Evaluation of Environmental Shadow Flicker

Analysis for “Dutch Hill Wind Power Project”

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1.0 Introduction

Two industrial wind turbine farms are proposed by parent UPC Wind Partners for the town of Cohocton, NY and will permanently alter the town. The large blades on MW scale turbines can at certain times produce moving shadows on the landscape or create distracting flicker on the scenery. To capture the wind these turbines are to be installed on hilltops around the town and thus have significant potential to create a shadow flicker nuisance at great distances from the turbines. All environmental effects of projects require consideration and possible mitigation. Siting selection is important since wind turbines are a permanent installation and may significantly impair resident's enjoyment of neighboring lands or even personal health.

Large scale shadow flicker is a new phenomenon, not experienced by people on an "industrial scale", with football field sized shadows moving across their home or through their local views. As a new sources of environmental pollution extra care is needed when evaluating the long term consequences.

2.0 "Dutch Hill Wind Power Project"

UPC Wind's has proposed two wind farms for Cohocton, the Cohocton Wind Power Project is first, the Dutch Hill Wind Power Project is the second. A DEIS for the Dutch Hill Wind Power Project has been submitted that includes a shadow flicker impact study (Ref. 1)

The purpose of this Evaluation of their impact study is not to repeat the DEIS shadow flicker analysis, which was the burden upon UPC Wind Partners through their contractor Wind Engineers, Inc. and included as Appendix I of the DEIS. (Ref. 2)

3.0 Shadow Flicker Definition

WEI defines shadow flicker in their study:

> 2. Shadow-Flicker Background
> Shadow-flicker from wind turbines is defined as alternating changes in light intensity caused by rotating blades casting shadows on the ground and stationary objects such as a window at a dwelling. No shadow will be cast when the sun is obscured by clouds/fog or when the turbine is not operating.
> Shadow-flicker can occur in project area homes when the turbine is located near a home and is in a position where the blades interfere with very low-angle sunlight. The most typical effect is the visibility of an intermittent light reduction in the rooms of the home facing the wind turbines and subject to the shadow-flicker. Such locations are here referred to as shadow-flicker receptors. Obstacles such as terrain, trees, or buildings between the wind turbine and a potential shadow-flicker receptor significantly reduce or eliminate shadow-flicker effects.

Although this is a seemingly reasonable definition it falls well short. In rural settings homes are often located on large parcels and in the fair-weather seasons home owners will frequently use their property outdoors for recreation and work – law mowing, car washing, picnics, relaxing etc. So in these conditions, which are also the sunniest in

WNY, the presence of blade flicker anywhere within a reasonable viewshed of a residence must be considered an environmental nuisance and must be mitigated. Wind turbine blade shadows are not a mere shadow being cast because they will often be moving and creating a highly objectionable nuisance. Also 400' high turbines on elevated hill ridges will cast distinct shadows for thousands of feet, well above any vegetative screening.

The WEI definition fails to include all flicker effects such as night-time flicker conditions as with moon shine. Rural residents experience very dark skies and on moon lit nights the night-scape can be very dramatic and enjoyable to the residents. Blade flicker nuisance from a rising or setting moon will be an environmental detriment and must be evaluated along with sun-shine effects.

Other flicker annoyance may be present as well such as with a picturesque sunset that expands well along the horizon. Brighltly lit from behind, though not casting shadows, the flickering blade movement of turbines on the horizon will likely cause visual disturbance to the viewscape and must be evaluated, particularly when linear strings of turbines are sited causing wide-angle disruptions.

4.0 Wind Engineers Inc. Modeling Approach

WEI uses the following assessment and modeling methodology

> 3. Modeling Approach
> A near worst case approach has been adopted for reporting the shadow-flicker results. Additional general site and receptor-specific assessments such as obstacles, diurnal and seasonal cloud and fog patterns may further reduce the reported shadow flicker impacts. The analysis assumes windows are situated in direct alignment with the turbine to sun line of sight. Even when windows are so aligned, the analysis does not account for the difference between windows in rooms with primary use and enjoyment (e.g. living rooms) and other less frequently occupied or un-occupied rooms or garages.
> The shadow-flicker model uses the following input:
>
> - Turbine locations (coordinates)
> - Shadow Flicker receptor (residence) locations (coordinates)
> - USGS 1:24,000 topographic and USGS DEM (height contours)
> - Turbine rotor diameter
> - Turbine hub height
> - Joint wind speed and direction frequency distribution
> - Sunshine hours (long term monthly reference data)
>
> The model calculates detailed shadow-flicker results at each assessed receptor location and the amount of shadow-flicker time (hours/year) everywhere surrounding the project (on an iso-line plot). **A receptor in the model is defined as a 1 m² area 1 meter above ground level**. This omni-directional approach produces shadow-flicker results at a receptor regardless of the direction of windows and provides similar results as a model with windows on various sides of the receptor.
> The sun's path with respect to each turbine location is calculated by the software to determine the cast shadow paths every 2 minutes, every day over a full year.

