Report from the
Bethany Wind Turbine Study Committee

25 January 2007

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A) Introduction and Scope

In November 2005, the Town Board of the Town of Bethany enacted a twelve (12) month moratorium on commercial wind energy conversion systems (CWECS) in the Town of Bethany. In November, 2006, the moratorium was extended for six (6) months. This moratorium was enacted and extended to allow the Town to take the time necessary to understand the possible ramifications of the placement of CWECS within the Town.

To facilitate the gathering, compilation and understanding of available information on CWECS, the Town selected a citizens committee comprised of seven (7) residents, representing the diverse interests, occupations and viewpoints within the Town. Within this report are the findings of the committee to date, outlining major issues to be concerned with and recommended mitigation strategies.

How to read this report: This report is divided into sections, each concerned with a major issue: Environment, Legal and Financial. Some topics cross lines and have been discussed in more than one location. A recommendation, in layman's terms, can be found at the end of each discussion. A summary of the committee's final recommendations, written in more formal language, can be found in *§ H – Summary of Recommendations*. Section titles, article titles, names of organizations and companies have been italicized. References take the form of [A:F.1], meaning go to Appendix F.1 for details or further information on the topic. The book of appendices has not been reproduced for each recipient of the report, but is available at the Town Hall.

The scope of this report is the potential impact of CWECS facilities within the Town of Bethany. Members of this committee have studied other towns, limiting research to those with similar configurations to Bethany – rural in nature. The conclusions of this report are applicable for the Town of Bethany, and perhaps for towns with similar configurations [A:D.1], but are not universal truths.

This report is not intended as a memorandum on the suitability of wind energy as an industry. While many members of the committee have researched the usefulness of wind energy in general, that research has not been included here, except where it directly impacts the Town. The suitability of wind energy in general and/or in theory is left for others to evaluate.

The committee has not directly addressed non-commercial turbines, believing those to be adequately handled by the Town in the past. That topic is addressed indirectly, however, by simply extrapolating data downward to the lower end of the spectrum.

The Town should also note the prevailing nature of the discussion in Albany. At some point in the future, New York State officials may choose to draft legislation, including zoning rights and limits, of their own. However, it is the belief of this committee that the Town should enact legislation to protect its residents now; and let Albany take legal liability for any actions they may override in the future.

B) Definitions

As used in this report, the following terms have the meanings given to them.

Associated facilities. "Associated facilities" means facilities, equipment, machinery, and other devices necessary to the operation and maintenance of a Commercial Wind Energy Conversion System, including access roads, collector and feeder lines, maintenance buildings and substations.

Commercial Wind Energy Conversion System. "Commercial Wind Energy Conversion System (CWECS)" means a facility consisting of one or more Wind Energy Conversion Systems with a rated capacity of more than 50 kW; or that is the primary use on the sited parcel. A facility shall be considered commercial if it supplies electrical power primarily for off-site use; or if net revenue is produced by such electrical power.

Construction. "Construction" means to begin or cause to begin as part of a continuous program the placement, assembly, or installation of facilities or equipment or conduct significant physical site preparation work for installation of facilities or equipment. Entering into binding power purchase contracts, obtaining wind easements from property owners, conducting an EIS or gathering wind data is not construction.

Developer. "Developer" means the entity or entities involved in the construction of a CWECS facility.

FAA. FAA means the Federal Aviation Administration.

Facility Owner. "Facility Owner" means the entity or entities having an equity interest in the Wind Energy Conversion System, including their respective successors and assigns.

Hub Height. "Hub Height" means the vertical distance from ground level to the top of the nacelle.

Local Provenance. "Local provenance" means plants which grow "in the wild" within ten miles to where they are going to be planted.

Native Vegetation. "Native vegetation" means plants of local provenance, where there is little to no possibility that the plants were planted or introduced and originated from somewhere else.

Non-commercial Wind Energy Conversion System. "Non-commercial Wind Energy Conversion System (NWECS)" means a facility to convert wind movement into electricity, with a rated capacity of not more than 50 kW; and that is incidental and subordinate to another use on the same parcel. A facility shall be considered non-commercial only if it supplies electrical power solely for on-site use, except that when a parcel on which a non-commercial WECS is installed also receives electrical power supplied by a utility company, excess electrical power generated by the WECS and not presently needed for on-site use may be used by the utility company in exchange for a reduction in the cost of electrical power supplied by that company to the parcel for on-site use, as long as no net revenue is produced by such electrical power.

Occupied Building. "Occupied Building" means a residence, school, business, hospital, church, public library or other building used for public gathering that is occupied or in use when the permit application is submitted.

Operator. "Operator" means the entity responsible for the day-to-day operation and maintenance of the Wind Energy Conversion System.

Person. "Person" means an individual, partnership, joint venture, private or public corporation, association, firm, public service company, cooperative, political subdivision, municipal corporation, government agency, public utility district, or any other entity, public or private, however organized.

Right-of-Way. "Right-of-Way" aka "right of way" means 1) the right to pass over property owned by another, usually based upon an easement; 2) A path or thoroughfare over which passage is made; 3) A strip of land over which facilities such as highways, railroads or power lines are built.

Rotor Diameter. "Rotor diameter" means the distance measured across a circle representing the full sweep of the turbine blades.

Shadow Flicker. "Shadow flicker" results from the position of the sun in relation to the blades of the wind turbine as they rotate. This occurs under certain combinations of geographical position and time of day. The seasonal duration of this effect can be calculated from the geometry of the machine and the latitude of the potential site.

Tip Height. "Tip Height" means the vertical distance from ground level to the tip of a wind turbine blade when the tip is at its highest point. This is approximately equivalent to the hub height plus one-half of the rotor diameter.

Viewshed. "Viewshed" means an area composed of land, water, and cultural elements which may be viewed and mapped from one or more viewpoints and which has inherent scenic qualities and/or aesthetic values as determined by those who view it.

Wind Energy Conversion System. "Wind Energy Conversion System (WECS)" means a facility consisting of a tower, wind turbine generator with blades, guy wires or other support structures and anchors, access roads, and associated control and conversion equipment to convert wind movement into electricity.

Wind Turbine. "Wind Turbine" means a single facility consisting of a tower, wind turbine generator with blades, guy wires or other support structures and anchors. Wind Energy Conversion Systems (WECS) may consist of one or more Wind Turbines.

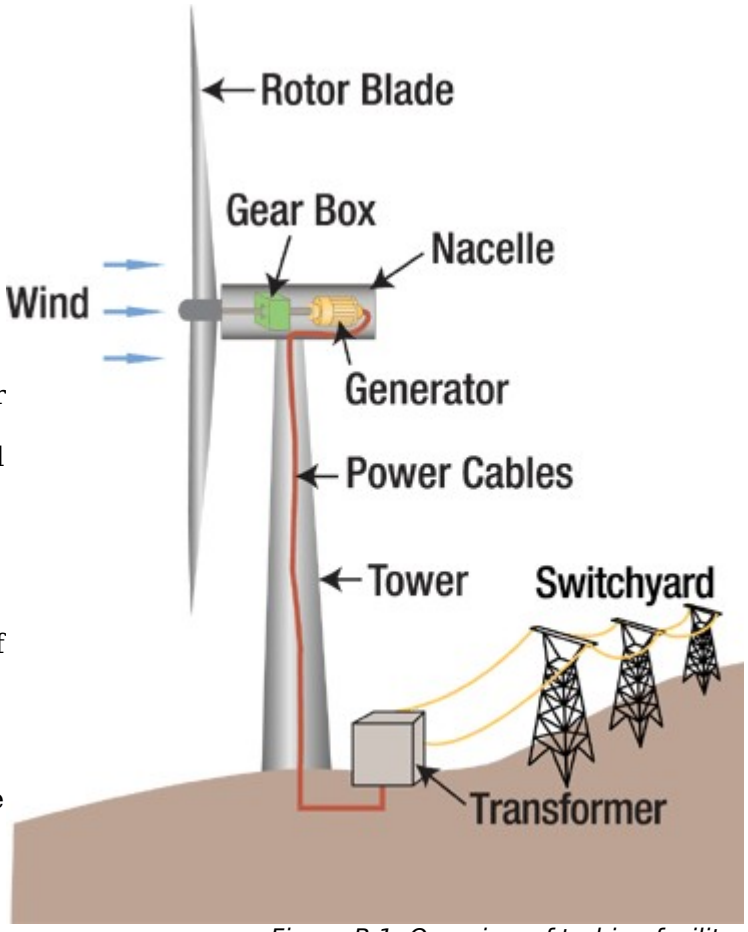

Figure B.1: Overview of turbine facility.

C) Work to Date

Beginning on February 6, 2006, the committee has met at least monthly for a total of 22 meetings. Altogether, committee members have reviewed approximately 2,800 documents plus countless web pages, local, state, federal and international reports and newspaper clippings. Committee members have served as a sounding board for each other, examining all evidence critically.

On May 3, 2006, committee members arranged a teleconference with Scott Rowland, Vice President of Construction and Engineering with *UPC Wind Partners*, to discuss critical technical and geologic issues.

On June 17, 2006, committee members arranged and participated in an unannounced trip to the Maple Ridge Wind Farm and the Town of Lowville. During this visit, committee members interviewed residents as well as tourists, visited several turbines and associated facilities, and arranged an impromptu tour from an on-site *Vestas* staff member.

Figure C.1: Chris, a Vestas employee, explains how remote monitoring works while inside the turbine.

The committee has also interviewed other Town officials already in the CWECS approval process. Several committee members also attended the spring *Local Government Workshop* which included a presentation from a NYS Agriculture & Markets expert on the lasting impact of wind turbine construction on farmland. One member also attended a zoning presentation at that same conference and was able to ask several questions regarding possible and non-possible zoning for CWECS.

Individually, members have also attended wind turbine informational meetings – both pro and con – in Alexander, Batavia, Oakfield, Maple Ridge, Perry, Stafford, and Sheldon. Findings from these meetings have been delivered to the committee verbally.

At this time the committee would like to note that *UPC Wind Partners*, the only company to have approached the Town of Bethany for CWECS development, has not been as forthcoming as the committee would prefer. In particular, *Noble Environmental Power* and *Horizon Wind Energy* have both provided significantly more information regarding proposed projects to the Towns of Bliss and Stafford/Sheldon, respectively. The committee has had to operate from a theoretical perspective, which has the advantage of application to any wind developer who might approach the Town, yet has made the committee's work tedious and frustrating.

The committee asks the reader to keep in mind that we do not, at this time, know what type of equipment is proposed for Bethany – in terms of size, configuration, capacity and even location. To provide concrete examples, the committee has frequently referenced the proposed *UPC Wind Partners* project – to whit, between 30 and 40

wind turbines of model GE 3.5mW (approximately 330ft hub height and 450ft tip height), placed primarily north-south along East Bethany Center Road and East Road, with offshoots north along Bethany-Stafford Townline Road and Brown Road. In general discussions, the committee has attempted to address the impacts of various types of equipment, making the report somewhat longer but more complete.

The committee has identified a list of significant issues, identified later in this document. Over the last four months, committee members have been writing, individually, reports on each of these issues. These reports have been integrated into this final report.

D) Summary Findings

The committee finds that CWECS facilities have both positive and negative impacts on any Town. Our recommendation is to work to accentuate the positive impacts while eliminating significant negative impacts in consideration of any CWECS project. Particularly, the Town should act immediately to protect the health, safety and quality of life for its residents from negative impacts of any CWECS project.

> Based on the information gathered, the committee recommends that the Town of Bethany immediately work to enact zoning legislation designed to protect the health, safety and quality of life for Town of Bethany residents prior to considering any CWECS project(s).
>
> This legislation shall not draw a conclusion on the presence of CWECS within the Town of Bethany, but rather guide any such presence along safe, secure lines.

To accomplish this goal, the committee has completed this comprehensive report providing, in the committee's opinion, undisputed facts and reasonable estimates around which successful zoning legislation can be drawn.

Questions regarding the report or any section thereof can be directed to Francis Ashley, the committee chair, for referral to the appropriate committee member. In addition, the committee offers its continued assistance for the duration of the extended moratorium to assist the Planning Board and/or Town Board in creating such zoning legislation.

E) Environmental / Health & Safety

1. Aesthetic / Quality of Life Impact

Visual

One of the controversies over wind turbines is the massive size and placement of these structures, where such an industrial view/operation may change residents' lifestyles. These are industrial machines and will have significant impact wherever they are sited for decades. Few people would object to siting them on the shores of Patagonia where the wind is fearsome; whereas in a bedroom community such as Bethany the situation is different.

Commercial turbines such as the 450ft GE models proposed cannot always be placed so that they are not visible from doors and windows of nearby residences. Curiosity-seekers currently stop at local residences, asking repeatedly about them. This would be part of the lifestyle change Bethany residents would be expected to make.

The placement of these turbines in Bethany is proposed to be as close as 1,000ft from property lines and other occupied buildings. Our committee saw, first-hand, a place of business literally surrounded by turbines on three sides, with the closest 1,100ft away. When you look over the rolling hills of Bethany you may see a farm silo or two, which in most cases are less than 100ft tall and are part of the agricultural district we live in – part of the expected view. Up to forty commercial turbines would definitely take away from the aesthetics of the countryside. Many members of our committee were struck by an 'alien' or 'industrial' feeling when viewing the Maple Ridge project. turbines dominated the landscape and our committee members felt out of place.

It may be the case that residents get used to the view, however, many Bethany residents moved here to get away from the city hustle and bustle; from towering structures and constant movement. Indeed, Bethany's peace and quality of life may be its strongest and sole attraction to new residents.

Turbines in other countries have been painted alternating red and white stripes for air safety, which makes them stand out. Turbines sponsored by certain groups in the US have been painted with the group's logo or identifying marks, which stand out against the non-reflective surface of the turbine tower. After trips to Wethersfield and Tug Hill, it became apparent that turbines, even when painted so as to be unobtrusive, will never blend entirely into our rural country setting, due to their space-age look and constant motion.

Service Disruption & Nuisances

In addition, turbines and associated facilities placed in line with occupied buildings result in low frequency noise, flicker effect, loss of TV, cell phone, and local networking reception. See *§ E.14 – Noise including Infrasonic*, *§ E.17 – Shadow & Flicker Effects*, *§ E.5 – Electronic and Electromagnetic Interference* for details on each of these effects.

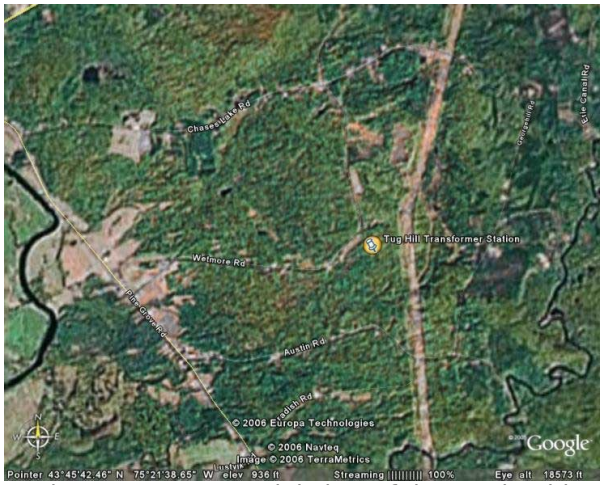

Figure E.1.1: An aerial view of the Maple Ridge Project location. Orange dot is the Maple Ridge power substation.

Figure E.1.2: an aerial view of the Town of Bethany; scale matches the Maple Ridge photo at left.

Careful placement of the turbines can mitigate these problems, however, in a town as densely populated as Bethany, there is some question as to whether such careful placement would result in a viable project. Turbines require a fair distance from occupied buildings, and Bethany may be too densely populated to fully mitigate visual and noise disturbances (there seems to be sufficient room to mitigate shadow flicker; electromagnetic disruption is an unknown). See figures E.1.1, an aerial view of the Maple Ridge Project locale on Tug Hill and E.1.2, an aerial view of Bethany at the same scale.

In the opinion of this committee, noise and destruction of the viewshed are quality of life issues that Bethany residents will simply have to live with, should a CWECS project be approved.

