THE STATE OF NEW HAMPSHIRE
SITE EVALUATION COMMITTEE

In the matter of the Application for Certification Pursuant to RSA 162-H of ANTRIM WIND ENERGY, LLC	)	**Docket No. 2012-01**

First Supplemental Pre-Filed Testimony
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Sudbury, Massachusetts

1. I, Gregory C. Tocci, am submitting this first pre-filed testimony supplementing that submitted on July 31, 2012.

2. I have been retained pursuant to RSA 162-H:10, V to assist Counsel for the Public and the Committee with the review of acoustics-related information pertaining to the proposed Antrim Wind Energy, LLC project.

3. In addition to the documents reviewed in connection with my pre-filed testimony, for this first supplemental pre-filed testimony, I have reviewed the following:

- A-weight ambient sound levels measured by Cavanaugh Tocci Associates, Inc. (CTA) over the period August 22 to August 31, 2012.
- One-third octave band sound levels measured on August 25, 2012 between midnight and 6:00 AM.
- Schomer, Slauch, and Hessler; “Proposed "Ai"-Weighting; a weighting to remove insect noise from A-weighted field measurements,” Internoise 2010, 13-16 June 2010, Lisbon, Portugal.

- The following files provided by Antrim Wind Energy:

Location 1 - OneThird Octave Band Data Request - 1minute.xls

Location 1 - OneThird Octave Band Data Request.xls

Location 4 - OneThird Octave Band Data Request - 1minute.xls

Location 4 - OneThird Octave Band Data Request.xls

Locations 1-5 - Broadband Data Request.xls

- Willard Pond Wildlife Sanctuary Map

PART 1. BACKGROUND SOUND LEVEL MEASUREMENTS BY CTA AT GREGG LAKE AND WILLARD POND

4. Beginning August 22 and ending on August 29, 2012, CTA measured background sound levels ($LA_{90,10\text{-min}}$, i.e. the A-weighted sound levels exceeded 90% of each 10-minute monitoring time interval) at two locations. These locations are at Gregg Lake and Willard Pond as shown in Figure 1 below.

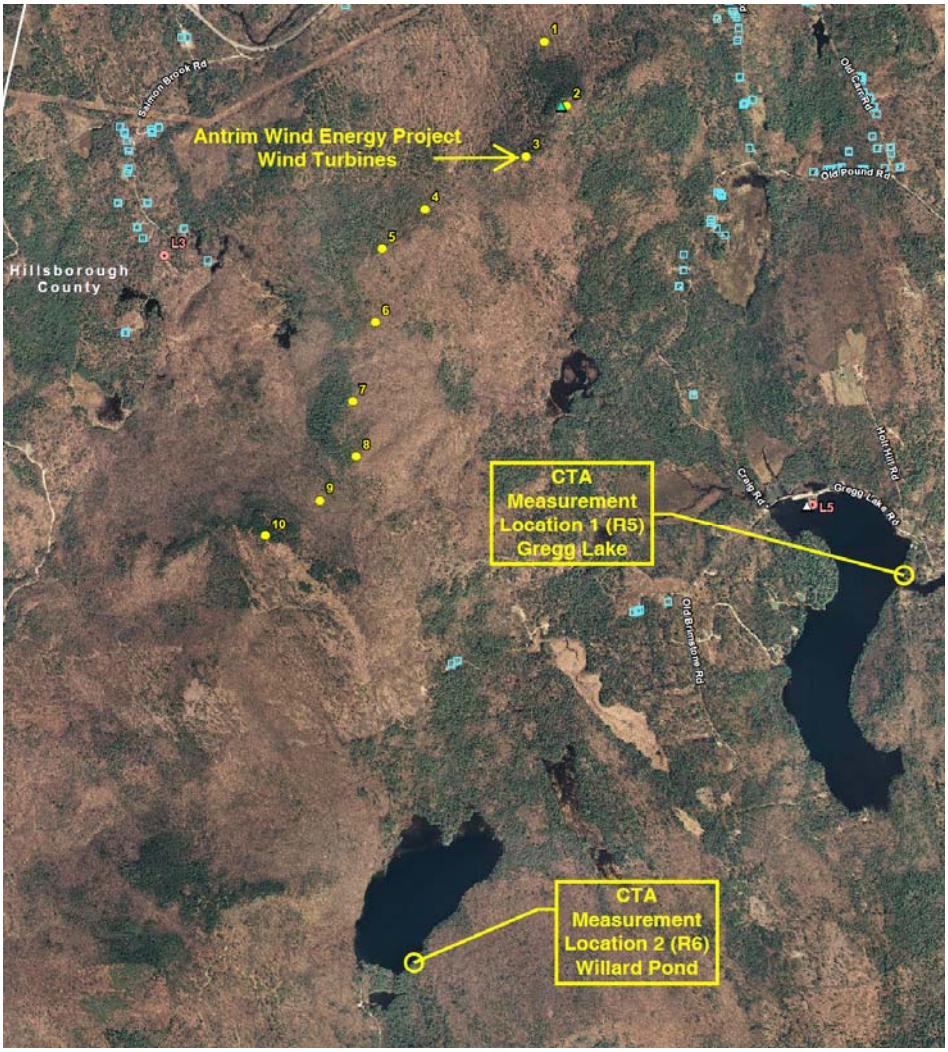

Figure 1. CTA measurement locations—Gregg Lake and Willard Pond
(Excerpted from Figure 5-1, Sound Level Analysis Report, Antrim Wind Energy Project, Antrim, NH, November 17, 2011)

5. Figures 2a and 2b graphically present A-weight background sound levels measured in ten-minute intervals from mid-day August 22 to mid-day August 29, 2012.