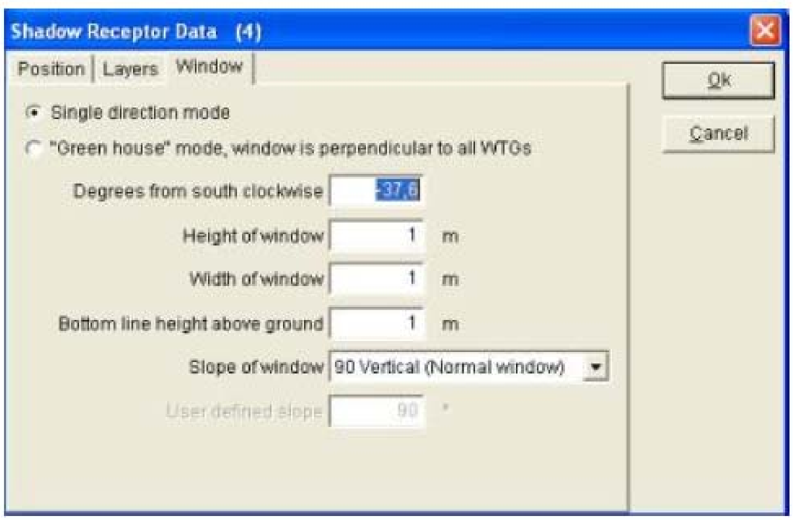
(emphasis added)

This modeling approach is not at all a "near worst case" analysis and is indeed a minimal case analysis because it only assumes shadow flicker is a nuisance if it occurs on a home window. Then only a minimal 1 m^2 (about 3’x3’) window at each receptor is selected, ignoring shadow effects on the residence as a whole or property.

4.1 Wind Pro Modeling Software

WEI used Wind Pro modeling software (Ref. 3) to generate predicted shadow flicker contours throughout a calendar year. Default (usually a baseline) analysis setup parameters were used:

> The shadow receptors are described by the following information:
>
> -The position of the “window” above ground level and its size (height and width).
>
> -The tilt of the “window” relative to horizontal (you can choose between vertical, horizontal and roof window [45°]).
>
> - The directional orientation of the window relative to south (in degrees, positive, westwards)
>
> The default parameters are good as a standard description of typical windows.



The figure shows the data input sheet for the above information.

A table is then given showing residences that were input for consideration and the resulting shadow flicker.

Using only a 3’ square of window for each receptor is extremely limiting and simplistic, and this is acknowledged in WindPro.

> 4.2.0 Introduction to SHADOW
>
> Also, it is sometimes questionable whether the shadow impact should be calculated for a window, the façade of a house or the full outdoor estate. Should a shadow in one end of the garden be added to a shadow in the other end of the garden?

A much better picture of the shadowing extent is given by an iso-line plot of shadows which WEI has WindPro output for various sections of the project. An example for Atlanta and Dutch Hill is shown below in Fig. 1. The quality of the plot in the WindPro output is rather poor so a decisive reading is difficult. Turbine #3 on Dutch Hill is shown to be about ½ mile from downtown Atlanta and according to the WindPro plot no shadowing will occur there. As will be discussed below in Section 4.3 however a simple benchmark computation for a ridgeline turbine shows that shadows can easily extend 2 to 4 miles. And for Atlanta the effects will last about an hour every morning. The entire hamlet of Atlanta it will likely be significantly impacted by turbine #3, #4 and #5 shadow flicker.

