August 20, 2006

To: Cohocton Town Board
Cohocton Planning Board

Subject: Wind Turbine Noise Analysis Errors and Requirements, Comments on UPC Wind (Canandaigua Power Partners) wind farm proposal and Windmill Local Law #2.

Wind turbine noise added to the prevailing ambient background sound is an important environmental consideration when siting wind turbines since they are a permanent installation and may significantly impair the enjoyment of neighboring lands. And relevant consideration of noise impacts is a specific requirement of a State Environmental Quality Review procedure.

The Town of Cohocton is proposing a noise limit in its Windmill local Law No 2. A comprehensive and detailed noise analysis is required prior to enactment. However no supporting analysis is provided to show how the noise levels were derived. Merely copying noise ordinance data from other towns, or limits suggested by the wind company, or guessing at a "reasonable figure" is not a sufficient analysis. Establishment of the law will create a "right of use" and in establishing the noise levels a suitable analysis must be prepared. The NYSDEC has a Program Policy "Assessing and Mitigating Noise Impacts" (Department ID DEP-00-1) that provides a detailed description of sound measurement methods, acoustical environmental factors, and levels that are considered intrusive. "Where activities may be undertaken as a 'right of use', it is presumed that noise has been addressed in establishing the zoning." A SEQR analysis is required to establish Local Law #2 and noise must be adequately analyzed to determine criteria since setback and siting criteria are highly dependent on noise levels.

UPC Wind (Canandaigua Power Partners) has proposed two wind farms for Cohocton; the Cohocton Wind Farm project is first. The DEIS submitted includes a noise analysis as Appendix I, by Hessler Associates (Environmental Sound Survey and Noise Impact Assessment, Cohocton Wind Farm Project, Report No. 1755-010606-B, March 10, 2006). Hessler purports to analyze the expected noise levels surrounding the wind farm but the background (ambient) noise data in this report is so severely flawed as to be completely useless. It must be redone, requiring re-analysis of setbacks.

Furthermore, UPC Wind uses the DEC Policy as its defining criteria in its Noise analysis but avoids many of the salient parts of the Policy.

a) All potential receptors that may be affected by unreasonable noise levels must be characterized, not just surrounding the 3 background measurement sites as was done by UPS. Unique acoustical features of the terrain may influence sound propagation.
b) Measurements of background noise were completely inaccurate and do not provide a baseline for establishing noise contour maps.
c) Vegetation was not present for the limited time field measurements, and vegetative cover will have an important effect on elevated noise source propagation.

From the Policy:

> B. Potential for Adverse Impacts
> Numerous environmental factors determine the level or perceptibility of sound at a given point of reception. These factors include: **distance from the source of sound to receptor; surrounding terrain; ambient sound level; time of day; wind direction; temperature gradient; and relative humidity**. The characteristics of a sound are also important determining factors for considering it as noise. The **amplitude (loudness), frequency (pitch), impulse patterns and duration of sound all affect the potential for a sound to be a noise.** The combination of sound characteristics, environmental factors and the physical and mental sensitivity of a receptor to a sound determine whether or not a sound will be perceived as a noise. This guidance uses these factors in assessing the presence of noise and the significance of its impacts. It relies upon qualitative and quantitative sound evaluation techniques and sound pressure level impact modeling presented in accepted references on the subject.
>
> (emphasis added)

The successful measurement and assessment of the complex noise potential of a large wind turbine farm project is therefore vitally important and there are specific instructions in the Policy about excessive noise:

> When a sound level evaluation indicates that receptors **may experience sound levels or characteristics that produce significant noise impacts or impairment of property use**, the Department is to require the permittee or applicant to **employ reasonable and necessary measures to either eliminate or mitigate adverse noise effects**.

Wind strength increases with elevation above earth and its frequently expected that the turbines will be operating just above cut-in while the land nearby is without wind or with very low wind.