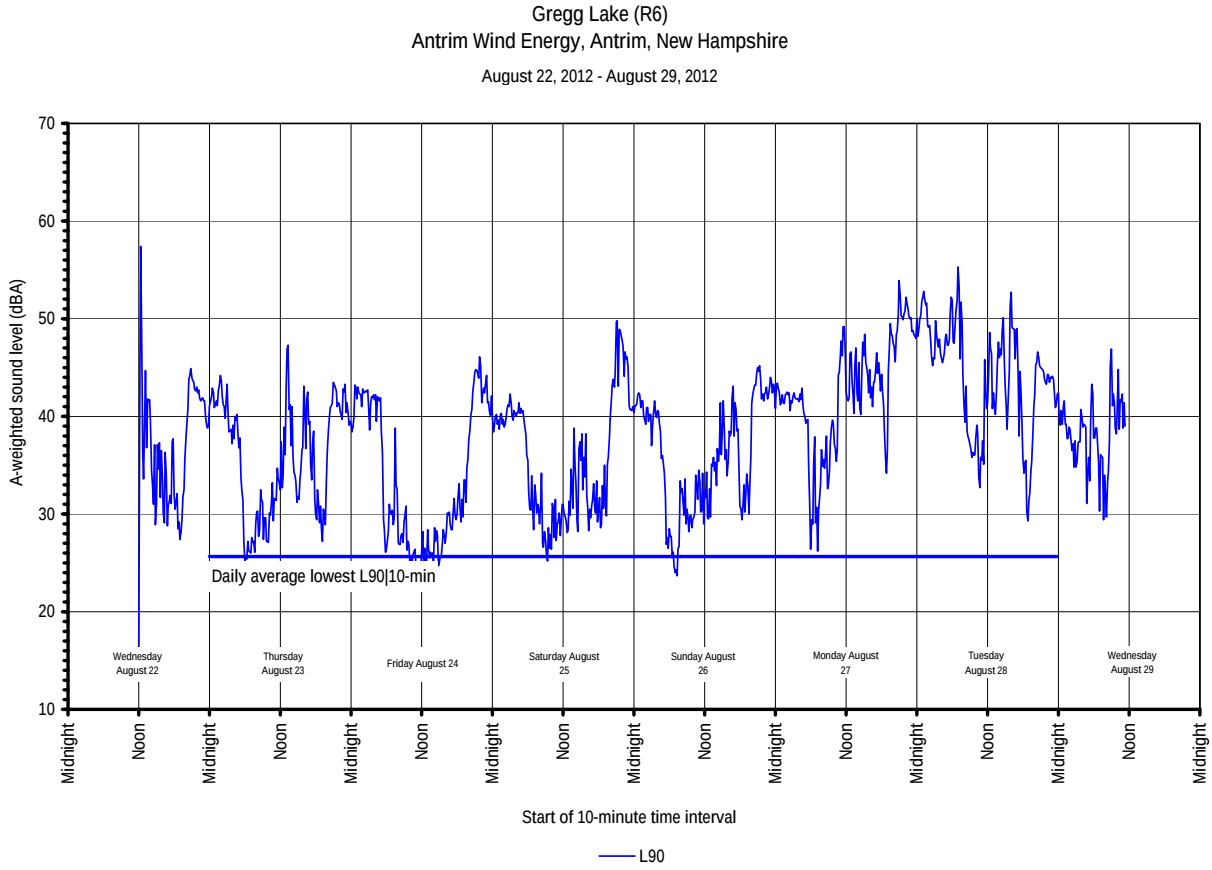

Figure 2a. Measured A-weighted background sound level ($LA_{90,10\text{-min}}$)—Gregg Lake Antrim, NH

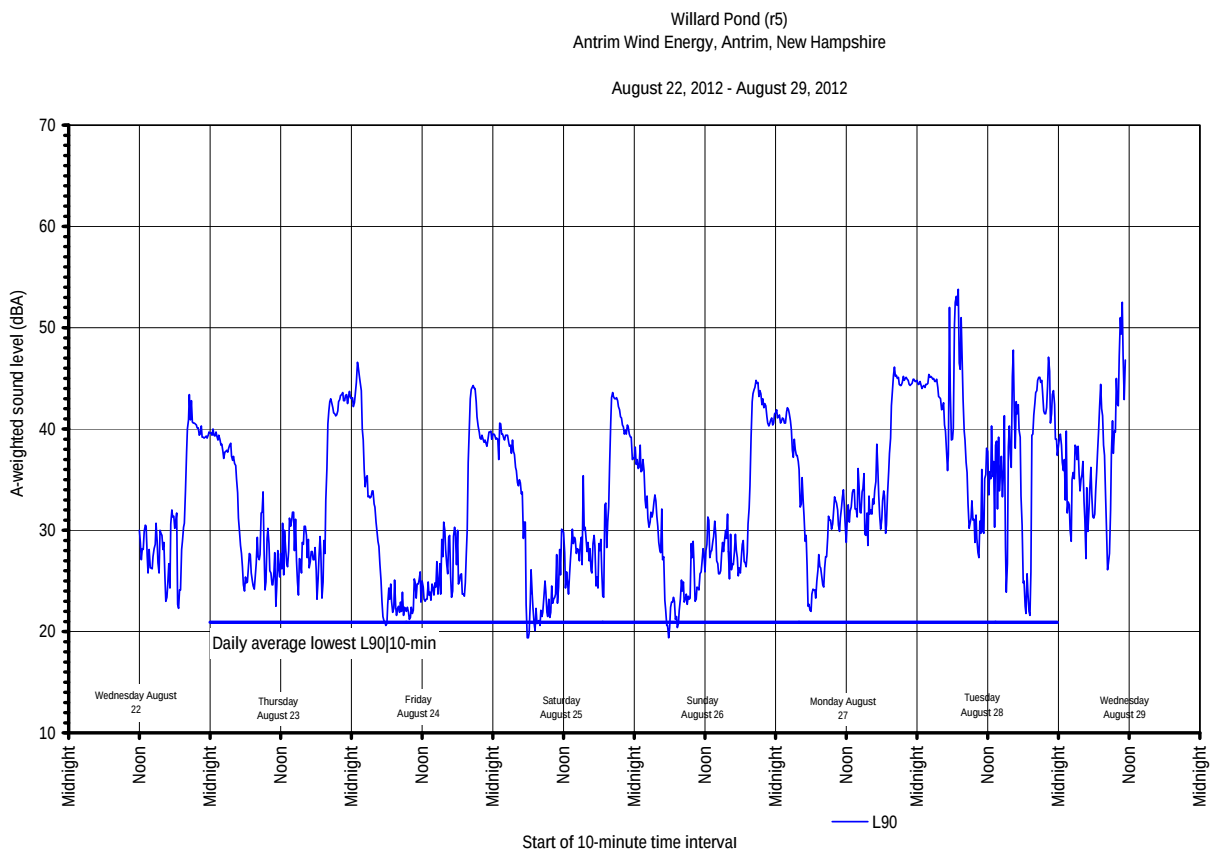

Figure 2b. Measured A-weighted background sound level ($LA_{90,10\text{-min}}$)—Willard Pond Antrim, NH

6. Note that in Figures 2a and 2b the diurnal pattern is opposite that normally expected, i.e. sound levels are highest at night, typically lower during the day, and lowest at sun-rise, at approximately 6:00 AM. On August 25, attended sound measurements were made by installing Larson-Davis model 831 sound level meters (LD meters) within several feet of the Gregg Lake and Willard Pond sound monitors. The LD meters were set to measure one-third octave bands and A-weight sound levels in 10-minute intervals. These measurements permitted insect sound contributions to be removed from the measured 10-

minute spectra to estimate the background sound levels that would otherwise exist in the absence of insect sound.

7. Figures 3a and 3b are graphical presentations of all of the 10-minute 1/3 octave band background sound level spectra measured. Individual spectra are not legible. The figures provide a qualitative perspective on the contribution of insect sound occurring in the 2,000 to 12,500 Hz one-third octave bands. Also shown for reference is the one-third octave band noise floor spectrum published by Larson-Davis, the manufacturer of the LD meters.