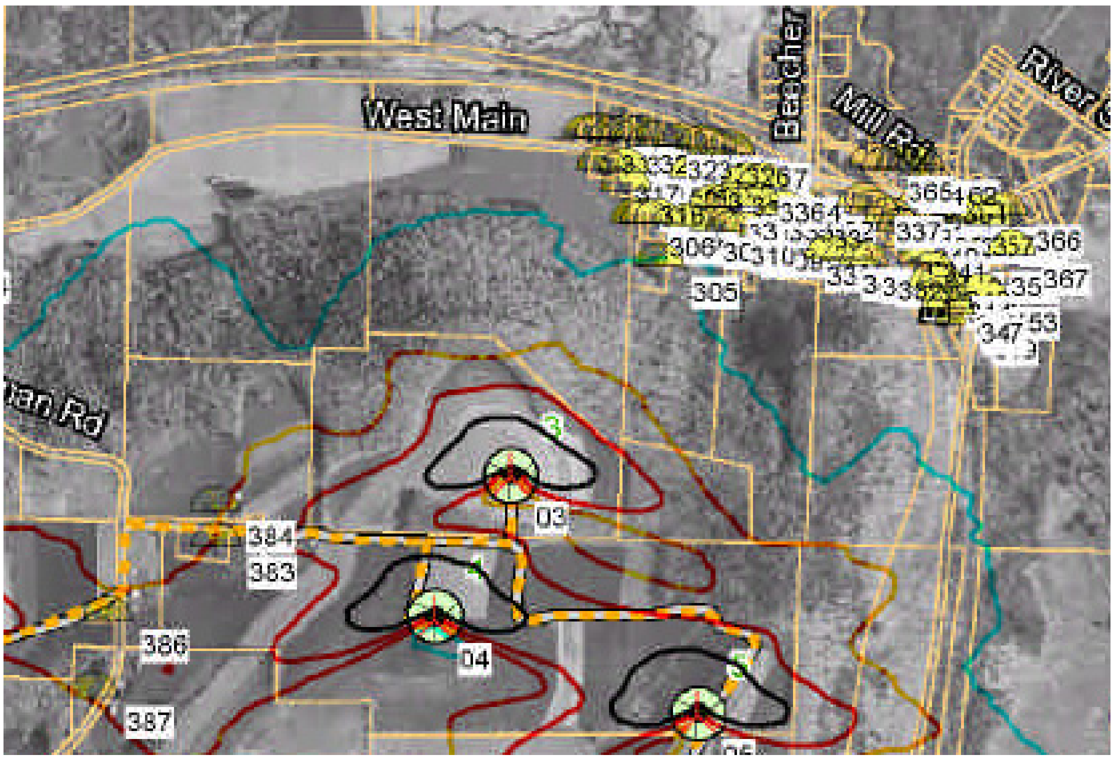


Fig. 1: Iso-Shadow Plot Segment

Wind Pro is not an impartial and unbiased software model, and is apparently designed to aid wind turbine siting. This is inappropriate for engineering software which should be based only on scientific principles with no editorializing.

> As an example, a factory or office building would not be affected if all the shadow impact occurred after business hours, whereas **it would be more acceptable for private homes to experience shadow impact during working hours, when the family members are at work/school anyway.**
> Also, it is sometimes questionable whether the shadow impact should be calculated for a window, the façade of a house or the full outdoor estate. Should a shadow in one end of the garden be added to a shadow in the other end of the garden?

(emphasis added)

4.2 Wind Energies Inc. Conclusions

This is the WEI conclusion based on their methodology and analysis:

Determination of Significance

4. Conclusion
The shadow-flicker model assumptions applied to this project are very conservative and as such, the analysis is expected to over-predict the impacts. Additionally, many of the modeled shadow flicker hours are expected to be of very low intensity.
The results are therefore prudent projections of the anticipated shadow flicker levels that would be experienced at the nearby residences. Of the 126 modeled receptors (126 receptors being within approximately 1,500 meter of a wind turbine), only four receptor potentially receive shadow flicker for more than 25 hours per year. All other modeled receptors potentially receive little or no shadow flicker.
The overall statistics are outlined below:

Cumulative Shadow flicker Time	Number of Receptors
	Total 126
>0 hours	90
>10 hours	15
>15 hours	9
>20 hours	5
>25 hours	4

Fig. 1. Overall statistics, all modeled receptors.

The number of shadow-flicker hours calculated and reported above in the **table is common and significantly lower than at other wind power projects installed in the state of New York and around the USA.**

(emphasis added)

This conclusion is not substantiated by any authoritative reference other than WEI's own assertion. Shadow flicker is one of the major nuisances with wind farms, often cited with aesthetic and noise concerns.