This committee recommends that the Town consider the viewsheds of adjoining and surrounding neighbors when considering any proposed turbine location. A non-confrontational method for determining each neighbor's opinion regarding the turbine should be developed, perhaps with a questionnaire.

Clean Air

One of the strongest arguments for wind power is that it is "green" energy, displacing CO2 emissions and other pollution from existing coal-fired plants. This could impact the quality of life not only for Bethany residents, but globally.

Elsam, the Jutland power generator, stated in May 2004 at a meeting of the *Danish Wind Energy Association* with the Danish government that increasing wind power does not decrease CO2 emissions. Ireland has drawn similar conclusions based on its experience that the rate of change of wind speed can drop faster than the rate at which fossil-fueled capacity can be started up. Hence spinning reserve is essential, although it leads to a minimal CO2 saving on the system. *Innogy* made the same observation about the operation of the UK system (note the *Innogy* report, by engineer D. Tolley in 2003, is no longer available online but is referenced over 1,000 times in both pro- and anti-wind literature of the period).

The result is that, while wind-generated power itself is CO2-free, the saving to the whole power system is not proportional to the amount of fossil-fueled power that it displaces. The operation of fossil-fired capacity as spinning reserve emits more CO2/kWh than if the use of that plant were optimized, thus offsetting much of the benefit of wind.

Recommendations: Wind turbines shall not be used for displaying any advertising except for reasonable identification of the manufacturer; colors and surface treatments shall be non-reflective in nature and minimize visual disruption; turbines shall not significantly impair a scenic vista or scenic corridor as identified by the Town or other published source; all cable shall be buried underground unless poles are in place to accommodate them at the time of the CWECS permit application. The Town shall carefully review proposed CWECS projects from the standpoint of destruction of the viewshed and quality-of-life for nearby residents.

2. Backup Power Issues

It is the determination of this committee that the efficiency and reliability of wind-generated power, while a valid concern for Albany and New York taxpayers, is not an issue directly related to the Town at this time. See also *§ E.1 – Aesthetics: Clean Air*.

3. Construction Disruption

CWECS facilities, particularly the turbines themselves, are extremely large construction processes, resulting in infrastructure impacts to the Town as well as to the individual landowners. Considerations include:

Roadways: Disruption to existing traffic patterns; wear and tear on roadways; temporary and permanent access roads.

Utilities: relocation and/or addition of power lines, communications lines and poles; possible relocation or addition of cell and/or TV transmission towers.

General: generation of dust; quarry operations; drainage issues; water well impact; construction noise.

Installation will require transporting heavy equipment and significant quantities of stone, gravel and concrete by trucks in rapid succession for each turbine base. Wind turbine components are also delivered to the installation site by truck. Trucks carrying turbine components and blades may require regular interruptions of traffic patterns, wide turning lanes and specific routes based on bridge weight capacities and

overhead obstructions. In Bethany, the intersections of Fargo Rd and Route 63 as well as East Rd with Route 20 are particularly dangerous and may be inadvisable as potential routes unless detours or restricted hours of operation were put into place.

Damage to existing roadways is a factor addressed under *§ E.15 – Road Upkeep & Repair.*

Existing power lines, communication lines and poles may have to be reconstructed to accommodate transportation and placement of equipment. This is in addition to the new transmission lines the CWECS developer is expected to construct for use with the project.

Portions of the construction involving heavy equipment will not be quiet. Sample CWECS leaseholder agreements allow for heavy equipment access 24 hours per day. Limitations on the use of such equipment to the hours of 7:00am to 6:00pm with no Sunday or holiday operations (except in the case of emergency or repair) will help reduce the negative impact of construction on nearby residents.

Creation of permanent new access roads may introduce new hazards to existing traffic patterns. In our Maple Ridge interviews, we learned of a Danish engineer who was run over by a local resident when he walked from the access road out onto a main road. While this accident occurred at approximately 3:00am and may not have been avoidable, heavy brush partially obscured the view of the access road from the main road. Consideration should be given to the safety of all new access roads with respect to existing traffic patterns.

Please see also *§ E.15 – Road Upkeep & Repair* and *§ G.1 – Agricultural Impact*.

Recommendation: The developer shall be required to submit regular scheduling reports to the Town, indicating work completed to date, in progress and scheduled; this report shall include locations, construction routes and impacted property lots. The developer and/or an independent oversight agency should be required to actively monitor and address dust levels via standard construction techniques. Any impact reports submitted with application should address proposed routes, overhead obstructions and any necessary electrical or communications lines changes that would be made. The Town shall specify a limit on hours of heavy operation to a reasonable time frame. The Town shall consider the safe placement of new access roads.

4. Earthquake / Seismic Effects

Figure E.4.2, the map of New York Faults, shows that the area extent of the wind turbine project proposed by *UPC Wind Partners* is directly on the main traces of the Clarendon-Lindon fault in western New York.

Historical seismic data shows that major structural damage was recorded in the 1920s and 1930s, including the area proposed for the wind turbine project. Significant structural damage was observed in buildings and masonry in an area bounded by Attica to the hamlet of Little Canada, a damage trajectory which cuts directly through the proposed wind turbine project area.

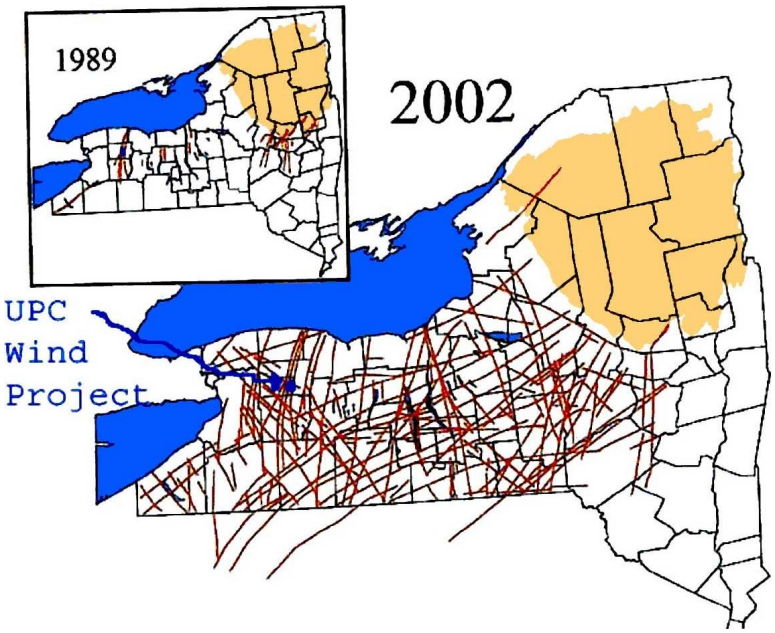

Figure E.4.2: Map of New York Faults. The proposed UPC Bethany project location is shown by the blue dot on the map. Courtesy SUNY at Buffalo Geology Department, Earthquake Data USGS

Mr. Swartley organized a teleconference at which town officials and committee members were able to ask technical questions from a *UPC Wind Partners* engineer, Scott Rowland, Vice President of Construction and Engineering. At that conference it became obvious that the issue raised above pertaining to possible seismic activity in the area proposed for turbine installation had not been addressed by *UPC Wind Partners*. Mr. Briggs specifically attempted to get some quantitative assessment of the probability of turbine failure in the event of a local earthquake, to no avail.

While a complete seismic assessment would be difficult to obtain due to rare harmonic frequency accidents such as the Tacoma Narrows Bridge incident of 1940, it seems clear that *UPC Wind Partners* is unprepared for the possibility of seismic complications in this area.

Recommendation: the Town shall require that the CWECS developer and at least one independent engineering firm produce a complete report on the likely effect of seismic activity consistent with historical data on each proposed wind turbine and all associated facilities. The Town shall notify any CWECS developers expressing interest of the seismic history of the town.

5. Electronic & Electromagnetic Interference

Upon notice from the Quebec Ministry of the Environment of a proposed 70 turbine CWECS facility in Murdochville, Quebec, the Canadian Broadcasting Company (CBC) conducted pre- and post-wind turbine television interference studies including satellite pickup [A:E.9]. The wind turbine configuration in this situation included 90 meter towers with non-metallic blades 40 meters long.

The CBC has two television stations in Murdochville: Channel 10 and Channel 21, with both transmitters located on the outskirts of the town. The CBC performed signal quality measurements before and after the installation of the CWECS facility at 14 locations around the affected area. Qualitative and quantitative measurements included signal levels, waveform measurements, tape recordings and subjective signal quality evaluations. The problems found were:

Static interference or "ghosting" which occurs when the signals are reflected off the turbine towers. Following turbine construction, an increase in the numbers and severity of ghosting was seen at 11 of the 14 Channel 10 locations and 3 of the 14 Channel 21 locations. The difference in the results between the two channels is attributed to their different antenna patterns.

Dynamic interference caused by the production of a secondary or interference signal reflected from the rotating turbine blades, seen as a periodic variation in picture brightness or color. Dynamic interference was found at all 14 Channel 10 locations and at 4 out of 10 evaluated locations for Channel 21.

Based on previous studies with NTSC, signals theory suggests that interference may occur with HDTV. It is expected that HDTV would be less likely to suffer the static (tower-related) effects but more likely to suffer dynamic (blade spinning) interference which would take the form of frozen frames and pixelation. Research papers suggest that other wireless and/or broadcast consumer services would suffer similarly, including cellular and wireless networking services [A:E.2].

Preventative measures can reduce or even eliminate these issues, but they must be taken during CWECS project planning stages. Wind energy companies need to factor in the location of all local radio communications towers, over-the-air RF links and areas of served populations. Mitigation measures, when signal degradation results from wind turbines, include: 1) replacing off-air reception with cable or satellite, 2) relocating television transmitters and 3) relocating or eliminating wind turbines.

Recommendation: the Town shall require the CWECS operator and at least one independent engineering firm to conduct pre- and post-construction signal evaluations for television, cell phone and wireless network interference. The Town shall require the CWECS operator to restore signals to pre-construction levels at its own expense.

6. Fire Risk & Fire Department Needs

While wind turbine fires are relatively rare, they do occur. Normal causes are lightning, overheating and/or lubrication failure, oil leaks and structural failure.

In Powys, Wales in 1997 a 4 year old turbine overheated and caught fire inside the nacelle. Witnesses reported "balls of fire" coming from the turbine as burning parts flew out of the nacelle. The turbine's rotors were impossible to stop as the brake controls were aflame. Rotating, burning debris was thrown 150m (495ft), setting the hillside and a public right-of-way on fire. With hub heights calculated proportionately, Bethany could potentially be facing 620ft of fire debris.

Figure E.6.1: Turbine fire in east Germany. Fire brigade has cordoned off the area to allow the fire to burn out.

Due to the height and danger of falling debris, the fire brigade could only cordon off the area and wait for the fire to burn out.

Note that fires in associated facilities can be treated as normal electrical fires; these repercussions only occur with turbine fires.

This committee has been able to locate evidence of California fire departments actively fighting turbine fires – using helicopters designed to fight forest fires. Such equipment is not currently available in Bethany and may be cost-prohibitive to acquire.

Finally, in consideration of possible accidents at wind turbine locations, and the fact that these may or may not be near to any dwellings, concerns arise with the reporting of fires or other emergencies. The 911 emergency system in the US is keyed to postal addresses – as an example, help was delayed to the Atlanta, GA Olympic bombing site because the 911 operator could not find a physical address for the park in which the bombing took place. Each turbine, therefore, should be given a postal address compatible with the 911 emergency system and clearly labeled with that address against such necessity.

Recommendation: the Town either require any CWECS developer to provide the necessary fire-fighting equipment and fire department training at its own expense and/or require setbacks of at least 150% of the turbine tip height from any road, right-of-way, designated historic area, and wildlife preserve. The Town shall require that each turbine be clearly labeled with a postal address compatible with the 911 emergency system. See also *§ E.9-- High Wind Failure & Other Breakdowns*.

7. Ground Water Impact

Surface features in the town are a complex mix of fluvioglacial and ice contact features which yield a great variety of soil types and drainage patterns. From what has been disclosed to the Town, *UPC Wind Partners* -- the proposed CWECS developer, has made only a superficial review of existing geological information on the town. Major field investigation of the proposed project area is essential if hydrologic impacts are to be addressed.

Figure E.7.1, the proposed wind turbine project map, shows that close to one-quarter of the town of Bethany would be under the control of CWECS leases.

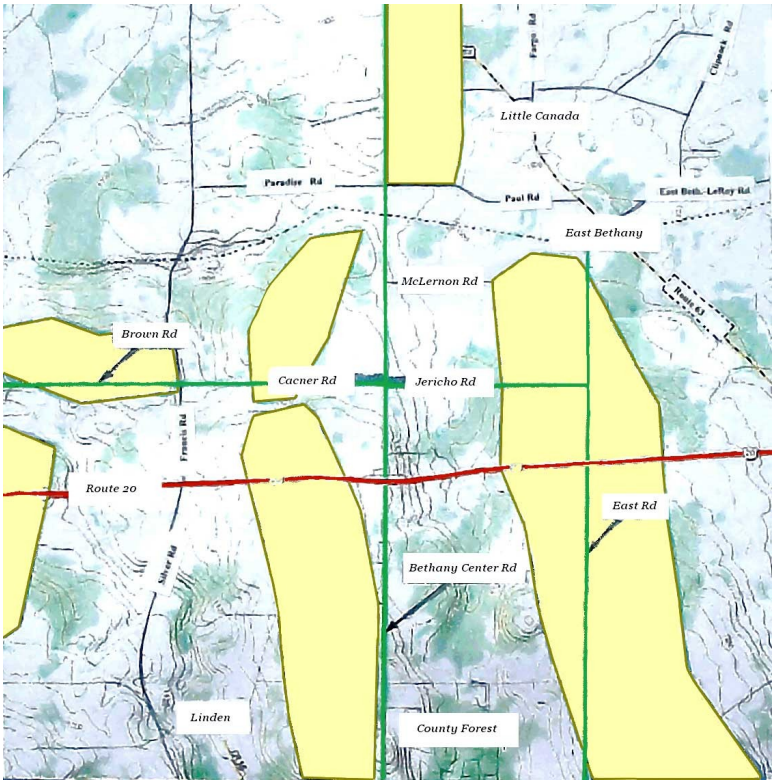

Figure E.7.1: Proposed wind project area map provided by UPC Wind Partners. Yellow areas are potential turbine placements.

Of significance is the fact that these leased areas are in or surround the Black Creek drainage system. To date, the CWECS developer has provided no field-based studies on the effects of excavation for turbine bases, roads, staging areas, buried or surface cables and/or subsequent removal of vegetation.

Regardless of wind turbine density or distribution, there is a major potential for disruption of both surface and groundwater flow due to the proximity of project excavation to Black Creek. Aquifer recharge, perched water tables and wildlife could be severely affected, especially if a north-south configuration is utilized. Such a configuration would effect a continuous, parallel disruption of flow to and from recharge areas.

Recommendation: the Town shall require an independent assessment, by one or more qualified Engineering firms, of possible hydrologic impacts and that the CWECS project commence in a manner consistent with minimal anticipated impact. The Town shall require compensation and/or infrastructure improvements to offset any actual hydrologic impacts. This may include the construction of water systems to replace destroyed aquifers.

8. Hazards to Aviation

This topic is still under investigation. Information solicited from the FAA and the Department of Defense has, so far, not been made available.

There are three main concerns: 1) possible collision hazards of approaching (landing) aircraft, especially in bad weather; 2) possible interference with military aircraft operations; and 3) possible interference with low-altitude air operations in Bethany such as crop dusting and recreational paragliding.

As for the first concern, we note that there are no major airports in Bethany, although there is at least one uncontrolled airstrip. Considering the impact to that airstrip, the FAA defines an obstruction to navigation as being 200' or taller above ground level and within three miles of a runway longer than 3,200ft. The Bethany Airport is less than 3,200ft long; the committee has been unable to determine the exact length.

As for the second, inhabitants of our town are aware of large military aircraft from the Niagara Falls Air Reserve Station occasionally passing low overhead (less than 1,000ft AGL).