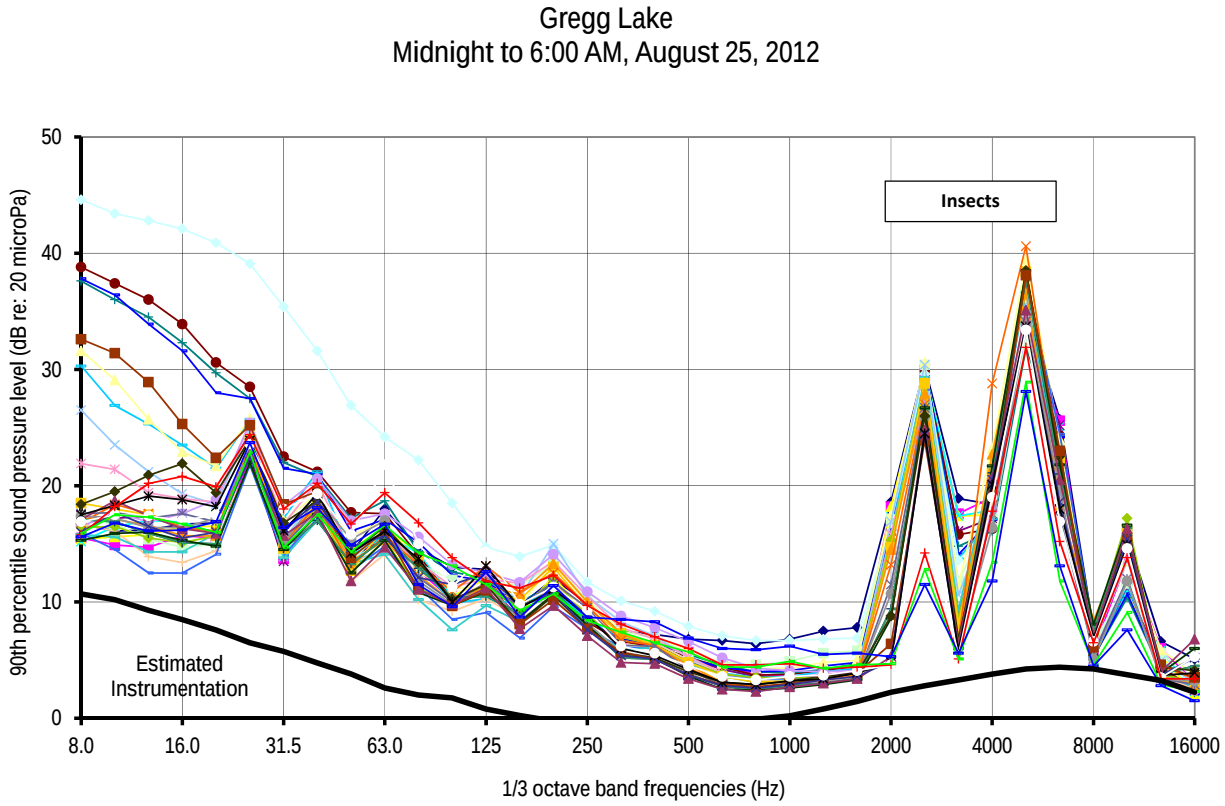

Figure 3a. Measured 10-minute interval background sound level spectra
Gregg Lake, Midnight to 6:00 AM, August 25, 2012

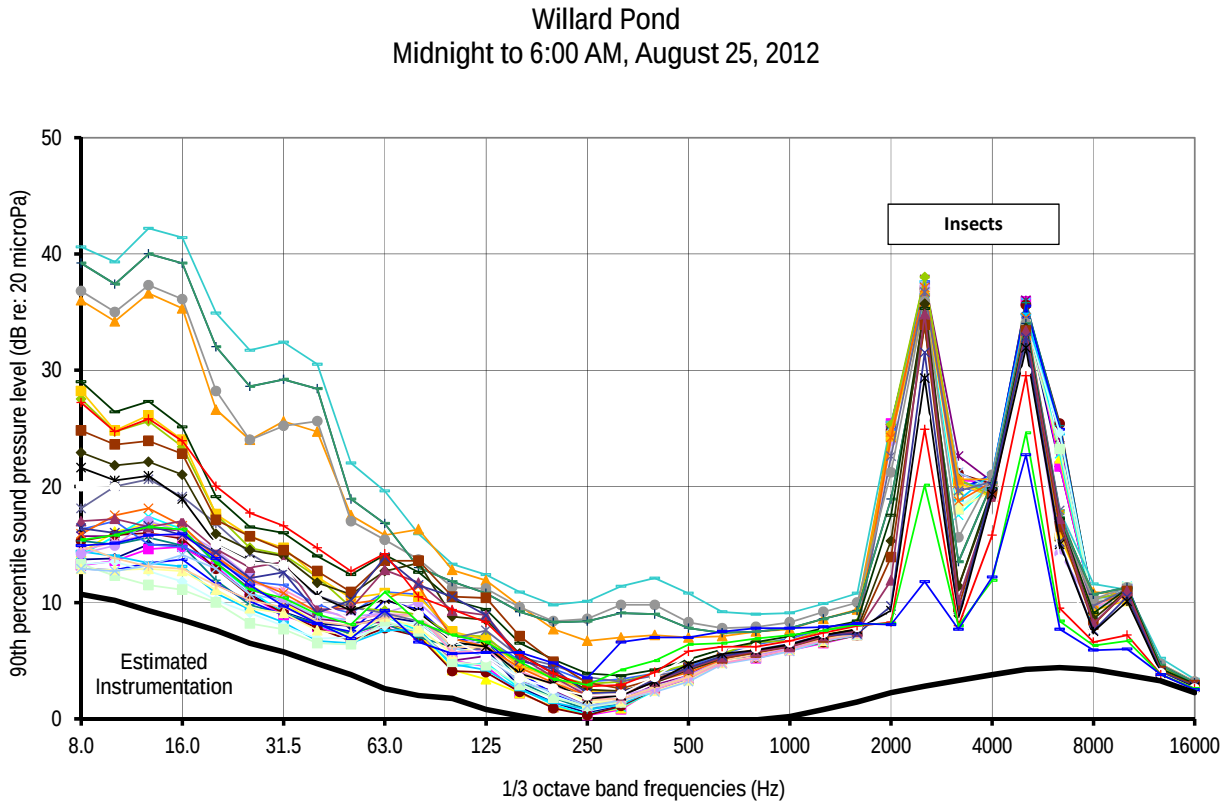

Figure 3b. Measured 10-minute interval background sound level spectra
Willard Pond, Midnight to 6:00 AM, August 25, 2012

8. Columns 2 and 5 of Table 1 report measured 10-minute interval A-weight background sound levels measured between midnight and 6:00 AM, August 25, 2012 at the Gregg Lake and Willard Pond locations respectively. Columns 3 and 6 show measured background sound levels for both locations corrected by subtracting instrumentation noise floor and insect sound.