4.3 Benchmarking Wind Pro

WEI does not indicate its familiarity with WindPro software nor any benchmark field tests it's ever performed to authenticate or bracket its predictions. We are therefore to believe that the software is written correctly, tested for accuracy by the authors and that WEI has setup and operated WindPro correctly. Any seasoned engineer quickly learns that modeling software must be very carefully used and verified to engender confidence and error sensitivity. At a minimum some crude benchmark calculations have to made by conventional means, which will now be done. To calculate blade flicker the propagation distances can easily be checked. The sun is a very distant object and always has nearly the same angular subtense of about 11 mrad (milliradians) to an observer. When looking through turbine blades toward the sun, the size of the visual impact depends on distance between the observer and the turbine. Thus if the observer is very close to the turbine blades the blades will be large in comparison with the sun, as illustrated in Fig. 2 below. As the observer-to-blade distance increases the proportion of the blades covering the sun decreases as shown in Fig.3.

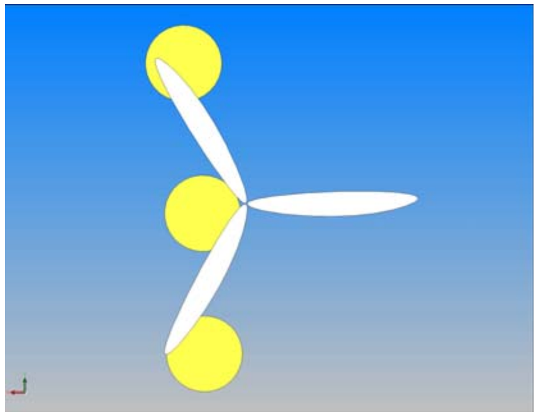


Fig. 2: Observer Close to Blades

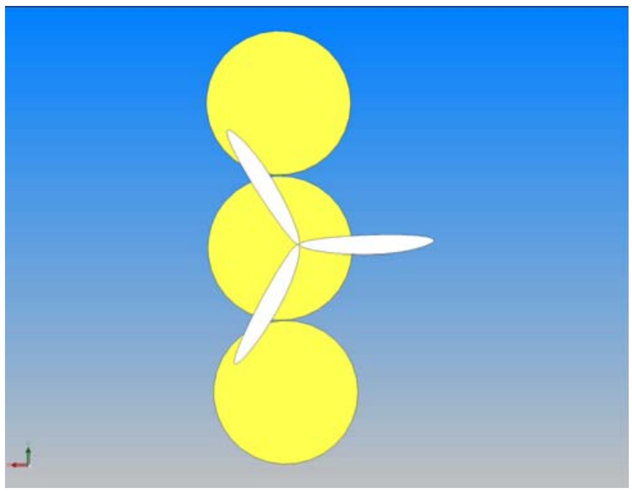


Fig. 3: Observer More Distant from Blades

Using this information some simple distance calculations can be done. For example when the blades just cover the sun they will occupy and angle of 11 mrad. The 3-blade diameter for the 2.5 MW Liberty Clipper turbines is about 300 ft. Using simple geometry the distance the observer would be for the sun to just cover 300 ft. is 300'/11 mrad = 27,000 ft., or 5 miles. This very long distance can only occur when the sun is at a low angle over the horizon.

WindPro acknowledges this great propagation distance in their operating manual but completely dismisses it and does not fully evaluate this effect.

> 4.2.1.1 The SHADOW calculation model
> In the shadow calculation model used by WindPRO the following parameters defines the shadow propagation angle behind the rotor disk
> •The diameter of the sun, D: 1,390,000 km
> •The distance to the sun, d: 150,000,000 km
> •Angle of attack: 0.531 degrees
>
> **Theoretically, this would lead to shadow impacts in up to 4.8 km behind a 45 m diameter rotor disk.** In reality, however, the shadows never reach the theoretical maximum due to the optic conditions of the atmosphere. When the sun gets too low on the horizon and the distance

> becomes too long the shadow dissipates before it reaches the ground (or the receptor). How far away from the WTG the shadow will be visible is not well documented and so far only the German guidelines set up limits for this (see section 4.2.0). The default distance of WindPRO is 2 km. and the default minimum angle is 3 degrees above the horizon.

(emphasis added)

As WindPro states, it calculates a 4.8 km (15,600') observation distance for a 45 m (150') diameter disk, ½ the size of the much larger Liberty units. Contrary to WindPro's flat-terrain assumptions, turbines on elevated ridgelines will cast very long shadows into the adjacent valleys because the sun will rise much higher in the sky. For a 700' high north-south ridgeline (eg Dutch Hill towering over Atlanta) and a 262' high nacelle the 300' diameter rotors will cast over a 2 mile shadow when the sun is at 5 degrees. This calculation is illustrated in Fig. 4 below.