The Town should consider the impact of any CWECS facility on low-level aviation such as crop dusting and paragliding. Adjoining agricultural parcel owners may be compensated for the inability to dust their fields. Bethany is also a known route for at least one paragliding business, which does not (to the best of our knowledge) operate from the Town directly. Future paragliding, ballooning and glider activities may be curtailed due to the CWECS facility. This is an issue that must be evaluated, however, at the time of application.

Wing tip vortices may also impair aviation by creating vast horizontal fields of air turbulence. This could result in potentially damaging effects, particularly on smaller and/or lighter aircraft including balloons and gliders.

Additionally, commercial wind turbines are recognized as a source of interference to VOR (VHF Omnidirectional Ranging) Systems used for aircraft navigation. Existing FAA rules prohibit a structure the size of a typical utility-scale wind turbine from being erected within 1km of a VOR station.

Note: there is the rare but still possible chance that a piece of ice, or turbine blade, could become detached while the turbine is spinning, and impact a low-flying aircraft. The maximum height such could possibly achieve, which could be significantly higher than the tip height, can be calculated.

Let **R** = turbine rotor radius, **H** = hub height, and now let **h^** = vertical height above hub height an object could be thrown in a vacuum, **f** = rotation frequency of turbine (Hz), **G** = acceleration due to the force of gravity at the Earth's surface, and finally **H^** = total height above the ground (grade) that an object detached from a turbine could reach in a vacuum: one finds that **H^** is closely given by

$$H^ = H + h^ = H + [2/G] [\pi R f]^2$$

where the asterisk denotes exponentiation. With a hub height of 330ft and 120ft blades turning at 1/3 Hz, we get 400 meters (about 1,312ft).

We know that in the real world, where aerodynamic drag must be considered, no object could reach this. A good sized chunk of steel, however, say a 1 kilogram bolt, could be thrown up an appreciable fraction of h^, perhaps more than 50%. Relevance to aircraft: the current germane FAR (2006 Federal Aviation Regulations, Part 91.119, Minimum safe altitudes, General, page 167) states:

> *Except when necessary for takeoff and landing, no person may operate an aircraft below the following altitudes:*
>
> *(a) Anywhere. An altitude allowing, if a power unit fails, an emergency landing without undue hazard to persons or property on the surface.*
>
> *(b) Over congested areas. Over any congested area of a city, town, or settlement, or over any open air assembly of persons, an altitude of 1,000 feet above the highest obstacle within a horizontal radius of 2,000 feet of the aircraft.*
>
> *(c) Over other than congested areas. An altitude of 500' above the surface, except over open water or sparsely populated areas. In those cases, the aircraft may not be operated closer than 500 feet to any person, vessel, or structure.*
>
> *(d) Helicopters. Helicopters may be operated at less than the minimums prescribed in paragraph (b) or (c) of this section if the operation is conducted without undue hazard to persons or property on the surface. In addition, each person operating a helicopter shall comply with any routes or altitudes specifically prescribed for helicopters by the Administrator.*

Conclusions

Fixed wing pilots *who are complying with the FARs* and *are flying over "congested areas, etc."* could not possibly be hit by anything thrown by one of the turbines proposed for Bethany.

Fixed wing pilots flying over "congested" areas *not complying with FARs*, fixed wing pilots not flying over "congested" areas, and helicopter pilots in general, could be hit by a dense object, with potentially fatal consequences. If such an admittedly rare event should occur, lawyers would focus on the meaning or/and definition of *"congested areas, etc."* and also *"operations conducted without undue hazard...",* and other factors.

Recommendation: the Town shall require that any CWECS project receive clearance from the Niagara Falls Air Reserve Station. The Town shall require the developer to notify local airstrip operators, recreational aviation businesses and MercyFlight of proposed turbine locations and flight risk areas prior to construction. The Town shall evaluate the potential for disruption of and the danger to crop dusting and recreational flight businesses prior to approval of any CWECS project.

9. High Wind Failure & Other Breakdowns

CWECS facilities are among the safest energy generation methods available. Accidents are rare and usually do not result in death or severe injury, only property damage. That said, accidents do occur; here are the most common types.

High Wind Failure

High Wind Failure occurs when the braking system fails. The braking system in a turbine is designed to stop the rotors in the event the wind is too strong. When the brakes fail, the turbine spins out of control. This is the most dangerous failure by far.

In Germany in multiple years including 1999, 2000 and 2003, the brakes on wind turbines failed in high wind, causing the rotor to hit the tower at high speed. This resulted in anything from parts of the blade to the entire nacelle (rotors attached) flying off the tower structure. Blades and other substantial parts have landed as far as 1,650ft away in typical cases.

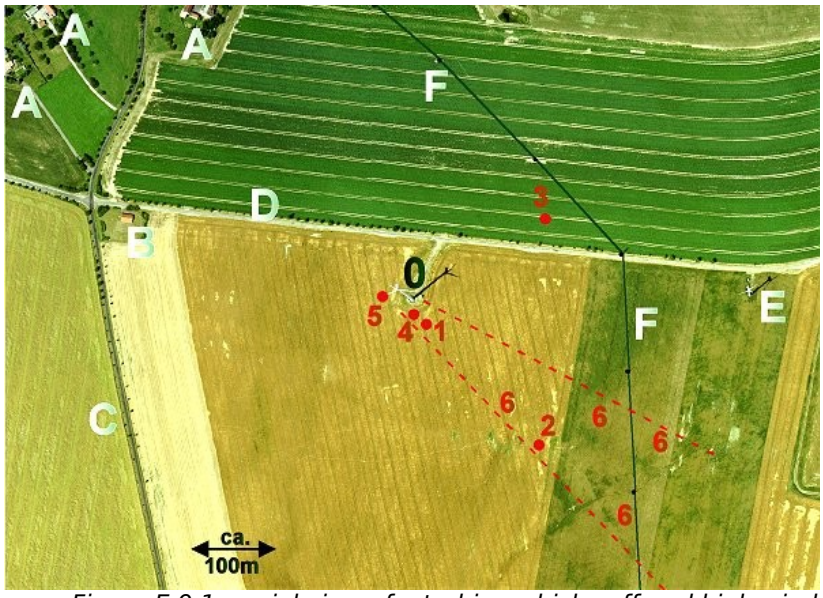

Figure E.9.1: aerial view of a turbine which suffered high wind failure. Significantly-sized debris is plotted in numerals.

Note that some researchers have calculated theoretical distances for high wind throw based on ice throw. These calculations do not match recorded damage assessments from actual incidents as they fail to recognize the aerodynamic nature of the blade segment and the force of the wind necessarily present in a high wind failure. In layman's terms, a blade segment doesn't fall like a rock; it falls like a loose kite. See diagram E.9.1: a plot of turbine debris following high wind failure.

Beginning in 2001, there are numerous counts of residents being evacuated and motorways closed anywhere from several hours to overnight under these same conditions. These turbines were model V80s, which have an 80m (264ft) hub height compared with *UPC Wind Partner's* proposed 330ft hub height. The GE model 3.5mW turbines proposed in Bethany have the potential to throw debris farther.

Structural Failure

Structural failure can be anything from a failure in the concrete base to a failure of the blades themselves. A bolt shears; a load-bearing brace buckles; these are physical, structural accidents. Damage is typically limited to the turbine and anything within its falling distance.

In France, in 2000, a turbine mast broke and toppled over during a storm with no further information available from the wind company. This was the first in a series of such incidents that led to a formal investigation. In Germany, 2000, four turbines experienced sudden and total collapse due to "concrete damage" at the base. Forty-four similar turbines were shut down pending investigation.

Figure E.9.2: Structural failure in western Germany.

In Germany, 2002, a blade broke in mid-turn with an audible "crack." Pieces were found scattered throughout surrounding fields. The cause was later found to be metal fatigue. The most common reasons for structural failure are improper installation and manufacturing defects.

Oil Spills

The hydraulic system inside the nacelle includes many gallons of oil in a sealed system. Sealed systems sometimes leak.

In Germany, 2003, a turbine destroyed by a storm was found to have been leaking oil into the ground. Three other turbines were found to leak that same year. As these were situated in an area protected for municipal drinking water supply, the municipality sued the turbine company. No information is available on the result.

Mitigation of the potential for loss of life and property is primarily available through regular maintenance and setbacks. In considering the type and distance for physical setbacks, it is useful to remember that should damage be caused by turbine operation, non-operation or falling down, a plaintiff could include the town in a potential lawsuit based on inadequacy of setbacks. See also *§ E.13 - Monitoring* and *§ F.7 - Setbacks*.

Recommendation: The Town shall institute setbacks between turbines, between turbines and overhead utility lines, roadways, public and utility right-of-ways (165% of hub height plus rotor diameter), and occupied buildings (450% of tip height) consistent with safety goals. The town shall require a minimum distance between ground level and any part of the rotor blade. The Town shall require the facility Operator to submit regular maintenance reports. See also *§ F.7 – Setbacks* and *§ G.10 – Success in Other Countries – Trends*.

10. Ice Throw

Ice throw results in falling lumps of ice – usually described as about the size of tennis balls. It is commonly trotted out as a reason to deny turbines within a community with many anti-turbine groups touting distances of 1,800ft or more.

Assuming for the sake of argument that ice is thrown at maximum rotation with no deceleration due to aerodynamic drag, the maximum distance is 2,438ft. This number is based on a hub height of 330ft, radius of 120ft and motion of 20rpm – maximums for the GE 3.5mW turbine proposed. This theory makes major assumptions that don't pan out in the real world. Aerodynamic drag would be increased by ice clinging to the blades, friction would reduce the size of the ice throw, altering its curve and modern turbines typically include safeguards to limit rotation under icy conditions.

Figure E.10.1: Ice throw captured on film in Denmark.

While the committee acknowledges that such distances are theoretically possible, we reject the theoretical in preference to a study which measured actual throw distances.

Damage has occurred as far away as 80m (264ft), including smashed windshields and windows; dented cars and roofs; and accidents on roadways. Typically, accidents are not caused by the ice hitting the car, but by the car hitting ice chunks which partially melted on the road. Ice throw has also been recorded as severing overhead utility lines, particularly television cables. This damage could conceivably occur with electrical, telephone or other overhead cables.

Building or structure damage from ice throw, on the other hand, is almost nonexistent. Ice throw, due to typically larger distance, the angle of the fall, and the density of the ice as it is thrown, does not seem to have the impact necessary to damage building materials including house windows; although the rare broken home window has occurred. Ice throw does not, therefore, seem to be of major risk to structures.

German scientists Henry Seifert, Annette Westerhellweg and Jurgen Kroning have put together a simplified equation for calculating the area of most likely risk in their study *Risk Analysis of Ice Throw from Wind Turbines* [A:E.12]. They plotted the throw distance of ice pieces observed to radius, and also included the weight of the ice pieces. Their calculation for ice risk area is d = (D + H) * 1.5, meaning add the diameter of the rotors to the hub height, then multiply that number by one and a half. With *UPC's* proposed 3.5mW turbines, that means (240' + 330') * 1.5 or 855ft. Because the German scientists designate this as a rough calculation and recommend further local studies to determine the exact conditions in a given area, some communities are adding a 10% margin of error (which would make our calculation 941ft.). This allows for local topographical features.

The only known method to protect roadways, right of ways, and utility easements is a setback; and should be based on ice throws which may interfere with traffic or the activities of persons not related to the project, or damage property. This setback is normally not applied to the access roads or transmission lines built by the wind com-

pany for the purpose of the CWECS project itself.

In reading various town and county ordinances available online, it is not clear whether the setback is applied to established public trails or snowmobiling paths (most likely this information is found in the communities' base zoning definitions, which are not included in the turbine document). In only one Minnesota document was this committee able to find a direct reference that snowmobile and walking trails were specifically included (that was a proposal from a wind turbine company, not a zoning paper). Given that New York snowmobiling paths are created, mapped and maintained with public money, the town should consider including them in any right-of-way setbacks.

> Recommendation: The Town shall establish a minimum setback distance between each turbine and overhead utility lines, roadways, public right-of-ways including marked trails, utility easements, and uninhabited structures, of no less than 165% of the proposed hub height plus the rotor diameter.

11. Lighting

Aesthetics

To maintain the rural characteristics of the Town, lighting of CWECS facilities should be the minimal amount necessary for safety. This includes strobe lighting on the turbines themselves, safety lighting at the base and at all associated facilities.

FAA lighting requirements for wind turbines are specified in document AC 70/7460-1K [A:E.14]. Daytime, twilight and nighttime lighting and/or marking of wind turbines is required. As painting in conspicuous colors is contrary to aesthetic considerations, FAA requirements should be met through appropriate lighting. Options include the use of flashing white lights or a combination of red and flashing white lights, with the combination used to reduce/mitigate environmental concerns in populated areas.

It is usually not necessary to apply lighting to every turbine in a project; *UPC Wind Partners* informs the committee that they typically light every third tower. FAA regulations further stipulate that the locations of all turbines be adequately marked on aviation maps. This committee further recommends that a map of turbine locations be sent to all local airports, whether FAA-regulated or not.

Electrical Pollution

As to the lighting itself, new research suggests that strobe lighting, such as typically employed on cell towers, is a source of electrical pollution resulting in measurable distress of those repeatedly exposed [A:E.15]. From Dave Stetzer's website:

> *In May 2001 some very high frequency signals appeared on equipment monitoring electrical ground currents at a few dairy farms in Wisconsin. The signal was traced to a nearby cell tower whose rotating beacon light had just recently been changed to a strobing light. The origin of the signal was verified by shutting off the strobing light momentarily.*
>
> *The signal starts at about 25 MHz and rings down from there. It is produced when the capacitors, which store up the 1000 volts or more needed to strobe the light, release that energy all at once to strobe the light. Therefore, a high frequency and high voltage impulse is released each time the light flashes. If an RF Choke is in place and the utilities wires are adequate to carry the current back to the substation, there is no problem.*
>
> *However, many companies, not realizing the problem they cause, have opted to save the approximately $30 and omit the filter. The utility system, in many areas, cannot return such a high frequency high voltage impulse to the substation on the neutral wire, as it should. Therefore, it takes the path of least resistance back to the substation. The path of least resistance is not always the shortest path. Problems have been found as far as 6 miles from the tower.*

The solution to this is a simple RF choke placed on each strobing light; the committee does not believe this to be an expensive or burdensome solution [A:E.16].

Recommendation: The Town shall require the CWECS developer to select a configuration of minimal lighting which meets FAA requirements. Furthermore, each strobing light will be required to be equipped with an RF choke and an adequate neutral pursuant to IEEE 519 standards.

12. Lightning Protection

Lightning occurs when the electrical potential between the ground and a storm cloud becomes great enough to exceed the breakdown potential of the air between ground and cloud. The mechanisms responsible for the charge separation, after decades of study, are still not well understood. Nonetheless the potential difference can exceed several million volts and the current flow can reach over 200,000 amperes. The heat energy released in a large flash, if converted to mechanical energy, is adequate to lift a railroad freight car from the ground to the base of the cloud.

The conducting path will follow that of least resistance, although the potential difference is so great that current will flow even in "non-conductors" such as fiberglass and wood turbine blades. The Joule heating is so great that unless conductors are built into the turbine blades, they will catch fire and/or explode, with obvious potential for fatal injury to anyone near the turbine (see *§ E.6 – Fire Risk & Fire Department Needs*). There is no way to prevent the turbine from being hit by lightning. The best one can do is provide a robust conducting path to ground.

Contrary to popular sayings, lightning can and does strike the same place twice and it is a known problem with wind turbines, particularly where the developer protected the hub and not the blades [A:E.4].Recent studies have shown that over 90% of damaging lightning strikes occur on the rotor blades, usually but not always near the tip.

John Korsgaard and Ivan Mortensen, in their article for *Windpower Today* [A:E.10], recommend a multireceptor system be used. Multireceptor systems include lightning receptors on each side of the rotor blade, one near the tip and one near the base, both connected to a robust ground path. They also recommend that the receptor system be rated for the longest possible service life as the rotor blade to minimize maintenance disruption. While lightning receptors on aircraft are designed to be replaced after each strike, turbine receptors should be more robust, remaining in place and functional past the first, and perhaps more, strikes.