Time	Gregg Lake			Willard Pond		
	Measured A-wt Background $LA_{90,10\text{-min}}$ (dBA)	Measured Background w/o noise floor w/o insects $LA_{90,10\text{-min}}$ (dBA)	diff	Measured A-wt Background $LA_{90,10\text{-min}}$ (dBA)	Measured Background w/o noise floor w/o insects $LA_{90,10\text{-min}}$ (dBA)	diff
1	2	3	4	5	6	7
00:00	38	17	21	40	14	26
00:10	36	14	22	41	14	26
00:20	36	13	23	40	14	26
00:30	36	13	23	40	14	26
00:40	36	13	23	41	15	27
00:50	36	13	23	41	14	26
01:00	35	13	22	41	15	27
01:10	36	13	23	41	15	26
01:20	36	13	23	41	15	26
01:30	36	16	19	40	15	25
01:40	36	14	21	40	15	25
01:50	41	15	26	40	14	26
02:00	38	14	23	40	14	26
02:10	36	15	21	40	14	25
02:20	35	16	20	40	14	25
02:30	36	15	22	40	15	26
02:40	39	15	24	40	15	25
02:50	39	15	25	41	16	24
03:00	36	15	23	40	19	21
03:10	39	16	23	41	15	25
03:20	40	16	24	39	15	24
03:30	38	15	23	40	17	23
03:40	42	15	27	40	15	26
03:50	36	13	23	40	15	25
04:00	35	12	23	39	17	22
04:10	39	15	23	38	17	21
04:20	40	16	24	39	15	23
04:30	39	15	24	39	15	24
04:40	39	15	24	38	15	23
04:50	36	15	21	38	14	24
05:00	35	15	20	36	14	22
05:10	35	15	21	35	14	21
05:20	34	15	20	32	14	18
05:30	33	15	18	32	14	18
05:40	30	13	17	27	14	13
05:50	29	14	15	25	15	10

Table 1. Measured background sound level corrected for instrumentation noise floor and insect sound.

9. Figure 4 shows the measured and corrected 10-minute interval background sound levels (values on left-hand scale) at Gregg Lake and Willard Pond reported in Table 1. In addition, the 57 m AGL average wind speeds provided by Epsilon are plotted as well (values on right-hand scale). It is observed in the data of Table 1 and Figure 4 that insects raise sound levels at the Gregg Lake and Willard Pond locations by 20 to 25 dBA at night. Hence, in the absence of insect sound, background sound levels at these locations would average 15 dBA at night.

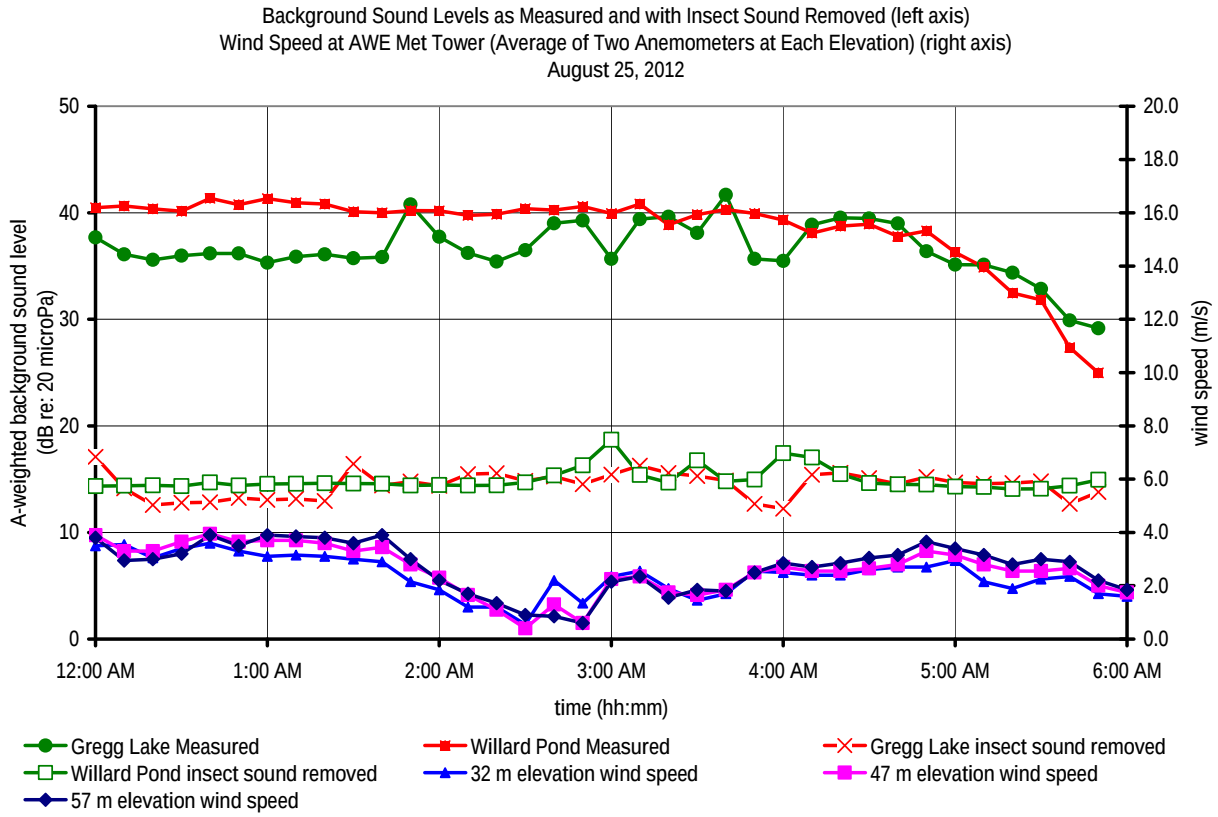

Figure 4. 10-minute A-weighted background sound levels as-measured and as-corrected to remove insect sound—Gregg Lake and Willard Pond
10-minute interval average wind speed for the same period (right hand axis)
Midnight to 6:00 AM, August 25, 2012

PART 2 BACKGROUND SOUND LEVEL MEASUREMENTS BY EPSILON AT LOCATIONS 1-5 (REF. EPSILON NOVEMBER 2011 REPORT)

10. Figures 5a through 5e are background sound levels measured by Epsilon and transmitted to us for our consideration. We have plotted the measured background sound levels (Y-axis) as a function of wind speed (X-axis). Similarly, Figures 5f and 5g are background sound levels measured by CTA at Gregg Lake and Willard Pond locations. Data in Figures 5a through 5f show that there is little correlation, i.e. relationship, between wind speed and background sound, except perhaps at higher wind velocities.