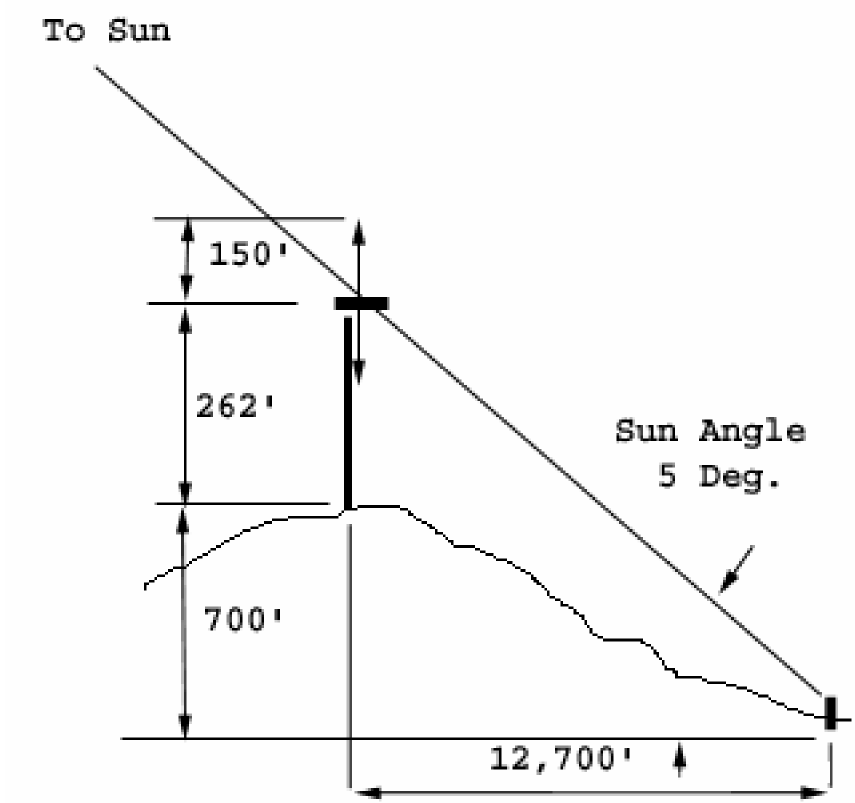


Fig. 4: Shadow Geometry

The flickering turbine shadow will be seen in the valley below the ridgeline shadow. Ridgeline shadows easily cast very long shadows as is well known to anyone living it a situation like this. For example the author frequently experiences the well defined ridgeline shadow of Bare Hill cast on opposing Johnson Hill across Canandaigua Lake, over a mile distant.

As the sun rises (or sets) the shadow distance decreases. A table of values as the sun rises is shown in Fig 5 below.

Sun Angle (Deg. Above Horiz)	Shadow Distance (ft)	(miles)
3 *	21,200	4.0
5	12,700	2.4
10	6,300	1.2
15	4,150	0.8
20	3,000	0.5

* Min. start of noticeable shadows according to references (see WindPro and Ref. 4 etc)

Fig. 5: Table of Shadow Distances

The sun rotates about 15 degrees/hr depending on time of year and latitude. From the table its clear that the shadow impact for this example extends at least 3,000 ft for over an hour a day.

Visual Impact

Receptors – human or animal (dairy cattle) directly under the shadow flicker cast by a bright sun will be highly affected by the rapid dimming and brightening. This has not been experienced by most people, or livestock ever before and will be a completely new phenomenon.

Residents and passersby (highway traffic) not immediately within the shadow will nevertheless readily observe the shadow flicker because of the unavoidable human attraction to motion and the large area covered. A 300' diameter shadow is as large as a football field and will be visible from long distances not in the direct path of the shadow. Human acuity is about 0.3 mrad and a shadow at this limit would be barely visible. But at angles larger than say an outstretched hand (~ 120 mrad) one would expect the shadows on the landscape to be easily distinct. This corresponds by simple geometry to a viewshed distance around the observer of 300'/120 mrad = 2500' or ~1/2 mile. Thus a property owner would be exposed to shadow flicker up to ~1/2 mile in each compass direction from his home as this is well within a rural scenic viewscape, not restricted to property lines.