Finally, hidden damage can occur to lightning protection systems with each strike. A thorough maintenance inspection is recommended following any lightning strikes to prevent blade shatter on a future occurrence.

Recommendation: the Town shall require an adequate conducting path from the tip of each turbine to the ground, using a multireceptor system, to help prevent lightning damage to turbines. The Town shall require turbines be sited away from residential, historic and wildlife refuge areas to prevent significant losses from fire. The Town shall require the facility Operator to submit regular maintenance reports including descriptions of lightning damage. See also *§ E.6 Fire Risk & Fire Department Needs*.

13. Monitoring

Monitoring of CWECS projects includes evaluating the energy production of the turbines as well as the observation and interpretation of effects the turbines the turbines and associated equipment have on the environment.

Wind energy projects require continuous monitoring for oversight and evaluation of:

1. Impacts of wind turbine production on the operation of the grid.

2. The wind project's ability to meet reserve and firm power commitments.

3. Grid stability and safety considerations.

Due to the size and complexity of wind turbine projects much of their monitoring is accomplished remotely with the use of satellite-based telecommunication systems.

Other forms of wind turbine monitoring involve environmental hazard analysis. These numerous hazards are described elsewhere in this report and use varying technologies for data collection and analysis. An example of such monitoring is the microseismic study by the British Wind Energy Association (BWEA) to detect infrasound vibrations from wind turbines, both ground and airborne (southern Scotland). Previous BWEA studies have been conducted to assess the effect of low-frequency noise on populations in wind turbine areas.

It is important to distinguish between monitoring and oversight. Oversight, supervision and the patrol of CWECS projects need to be carefully detailed for the various stages of construction and operation to ensure that the project developer adheres to all requirements-federal, state and local. Oversight requires locally based personnel working on a continuous basis to assess and mitigate, on site, maintenance and emergency issues. [A:E.3]

> Recommendation: the Town shall not attempt to directly inspect or monitor turbines due to the dangers inherent in their operation; rather the Town shall require regular inspection reports, perhaps with an independent analysis of each.

14. Noise, Including Infrasonic

Wind turbines generate noise in various ways, both mechanical and aerodynamic. As technology in the wind energy industry has advanced, wind turbines have become audibly quieter. However, sound from wind turbines is still a major siting issue. Wind turbines produce two major categories of sound – audible and infrasonic.

Audible

Although sound levels can be measured, the public's perception of wind turbine noise – noise being defined as any unwanted sound – is often a subjective determination. The intensity of sound is measured using units known as decibels (dB). On the decibel scale the smallest audible sound is 0dB. A sound ten times louder is 10dB. A sound 100 times louder is 20dB. Some common sounds and their dB ratings follow:

Silence	0 dB
A whisper	15 dB
Normal conversation	60 dB
Lawn mower	90 dB
Jet engine	120 dB

Note: A 6dB increase is equivalent to moving half the distance toward the sound source.

Wind turbine noise perceived at any given location is a function of wind speed, wind direction, distance to turbine(s), precipitation (if any) and ambient (background) noise levels [A:E.25]. Other factors which may affect wind turbine noise include landscape features and vegetation. Valleys have a channeling effect and tend to intensify and extend the range of wind turbine noise. The numerous and variable factors which affect wind turbine noise mandate an extensive investigation of each proposed location to determine the magnitude and direction of potential turbine noise.

At present, noise standards and regulations for wind turbines vary from country to country. Numbers listed in Fig. 1 define the upper bounds for the noise to which people may be exposed (Gipe, 1995).

Country	Commercial	Mixed	Residential	Rural
Denmark			40	45
Germany (day)	65	60	55	50
Germany (night)	50	45	40	35
Netherlands (day)		50	45	40
Netherlands (night)		40	35	30

Fig. 1 Noise Limits of Sound Pressure Levels in dB(A) in Various countries.

Notice that, with one exception, acceptable noise levels are lowest for the rural setting and for night. These numbers reflect the inclusion of ambient noise levels calculated for those areas and time periods.

Tonal noise, or sounds produced at discrete frequencies may require stricter noise standards. Turbine gearbox grinding is an example of tonal noise.

Infrasound

Infrasound, also produced by wind turbines, is below the limit of human perception (sound below 20 Hz or cycles per second). Infrasound travels farther than higher frequencies. Infrasound may be perceived as a tactile sensation or feeling of pressure. Some effects of infrasound include fatigue, hypertension and abdominal symptoms.

Infrasound is an especially important consideration for rural-agricultural areas such as Bethany. G. P. Van den Berg, in his study of a wind turbine park on the Dutch-German border found that *"Residents living 500m (1,500ft) and more from the park have reacted strongly to the noise; (and) residents up to 1,900m (5,700ft) distance expressed annoyance, particularly at night."*

Van den Berg has pointed out that, although inaudible, turbine blades passing their towers produce higher frequency sounds which are periodic with the effect strengthened at night. If several turbines are in the area, such as proposed for several projects in western New York state, there can be an amplification effect of the rhythmic thumping caused when turbine blades pass the towers on which the are mounted [A:E.5]. Some residents have experienced noise levels 15dB higher than expected.

Assessment

Noise assessment studies to determine appropriate levels should include:

1. An estimation or survey of existing ambient background noise levels at various times of day and seasons of the year [A:E.7].
2. Prediction (or measurement) of noise levels from the turbine(s) at the site.
3. Identification of a model for sound propagation-modeling software.
4. Comparing calculated sound pressure levels from the wind turbines with background sound pressure levels at the locations of concern.
5. Specification of frequency ranges to be addressed.

If a wind turbine is proposed within a distance equal to three times the turbine blade tip height (approximately 1,200ft for the proposed 3.5mW turbines) of houses, barns, stables or other noise-sensitive sites, a noise study should be conducted and publicized. Appendix A:E.7 has a measurement protocol which the Town may use as a guideline.

Noise mitigation is typically accomplished with setbacks and acoustic dampeners. The exact nature of the noise mitigation will be left to the CWECS developer; a thorough assessment study prior to and immediately following construction is the best way to prevent and mitigate noise issues.

Recommendation: Noise, both audible and infrasound, shall be limited to a maximum of 35db [A:E.1], measured at the property line of any non-participating landowner. Quarterly reviews of noise levels and mitigation of these shall be an ongoing requirement for renewal of CWECS operating permits.

15. Road Upkeep & Repair

Components delivered to the installation sites by truck would be of significant weight. Nacelles, typically transported in two sections, can have a total weight of 80 tons. Assembled cranes, typically transported in as many as 15 trucks, can weigh as much as 450 tons.

The Town of Bethany is criss-crossed with both town- and county-maintained roads. As of this writing, Bethany's town roads are not sufficiently engineered and/or constructed to support the weight of turbine parts, cranes and other construction equipment necessary for CWECS installation, possibly requiring road improvements prior to construction. County roads are likely adequate, as turbine parts bound for nearby projects have already been seen on them, although that is not a guarantee. Generally speaking, county roads are painted with stripes, whereas town roads are not.

Due to the weight of parts and equipment, it is likely that damage would occur to any roads used by the CWECS developer, even with the infrastructure improvements prior to construction. Several methods are used to mitigate this damage. If any road is found to be unsafe for travel during construction, temporary repairs must be effected immediately to allow regular vehicular traffic.

CWECS developers are often required to submit proposed construction routes and timetables to the Town for approval. The Town may choose to have construction routes posted primarily on county roads or primarily on a few central roads to contain the damage. The Town should consider, for example, the advisability of hauling large components in a north-south direction through Suicide Corners.

Also, developers are typically to return the roads to town/county specifications once the project is completed. Standard language in ordinances suggests that roads should be completed to the satisfaction of the Town Highway Supervisor and that a surety bond or other financial instrument should be established to ensure the completion of this task [A:E.18].

> Recommendation: the Town shall require the CWECS developer to submit proposed construction routes to the Town for approval; restore all roads to county or town specifications, as appropriate, within one month of the developer's last use of such road; and submit a surety bond or other financial instrument to ensure that road repair is completed.

16. Security (Vandalism / Terrorism)

In computer security, trade offs are a necessity. The safest place for data is burned on a CD, located in a safety deposit box. That makes it extraordinarily difficult, however, for legitimate users to get to that data. Making computer controls accessible to legitimate users and inaccessible to hackers is a best-effort process.

CWECS developers and turbine manufacturers have worked together to create a reasonably safe but accessible system. Turbines are placed on a local network, allowing for central monitoring and control in case of emergencies and/or unforeseen situations. This network is placed, behind a firewall, on the Internet. This allows for remote control of the turbines in the event the central monitoring site is unmanned or becomes inaccessible (due to adverse weather, etc).

To secure the Internet-connected turbine controllers against hackers, CWECS developers use a technology called an authentication token. This piece of hardware is linked to the firewall at setup, then distributed to each user wishing to pass through it. Randomized tokens enables two-token authentication of users through the firewall, and is difficult to crack.

However, one of the largely neglected security efforts in computers (and so it seems in CWECS facilities) is physical security. As an example, a web development firm in Buffalo opted for three layers of authentication to prevent hackers from breaking into the servers via the Internet; these same servers were physically stolen from the premises and all sensitive data within them laid bare.

During our trip to Maple Ridge, committee members walked right into the central monitoring station unchallenged. Such lax physical security is not acceptable for a facility providing electricity to our national grid. Each turbine should be secured and provided with remote intrusion monitoring as well as the central monitoring point.

> Recommendation: the Town shall require the CWECS operator, in addition to randomized two-token authentication for Internet protection, to enact and maintain physical security protocols including locks and remote intrusion monitoring.

17. Shadow & Flicker Effects

Flicker takes two forms – Shadow Flicker aka the Disco Effect or Strobe Effect, and Reverse Flicker or Blade Glint. Shadow Flicker is caused when the rotating wind turbine blades cast moving shadows that cause a flickering effect. Reverse flicker occurs when glossy blades reflect light in a moving pattern, causing a sharp reflection.

Shadow flicker occurs under a combination of conditions at particular times of the day and year. It happens when the sun shines from behind a turbine rotor. This can cause the shadow of the turbine blades to be cast onto roadways, buildings and other objects; which appears to flick the sun on and off as the turbine rotates. Reverse flicker, or Blade Glint, occurs likewise under certain conditions. It happens when the sun reflects off turning rotor blades, reflecting a bright light back to the sun ward side of the turbine. An excellent animated image is available at http://www.windpower.org/en/tour/env/shadow/index.htm

The distance between a wind turbine and a potential shadow flicker receptor affects the intensity of the shadows cast by the blades, and therefore the intensity of flickering. Shadows cast close to a turbine will be more intense, distinct and ‘focused’. This is because a greater proportion of the sun’s disc is intermittently blocked.

Sources of Flicker, for Comparison

Fluorescent Lights:	120Hz
Computer Screens:	75Hz
Vehicle Turn Signals:	13Hz
Wind Turbine Shadow:	1.25-5Hz

Most people notice flicker up to about 50Hz, after which the brain's response to the flash lasts longer than the flash itself. Flicker vertigo, while not well referenced in medical literature, has been experimentally studied in the psychology laboratory. It is relatively well-known by experienced helicopter pilots. One definition is "A steady light flicker, at a frequency between approximately 4 to 20Hz can produce unpleasant and dangerous reactions in normal subjects, including nausea, vertigo, convulsions or unconsciousness. The exact physiological mechanisms are unknown." (US Naval Flight Surgeon's Manual: Third Edition). The Epilepsy Association (US) sets the lower bound at 3Hz.

Effects of Flicker

Shadow flicker is one of the 'annoyance' or 'nuisance' effects of wind turbines, similar to noise and view complaints, however it is unique among these. While all are somewhat subjective and tolerated by different percentages of nearby residents, shadow flicker is by far the least well tolerated. Residents impacted by flicker complained of headaches, migraines, nausea, flicker vertigo and disorientation after only 10 minutes of exposure [A:E.22]. This is consistent with our interviews in Lowville and our observances of shadow flicker while there.

As with car or sea sickness, this is because the three organs of position perception (the inner ear, eyes, and stretch receptors in muscles and joints) are not agreeing with each other: the eyes say there is movement, while the ears and stretch receptors do not. People with a personal or family history of migraine or migraine-associat-

ed phenomena such as car sickness or vertigo are more susceptible to these effects.

While the annoyance factors are obvious, yet subjective, other medical factors are measurable. Photosensitive epilepsy is triggered when the visual disturbance is within certain frequency ranges. Older model turbines generate flicker at about 1.1Hz, which is outside the boundaries of photosensitive epilepsy (although it may still cause nausea and migraines). Newer six-bladed turbines, however, can generate disturbances of 2.5Hz, theoretically approaching the realm of neural dysfunction.

Calculating Flicker Areas

While some wind developers tout a flat distance (usually 10 rotor diameters) as a radius, the best calculation of seasonal timing and duration of flicker effects uses computer software to accurately calculate amount of shadow per year in the area around the turbine. The relevant data points are the latitude and longitude of the site, used to create a shadow map. This map will clearly outline affected areas by distance and direction from the turbine. Any properties which may potentially be affected can be identified and the risk calculated.

For purposes of zoning, it may be sufficient to create one shadow geometry for the center of the Town and use it as a guideline for all areas. Our committee has calculated a shadow map for the center of the town, figure E.17.1. The complete distance from the turbine base (the red dot) to the outside flicker effect area (medium gray) is about 1,800ft based on the proposed 3.5mW turbines.

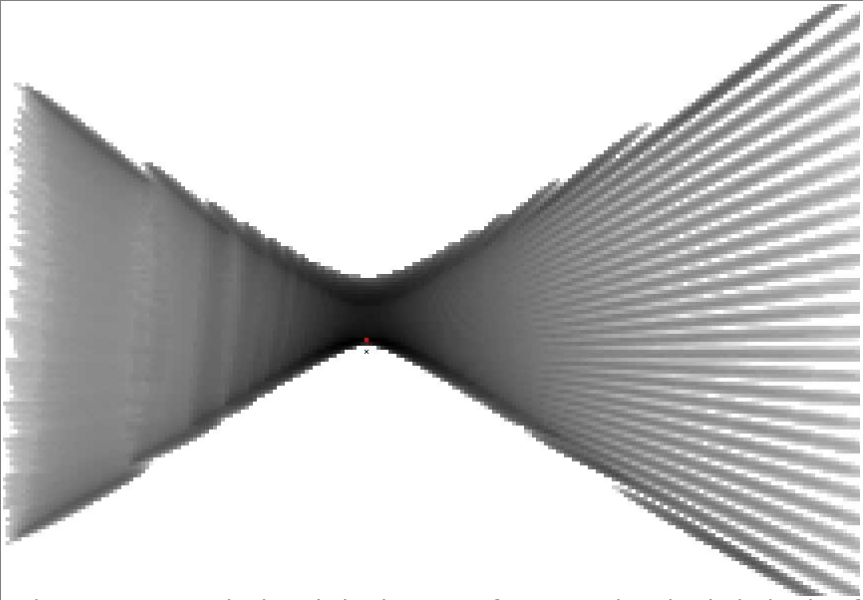

Figure E.17.1: Calculated shadow map for center longitude/latitude of Town of Bethany, courtesy Danish Wind Assoc. online calculator.

Note, regardless of final size, the shadow map primarily effects areas to the east, west and immediate north of the turbine site. The eastern direction is most impacted, while western locations are more solidly covered but affected for a lesser distance.

Reducing Flicker

Wind turbines can be painted by the manufacturer so that they blend with the natural environment. In most cases turbines are painted gray so that they will blend well with the skyline, but some are also painted green or are two-toned. Other turbines are manufactured with a galvanized metal so that the metal will weather and turn gray naturally. Zoning can require the turbine to be painted with a blending color that is non-reflective in nature, removing Reverse Flicker effects altogether.

One of the simplest and most controversial ways to reduce shadow flicker on an existing turbine is to plant tall vegetation in the shadow path. This overrides the flickering shadow and provides relief from its effects. However, vegetation taller than ¼ the hub height cannot be planted near the turbine as it will disrupt the wind stream [A:E.23] and many property owners object to this strategy as they desire sunlight on their home and/or yard.

Installing special controllers on the turbine which automatically turn it off during peak times of flicker is a common and reasonably inexpensive solution.

