Appendix D
Sound Level Report

WEST HILL WINDPOWER PROJECT
SOUND LEVEL REPORT
MARCH 27, 2006

INTRODUCTION

Tetra Tech EC, Inc. (Tetra Tech) performed computer modeling in order to calculate sound levels that would be generated by operation of the proposed West Hill Windpower Project, located in Madison County, New York, near the small towns of Stockbridge and Munnsville. The commercially available CadnaA model, developed by Datakustik GmBH, was used for this analysis. The software takes into account spreading losses, ground and atmospheric effects, shielding from terrain, barriers and buildings, and reflections from surfaces. The software is standards-based and the ISO 9613 standard was used for air absorption and other noise propagation calculations (ISO, 1989).

West Hill Windpower, LLC proposes to install and operate twenty-five (25) of the GE 1.5 MW wind turbines for the proposed project. All of the turbines were assumed to be operating at their maximum sound level, which occurs at wind speeds of 8 m/sec and above, as measured at 10 meters above the ground. The wind turbine hub is located 80 meters above the ground. The predicted sound level standing directly under one wind turbine under these operating conditions is 54 dBA.

The model results are presented in two ways. First, we depict noise contours that show the distribution of noise levels from 45 dBA up to 55 dBA over the entire project area. Secondly, we depict the calculated sound level at specific receptor points, which are the nearest residences. Both the noise contours and the receptors are overlaid on the same topographic map of the area. Predicted levels at the specific receptor points are presented in tabular format.

APPLICABLE NOISE STANDARDS AND ORDINANCES

The New York State Department of Environmental Conservation (NYSDEC) document entitled *Assessing and Mitigating Noise Impacts (NYSDEC*, Feb 2, 2001) provides the following guidance for assessing noise impacts:

TABLE 1

EFFECT OF INCREASES IN NOISE LEVELS ON RECEPTORS

Increase in Existing Ambient Sound Levels (dBA)	**Expected Effect on Receptors**
0 – 3	No appreciable effect
3 - 6	Potential for adverse noise impact only in cases where the most sensitive receptors are present
> 6	Potential noise impact. Requires a closer analysis of impact potential depending on existing SPLs and the character of surrounding land use and receptors.
10	Perceived as a doubling of the sound level

The Town of Stockbridge has a reported wind power ordinance that limits noise at residences to no more than 50 dBA from wind turbines.

Table 2 below provides examples of sound levels of common sources of noise.

Table 2

TYPICAL A-WEIGHTED* SOUND LEVELS

Sound Level (dBA)	Location/Source	Subjective Impression
180	Rocket Engine @ 3 ft.	Severe pain
160	Sonic Boom	
140	Threshold of Pain	Slight Pain
130	Hydraulic Press @ 3 ft.	
120	Pneumatic Riveter @ 3 ft.	Extremely Loud
110	Unmuffled Motorcycle @ 3 ft.	
100	Chain Saw @ 3 ft.	Very Loud
90	Train @ 100 ft.	
80	Truck Traffic @ 50 ft.	Moderately Loud
70	Auto Traffic @ 50 ft.	
60	Normal Conversation	Typical
50	Typical Office	
40	Bedroom at Night	Quiet
30	Soft Whisper	
20	Sound Test Booth	Very Quiet
10	Breathing	
0	Threshold of Hearing	No Sound

Source: Holman, 1978; and Stusnick et al., 1981. Compiled by T. Adams.
*A-weighted sound levels are levels that have been adjusted to match the frequency response of the human auditory system.

NOISE MODEL INPUT DATA

The sound power level of a typical GE 1.5 MW wind turbine was obtained on an octave band basis from GE's "Technical Documentation Wind Turbine Generator System GE 1.5sl/sle 50 & 60 Hz, Noise Emission Characteristics" document. The data are provided as A-weighted (dBA) octave band sound power levels (PWL) in decibels (referenced to 10^{-12} watts). Sound power is a measure of the total acoustic power generated by a sound source and is independent of distance from the source. Prior to entering the levels into the model, the A-weighting factors were added back in to produce un-weighted (dB) levels used by the model. The A-weighting factors adjust the levels at different frequencies to approximate the frequency response of the human auditory

system. The modeling results are converted back to A-weighting for comparison with noise ordinance or standards levels.