Often numerous wind turbines are sited linearly if placed on a ridgeline and nearby residents will be exposed to numerous shadow flickers simultaneously. Western New York has its sunniest months in summer when people are most active outdoors and when the shadow impacts will be far greater. With roughly 30 days of sunshine per summer an affected resident can expect 30 hours of shadow flicker by this benchmark analysis. It is patently obvious that the WEI use of WindPro dramatically understates the shadow flicker impact and that the software model or setup is seriously flawed.

5.0 Shadow Flicker Assessment Comparisons

Flicker annoyance standards and requirements are not set by any agency in the United States and are governed in New York by SEQR review requirements. There however is a rule of thumb, derived apparently from a Meridian Energy study based on their experiences with shadow flicker (Ref 3) that says the nearest affected receptors should be no closer than 10 turbine rotor diameters. This reference is sometimes cited by other agencies when evaluating shadow flicker, see Ref. 5 for example and section 5.4 below. The turbine rotors for the Dutch Hill Wind Power Project are now 300' diameter so with this rule of thumb the nearest receptor should be no closer than 3000', far in excess of siting setbacks currently determined by Cohocton Windmill Law #2-2006.

5.1 Michigan, Delphi Inquiry

Some indication of the potential adverse impacts and community resistance comes from a Delphi method study conducted in Michigan (Ref. 6).

A Delphi inquiry is a methodological technique to inform participants in a panel study about issues which they may have had little, or a lot of experience. From the Report:

> Traditionally, a Delphi Inquiry involves a panel of experts. However, our goals included:
> · providing a formal instrument to gather and analyze concerns about wind turbine siting issues from as many stakeholders as possible statewide,
> · analyzing and building consensus among stakeholders, public policy makers, and concerned citizens on how to best address wind turbine siting issues, and
> · supplementing the pending state guidelines and providing local government policy makers with information to help develop zoning ordinances.

The Process follows this outline:

Delphi Process:

- Present basic information
- Open dialog
- Develop survey questions
- Answer survey questions
- Analyze results
- Repeat
- Goal: develop a consensus of INFORMED opinions

The panelists in this portion of the study and expertise are listed below. After the presentation and survey these results are posted:

> Participants' provided a few comments on this issue.
> - Comparison of flicker rates was informative.
> - The video was the best example of the experience of shadow flicker.
> - I don't see flicker as a problem.
> - I wouldn't want to live with the nuisance anymore than I enjoy driving when the low sunlight shining through the trees on the roadside causes a similar flicker on the side windows. It is unpleasant and distracting.
> - Even though you dismiss the potential for seizures, the potential for flicker to invade a person's living space could cause stress and headaches.
>
> Survey Conclusions
> Participants demonstrated significant agreement that Michigan's Wind Turbine Siting Guideline

address the issue of shadow flicker. However, there is no significant agreement on how to address this issue. The closest participants came to agreeing was recommending that permitting agencies require wind developers to provide a map of projected shadows, and to make this map available to the public.

Table 13. Participant Affiliations

Stakeholder Affiliation	Number[1]	Percent
Local zoning board member	2	25%
Planning Commissioner	2	25%
Farm or land owner	6	75%
Not identified	1	12%

[1]Participants were permitted to identify multiple affiliations.

Table 14. Prior Knowledge of Wind Energy

Experience Level	Number	Percent
Professional with more than 5 years experience	0	0%
Professional with less than 5 years experience	0	0%
College degree	0	0%
Extensive Self Education	5	63%
Read a few articles	2	25%
No experience	1	12%

Table 15. Prior Knowledge of Flicker Issues

Experience Level	Number[1]	Percent
Professional with more than 5 years exp.	1	12%
Professional with less than 5 years exp.	0	0%
College degree	0	0%
Extensive Self Education	3	38%
Read a few articles	2	25%
No experience	2	25%

Table 16. First Flicker Survey Results

	Question	Selection	# Resp	%
1	Should Michigan's Wind Turbine Siting Guidelines address the issue of shadow flicker?	Yes	7	88%
		No	1	12%
2	Should turbines be constructed ONLY where they can cast NO shadow on a residence, or should turbine owners be allowed the option of constructing turbines where they might need to be turned off to prevent shadow flicker from negatively affecting a neighboring residence?	No Shadow Only	2	25%
		Option of turning off turbine	4	50%
		No Answer	2	25%
3	What is the maximum amount of time per day that flicker should be allowed to affect a residence?	O min	3	38%
		15 min	1	12%
		No Answer	4	50%
4	What is the maximum number of consecutive days that flicker should be allowed to affect a residence?	1 day	1	12%
		No Answer	7	88%
5	What is the maximum number of days per year that flicker should be allowed to affect a residence?	2 days	1	12%
		No Answer	7	88%
6	Should permitting agencies require a map (or model) of all potential turbine shadows as part of the permitting process?	Yes	5	63%
		No Answer	3	37%

It is evident from the Delphi study that caution and concern should be exercised. Half the participants had little or no flicker knowledge with ¾ being landowners. Though allowable flicker was not determinable, fully 75% believed that flicker was a great enough nuisance to require no flicker exposure, either due to siting requirements or shutting down of the turbine in flicker conditions.