Hessler "Noise Survey", Appendix I

The study consists of two parts, identification of the ambient background noise and then computer modeling analysis of the future turbine noise expectations. The background ambient determination is important because the new wind turbine noise emissions will be added with the ambient to provide a "limit of acceptance." The DEC Noise Policy suggests a 3 dBA increase over ambient for "sensitive receptors" and a generally applicable limit of 6 dBA increase as acceptable under most circumstances. Therefore the computer modeling of noise contours around each turbine depends exclusively on obtaining reliable ambient background noise data. Inaccurate noise contours and inaccurate background noise limits will lead to serious errors in delineating setback requirements for turbine siting. Hessler agrees:

> The primary basis for evaluating potential project noise is the Program Policy *Assessing and Mitigating Noise Impacts* issued by the New York State Department of Environmental Conservation (NYCDEC), Feb. 2001. This assessment procedure is incremental in the sense that a simplified "first level noise impact evaluation" is initially carried out to determine if any residential receptors *may* experience a noticeable increase in sound level followed by a more in depth "second level noise impact evaluation" if any sensitive receptors are identified as being possibly affected. **The procedure essentially defines a cumulative increase in overall sound level of 6 dBA as the threshold between no significant impact and a potentially adverse impact.**
>
> (emphasis added)

Analysis of the Hessler study reveals however that the background noise levels were not measured due to overwhelming contamination of measurements by the wind blowing through the noise meter microphone.

It is well known that wind induced microphone noise is a large source of error in any windy measurement situation. The reader may recall news broadcasts where the reporter is trying to talk despite breezes causing "wind noise" that overcomes the reporter's voice. It's the same thing here, a breeze on the microphone, even with a windscreen, will cause significant errors due to this unwanted effect. Noise meter manufacturer data clearly show the error and it has been studied theoretically, with good agreement between theory and instrumentation (see *The sound of high winds: the effect of atmospheric stability on wind turbine sound and microphone noise* by Godefridus Petrus van den Berg, Chapter 8 "Rumbling Wind: wind induced sound in a screened microphone"). Rion, manufacturer of the model used by Hessler, give error curves for their instruments in varying wind conditions. The attached Fig. 1 shows a plot of wind speed vs. dBA error for two manufacturer's noise meters and two conditions for the van den Berg model. All are in good agreement. Also shown on the graph as vertical bars are the cut-in wind speed and cut-out wind speed for the Gamesa G87-2.0 MW turbine, proposed as "typical" by UPC Wind in their DEIS Appendix 20. It can be seen that at the cut-in wind speed of 9 mph the noise meter error is about 35 dBA. Unless the background noise being measured is above 35 dBA it won't be registered. Since wind itself is completely silent, it creates sound only when acting on some object causing it to react to the wind pressure. A 9 mph wind may not create an "ambient" of 35 dBA, depending on "ambient" physical conditions around the measuring site - nearby woods and vegetation, structures, and terrain. At the turbine cut-out wind speed of 56 mph the microphone error has risen to an astonishing 80 dBA. Only loud background sounds can be now be registered, with no way of discerning any quieter ambient.

A study on behalf of the United Kingdom's Energy Technology Support Unit called "Noise Emission from Wind Turbines" (Feb 10, 1999) evaluated some methods of correcting erroneous noise meter measurements:

> "The project has dealt with practical ways to reduce the influence of background noise caused by wind acting on the measuring microphone."

The report identifies four methods to eliminate microphone error:

> "3.1.1 Reduction of Wind Induced Microphone Noise
>
> Wind induced microphone noise is a major problem in wind turbine noise measurement during strong wind. Four techniques for reducing this so-called pseudo noise were tested in the project.
>
> - *Two microphone cross correlation*. Noise signals from two identical microphones positioned some distance apart were analyzed applying correlation technique to suppress wind induced noise components, which are uncorrelated in the two signals.
> - *Mounting the microphone on a vertical reflecting board.* The board reduces wind velocity at the microphone, screens the noise from any source behind the board, and causes pressure doubling (+6 dB) for sources in front of the board.
> - *Directional microphone with supplementary wind shield*. A directional microphone reduces noise from directions other than that of its axis. Wind noise sensitivity of the directional microphone was reduced by mounting a supplementary wind shield.

- *Large secondary wind screen.* An extra wind screen used simultaneously with the normal wind screen reduces wind noise. The attenuation of the acoustic signal when transmitted through the secondary wind screen was measured in an anechoic room and the wind-induced noise was measured in the field.