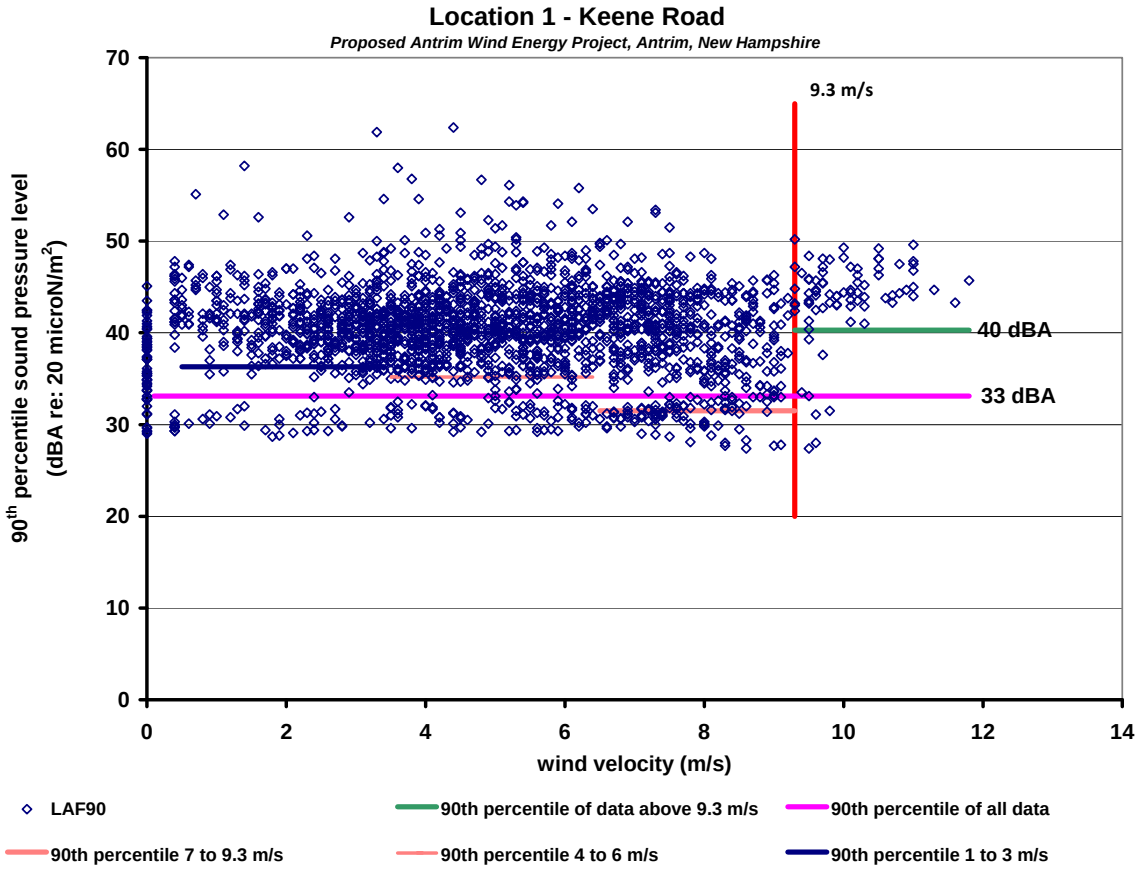

Figure 6a. Background sound levels measured by Epsilon September 16 to October 4, 2011 at Location 1 Keene Road.

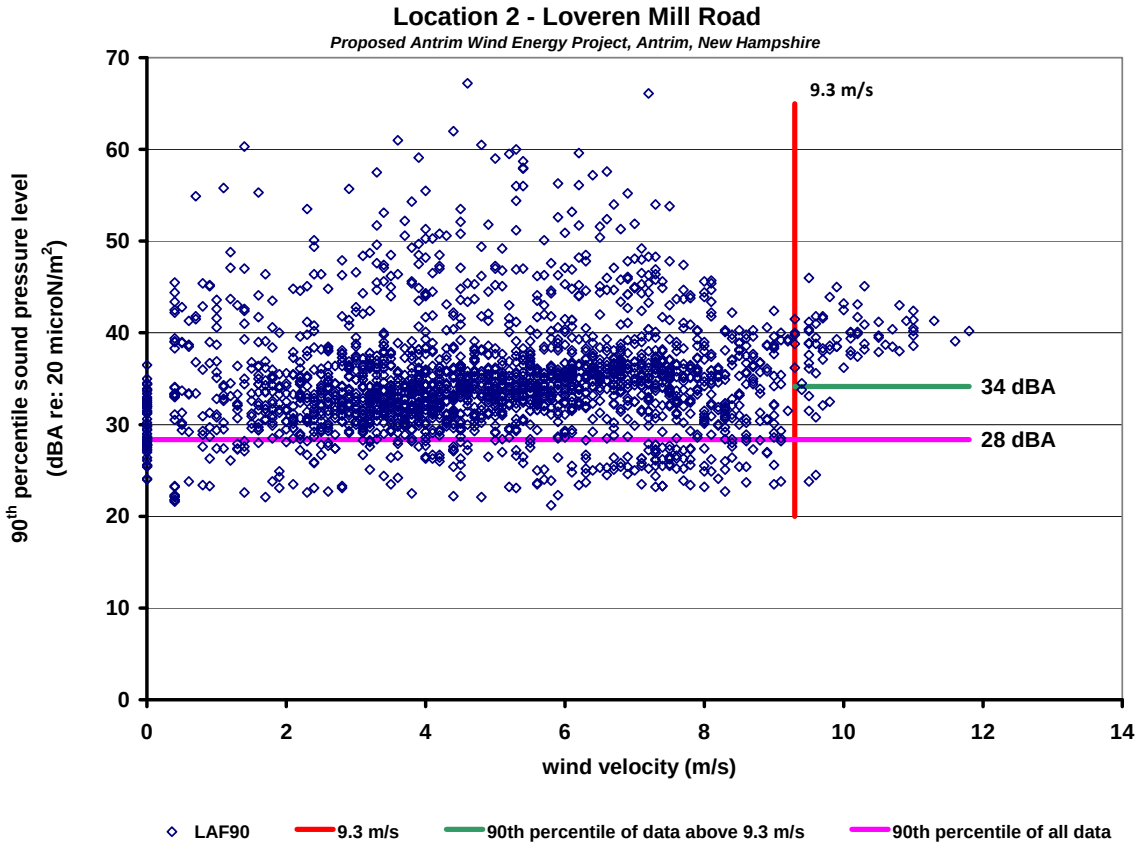

Figure 6b. Background sound levels measured by Epsilon September 16 to October 4, 2011 at Location 2 Loveren Mill Road.