Cohocton's Wind Mill Law #2-2006 controlling the siting of wind turbines is completely silent on this issue due to inadequate SEQR review during enactment of that law.

5.2 Massachusetts

Some guidance comes from Massachusetts and is similar to NYS SEQR requirements, discussed in section 6.

Model Amendment to a Zoning Ordinance or By-law: Allowing Wind Facilities by Special Permit, Massachusetts Division of Energy Resources , Massachusetts Executive Office of Environmental Affairs:

> 6.2 Shadow/Flicker
> Wind facilities shall be **sited in a manner that minimizes shadowing or flicker impacts**. The applicant has the burden of proving that this effect does not have significant adverse impact on neighboring or adjacent uses through either siting or mitigation.

(emphasis added)

5.3 Sweden

A comprehensive Swedish study (Ref. 7) undertook a detailed public reaction to wind farms there, which were generally favorably received by the community.

> Abstract
> The aim of this project has been to **get more knowledge about the impact of noise, shadows and on the view of the landscape from wind turbines.** Further to be able to increase the reliability and relevance of the methods used to calculate and evaluate nuisances from wind turbines in applications for windpower development. We have also tried to find other factors that can play a role for the evaluation of wind turbines, if they will be considered as a nuisance or not. The research has focused on a critical review of the methods and regulations that are used in Sweden and other countries, and case studies to find out how people living neighbors with wind turbines will be affected by noise, rotating shadows, visual intrusion and other factors. This report includes the case studies of wind turbine areas at Gotland.
>
> Shadows.
> Although none of the respondents in Klintehamn according to calculations of shadows on the facade, in the worst case, has more than 30 hours/year and a maximum of 30 minutes/day **24 % are rather or much annoyed by shadows**. On Näsudden 17 % of the respondents had according to calculations more than 30 hours/year (facade, worst case) but only 4 % are rather or much annoyed by shadows. In När nobody was annoyed by shadows.
>
> **One possible explanation that so many in Klintehamn are annoyed by shadows, could be that most of the respondents live east south east of the turbines, and will get shadow flicker in the evenings during the period April to September (90 % of the respondents), that is when the shadows are most intensive and most people are at home.** On Näsudden half of the respondents get shadows in the evening, while the rest get shadows in the morning or in the middle of the day. Respondents that are not annoyed by shadows although they have a large shadow impact, these appear in the morning or during winter. Respondents that are annoyed although the shadow impact is small, the shadows appear in the evening. In När no respondent gets shadows during summer evenings. **The conclusion from this is that it is more important at what time of the day and the year shadows have an impact, than the total calculated time in hours a year of shadow impact**.
>
> On Näsudden there is no connection between calculated duration of shadow impact and annoyance. There is however a moderate-strong connection between the distance to the closest turbine and annoyance from shadows. This could indicate that the geometrical model for shadow impact calculation is not accurate when there are several turbines at large distances from a building, since the shadow impact from distant turbines are included, although the shadows, according to a recent study, have a maximum extension of approximately 1 km (Freund 2002).
>
> Since a new rule about calculation of shadow impact, which states that the calculation should be made for the building lot (garden), instead of window, has been introduced by the Swedish building authority (Boverket), the time for shadow impact in Klintehamn has been calculated for both lot and façade. There is a statistically significant *moderate* connection between shadow *minutes/day on facade* and annoyance.

(emphasis added)

5.4 United Kingdom

From a "Planning for Renewable Energy" guide (Ref. 8):

> 76. Shadow flicker can be mitigated by siting wind turbines at sufficient distance from residences likely to be affected. **Flicker effects have been proven to occur only within ten rotor diameters of a turbine. Therefore if the turbine has 80m diameter blades, the potential shadow flicker effect could be felt up to 800m from a turbine.**

This report supports the setback of turbines at 10x the rotor diameter, or 3000' for Dutch Hill Wind Project turbines.