The reduction of wind-induced noise turned out to be more or less the same no matter which of the methods is used…"

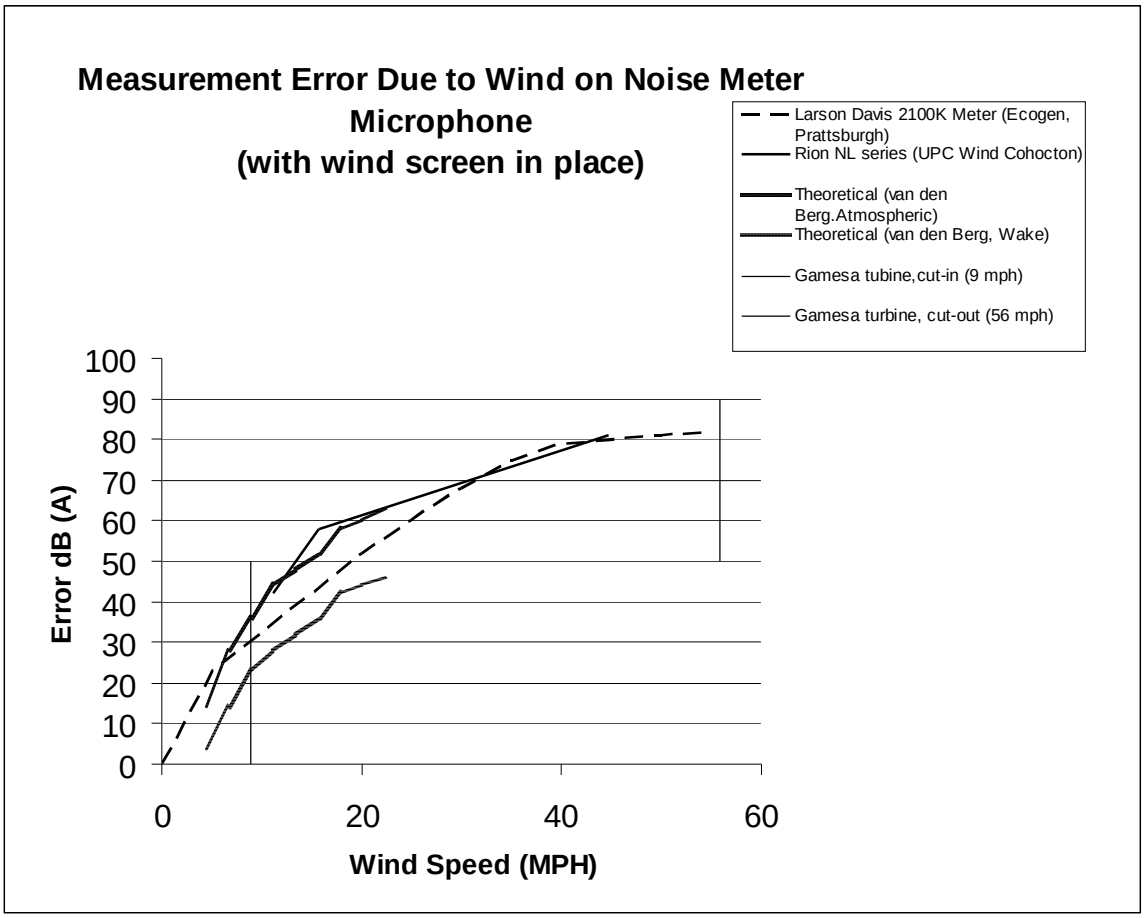

Fig 1: Noise Meter Microphone Error

Hessler did not study the characteristics nor identify the easily discovered wind induced errors by merely looking through the Rion meter spec. sheet, excerpted as Fig. 2 below. This is unconscionable.