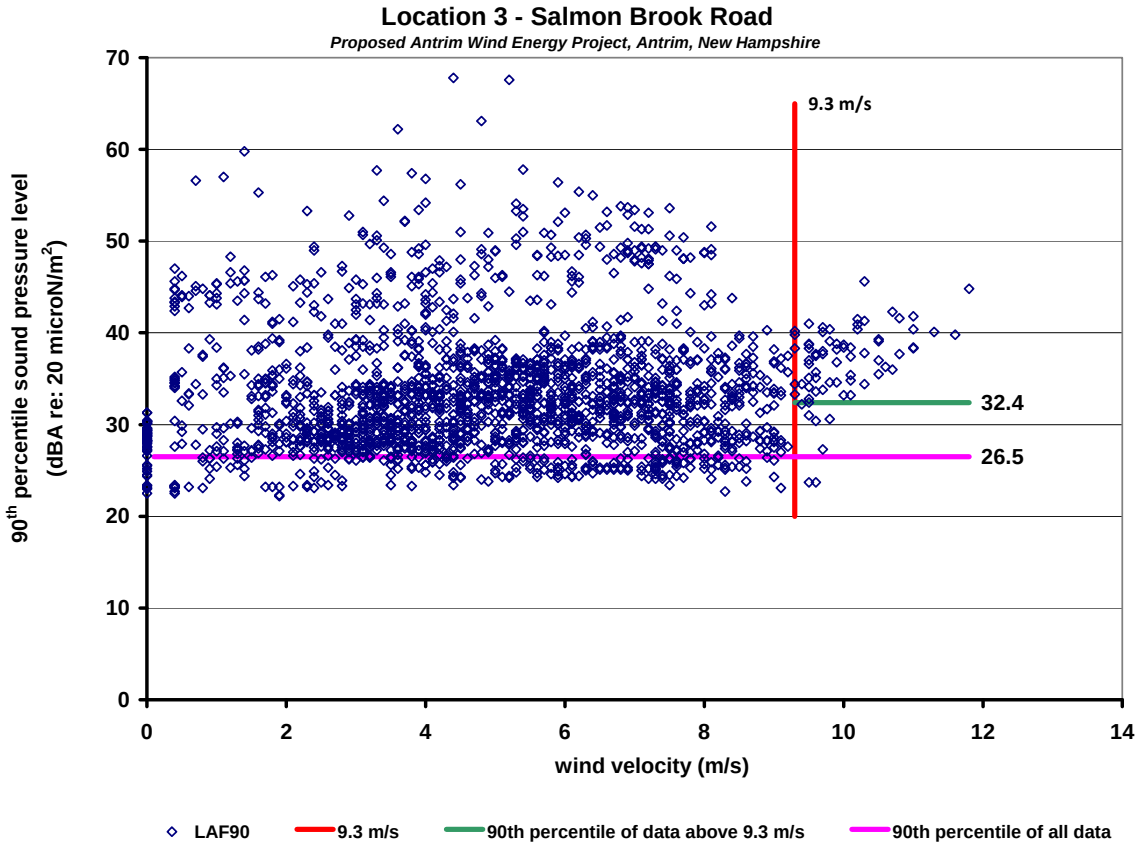

Figure 6c. Background sound levels measured by Epsilon September 16 to October 4, 2011 at Location 3 Salmon Brook Road.

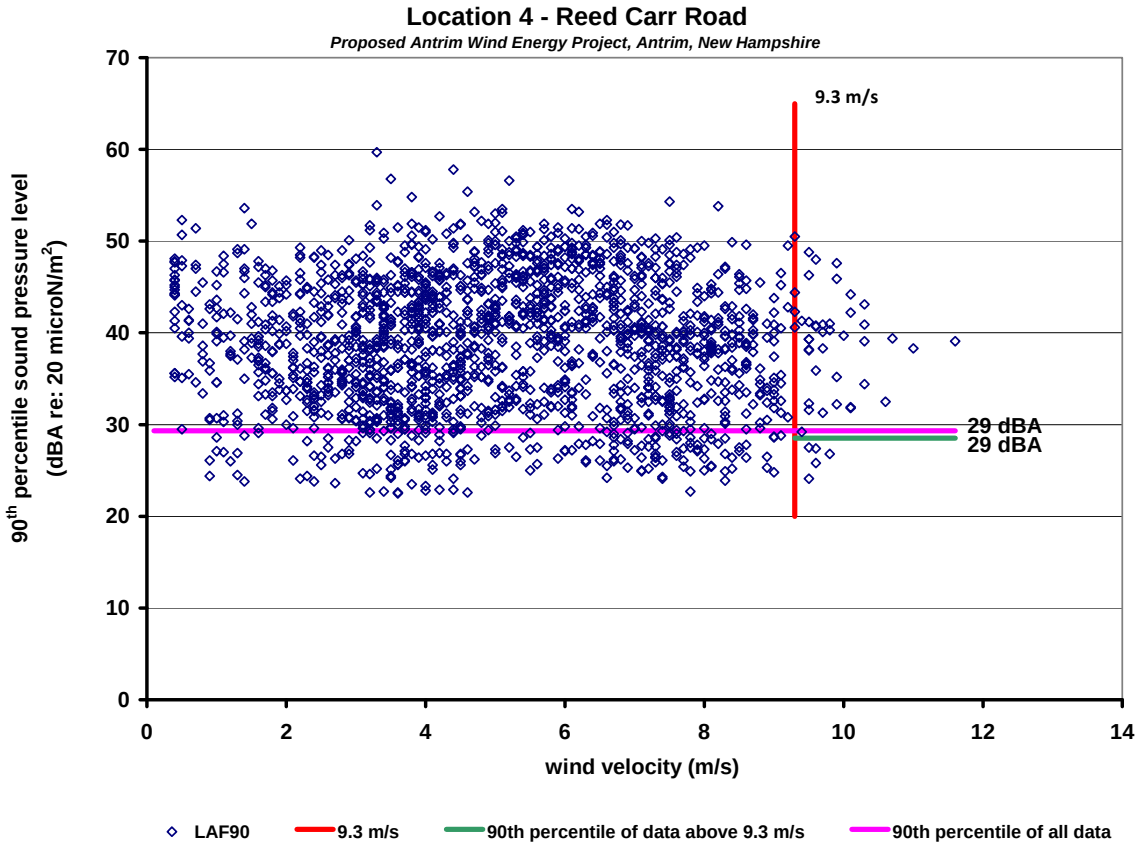

Figure 6d. Background sound levels measured by Epsilon September 16 to October 4, 2011 at Location 4 Reed Carr Road.