6.0 NYS SEQR Guidance

The NYS ECL requires comprehensive evaluation and mitigation of environmental damage from projects. Although no specific evaluation criterion are set forth, this is reasonable given the complex and varied nature of New York State. Guidance for handling shadow flicker issues can be obtained from the NYS DEC Visual Policy (Ref. 9)

> When a facility is potentially within the viewshed of a designated aesthetic resource, the Department will require a visual assessment, and in the case where significant impacts are identified, require the applicant to employ reasonable and necessary measures to either **eliminate, mitigate or compensate for adverse aesthetic effects.**

(emphasis added)

This strong requirement as applied to shadow flicker does not give sanction to hours-of-disturbance on affected resident's, as concluded by WEI.

> SEQR obligates the Department to mitigate such impacts to the maximum extent practicable [6NYCRR Part 617.11(d)(5)]. **Local involved agencies must do the same with respect to local resources** and likewise comply with Article 8 of the ECL and 6NYCCR Part 617.

(emphasis added)

Mitigation measures that are to be considered include:

> Mitigation strategies can be categorized into three general groups as outlined below.
> 1) Professional Design and Siting….A **properly sited and designed project is the best way to mitigate potential impacts.**
>
> > d) Low Profile Reducing the height of an object reduces its viewshed area.
> > e) Downsizing. Reducing the number, area or density of objects may reduce impacts.
>
> Nevertheless, it is the burden of the applicant to **provide clear and convincing evidence that the proposed design does not diminish the public enjoyment and appreciation of the qualities of the listed aesthetic resource.** Staff can and should review the strength or merit of such proof. **An applicant's mere assertion that the design is in harmony with or does not diminish the values of the listed resource is insufficient for the purposes of reaching findings.** Instead, an applicant must demonstrate through evidence provided by others e.g. recognized architectural review boards, comparative studies that are clearly analogous, or other similar techniques, that the public's enjoyment and appreciation of the qualities of the aesthetic resource are not compromised.

> Are the estimated costs of all mitigation insignificant (for example, are the costs of visual mitigation taken together with all other mitigation less than10% of the total project cost?)

In the case of a wind farm, a 10% reduction in siting should be evaluated to examine the impact on shadow flicker.

7. 0 Conclusion

It is a well documented fact that shadow flicker is a serious environmental pollutant that can have significant harmful effects on the welfare of persons subjected to it. The WEI study is fatally flawed due to critical modeling errors. The scope of the community impact of the project as proposed is substantially greater than the 200 residences indicated with regard to both the hours of nuisance and the potential number of harmfully affected persons.

When coupled with the noise pollution and visual degradation that many residents will be subjected to, it is clear that wind farm turbine siting setbacks should be increased to a minimum of 3,000 feet from any residence.

SEQR regulations specifically require and demand strong and effective mitigation measures by the applicant in order to protect the public welfare and residents' rights. This fatally flawed study does not comply with SEQR regulations. A new, thorough and competent analysis must be done to correct the critical errors before the project can be approved.

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Richard H. Bolton , CV in Appendix 1

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Appendix 1

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I graduated from the University of Rochester in 1975 with a B.S. in Physics and subsequently took graduate courses in optics there.

From 1975 to my retirement in 1998 I was a Project Engineer at Eastman Kodak and receive 5 US Patents. Always working in new product research, engineering and development I was often involved in "due diligence" engineering analysis for new product proposals throughout the corporation. This involved considerations of manufacturability, reliability, ergonomics, customer acceptance, and design methodology. My work was cross-disciplinary because of my physics background and my exposure within Kodak to many other scientists and engineers. I often worked in engineering disciplines of optical design, mechanical design, systems design, and product software.

From 1976 to 1986 I had the position of Adjunct Faculty, Rochester Institute of Technology, Physics Laboratory.

From 2005 to present I have been a Technician at Hobart and William Smith Colleges' Physics Department, where I am responsible for laboratory setup, physics equipment parts manufacture, and devising new demonstrations.

I am President of Bare Hill Software Company that develops engineering software for Macintosh and Microsoft personal computers. In that capacity I served as consultant engineer to Eastman Kodak, Corning Glass, and Xerox on various equipment projects.

I am President of the Environmental Compliance Alliance founded to promote public and government agency awareness of New York State and Federal environmental regulations, and promoting agency compliance with those regulations.

In my professional experience I have learned to examine and analyze technical reports, especially with regard to methodological, technical and statistical errors. I recently consulted on a wind turbine project slated for Clinton County in upstate NY. My noise analysis is being used in a proceeding there.

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