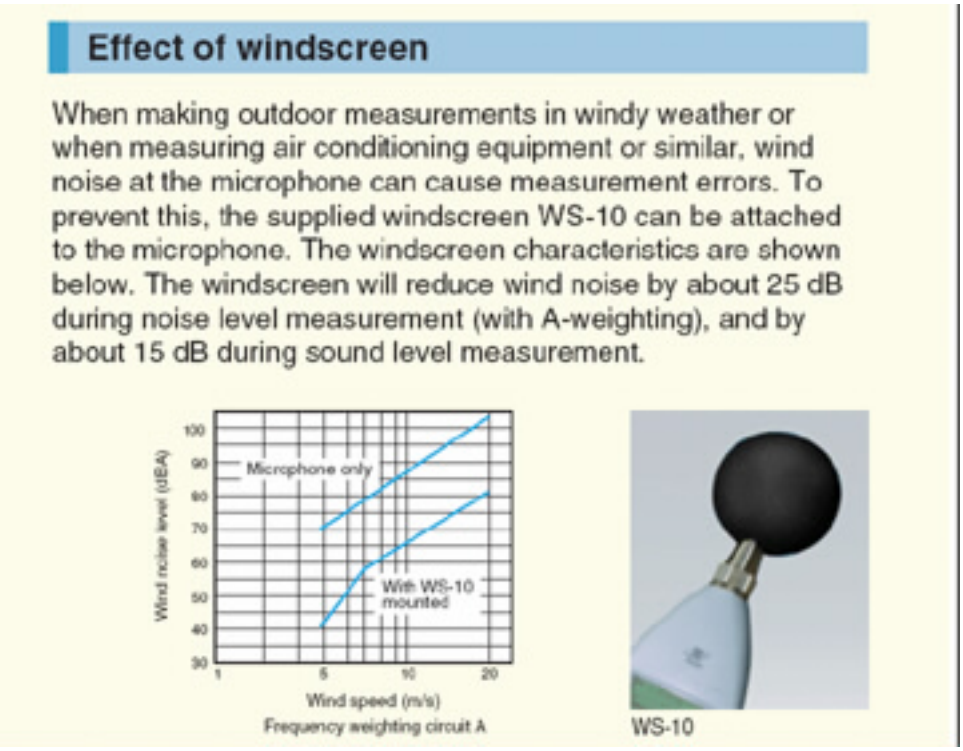

Fig 2: Excerpt from Rion NL Series Specification Sheet

UK Criteria

Several other reports identify rural, country ambient sounds as about 30 dBA, or frequently quieter, and that quieter noise levels in the 30 dBA range should be used as opposed to urban environments that frequently allow 50 dBA limits. For example, wind turbines in Europe are more widely established and noise studies there indicate that in terrain similar to Cohocton and other WNY areas low noise backgrounds are to be expected, that the wind turbines noises are therefore much more objectionable, and that setbacks up to 1 mile, or more, are needed.

From : *Location, Location, Location, An investigation into wind farms and noise by the Noise Association,* by John Stewart, UK Noise Association

> Wind Farm Noise – the impact on areas of low background noise
>
> Mid Wales - a land of hills and valleys. A place where the wind blows frequently and the population tends to be thinly spread. Ideal for wind farms. And, not surprisingly, many are planned. **The best place very often for the turbines to catch the wind is close to the top of a hill**. It means that the wind turbines can be at their most productive. But it also means that the **noise may cascade down the surrounding valleys**. To makes matters worse, many of the scattered hamlets within the valleys snuggle into corners protected by the hills and the mountains where the background noise level is very low indeed. **You only need to visit these areas to hear the 'swish, swish, swish' of the turbines – particularly downwind – over a mile away from the wind farm.**
>
> (emphasis added)

The description of Mid Wales above describes Cohocton and much of scenic Western New York. The prevailing (urban) UK national guidelines for noise limits are (from Stewart)

> • Daytime noise levels outside the properties nearest the turbines should not exceed 35-40 dBA or 5 dBA above the prevailing background, whichever is the greater.
> • Night noise limits outside the nearest property should not exceed 43 dBA or 5 dBA above the prevailing background, whichever is the greater.

But in areas like Mid Wales, the guidelines are deemed to give noise levels too high. Likewise with Cohocton, a lower noise threshold in the 35 dBA range is to be anticipated, far below the approximate 46 dBA contemplated in Windmill Law #2 (52 -6 = 46 ambient). The DEC Noise Policy, if faithfully followed, gives acceptable noise levels about 6 dBA higher than the prevailing background. The background must be accurately measured.

Further support comes from Dick Bowdler, "a noise and acoustic consultant for more than 30 years and most of my current work is dealing with the assessment of environmental noise as it affects residential properties. I work equally for those potentially creating noise and those affected by it. I have been a supporter of wind energy and other forms of renewable energy for some 35 years. " (private letter to Susan Sliwinski, Oct. 16, 2002). Continuing, he says:

