and
  - The surface wind speed (10 meter height) (32.8 feet) is 6 mph or less for 80% of the measurement period and does not exceed 10 mph at any time, or the turbines are shut down during the monitoring period and the difference in the observed L_{A50} after shut down is equal to or greater than 6 dBA; and
  - Observer logs or recorded sound files clearly indicate the dominance of wind turbine(s).
- Measurement intervals affected by increased biological activities, leaf rustling, traffic, high water flow, aircraft flyovers or other extraneous ambient noise sources that affect the ability to demonstrate compliance shall be excluded from all compliance report data. The intent is to obtain 10-minute measurement intervals that entirely meet the specific criteria.
- During 10 10-minute periods, when the turbines are generating power concurrent with their maximum sound output (>924 kW), the turbines will be shut down. A comparison will be made between the L90s during operations in a one hour period on either side of the shutdown, and the L90 during shutdown. The results will be used to determine the extent the above measurement protocol is affected by background sound. Shutdowns will be synchronized to start at a multiple of 10 minutes of the hour (e.g. 12:00, 12:10, 12:20…), and no more than one shutdown will occur in any eight-hour period to minimize the impact on potential valid periods.

5. REPORTING

A report will be provided to the third party consultant no later than December 1, 2013 for their review. Any data requested will be provided to the third party consultant. Audio data may be screened to remove private conversations.

The report will include the procedures for determining valid periods and data collected during those valid periods including:

- Sound levels
- Tonal penalties, according to Chapter 375(I)(3)
- Short duration repetitive sound penalties according to Chapter 375(I)(4)
- Adjusted sound levels which include the above penalties.
- Turbine power output

- Wind direction as measured at the turbines
- Wind speed as measured at the 10-meter met tower