Moving the turbine is the most expensive option and one that is nearly impossible to effect without strict zoning laws. Proving the annoyance factor of flicker is difficult as it is often viewed as a subjective determination and property owners are typically asked to sign "hold harmless" clauses with the wind developer, preventing many suits from coming to court.

The most effective way to reduce flicker effects is to zone them away from occupied buildings prior to construction, via materials requirements and setback requirements.

Some communities also take care to prevent flicker from distracting drivers on the road. Irish guidelines state that turbines should be set back from the road by up to 300 m (990 feet) depending on circumstances. A report by the Michigan State University Extension suggests that a shadow flicker study be commissioned and included with each turbine permit application [A:E.20].

In any case, it is recommended that turbines be limited to a flicker frequency of less than 3Hz, regardless of whether an occupied building is affected [A:E.17].

> Recommendation: the Town shall specify coating materials or effects in zoning and either a) a distance from occupied buildings and roadways sufficient to eliminate shadow flicker from such, as determined by a shadow map overlay or b) require shutdown of the turbines during periods of peak flicker. Also, flicker frequency shall be limited to less than 3Hz. The Town shall require the CWECS developer to mitigate any unexpected shadow flicker effects at its own expense. See also *§ F.7 - Setbacks*.

18. Siting & Placement Issues

As the report developed, the committee determined that this section is redundant with several other sections; this information was moved to the appropriate location. See *§ E.6 – Fire Risk & Fire Department Needs, § E.8 – Hazards to Aviation, § E.9 High Wind Failure & Other Breakdowns, § E.10 – Ice Throw, § E.17 – Shadow and Flicker Effects*, and *§ E.21 – Wildlife Effects*. Most of the siting concerns are also summarized in *§ F.7 – Setbacks*.

19. Storm Water Runoff, Erosion & Sedimentation

The proposed *UPC Wind Partners* CWECS project for the Town falls within portions of the Black Creek watershed. Requirements set in the New York State Standards and Specifications for Erosion and Sediment Control mandate that an erosion and sediment control plan be prepared when industrial disturbances are imminent - in this case industrial-scale wind turbines and associated transformers, substations, transmission lines and cables which will disturb one or more acres.

The physical characteristics of each turbine site must be assessed to preclude disturbance to wetlands, stream corridors and other environmentally sensitive areas such as Genesee County Park. Site development plans must also include provisions to control suspended and colloidal solids to meet water standards (NYCRR, Part 703.2). Project developer plans must also include provisions for stabilization of disturbed areas such as re-seeding and other structural erosion control measures.

Soil loss predictions for each turbine location must be made using the RUSLE equation. Some state-required studies require a full-year data set using a plan to address all points covered by the Storm Water Pollution Prevention Plan (SWPPP) check list as per New York state standards.

> Recommendation: Construction site monitoring and inspection by a professional who is independent of the project developer is essential for effective storm water and erosion management control. Because of the hydrologic variability and scope of the proposed project area, a standard site-specific EIS should be required.

20. Stray Voltage AKA Ground Current

Apprehension over stray voltage has been expressed by committee members and other concerned members of the community. Extraneous voltage or ground current appears on grounded surfaces in buildings, barns and other structures. It is also present on the surface of the earth. It is classified as a low-frequency form of conductive electromagnetic interference.

In most buildings stray voltage is not considered a problem, because the levels are generally below the perception level of humans. Usually there is no sensitive electronic equipment which can be affected by it.

Concern in the agricultural field: In the 1970s, stray voltage became a concern in the agricultural field with dairy farmers. Cattle are ten times more sensitive to electricity and electronic interference than humans, as they are constantly standing in water or on moist areas of the barn. Concerns in the Midwest with stray voltage on farms and their connection to wind farms are not conclusive at this time. While a large volume

of anecdotal evidence is present, accepted documentation concerning herd health and reproductive problems is unavailable at this time.

Proper Installation/Grounding: if equipment is properly installed and properly grounded, evidence does not lead to CWECS projects as being a major source of stray voltage [A:E.29].

Conclusion

The Town should be concerned about stray voltage, however, if the CWECS project is properly installed and maintained according to IEEE standard 519 (which has been law since 1992), the wind turbines should not themselves dictate a major concern in the community.

> Recommendation: the Town shall require any CWECS project to meet IEEE 519 standard for the life of the project. See also *§ E.11 - Lighting* recommendations.

21. Wildlife Effects

Concerns should include *"noise, and impact on wildlife, rare plants, native vegetation, historical resources and wetlands". "Placing a priority on these issues during the planning stage can be key to the eventual project approval"* (North American Wind Power Magazine, Dec 2006).

Cattle Impact

Observation of existing structures in the Midwest seems to indicate that cattle are not bothered by any aspect of the CWECS facility. Ranchers routinely observe cattle, including dairy herds, congregating in the shade of turbine towers on hot days.

Avian Impact

The nationwide estimated mortality rate is 2.19 birds per turbine annually. This average is considerably less than the number of birds killed annually due to collisions with motor vehicles, tall buildings and homes, and lighted communication towers [A:E.26]. However, there are far more motor vehicles, tall buildings and homes than CWECS facilities. The percentage of kills per turbine is higher than any of these.

Local resident and avian authority, Mr. Douglas Beattie, said that although Bethany is not a major flyway, local, low flying migrating birds such as thrushes and the endangered wood warbler risk collision, especially at night, with structures in the 100 to 300ft height range [A:E.24].

UPC Wind Partners reports that "siting" is the key to mitigating the disruption of migrating birds. *UPC Wind Partners* said they [have] extensive studies to ensure that an area does not have a high concentration of migrating birds. We recommend the re-

search company be one of the Town's choice, and the study completed prior to construction [A:D.1].

Mr. John Flicker, President of the National Audubon Society recently wrote in favor of wind turbines, however, Mr. Flicker *"emphasized the importance of prudent siting…if (turbines) are located in the wrong places, they can still be hazardous and fragment critical habitat"* (RenewableEnergyAccess.Com. National Audubon Society, Dec 14,2006).

In wind power projects, mitigation *"generally means changing the location of the turbine, often shifting turbine strings away from important wildlife habitat or, avoiding certain highly sensitive areas"* (American Bird Conservancy, Wind Turbines and Birds).

In addition, The American Bird Conservancy recommends *"attention should be paid to impacts on specific species, not just general number of kills. The use of guy wires should be avoided. Transmission lines should be placed underground to minimize project footprint. Lighting should be minimized, with a limited number of towers being lit using only white or red strobes at no more than 24 pulses per minute. Sites should be monitored for avian impact using scientifically rigorous methods and data should be published."*

Bats

Bat fatalities are an expected effect; studies are currently in progress to determine fatality levels and whether they should be of concern. [A:E.6], [A:E.8].

Recommendation: while domesticated animals do not seem affected by CWECS facilities, a variety of wild creatures can be severely impacted. This committee recommends that the Town requisition several wildlife impact studies, including avian and bat, as part of the permitting process.

F) Legal

1. Decommissioning

One of the major issues with wind turbine engineering is the decommissioning of these units – whether it is at the end of their service life or the unit is out of commission for some reason. The committee asked UPC Wind Partners the following question about decommissioning a unit:

> *If a wind turbine is placed on the landowner's property and is not producing or has not produced for several months for some reason, what would UPC do? Remove?*

UPC's answer:

> *Yes, we would, and often town codes stipulate this. We would be interested in speaking further with you regarding our experience with towns that have produced wind code. The town of Cohocton is one such town. I think our ideal picture would be to work with Bethany to develop a code that works for Bethany and the wind farm. There are quite a few precedents out there. Please take a look at the following link from NYSERDA for a start. This was especially developed for towns and communities and includes examples of wind codes http://www.powernaturally.org/Programs/Wind/toolkit.asp*

Should the Town decide to allow CWECS facilities to be placed in Bethany, the following issues should be addressed within the contract:

Responsibility for the removal of the unit [A:E.19]. The committee suggests the Town have a clause written into the contract that states the owner of the CWECS facility be responsible for all costs involved in the removal of the turbine units and restoration of the property. The wind developer shall also be responsible for the restoration of any Town, county or state property that may be affected by the decommissioning. These issues and costs should be addressed along with a surety bond or other financial instrument in the name of and held by the Town. This financial instrument should also have an annual escalation clause.

Figure F.1.1: California Wind Farm. Derelict wind turbines can be seen in the distance, behind their modern counterparts.

The degree to which the property should be restored. The contract should read that the property is to be restored to the same condition as it was prior to construction, includ-

ing the removal of buried concrete to a depth of 4ft. Based on another town's responses and investigation, developers typically remove all components to a depth of 2ft. This doesn't seem acceptable and the concrete structure should be removed to a depth suitable for a more varied range of future purposes.

Final disposition of overhead and underground transmission lines. Again, we suggest a written agreement which specifies the final disposition of any lines laid as part of the CWECS project and states that the CWECS developer will be responsible for these costs. A surety bond with annual escalation clause would be the best way to address this issue.

Along with the above issues the town needs to develop a contract that will cover any and all ownership changes that may take place from the time that the initial contract and turbines are installed until they are decommissioned. This would include the transfer of the bond money and the annual escalation factor.

Decommissioning is also a construction process. This committee recommends that any regulations, such as limiting the time of heavy equipment operation, applied to the construction of CWECS facilities should also be applied to decommissioning.

While there are no fixed-wording guidelines in the US, UK, European and Australian best practice documents, all suggest that inactive turbines be completely decommissioned (or repaired / replaced / repowered) within six (6) months of their production stoppage. Specifically, no turbine should sit idle for more than six months. Evidence in the UK and other locations suggests that this time frame is adequate.

AusWEA suggests that at sites where native vegetation was removed during the turbine's construction and removal, the operator should re-vegetate the site with native plants of local provenance. This is a subtle but important detail – damage done to our environment by non-native plants is already quite serious. Seeds for native plant restoration are often more expensive than seeds traditionally used to quickly establish a ground cover, making this requirement a necessary one to have in writing.

In the event that the funding to remove CWECS facilities is inadequate or unavailable at the time removal is required, the responsibility for removal should fall upon the landowner. The Town may suggest that landowners place a percentage of their annual lease payments aside against this need.

Recommendation: the Town shall require any CWECS developer to post a separate surety bond or other financial instrument with annual escalation factor to fully decommission a turbine for each turbine constructed. The Town shall require any CWECS developer to generate a suitable agreement with each landowner giving right-of-way to transmission lines as to the final disposition of those lines, and shall post a financial instrument, as above, for each property owner who requires their removal. The Town shall require any CWECS developer to create a new property survey map, showing underground features of the CWECS, including but not limited to concrete bases and underground cables.

2. Independent Oversight

Previous sections have discussed the need for independent sourcing of information related to the CWECS application process. Also the identification of appropriate enforcement agencies and methods should be clearly defined prior to the permitting of any CWECS project. Independent oversight is required in at least the following areas:

Pre-Construction: Engineering evaluations; site selection and access road placement; television and other wireless signal quality testing; water well quality and quantity testing; identification of enforcement agencies.

Construction: construction locations and techniques; inspections along a predetermined schedule; permit limitations compliance.

Post-construction: engineering inspections; television and other wireless signal quality testing; water well quality and quantity testing; agricultural impact assessments; road reconstruction and impacts.

Independent oversight or regulation of the permitting and construction processes are particularly important. This oversight should be the responsibility of one or more independent engineering firms which are directly answerable to the Town. Status reports at predetermined stages of construction should be delivered to the Town to ensure that the installation has been properly completed at meets all safety requirements. Compensation to this firm(s) should be provided by the CWECS developer in the form of a surety bond, escrow account or other autonomous financial instrument which the Town will control. The CWECS developer shall have no direct contact with the engineering firm to ensure non-biased results.

The Town may wish to consider creating a salaried position(s) to oversee the many aspects of the project that require external oversight, coordination and review. Compensation for this position(s) should be provided by the CWECS developer and should be guaranteed in the event of transfer of ownership or abandonment of the project. The duration of this position may be only during the construction and decommissioning phases or a continuous position for the duration of the CWECS operation.

Recommendations: the Town shall create an escrow account to compensate one or more independent engineering firms and one or more salaried personnel who will oversee the CWECS project permitting, construction and decommissioning. The salaried personnel may also be responsible for reviewing regular maintenance reports during CWECS operation and serving as a liaison between the facility owner and residents.

3. Landowner Contract Control

While the Town may not be able to negotiate between the CWECS developer and the landowner, this committee recommends that Town officials familiarize themselves with typical lease, easement and nuisance contracts as well as other typical contracts associated with CWECS development.

Attached please find a lease agreement used in the Maple Ridge Project [A:F.2], a Neighbor Agreement with Easements [A:F.3], *Wind Turbine Land Leases and Options*, a position paper for landowers [A:G.6] and the *Canastota Wind Power Property Value Assurance Plan* [A:G.9].

4. Legal Views from Albany & Elsewhere

In the roughly five months since this report was initiated, the development pressure, itself a function of factors both local and international in scope, has continued to increase relentlessly.

Middle East cognoscenti believe that Israel is now preparing to use both conventional and nuclear warheads to attempt to destroy Iran's blossoming nuclear capability. Such could easily ignite a conflagration of uncertain scope, since the United States and Russia back opposite sides, and both countries have enough warheads to retard civilization. Even without a doomsday scenario, or an attack on Iran, instability in the region could cause the price of oil to skyrocket with minimal provocation. In the future, turbines could be used to create hydrogen-based power, lessening the need for oil.

At a more local level, the state of New York has committed itself to the development of alternative energy sources including wind. A recent position paper by the law firm of *Thomson/West of Rochester* cites numerous instances in case law to show that wind turbine farms meet the three essential criteria required to have them enjoy the relaxed zoning laws applicable to public utilities [A:F.4]. While CWECS facilities remain private domain at the moment, there is some legal grounds for publicizing them in the future, giving them rights of eminent domain.

On June 16, 2006, a conference titled *Siting Wind Power in New York* was jointly presented by the Government Law Center of Albany Law School and the NYSERDA. There were three main take-home messages: 1) wind energy is becoming increasingly competitive with other sources, 2) whether a town government is pro or con, new York state is committed to developing wind energy. If development lags behind state expectations, it was implied that steps will be taken to ensure it, 3) town and local governments are strongly advised to get the best lawyers they can afford when dealing with wind developers, as the latter will surely have them.

Recommendation: the Town shall keep abreast of the legal debate in Albany,

to the extent that CWECS facilities may become public utilities with all the rights thereof. The Town may additionally publish such information via the Town website or newsletter for the benefit of voters within its borders.

5. Potential Lawsuits

This is an extremely light analysis due to time constraints.

For the landowner, the liabilities are many and it appears that standard home, business and farm policies will not cover damage or loss of use due to CWECS facilities operations. The testimony of an insurance underwriter at a Stafford presentation confirmed this in early 2006. Certainly landowners are not insulated against lawsuits [A:F.1].

The Town has somewhat less risk, the main being precedent. In creating zoning and approving permits, the Town should review all data formally presented and recorded to establish precedent for types of accidents or other damage and act in accordance with lessening the risk from such occurrences. Failure to do so will open the Town to negligence claims in accordance with NYS law.

The Town should also be aware that New York law prohibits the transferral or elimination of certain types of liability. Liability waivers and the deep pockets of the CWECS developer are not enough to prevent a plaintiff from including the Town on a list of defendants in any CWECS case.

Recommendation: the Town shall provide a summary of precedent and existing zoning law to the Town attorney for liability review prior to the approval of any zoning instrument. An additional review of each permit application and Town response may be ordered at the expense of the CWECS applicant.

6. Wind Rights

Lease agreements stipulate distance from the turbine to any large feature and prohibit the landowner from building or planting any such feature within a fixed distance of the turbine(s). Wind rights between properties are typically protected by property line setbacks.

The *Town of Spring Valley, North Dakota* has passed regulations based on landowner rights, to whit: the turbines must be placed at least their tip height away from the property line. Turbines must be twice their tip height away from each other for engineering/performance reasons per *UPC Wind Partner's* informational meeting in Bethany. If the Hatfields and McCoys (neighboring landowners) both sign leases, and the wind company first determines the best placement for Hatfield is within a tip height of McCoy's property line, that limits McCoy's ability to lease land to the wind company See Figure F.6.1.