> In practice, in most rural areas, my rule of thumb is that the nearest turbine needs to be at least 1¼ miles from any house. However, these are areas where the background noise level can be 20 dBA at night. You suggest that your background noise level could be 30-32 dBA. This seems a likely figure if you have 350 houses in the area, though I suspect it could be a bit lower than this. On this basis, noise from the wind farm should not exceed 35 dBA. **If the developers are suggesting that 55 decibels is acceptable, this is quite outrageous. 55 dBA is more than four times as loud as your background noise.**
>
> Most of the Scottish wind farms that have recently been approved have no housing closer than about 1 mile, except where the house belongs to the landowner of the wind farm site. There are a few applications with houses as close as about 2000 feet but these have all either been turned down or withdrawn by the developer.
>
> I am not familiar with the GE turbines, but I suspect that they have a sound power level of about 105 dBA. In this case, the noise level would be between 45 and 50 dBA at 1400 feet in neutral weather conditions and if the nearest turbines were in full view.
>
> (emphasis added)

NASA

Noises carry greater distances from elevated noise sources like wind turbines and this has been reported by NASA in a 1990 study *Wind Turbine Acoustics* by Hubbard and Shepherd. From the Introduction:

> Wind turbine generators… are producing electricity both singly and in wind power stations that encompass hundreds of machines. Many installations are in uninhabited areas far from established residences, and therefore there are no apparent environmental impacts in terms of noise. There is, however, **the potential for situations in which the radiated noise can be heard**

by residents of adjacent neighborhoods, particularly those neighborhoods with low ambient noise levels. …

(emphasis added)

This report contains detailed noise analyses of various wind turbine styles – upwind rotors *vs.* downwind rotors, blade shape, rotational speed etc. And it includes a detailed sound propagation analysis. Sound "bends" (refracts) in the atmosphere much like light refracts in striking a lens. A graph of the effect, from the report, is shown in Fig 3 below.

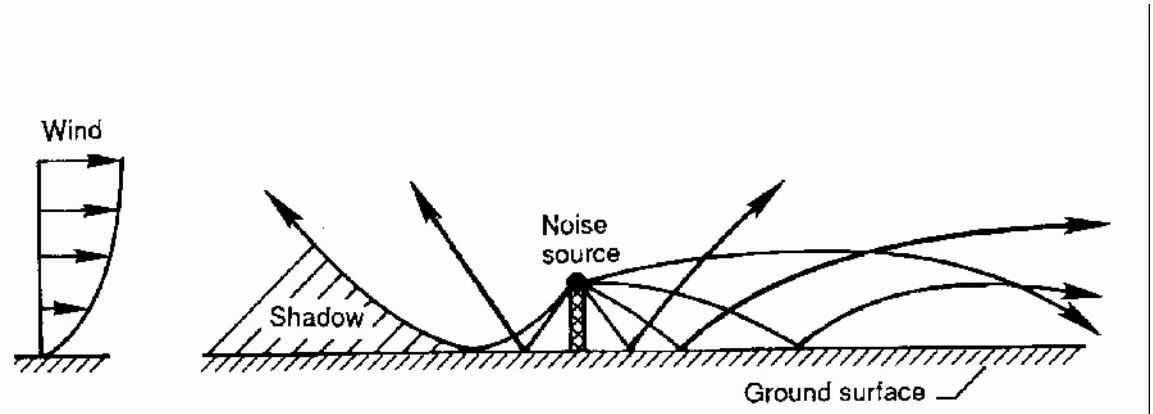

Figure 7-20. Effects of wind-induced refraction on acoustic rays radiating from an elevated point source [Shepherd and Hubbard 1985]

Fig 3: Sound Refraction Effects

The "Shadow" zone in Fig. 3 may explain the observed "quietness" experienced by observers when taken to stand near wind farm turbines such as Fenner. The noises are masked unless the observer is 4x the tower height distance. And it underscores the necessity of comprehensive and accurate engineering studies of complex phenomena. Merely relying on anecdotal "I don't hear anything" knee jerk responses to a turbine visit is misleading and hardly equivalent to living year round as a "receptor".

Recall from the Mid Wales description above that turbine sounds carry one mile. This is shown in the NASA study, Fig 4 below, for a single "point source" turbine. The sounds carry further for a "line" of turbines and many wind farms do have linear clusters of turbines along a hill ridge.

From the Figure it can be seen that the sound drops about 30 dB (for 1000 Hz, the most sensitive to human hearing) at 1000 meter (about 3000 ft). The Gamesa wind turbine spec. sheet lists about a 100 dBA noise level at the turbine. (Appendix 20, UPC Wind, Cohocton) and therefore at 3000 ft the noise is 100-30 = 70 dB. At one mile (5280 ft = 1609 meter) the chart (which has a logarithmic scale) gives about a 60 dB drop, or 40 dB remaining (100-60= 40). The 40 dB figure is about what the Europeans use for their noise boundary, with the 1 mile setback. Notice that for low-frequency sounds, such as the blade-support tower induced "whosh" (250 Hz on the graph), that the sound carries much further, out to 2 miles.