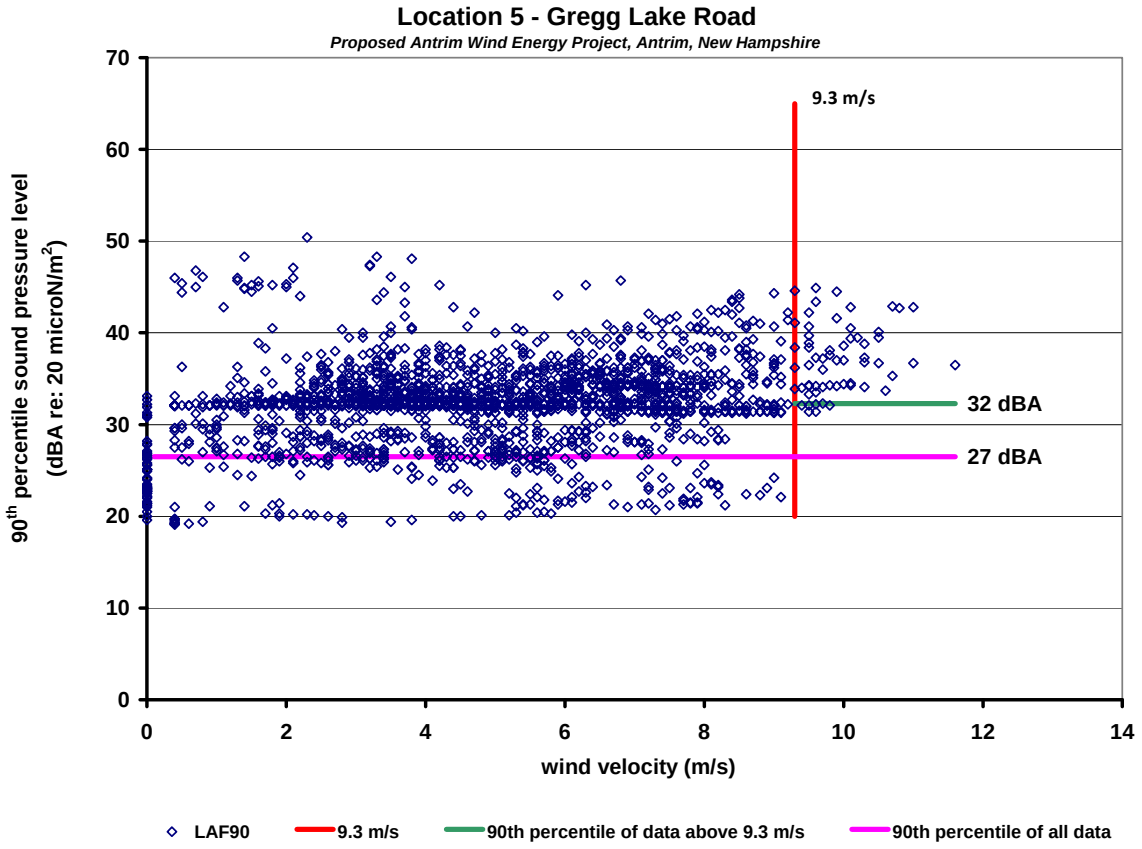

Figure 6e. Background sound levels measured by Epsilon September 16 to October 4, 2011 at Location 5 Gregg Lake Road.

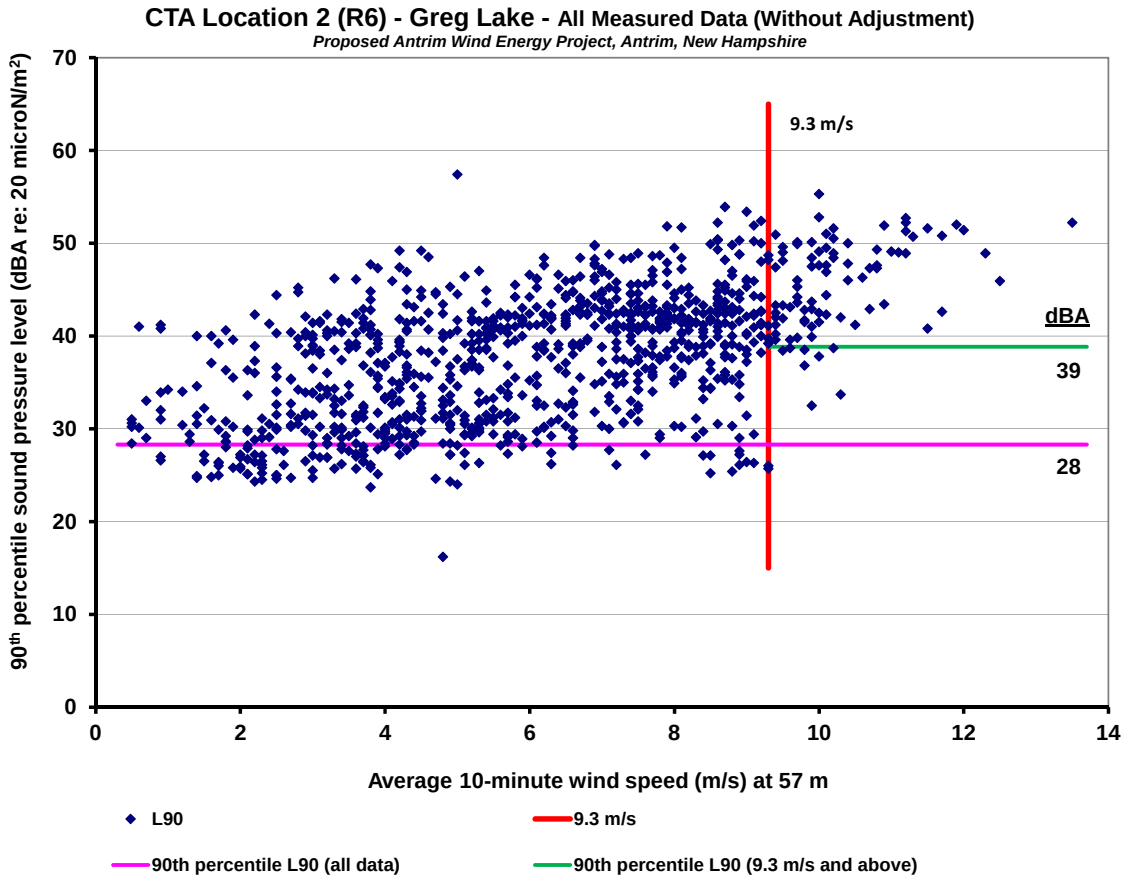

Figure 5f. Background sound levels measured by CTA August 22 to August 29, 2012 at Gregg Lake