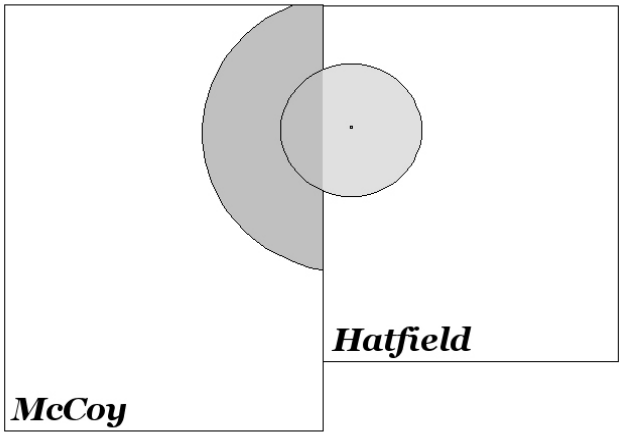

Figure F.6.1: Hatfield's turbine infringes on McCoy's ability to place turbines on his property.

In addition, if the turbine is located close to a property line, McCoy might, later on, build an obstruction which would affect wind flow and possibly make the turbine ineffective. While the turbines are tall, certain regular sizes and shapes of objects can severely impact wind flow at higher altitudes. UPC Wind Partners specifies anything taller than one-quarter the tip height as being a potential interference. Communities using this reasoning allow an exception where adjoining landowners have signed a joint lease sharing revenues.

NYSERDA's own document "Wind Energy Development: A Guide for Local Authorities in New York" specifies 1.5 times the tip height of the turbine.

> Recommendation: the Town shall implement language protecting neighboring wind rights, specifying a minimum setback distance between each wind turbine and all surrounding property lines of no less than 150% of the tip height per NYSERDA regulations. This may be reduced when a joint lease or neighbor easement agreement has been signed and accepted by the Town.

7. Setbacks

Location ... location ... location. This is the key to determining the best-for-all placement of wind turbines. Location, or more specifically, the distance wind turbines are placed from residential areas may mitigate some of the issues and/or problems reported with wind turbines.

In Pavilion, NY, the setback distance from occupied buildings is 1,000ft for non-commercial (smaller) turbines. Perry and Cohocton have set 1,500ft setbacks for turbines somewhat larger, but still smaller than those proposed for Bethany. As wind turbine sizes have grown, siting concerns have become more commonplace especially in areas of higher population.

Globally, we see more variation, with reasoning typically covering safety and infrasonic health issues:

US NWCC	0.50mi
France	1.5km (.932mi)
German RETEXO-Rise	1.24mi
Nina Pierpont, MD, PhD	1.5mi

France's National Academy of Medicine cites significant health hazards caused by turbine noise and infrasound for their setback, although this research is not universally accepted at this time. Nina Pierpont [A:E.22], also cites health issues as the reason she recommends 1.5mi setbacks from any CWECS facilities.

Wind Turbines are relatively new to our area and the available information is based, in part, on other people's experiences with smaller turbines. Unfortunately, *UPC's* proposed 450ft turbines have never been installed anywhere before, so our setbacks and siting concerns must be extrapolated from existing facilities.

Types of Setbacks

Most (if not all) ordinances for CWECS facilities include distances from occupied buildings and property lines, while others include these plus roadway, right-of-way, livestock barns and pastures, and others. Obviously, not all communities measure the same types of setbacks and some clearly place more value on livestock and outbuildings than others.

Some communities have setbacks for occupied buildings, but none for business or livestock "homes." Some have two of the three and some have all three. This committee believes that, in keeping with our image as a caring agricultural community, any setback which applies to residences should also be applied to businesses, schools, libraries, public meeting facilities and barns housing livestock of any kind.

Roadways, Right of Ways

Roadways and Right-of-Ways, including roads, train tracks, hiking trails and published snowmobile trails, require protection from ice throw, fire, flicker effects and structural failures. Of these, the greatest length is ice throw at 165% of the sum of the hub height plus the rotor diameter. The ice throw setback may also be applied to overhead utility cables. Roadways also should be protected from flicker by use of a flicker shadow overlay map.

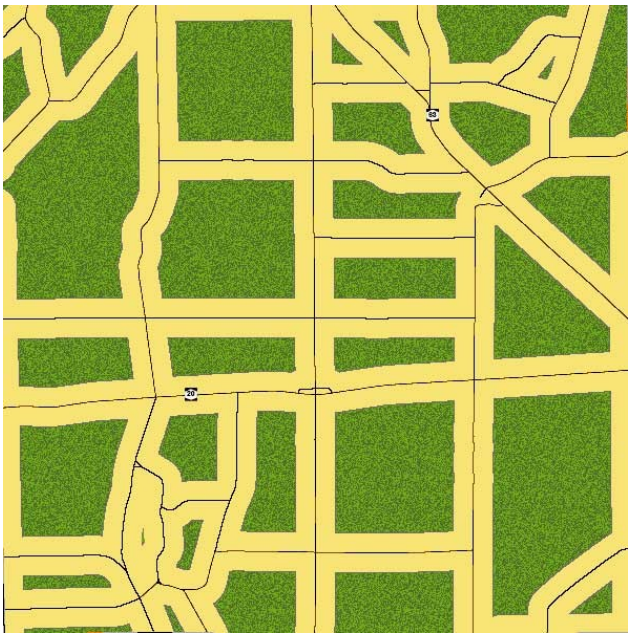

Figure F.7.1: Road map of Bethany with estimated setback marked for proposed 3.5mW turbines.

Historic Areas

Designated historical areas are often covered under setbacks for occupied buildings. Historic Areas, here, means those historic areas that are not occupied buildings such as the County Park (State Historic Register). These require protection from fire at 150% of tip height.

Wildlife Areas

Wildlife areas require protection from fire and, depending on the type of wildlife, noise. Both protections should be enacted, at 150% of tip height and a maximum of 35db measured at the wildlife boundary if applicable. See also *§ E.21 – Wildlife Impact* for impact report recommendations.

Occupied Buildings

Occupied Buildings need protection from fire, flicker effects, high wind and other structural failures, and noise. Only fire and structural failure are measured in setbacks; noise is typically limited by a decibel/property line figure while flicker effects are determined through use of an overlay map. Of the two remaining, high wind failure is the larger setback, at 450% of tip height.

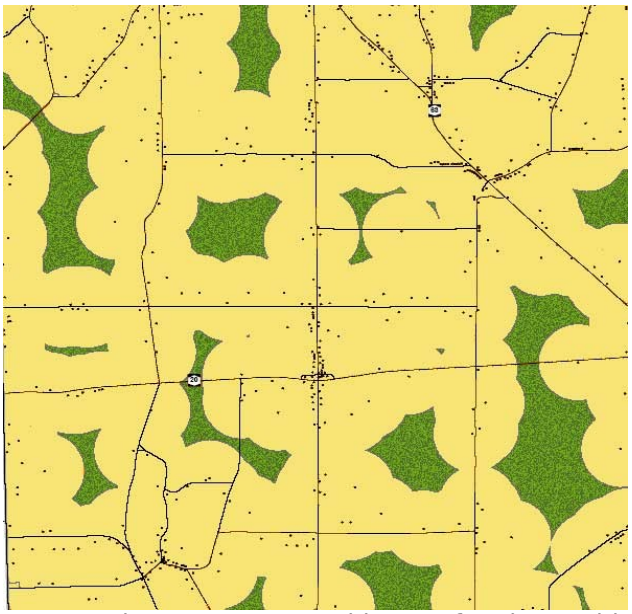

Figure F.7.2: Centroid map of Bethany with estimated occupied building setback marked based on proposed 3.5mW turbines.

Occupied buildings setbacks in current zoning ordinances range from the full tip height (hub height plus rotor length) to a fixed 1,000 meters (3,300 ft). Fixed numbers between 1,200' and 1,850' are common – note that in all instances these were ultimately applied to smaller turbines. A town in West Virginia attempted a fixed mile setback with modern, taller

turbines, which was challenged in court; a judge ordered it down to ½ mile.

In the USA, this particular setback represents extremely esoteric concerns – goals include: a) reducing noise by insisting on a minimum distance; b) reducing flicker in the same manner; c) preserving real estate values; d) appeasing residents who don't want tall spinning objects too close to their homes; e) preserving quality of life.

In Europe, occupied building setbacks in the range of 1,650ft have come after hard lessons of property damage and near loss of life. Germany, in particular, suffered as it did not – initially – require sufficient setbacks.

The NWCC's Permitting of Wind Energy Facilities Handbook notes that ideal setbacks measure at least 750-1,000 ft – written in 2002 when a typical turbine measured 80 meters. Proportionately for *UPC's* proposed 100 meter turbines, that setback would equate to 937-1,250ft.

The European Best Practices document [A:E.21] does not set a fixed distance, but suggests a safety assessment including distance to occupied buildings and roadways prior to the installation of any turbine facility. This practice, put into effect for more recent installations, has resulted in average setbacks from occupied buildings of about 600m or 1,980ft.

Property Lines

Property lines need protection from fire, noise, structural failure and to protect wind rights. Noise is typically determined by measuring decibel level at the property line of non-participating landowners. This committee recommends a limit of 35db. Of fire and structural failure, fire is the largest risk radius at 150% of tip height.

There is ample precedent for determining setbacks at least equal to the height of any construction within most communities' existing ordinances, in case of the structure falling over. Turbine companies will tell you that the chances of a turbine falling over is extremely slim, and they are correct. However, fire and wind rights are both good reasons for keeping property line setbacks to at least the tip height of the turbine.

Property line setbacks can also be problematic in their impact on potential land use on adjoining properties. This could adversely affect the property value of the adjoining property. It may also require the Town to rewrite building codes to match the CWECS facilities setbacks.

At least five towns border Bethany; impact on these towns should also be considered. One CWECS ordinance this committee reviewed included a provision stipulating compliance with applicable zoning ordinances of adjoining towns.

Cost-Effectiveness of Larger Setbacks

Any CWECS developer would likely take a public position that larger setbacks would be cost prohibitive. However, one can show that increased line loss (power loss from the turbine to the grid) is not the major problem. Jeffrey Pfaff, an electrical engineer and contractor who is not affiliated with any wind development company, notes that such line losses are deliberately engineered. Appropriate choice of conductor size, insulation and distribution voltage lowers line losses to less than about two percent.

Simple arithmetic shows that the revenue generated, compared to the revenue of-

fered to towns and/or landowners, can easily absorb this two percent (see *§ G.8 – PILOT – Approach* and *§ G.9 – Depreciation and Financial Effects*). The main concern would likely be the initial cost of installation and limiting the number of turbines which can be constructed.

Recommendations: The Town shall institute all setbacks in terms of a percentage of the turbine dimensions, with fixed footage as a minimum; e.g. "1500ft or 150% of the tip height, whichever is greater."

The minimum setback distance between each wind turbine and overhead utility lines, roadways, public and utility right-of-ways, and uninhabited structures shall be equal to no less than 165% the sum of the proposed hub height plus the rotor diameter.

The minimum setback distance between each wind turbine and dwellings, active places of business, and structures housing live animals shall be equal to no less than 450% of the tip height.

Property line setbacks shall be no less than 150% of tip height. The property line setback requirement may be reduced by the Town Board when it finds that the following circumstances apply: the owner of the parcel for which the reduced setback is sought executes and presents for recording a development easement satisfactory to the Town in which the reduced setback is consented to, and construction within, and use of, the easement area is appropriately restricted.

8. Zoning

This is a fairly light overview due to time constraints.

The choices for the Town to zone CWECS facilities seem to be overlay districting, incentive zoning or standard setbacks with land-use restrictions.

Overlay districting is most commonly used to simplify zoning. Given that the restrictions in this document are primarily designed around safety and quality-of-life, any overlay district should be located in the same effective area that applying these restrictions would create. A rudimentary map, constructed for this very section, reveals that a) any overlay district created by safety setbacks would be tremendously fragmented and b) new construction of homes and businesses would either be severely restricted or would severely impact the overlay zone. For this reason, an overlay zone does not seem appropriate for the Town.

Incentive zoning can and is used to realize tremendous gains for any Town or County accepting CWECS facilities into its midst. The Town can most easily accomplish the longtime goal of town-wide water by incentive zoning. This method, however, presents Town officials with years of confrontational meetings. Each CWECS facility, change and expansion would require additional sets of public meetings on a controversial topic, possibly fragmenting an already-divided community. That is not to say that incentive zoning is not a desirable means to regulate CWECS facilities – only that the consequences must be kept clearly in mind.

Standard setbacks are complex, due to the number of variables and the many impacts such large structures will have on the Town. However, standard setbacks have several advantages: a) they can be applied to a variety of different turbine types and sizes – including non-commercial models – with no change to regulations; b) they are justified in safety and quality-of-life concerns with less risk of legal challenge; c) they apply easily to reconfiguration and repowering of the CWECS facility and d) this committee has already done much of the leg-work for them.

Recommendation: The committee recommends standard setback zoning restrictions designated for agricultural and commercial overlay districts.

G) Financial

1. Agricultural Impact

A conference on the effect of Wind facilities on Agricultural districts brought forward a number of potential problems. Done properly, CWECS facilities can be a great tool to generate income for farmers with minimal disruption to field and/or herd. However, improperly installed CWECS facilities have the potential to take away more income than they generate through soil compaction, increasing un-tillable areas and increasing man-hours needed to tend the same land.

Specifically, siting concerns include turbines located in the middle of fields rather than along hedgerows; access roads that cut across fields rather than along the edges; guy wires that cut across active fields; drainage and erosion control issues caused by soil disturbance during construction or by the reconfigured contour.

Construction concerns include access roads constructed considerably higher than the surrounding fields; soil erosion caused by inadequate controls during construction, topsoil separation from subsoil; construction and equipment vehicles parked on topsoil; construction and equipment vehicles operating on areas other than the access/staging area; less than 48in of cover for buried electric cables in cropland and improved pasture; less than 36in of cover for unimproved pasture; improper disposal of excess subsoil and rock; unfenced work areas allowing livestock access to the construction site; wire, bolts and other unused metal objects left on the ground; excess concrete piled on the surface; concrete residue from trucks rinsed in an active agricultural area.

Restoration concerns include soil compaction to an inappropriate depth; surface location of rocks 4in and larger; improperly graded access roads not allowing farm equipment crossing and providing inadequate drainage patterns; non-seeding or seeding with non-native vegetation resulting in overgrowth of weeds; improper restoration of existing drainage structures damaged during construction; and remaining construction debris.

All these translate into dollars lost as the farmer is forced to increase man-hours to work around the obstructions and will not reap maximum harvest on compacted soil.

The state Agricultural department has come up with guidelines to be adhered to in all County-adopted, State-certified agricultural districts [A:G.1]. These guidelines protect the landowner with minimal interference in the CWECS construction process.

> Recommendation: the Town shall require that the state's agricultural guidelines be adopted throughout the Town, regardless of the land's status as a certified Agricultural district.

2. Effect on Property Values

In our visits to other towns that have turbines installed we found that generally those properties with turbines have increased in value. This is to be expected due to the fact that they are now producing a greater amount of income.

For those properties in the immediate area the picture is far from clear. We have learned of property owners trying to sell and not being able to locate buyers due to CWECS or even the potential of future CWECS facilities.

Of published data, the REPP report states no loss of property value. However, this report uses assessed value to make its determination, which may or may not have any relevance to the ability to sell the parcel and realize its value. Other documentation suggests that properties in the immediate vicinity to a CWECS facility are difficult to sell and may realized reduced sale prices [A:G.5], [A:G.10], [A:E.25].

However, because of relatively little hard data on this subject, the committee believes it is much too early to make a definitive statement on this topic, regardless of what the wind development companies and wind opponents would like us to believe.

There is precedent for CWECS developers and/or operators to provide property value assurances [A:G.9]. While this does not mitigate the disruption involved in moving families, it does at least assure a fair market value for any home within the viewshed of such a facility. We have learned, however, of developers in Fenner signing such contracts which became invalid when the facility was sold to a new owner. Any such contracts must be worded as to pass liability to any subsequent owners of the CWECS facility.