The un-weighted octave band sound power levels are presented in Table 3 below.

Table 3

Sound Power Levels for GE 1.5 MW Wind Turbines

	Octave Band Center Frequency (Hertz)									
	63	**125**	**250**	**500**	**1000**	**2000**	**4000**	**8000**	**Total (dBA)**	**Total (dB)**
PWL (dB re: 10^{-12} watts)	111.3	110.1	105.8	101.8	97.9	93.3	86.3	79.2	101.7	104.0

RESULTS

The noise contour map is presented in Figure 1. The predicted level directly under each turbine is 54 dBA and the area for potential impacts is very small right around the turbines (600 to 1000 feet depending upon the ambient noise level).

Forty-five decibels is the approximate ambient or background level in rural environments with little or no wind (NYS DEC, Feb.2, 2001). Ambient levels would be expected to be at least 10 dBA higher, or about 55 dBA, in areas with the higher wind speeds associated with wind turbine operation. That is, the wind produces noise that raises the background noise level.

Predicted sound levels at the seventy-seven (77) nearest residences vary from 33.8 to 44.4 dBA (Table 4). The last two columns of the table show the calculated increase in assumed existing ambient levels of 45 and 55 dBA. These increases range from 0.4 to 1.2 dBA with an ambient level of 45 dBA, and from zero to only 0.4 dBA when the ambient level is at 55 dBA. Considering that the actual ambient level would be higher at about 55 dBA or greater during windy conditions, the results presented in the last column are more realistic at a zero to 0.4 dBA predicted increase in levels. Typically, increases in ambient levels ranging from 0-3 dBA would have no appreciable effect on receptors. Thus, the sound from the turbines would not produce a significant noticeable noise impact at either ambient level.

TABLE 4
Predicted Sound Levels at Nearest Receptors to Turbines

Predicted Sound Level Range	Number of Residences within Range	Predicted Increase in 45 dBA Ambient (dBA)	Predicted Increase in 55 dBA Ambient (dBA)
33.8 – 34.9	6	0.3 – 0.4	0
35 – 39.9	55	0.4 – 1.2	0 – 0.1
40 – 44.4	16	1.2 – 2.7	0.1 – 0.4

The predicted sound level at every nearby residence is below the 50 dBA maximum in the Town of Stockbridge noise regulations. In addition, the predicted increases in sound levels over the existing ambient are below the 6 dBA increase identified by the NYS DEC as having the potential to produce a noise impact. Thus, noise levels from the proposed West Hill Windpower Project are in compliance with all applicable guidelines and ordinances and will not produce a noise impact.

Table 5 presents the predicted sound level results in 100-foot increments from the base of a turbine extending from 100 feet to 2000 feet. The results include the sound dampening effects of relatively soft and absorptive ground with grasses, brush and trees.

TABLE 5
Predicted Sound Levels in 100-ft Increments from Turbine Base

Distance from Base of Turbine (feet)	Predicted Sound Level (dBA)
100	51.9
200	44.7
300	39.5
400	35.9
500	33.1
600	31.1
700	29.3
800	27.9
900	26.8
1000	26.7
1100	26.5
1200	26.5
1300	26.7
1400	27.1
1500	27.4
1600	28.2
1700	27.8
1800	28.1
1900	28.3
2000	28.3

CONCLUSION

Predicted sound levels from the turbines operating at maximum sound level producing conditions are quite low at the residences (i.e., < 45 dBA) and would not add significantly to existing ambient sound levels nor create a significant noise impact. In general, the turbines would be inaudible at most residences. Predicted levels are in compliance with all applicable guidelines and ordinances.

REFERENCES:

DataKustik GmbH, 2005. *Computer Aided Noise Abatement Model CadnaA*, Version 3.5. Munich, Germany.

GE Energy, 2004. "Technical Documentation Wind Turbine Generator System GE 1.5sl/sle 50 & 60 Hz, Noise Emission Characteristics" GE Energy GmbH, Salzbergen, Germany.

ISO, 1989. International Organization for Standardization. *Standard ISO 9613 Acoustics – Attenuation of Sound During Propagation Outdoors.* Geneva, Switzerland.

New York State Department of Environmental Conservation (NYS DEC). February 2, 2001. *Assessing and Mitigating Noise Impacts*, Program Policy. Albany, NY