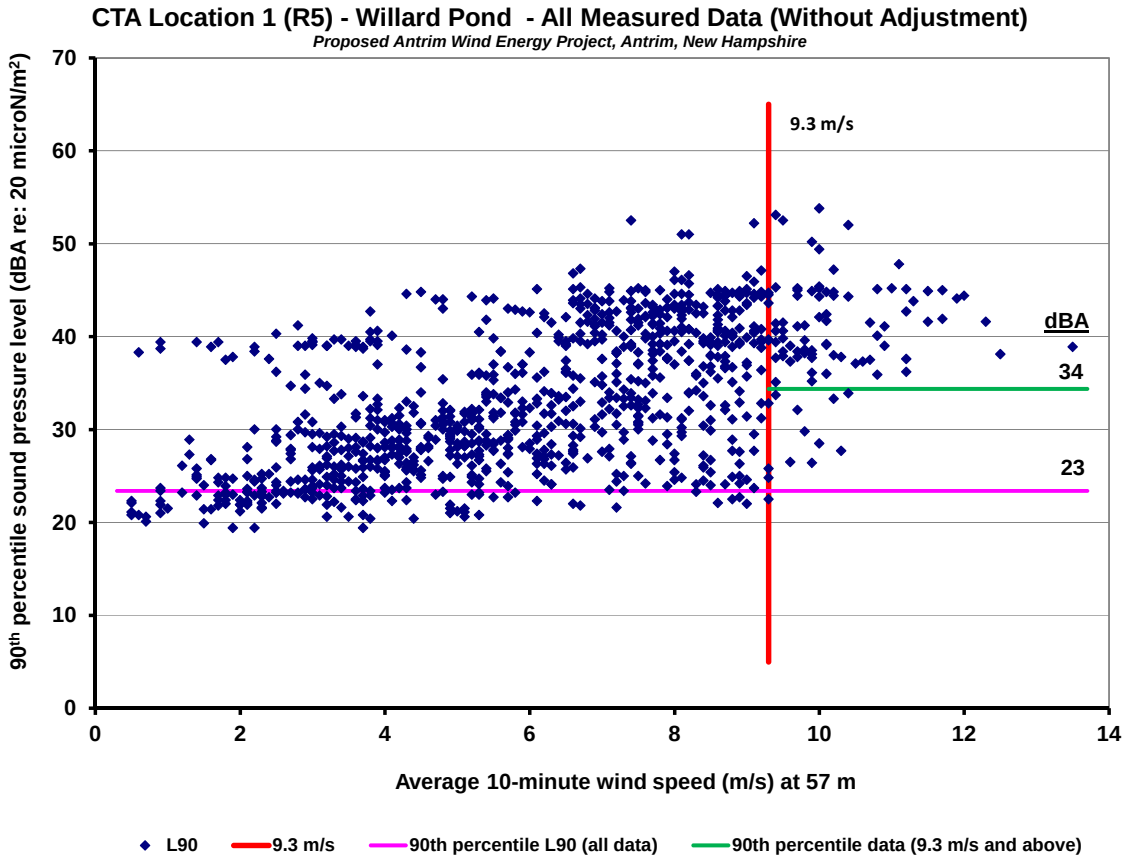

Figure 5g. Background sound levels measured by CTA August 22 to August 29, 2012 at Willard Pond

11. Figures 6a through 6g also show the 90th percentile of the entire measurement population at all wind speeds and at wind speeds exceeding 9.3 m/s at the met tower 57-m AGL location. (See p. 6-2 of the Epsilon November 2011 Report.) In all but one case, the 90th percentile of the population above 9.3 m/s is higher than the 90th percentile of the entire population. Despite the weak relationship between background sound level and wind speed observed in Figures 6a through 6g, the data suggest that background sound is at least weakly dependent on 57-m AGL wind speeds above 9.3 m/s.

12. Late September background sound levels reported in the Epsilon November 2011 report appear to show that insect sound did raise nighttime background sound levels, especially at Locations 2 (Loveren Mill Road) and Location 3 (Salmon Brook Road), though less so at other locations (see Epsilon November 2011 Appendix Figures A-2 and A-3). In Epsilon's data, it appears that insects raised background sound levels by at least 15 dBA, not quite as much as insects did during monitoring in August 2012 by CTA at Gregg Lake and Willard Pond. Therefore, use of Epsilon's nighttime background sound levels without correction would overstate background sound levels otherwise occurring during times of year when insect sound is absent. Accordingly, use of Epsilon data would understate AWE sound impact when impact is quantified as an amount that the background sound would be raised during AWE operation.

PART 3. EVALUATION OF AWE NOISE IMPACT

13. I am of the opinion that to avoid adverse community response, a criterion should be established that limits AWE wind turbine sound to not more than a defined margin above a baseline sound level. To accommodate scatter observed in measured data, the baseline sound level is defined as the 90th percentile of the 10-minute interval, insect-corrected, background sound levels ($LA_{90,10\text{-}min}$) measured when the average 57-m AGL wind speed exceeds 9.3 m/s. The margin is 5 to 10 dBA. If AWE sound at a residential receptor location exceeds the baseline by:

- not more than 5 dBA, then no sound impact is expected.
- 5-10 dBA, then modest noise impact is expected.
- more than 10 dBA, significant impact is expected.

The above criteria are applicable to residences where AWE sound does not exceed 30 dBA. This is to be consistent with the findings of Pedersen (2009)[1] that no complaints of sound by residents were recorded in his study for wind turbine sound below 30 dBA.

[1] Pedersen, van den Berg, Bakker, Bouma; "Response to noise from modern wind farms in The Netherlands," J. Acoust. Soc. Am. 126 (2), August 2009 (Pedersen 2009)

Locations	Baseline[1] (dBA)	Insect Removal Adjustment	Adjusted Baseline (Insect Sound Removed) (dBA)	AWE Sound Level[5] (dBA)	Impact (dBA)	Comment[6]
Location 1 Keene Road	40	0[2]	40	40	0	No residential impact.
Location 2 Loveren Mill Road	34	-15[3]	19	35	16	Significant residential impact. 25% chance of residents annoyed 18% chance of very annoyed
Location 3 Salmon Brook Rd	32	-15[3]	17	42	25	Significant residential impact. 25% chance of residents annoyed 18% chance of very annoyed
Location 4 Reed Carr Road	29	0[2]	29	39	10	Modest residential impact. 20% chance of residents annoyed 5% chance of very annoyed
Location 5 Gregg Lake Road	32	0[2]	32	33	1	Little or no residential impact. 8% chance of residents annoyed 2% chance of very annoyed.
Gregg Lake (CTA Location NIGHT)	40	-25[4]	15	30	15	Significant residential impact. 25% chance of residents annoyed 18% chance of very annoyed
Willard Pond (CTA Location NIGHT)	40	-25[4]	15	30	15	No residential impact. See discussion of wilderness area.

[1]From Table 6-2 of the Epsilon November 2011 Report
[2]Insect or other indigenous sound adjustment could not be determined from data presented.
[3]Minimum likely adjustment observed in Epsilon November 2011 Report appendix data.
[4]Determined from data measured by CTA on August 25, 2012.
[5]From Table 7-3 of the Epsilon November 2011 Report.
[6]Refer to Gregory C. Tocci Response to Applicant's First Set of Consolidated Data Requests Propounded on Witnesses for Counsel for the Public

Table 2. Summary of sound impacts
Antrim Wind Energy, Antrim, New Hampshire

14. I am also of the opinion that criteria found to be suitable for residential areas are not acceptable for wilderness areas valued for their quiet. Within about 4000 feet of the AWE facility, wind turbine sound levels will be 40 dBA or higher. Background sound levels in these areas would be comparable to those measured at Willard Pond, i.e. as low as 15 dBA without insect sound. Hence, in wilderness areas within 4000 feet of the AWE facility, wind turbine sound will exceed the background by 25 dBA, depending on distance from the AWE facility and wind conditions. Wind turbine sound would then dominate the acoustical

environment in much of the remote area surrounding the AWE facility thus greatly diminishing the wilderness experience. At the Audubon trails on the northwest side of Willard Pond, background sound levels would also be as low as 15 dBA without insect sound. Along those trails, AWE facility sound levels will range between 30 and 35 dBA, suggesting wind turbine sound will be audible, thus also detracting from a wilderness experience there as well.

15. This completes this pre-filed testimony for now.

Gregory C. Tocci