> Recommendation: if the Town requires a Property Value Assurance plan from the CWECS developer, it should be written such that responsibility passes to each subsequent owner(s) of the facility.

3. Employment Issues

It is the opinion of this committee that any CWECS project will have no significant impact on employment in the Town. One new job may be created within the Town offices itself – the project coordinator. A handful of jobs may be created at the CWECS central monitoring station.

Our trip to Maple Ridge and interviews with residents near other CWECS facilities reveal that most employment is temporary in nature and/or filled with outside personnel. While CWECS developers may suggest that new turbine plants are being constructed near CWECS facilities, such plants happen rarely and are often are located overseas due to labor costs. At any rate, the Town lacks the proper infrastructure to operate such a plant, leaving the employment situation essentially unchanged.

4. Lack of Competition

It seems to be the case with most towns that only one wind development company has shown any interest in developing wind energy in our town. While several likely theories have emerged, this committee has not been able to come up with any solid information on the lack of competition in any given area.

Wind developers typically purchase commercial-scale turbines from manufacturers, requisition engineering reports from outside firms and contract out much of the construction, leaving no appreciable special talent required for the project. Given the profit potential in developing wind energy, competition for the right to reap these profits should be intense.

The Town can only benchmark success against other New York communities that have negotiated CWECS projects.

5. Loss of Property Use

Loss of property use includes losses suffered by both the lessor and neighboring non-lessors (abutter-owners). Losses include a wide range of immediate and future bans and/or restrictions and hardships on wind project area residents. The following list illustrates the nature and scope of typical losses-hardships that have been included in some lease agreements:

- Access: wind company motorized access to property at all times-day or night
- Line Placement at Will: unlimited placement of electrical lines and removal of trees without notice; unlimited placement of cables, above and below ground, foundations, substations
- Building Restrictions: all building plans of lessor subject to review by wind company along with height restrictions
- Zoning Restrictions: land use restrictions based on appropriate turbine setbacks of varying lengths.
- Claims Forfeiture: forfeiture of any right of claims against wind company regarding noise, flicker, ice throw
- Wind Rights: exclusive rights to wind resources go to wind company
- Length of Agreement: period of agreement varies from 17-40 years
- Easement Succession: sale of property subject to lease restrictions-lessor restrictions go with the property if lessor decides to sell

Recommendation: as each CWECS permit is reviewed, the Town shall consider current use of the parcel as well as potential future use.

6. Operating Permits

Operating permits are one method to reach two major goals: a) maintaining a safe facility and b) realizing local fees for the Town specifically.

The EPA recommends the use of operating permits whenever on site systems need to provide or maintain treatment to achieve environmental safety goals. While CWECS facilities are not on the standard list, environmental safety including oil spills, nuisance disturbances and other issues abound with their operation. Regular permitting requirements related to CWECS safety and nuisance issues can be used as a means to assure that the issues are addressed to the Town's satisfaction.

PILOT arrangements (see *§ G.8 – PILOT – Approach*) are often split along tax percentage lines, leaving Bethany with about 10% of PILOT revenue. The Town may not be able to realize needed infrastructure changes with so small a percentage. Operating permit fees, requested up front, will allow the Town to set a budget commensurate with needs and goals.

Some towns have tied operating permits to the rated capacity of the turbines. A fee per mW capacity would adequately address the issue of the number of turbines installed, future expansions and repowering.

> Recommendation: the Town shall require an annually-renewable operating permit, along with fee per mW capacity, for any CWECS facility. Operating permits shall be renewed at the Town's discretion.

7. Payments to Landowners

The installation of wind turbines and the requirements to install high voltage transmission cables above and/or below ground requires right-of-way permission from private landowners and possibly the Town and state for use of their land [A:F.2]. There is also the issue of restoring the property to its original configuration post-construction.

The committee contacted *UPC Wind Partners* about this requirement; *UPC Wind Partners* stated they would pay the landowner a right-of-way payment for an easement on their property.

The committee also requested information from *UPC Wind Partners* regarding so-called 'nuisance' payments to neighboring landowners and easement payments for relaxed property line setbacks. Attached, please find a similar letter initiating that process from *Noble Environmental* [A:G.7] and a similar contract associated with the Maple Ridge project [A:F.3].

UPC indicated that they do not consider nuisance payments. Easement agreements

will depend on the nature of the Town's zoning requirements. There was no indication as to how much any payments to landowners might be; rather, *UPC* indicated it would review payments on a case by case basis.

> We suggest the Town provide payment and restoration guidance to the landowners and/or include payment structure and restoration requirements into the Town contract or zoning statutes. A legal firm, *Stamp, Jackson and Procter*, have produced reasonably comprehensive guidelines for landowners in dealing with CWECS developers [A:G.6], which the Town may use as a template.

8. PILOT – Approach

If a CWECS facility were to be installed in Bethany, PILOT revenue would be of unprecedented amounts. Developers have, historically, offered as little as two- or three-thousand dollars per mW per year. Recent PILOT agreements with local communities, however, have been as high as $8,000 per mW per year, which should stand as a current benchmark.

PILOT agreements are often touted as the means to a fair distribution between town, county and school district. For example, some counties in western New York, working through their respective IDA/EDAs, have realized roughly the following distribution, based on the tax distribution:

County:	40%
School District:	30%
Town:	30%

But each county is different: in Livingston County:

County:	30%
School District:	52-58%
Town:	12-18%

The Town of Bethany is located in more than one school district, which districts also extend outside the Town. If reductions (or non-increases) in school taxes are realized from PILOT payments in the Town, they would likely be applied uniformly, benefiting all property owners in the school district, not just in Bethany. Furthermore, a uniform school tax reduction (or non-increase) to all property owners in the Town would not be realized unless negotiated between the Town and all school districts therein.

From conversations with Joe Kushner of Eagle, the committee has learned this process: The Town of Eagle posed the following question: How many new school students result from the installation of a CWECS facility? Essentially none.

Convincing the Wyoming County EDA of the lack of fairness in this distribution, Eagle was able to arrange a licensing agreement between the developer and the Town of Eagle, whereby Eagle, prior to the PILOT payments division, gets 80% of the wind-generated revenue up front. The remaining 20% then goes into PILOT and that portion is divided as follows:

County:	30%
School District:	40%
Town:	30%

By this method, Eagle receives 86% of the wind-generated revenue. This is a new, unprecedented arrangement, and an ideal on which to model any Bethany PILOT arrangements.

9. Depreciation and Financial Effects

Developers can recover their capital investment very quickly, because wind energy facilities are eligible for *five-year double declining balance accelerated depreciation* for federal income tax purposes [A:G.12]. In a sample $500,000,000 facility (the approximate cost of 480kWh capacity), the developer can recover the entire investment through depreciation charges to offset income tax liability in just six years [A:G.2].

To benefit from tax shelters, the wind developer must have income. For this reason, many CWECS developments consist of two or more companies. One company will develop the facility and then sell it to the partner company, using the income for depreciation and presenting an entirely different owner for the community to deal with. On the Lake Erie project, *UPC* is partnering with *Clipper Wind;* in Prattsburgh with *Global Wind Harvest;* in Hawaii with *Makani Nui Associates.*

Due to these unique tax situations, there is an incentive for facility owners to abandon these projects once the initial term of tax credits have dried up, forsaking their projections and promises of twenty- to thirty-year life expectancies for the project.

At the "informational meeting" in June 2005, Chris Swartley presented a few hard numbers on the proposed project. *UPC Wind Partners* intends to build between 30 and 40 turbines in the Town. For the purposes of our calculations, we will assume the middle, or 35 turbines. They are to be GE 3.5mW turbines, a model just barely on the market, with a quoted price tag of $2.6 million each.

Now, we estimate some numbers based on current and completed CWECS projects. Landowner payments can be as high as $10,000 per year, but are somewhat less in rural areas. The rural range is $2,500 - $5,000. Note that while some landowners tie their payments to mW produced, historically landowner payments have been per annum. We'll assume the high number of $5,000 or $175,000 for the entire project.

Wind farm developers acknowledge that wind electricity costs more than traditional electricity – a cost that is ultimately passed on to consumers. (Note that we are not talking about the SBC credit – that money is used to fund wind developer's preliminary studies.) Let's take a conservative number: two cents more per kWh [A:G.17]. If

the Bethany wind turbines generated electricity 100% of the time, they would produce 1,073,100,000 kWh annually. However, experts acknowledge that wind turbines produce only about 30% of their rated capacity due to lack of wind and other factors [A:G.16], which makes the annual production 321,930,000 kWh.

Electricity from wind turbines will therefore cost consumers an additional $6,438,600/year – with $175,000 of that going to the landowners, or a net $6,263,600 loss for the community.

Developers are eligible for a federal Production Tax Credit of $0.017 per kWh produced during the first ten years of the project. If the wind turbines generate the 321,930,000 kWh listed above, developers will receive an additional $5,472,810 in tax credits.

Conclusion: while Bethany landowners will receive $175,000 in payments, $11,736,410 in electric fees and tax credits will be heading to the developer. Other analysis has produced similar numbers [A:G.3], [A:G.8], [A:G.11] which CWECS developers dispute without offering any unexposed costs of their own [A:G.4].

Many wind power producers try to sell their product on its environmental advantage – fewer emissions for our atmosphere. Yet even a quick analysis of their profitability leads us to more likely motives for large corporations to be involved with such projects. A simple revenue vs. expenses comparison nets us these numbers for the first year:

Costs:	
35 GE 3.5mW turbines:	$91,000,000
Annual Maintenance (first 10 years):	7,000,000
35 Landowner Payments:	175,000
Tax Credits:	
Federal Production Credit:	5,472,810
Federal MACRS Depreciation Credit:	18,000,000
Sales:	
321,930,000kWh x $0.05	16,096,500
Total:	-$58,605,690

Extrapolating over the six year MACRS deduction gives us:

Costs:	
35 GE 3.5MW turbines:	$91,000,000
Annual Maintenance (first 10 years):	42,000,000
35 Landowner Payments:	1,050,000
Tax Credits:	
Federal Production Credit:	32,836,860
Federal MACRS Depreciation Credit:	91,000,000
Sales:	
321,930,000 kWh x $0.05 x 6yrs	96,579,000
Total:	$86,365,860

While a community cannot zone for lost profits and tax dollars, we have located a number of suggestions made by and for communities such that at least some funds remain local.

PILOT payments should be of an adequate amount. Please see *§ G.6 – PILOT – Approach* for a detailed analysis. The Town may also wish to consider enhanced Operating Permit fees tied to the number of mW produced and/or negotiating an infrastructure improvement via incentive zoning. The Town of Bethany could potentially negotiate a town-wide water project as part of an incentive zoning package with any CWECS developer.

In relation to the lifespan of the project, it is recommended that any "annual" payments, whether to individual property owners or community agents, be contracted for a specified number of years and placed in escrow. Most ordinances are settling on 10 years as a compromise between the 20 years the developers are promising and the five to six year term of the bank loans and tax credits. This prevents the developer from abandoning their financial responsibilities along with the project when the tax credits dry up [A:G.13]. Ten years also tends to be a common length for electricity purchasing contracts, which makes the developer comfortable with that number [A:G.15].

With respect to the depreciated value of the structures over time, it is recommended that insurance covering full replacement value (not actual cash value) be required for the wind turbine during its entire production cycle. Should the structure be damaged after depreciation, any insurance policy which does not cover full replacement cost will likely leave the town and residents with an eyesore.

Recommendations: the Town should not attempt to override state tax shelters for wind farms, as they will have limited "on the books" income. Instead, negotiate fixed annual payments to the community in lieu of taxes and/or infrastructure improvements via incentive zoning. Contract any annual payments for a fixed number of years and place them in escrow. Require the developer and/or operator to carry full replacement value insurance on all CWECS facilities. Finally, word all contracts so that financial, community and legal burdens of the developer are passed unchanged to any and all subsequent owner/operators.

10. Success in Other Countries – Trends

Size

As turbines have improved technologically, the trend has been toward larger and larger turbines. One reason for this has been the US Government's research funding, which has been directed towards capturing wind in remote areas, allowing for larger

structures. Another reason is to escape wind disturbances caused by objects – both natural and man-made – along the ground. Either way, the trend is toward larger structures that capture wind at higher elevations. It is possible that any turbines introduced within the Town would eventually be repowered (replaced) with larger turbines.

As a counterpoint to this trend, European companies are introducing smaller turbines, specifically, rooftop designs. These standard horizontal turbines, about the size of a ground-mounted satellite dish, provide enough electricity to help offset the cost of the household bill. Londoners, in particular, have adopted this technology wholesale. It is not likely, however, that CWECS facilities would be replaced with this technology – it is not cost-effective on a larger scale.

Setbacks

Overall, the trend in setbacks is upward at a scale outdistancing the size increases of the turbines themselves. German setbacks ranged in the few hundred meters to begin with and have crawled upwards to averages of 1,980ft for 240ft hub height turbines. While wind power is among the safest electrical power generation methods, it is still an industrial method with some dangers. The only known mitigation for most dangers is an adequate setback.

In the UK, public resistance and planning agreement are thwarting the development of onshore wind farms. In 2003, the Irish government placed a moratorium on all onshore CWECS projects. David White, UK engineering consulting with years of research in wind power, believes that the bulk of new renewable capacity up to 2010 is likely to be offshore wind power.

H) Summary of Recommendations

Based on the information gathered, the committee recommends that the Town of Bethany immediately work to enact zoning legislation designed to protect the safety and quality of life for residents prior to considering any CWECS project(s). This legislation shall not draw a conclusion on the presence of CWECS within the Town of Bethany, but rather guide any such presence along safe, secure lines.

The Town shall provide a summary of precedent and existing zoning law to the Town attorney for liability review prior to the approval of any CWECS zoning.

This committee suggests the Town provide payment and restoration guidance to the landowners and/or include payment structure and restoration requirements into the Town contract or zoning statutes. A legal firm, *Stamp, Jackson and Procter*, have produced reasonably comprehensive guidelines for landowners in dealing with CWECS developers [A:G.6], which the Town may use as a template.

The Town shall keep abreast of the legal debate in Albany, to the extent that CWECS facilities may become public utilities. The Town may additionally publish such information via the Town website or newsletter for the benefit of local voters.

1. Planning Considerations

Siting

a) Turbines shall not significantly impair a scenic vista or scenic corridor as identified by the Town or other published source

b) The Town shall carefully review proposed CWECS projects from the standpoint of viewshed destruction and quality-of-life impact for nearby residents, perhaps utilizing a questionnaire to evaluate more esoteric concerns.

c) A Property Value Assurance plan should be required from the CWECS developer, written such that liability passes to subsequent owner(s) of the facility.

d) The Town shall evaluate potential disruption of crop dusting and recreational flight businesses prior to approval of any CWECS project.

e) The Town shall institute all setbacks in terms of a percentage of the turbine dimensions, with fixed footage as a minimum; e.g. "1500ft or 150% of the tip height, whichever is greater."

f) The Town shall require setbacks of at least 150% of the turbine tip height from any right-of-way, designated historic area, or wildlife area.

g) The Town shall establish a minimum setback distance between each turbine and overhead utility lines, roadways, public right-of-ways including marked trails, utility easements, and uninhabited structures, of no less than 165% of

the proposed hub height plus the rotor diameter.

h) The minimum setback distance between each wind turbine and dwellings, active places of business, and structures housing live animals shall be equal to no less than 450% of the tip height.

i) The Town shall specify a distance from occupied buildings and roadways sufficient to eliminate shadow flicker from such, as determined by a shadow map overlay and/or require turbines to be shut down during hours of flicker.

j) The Town shall implement language protecting wind rights, specifying a minimum setback distance between each wind turbine and adjoining parcels of no less than 150% of the tip height. The property line setback requirement may be reduced by the Town Board when it finds that the following circumstances apply: the owner of the parcel for which the reduced setback is sought executes and presents for recording a development easement satisfactory to the Town in which the reduced setback is consented to, and construction within, and use of, the easement area is appropriately restricted.

k) Access roads which cross agricultural fields will be located along ridge tops where possible to eliminate the need for cut and fill as well as reduce drainage problems. The Town shall consider the safe placement of new access roads.

l) In agricultural areas or by landowner request, structures will be located along field edges and in nonagricultural areas where possible.