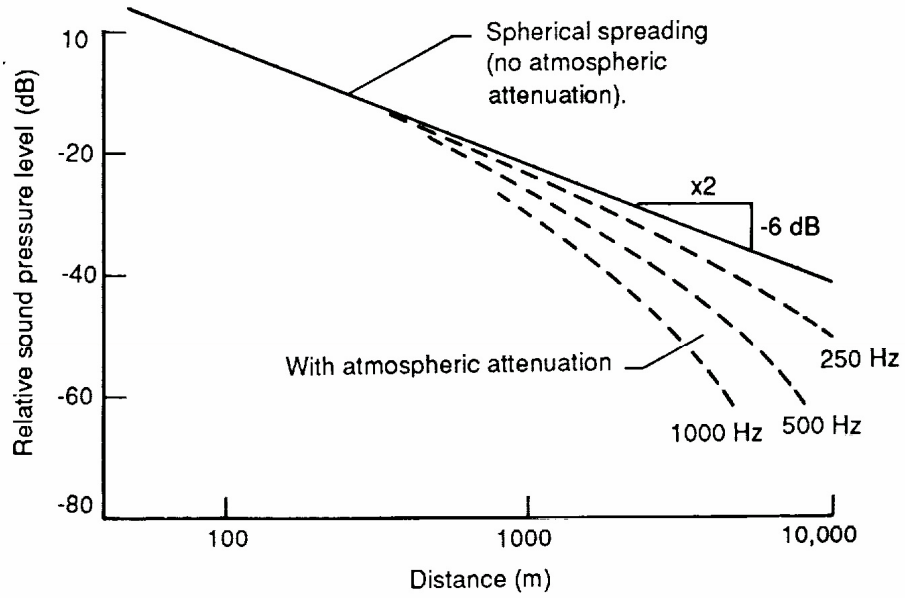

Figure 7-18. Decrease in sound pressure levels of pure tones as a function of distance from a point source [ANSI 1978]

Fig 4: NASA Graph of Sound Diminution with Distance

Vegetation

The Hessler Noise study was conducted for a brief period in November, when vegetation is lacking. Hessler attempts to justify this:

> 3.6 SEASONAL INFLUENCES ON POTENTIAL NOISE IMPACTS
> Experience in conducting ambient sound level surveys at all times of year indicates that, as might be intuitively obvious, background levels are lowest in winter when the leaves are off the trees.

It would however seem "intuitively obvious" from my own experience living in quiet rural setting that ambient noises in the summer are much less than the winter, absorbing road noises and other distant sounds. And since the wind turbines are elevated and directly radiating, their noise will be more easily heard against a much lower background due to summer vegetation. And, from the DEC Noise Policy:

> A. Environmental Setting and Effects on Noise Levels
> 4. Time of Year - **Summer time noises have the greatest potential for causing annoyance** because of open windows, outside activities, etc. During the winter people tend to spend more time indoors and have the windows closed.
>
> (emphasis added)

Conclusion

Occupying 20 square miles of the Town, the first Cohocton Wind Farm project is very large and has a potentially large noise footprint on the entire Town. An accurate and comprehensive noise

analysis is essential but clearly the Hessler study is critically flawed. This study must be repeated with far better analysis in terms of a) reasonably accurate background levels b) inclusion of summer vegetation c) measurement sites that comprehensively represent the likely intrusion on non-leaseholder lands and dwellings. These requirements must be satisfied to conform to the NYS SEQR law:

> In circumstances where noise effects cannot readily be reduced to a level of no significance by project design or operational features in the application, the applicant **must evaluate alternatives and mitigation measures in an environmental impact statement to avoid or reduce impacts to the maximum extent practicable** per the requirements of the State Environmental Quality Review Act.

Many sites may be found to be unsuitable for use due to unacceptably high noise levels requiring higher setbacks, with 1 mile an expected outcome from a genuine study. Mitigation suggestions from the DEC Noise Policy include "increasing the setback distance". It is entirely likely that other turbine locations must be sought, or the scale of the wind farm must be reduced.