Building

a) The Town shall notify any CWECS developers expressing interest of the seismic history of the town.

b) Wind turbines shall not be used for displaying any advertising except for reasonable identification of the manufacturer.

c) Colors and surface treatments of wind turbines shall be non-reflective in nature and minimize visual disruption

d) All cable shall be buried underground unless poles are in place to accommodate them at the time of the CWECS permit application.

e) The Town shall require that each turbine be clearly labeled with a postal address compatible with the 911 emergency system; visible from 500ft or from the nearest roadway / right-of-way.

f) The Town shall require a minimum distance of 30ft between ground level and any part of the rotor blade consistent with public safety.

g) The Town shall require an adequate conducting path from the tip of each turbine to the ground using a multireceptor system to help prevent lightning damage to turbines.

h) Flicker frequency shall be limited to less than 3Hz.

i) The Town shall require that the state's agricultural guidelines be adopted throughout the Town, regardless of the parcel's status as a certified Agricultural district.

j) The Town shall require the CWECS operator to notify local airstrip operators, crop dusters, recreational flight businesses and MercyFlight of proposed turbine locations and flight risk areas prior to construction.

k) The Town shall require the CWECS developer to select a configuration of minimal lighting which meets FAA requirements. Furthermore, each strobing light will be required to be equipped with an RF choke and an adequate neutral pursuant to IEEE 519 standards.

l) The Town shall require the CWECS operator, in addition to two-token authentication for Internet protection, to enact physical security protocols to the Town's satisfaction including remote intrusion monitoring.

m) The Town shall create an escrow account to compensate one or more salaried personnel who will oversee the CWECS project permitting, construction and decommissioning. The salaried personnel may also be responsible for reviewing regular maintenance reports during CWECS operation and serving as a liaison between the facility owner and residents.

2. Permit / Application Process

a) The Town shall require that any CWECS project receive clearance from the Niagara Falls Air Reserve Station prior to construction.

b) The Town shall require the CWECS applicant to place funds in escrow sufficient for the Town to conduct engineering and legal evaluations as outlined below. The Town shall choose the engineering firm(s) and attorney(s); the applicant will have no contact with them.

c) The Town shall require any CWECS developer to post a separate surety bond or other financial instrument with annual escalation factor of sufficient value to fully decommission a turbine for each turbine constructed.

d) The Town shall require any CWECS developer to generate a suitable agreement with each landowner giving right-of-way to overhead or underground transmission lines as to the final disposition of those lines, and shall post a surety bond or other financial instrument for each property owner who requires removal of these lines.

e) The Town shall require that the CWECS applicant and at least one independent engineering firm produce a complete report on the likely effect of seismic activity consistent with historical data on each proposed wind turbine and all associated facilities.

f) The Town shall require the CWECS applicant and at least one independent engineering assessment of possible hydrologic impacts and that the CWECS project commence in a manner consistent with minimal anticipated impact.

g) The Town shall require the CWECS applicant and at least one independent engineering assessment of possible noise impacts – both audible and infrasound. The CWECS project shall commence in a manner consistent with decibel limitations.

h) Any impact reports submitted with application should address proposed routes, overhead obstructions and any necessary electrical or communications lines changes that would be made.

i) The Town shall request a legal review of each permit application and response from an attorney of the Town's choice, at the expense of the CWECS developer.

j) The Town may require any CWECS developer to provide the turbine fire-fighting equipment and fire department training at its own expense.

k) The Town shall negotiate fixed annual payments to the community in lieu of taxes and/or operating permit fees and/or infrastructure improvements via incentive zoning. Any annual payments will be contracted for a fixed number of years and placed in escrow.

l) All contracts between the Town and the applicant will be so worded that financial, community and legal burdens of the developer are passed unchanged to any and all subsequent owners/operators.

3. Construction

a) The developer shall be required to submit regular scheduling reports to the Town, indicating work completed to date, in progress and scheduled; this report shall include locations, construction routes and impacted property lots.

b) The Town shall specify a limit on hours of heavy operation to a reasonable time frame such as 7:00am to 6:00pm with no Sunday or holiday hours.

c) The Town shall require the developer to submit proposed construction routes to the Town for approval and submit a surety bond or other financial instrument to ensure that road repair is completed.

d) The Town shall require construction site monitoring and inspection by a professional who is independent of the project developer for effective storm water and erosion management control.

e) Construction activity, including soil stockpiles, shall be limited to a specified area agreed upon by the developer and landowner. No construction equipment or personnel shall be found on private property outside of this designated area.

f) All topsoil will be stripped from work areas (tower sites, parking areas, open-cut electric cable trenches and along access roads) and stored separately from other excavation material. At least 50ft of temporary workspace will be alloted along open-cut trenches to allow for topsoil segregation.

g) An independent oversight agency or project manager should be required to actively monitor and address dust levels via standard construction techniques.

h) A minimum depth of 36in of cover will be required for all buried cables in unimproved grazing areas and land permanently devoted to pasture. A minimum depth of 48in of cover will be required for all buried cables in other locations. In areas where the depth of soil over bedrock ranges from 0 to 48in, the electric cables shall be buried entirely below the top of the bedrock or at the depth specified for the particular land use, whichever is less. At no time will the depth of cover be less than 24in below the soil surface.

i) All excess subsoil, rock and construction debris will be removed from the site. On-site disposal of subsoil and rock may be allowed if approved by the landowner and the Town project monitor.

j) The Town shall require the developer to create a new property survey map for each impacted parcel, showing the location of any underground features of the CWECS, including but not limited to concrete bases and buried cables.

3. Pre- and Post-Construction Testing

a) The developer shall be required to restore all roads to county or town specifications, as appropriate, within one month of the developer's last use of such road.

b) The Town shall require compensation and/or infrastructure improvements to offset any actual hydrologic impacts. This may include the construction of water systems to replace destroyed aquifers.

c) The Town shall require the CWECS developer to restore television, cell phone and wireless network signals to pre-construction levels at its own expense.

d) The Town shall require the CWECS developer to mitigate any unexpected shadow flicker effects at its own expense.

e) Pre-construction modeling and post-construction noise testing will be conducted to determine any adverse effects. The CWECS developer shall mitigate any unexpected noise impacts at its own expense.

f) Disturbed areas will be decompacted to a depth of 18in. In areas where the topsoil was stripped, soil decompaction shall be conducted prior to topsoil replacement.

g) All access roads will be removed or regraded to allow for farm equipment crossing and drainage issues.

h) All restored areas will be seeded with native vegetation of local provenance, satisfactory to the landowner.

i) All surface or subsurface drainage structures damaged during operations shall be repaired.

j) All parts and construction debris will be removed from the site.

4. Operations

a) The Town shall require and issue annual operating permits, with appropriate fees, to each turbine; operating permits shall be renewed based on the operator's compliance with all stated regulations.

b) The Town shall require any CWECS project to meet IEEE 519 standard at any time that they are operating.

c) The operator shall be required to carry full replacement value insurance on all CWECS facilities at any time that they are operating.

d) The Town shall require the facility Operator to submit regular maintenance reports including oil pressure checks.

e) The Town shall require the facility Operator to submit critical maintenance reports following any instance of lightning, fire or structural damage.

f) The Town shall require the facility Operator to notify the town of any turbine which has sat idle for more than three months.

5. Decommissioning

a) The Town shall require all construction constraints present during installation to apply during decommissioning, including inspections, oversight and hours of operation.

b) Disturbed areas will be decompacted to a depth of 18in. In areas where the topsoil was stripped, soil decompaction shall be conducted prior to topsoil replacement.

c) All access roads will be removed or regraded to allow for farm equipment crossing and drainage issues.

d) All restored areas will be seeded with native vegetation of local provenance, satisfactory to the landowner.

e) All surface or subsurface drainage structures damaged during operations shall be repaired.

f) All parts and construction debris will be removed from the site.

I) Catalog of Attachments

These attachments can be found at the Town Hall in Bethany. A duplication fee may apply for those wishing to obtain a take-home copy.

D.1: Wind Committee Questions, a list of questions and answers between the Stafford Wind Study Committee and UPC Wind Partners.

D.2: Letter to Warsaw Town Board from David Bassett, a letter from a wind-electric equipment patent-holder on the suitability of CWECS installations in small towns.

E.1: Letter to Susan Sliwinski from NewAcoustics of Scotland, a letter detailing noise rulings and possible resident impact.

E.2: White Paper: Wind Farms and their Effects on Public Safety Radio Systems by LJK Wireless Communications Engineering. An analysis of wind turbine effects on public safety, utility and governmental microwave systems.

E.3: News Story: Man Dies in Wind Tower Fire, an account of a recent South Dakota accident involving maintenance workers.

E.4: News Story: Lightning Strikes Wrecks Searsburg Turbine Blade, an account of repeated lightning damage to a CWECS facility and steps local officials are taking to investigate.

E.5: The Beat is Getting Stronger: The Effect of Atmospheric Stability on Low Frequency Modulated Sound of Wind Turbines by G.P. van den Berg. An article on the variations in wind turbine noise caused by the atmosphere/weather.

E.6: Relationships Between Bats and Wind Turbines in Pennsylvania and West Virginia by the Bats and Wind Energy Cooperative. An assessment of fatalities and behavioral interactions between bats and wind turbines.

E.7: Shawano County Measurement Protocol for Sound and Vibration Assessment of Proposed and Existing Wind Energy Conversion Systems. A planning paper outlining best practices for assessing wind noise levels.

E.8: Journal Article: Alberta Bat Fatalities Studied. A summary of the experiences of *Vision Quest Windelectric*'s bat research.

E.9: CBC Technology Review: Effects of Windmills on Television Reception. An article describing signal degradation as measured before and after a CWECS installation.

E.10: Journal Article: Lightning Protection Sought for Wind Turbine Blades by John Korsgaard and Ivan Mortensen. An analysis of different methods of protecting turbines from lightning with their efficacy.

E.11: FAR Part 77 – Obstructions to Navigation by Dr. A.A. Trani, Virginia Tech.

A power point presentation outlining airport planning and describing the size/distance of objectionable features.

E.12: Risk Analysis of Ice Throw from Turbines by Henrie Siefert, Annette Westerhellweg and Jurgen Kroning. An analysis of actual ice throw to determine approximate range for future projects.

E.13: News Article: More Attention Must Be Paid to the Harmful Effects by Dr. Amanda Harry. A medical analysis of noise and flicker effects by a local UK doctor.

E.14: Obstruction Marking & Lighting (AC 70/7460-1K) by the FAA. Regulations concerning the lighting of wind turbines.

E.15: International Association of Firefighters (IAFF) Votes to Study Health Effects of Cell Towers on Fire Stations by Susan Foster Ambrose, M.S.W. A resolution for to study the health effects of RF radiation below cell towers and a moratorium on cell towers over fire stations.

E.16: Eliminating Electrical Pollution Caused by Cell Towers by David Stetzer of Stetzer Electric. Suggested wording for a zoning ordinance to require cell towers be compliant with IEEE 519.

E.17: Photosensitive Epilepsy - Other Possible Triggers by Professors G Harding (Aston University, England) and S Seri, 28 October 2005. Recommendations on lower limits for wind turbine shadow flicker.

E.18: Ordinance for Regulating Energy Generation Using Wind Power in Benton County, Indiana. Drafted by The Advisory Plan Commission. Although this draft version is incomplete, it includes useful language on road routes and repair.

E.19: Self-Guided Tour to the Wind Farms of the Tehachapi Pass by Paul Gipe. A description of the Tehachapi Pass which includes several fields of abandoned CWECS facilities.

E.20: Land Use and Zoning Issues Related to Site Development for Utility Scale Wind Turbine Generators. A Michigan State University Extension analysis.

E.21: European Best Practice Guidelines for Wind Energy Development by the European Wind Energy Association. Statements about more recent setback increases.

E.22: Health, Hazard and Quality of Life Near Wind Power Installations: How Close is Too Close? By Nina Pierpont, MD, PhD. An analysis of health risks near CWECS facilities.

E.23: Stafford Citizens Wind Committee Report.

E.24: Letter to the Bethany Wind Committee. By Douglas Beattie. An analysis of avian risk to the area.

E.25: Letter from landowners near a CWECS facility by Julian & Jane Davis.

E.26: Putting Wind Power's Effect on Birds in Perspective by Mick Sagrillo. An

analysis of avian impact.

E.28: Why Avian Impacts are a Concern in Wind Energy Development by Gerald Winegrad, American Bird Conservancy. An analysis of avian impact.

E.29: Letter from David Stetzer of Stetzer Electric. An analysis of ground current and its possible impact on people and animals.

F.1: Letter sent to 18 Landowners in Stafford by Arthur J. Giacolone. A legal opinion that turbines may constitute a 'private nuisance.'

F.2: Amended and Restated Lease for Construction of Wind Turbine Generators. A sample lease agreement from the Maple Ridge project.

F.3: Neighbor Agreement and Grant of Easements. A sample 'nuisance payment' agreement from the Maple Ridge project.

F.4: Siting Wind Farms in New York: Applicability of the Relaxed Public Utility Standard by Patricia E. Salkin and Robert Burgdorf. An analysis of the potential for declaring CWECS facilities to be public utilities for zoning purposes.

G.1: Guidelines for Agricultural Mitigation for Windpower Projects by NYS Department of Agriculture and Markets. A set of best practices for preserving agricultural land throughout the construction process.

G.2: Wind Energy Economics in the State of Washington by Glenn R. Schleede. An analysis of cost/benefits to an area when a wind facility moves in.

G.3: Golisano's Numbers by Tom Golisano. An analysis of the profitability of commercial wind facilities.

G.4: News Article: Invenergy officials dispute Golisano Numbers. A rebuttal by Invenergy, a CWECS developer.

G.5: News Article: Questioning Property Values. An example of a town board requiring a property value protection plan as part of a proposed CWECS facility.

G.6: Wind Turbine Land Leases and Options. A client briefing note from Stamp, Jackson and Proctor. Guidelines for landowners in dealing with CWECS developers.

G.7: Letter from Noble Environmental to residents in the Town of Altona. A sample letter requesting relaxed setbacks from neighboring properties.

G.8: Local Reaction to the Eco-Northwest "Economic" Study of Wind Farms. A study review by the Preservation League of New York State, analyzing Zilkha's economic study prepared for the Kittitas Valley; pointing out flaws to look for.

G.9: Canastota Wind Power Property Value Assurance Plan. A sample property value assurance agreement.

G.10: Testimony of Russell Bounds, Banking and Mortgage Expert. The deposition of a mortgage expert on the probability of property value changes following a CWECS installation.

G.11: Tilting at Windmills: the Economics of Wind Power by Professor David Simpson of the David Hume Institute. An economic analysis of CWECS projects in the UK.

G.12: US Title 26, 168: Accelerated Cost Recovery System. Rules for applying MACRS to CWECS facilities.

G.13: Letter to M. Stolzenburg from NYSERDA. Verifying landowner and town payments can be and are contracted for a specified number of years.

G.14: Danish Wind: Too Good to be True? By David J. White. An analysis of the overall effectiveness of wind power in Denmark.

G.15: Why Should Minnesotans Subsidize the Burning of Poultry Manure? By David Morris. Testimony for wind operations in Minnesota.

G.16: Electricity Output from the Maple Ridge Windplant; July, August, September 2006 by Richard Bolton, Environmental Compliance Alliance. An analysis of actual electrical output.

G.17: Wind Makes Food Retailers Greener by Janet Raloff. Includes some basic information, validated elsewhere, about the extra cost of wind power.

J) Committee Background

Francis Ashley (Chair): a resident of Bethany for over thirty-seven years, Francis is a retired financial executive with a BS in Accounting and experience in public accounting, not-for profit organizations, manufacturing and petroleum distribution. His community service includes several terms on the *Pavilion Central School Board of Education* as well two terms as assessor for the Town of Bethany; he has also been active as a Little League baseball coach.

Steven Breckenridge: a resident of Bethany for fifty-one years, Steven is currently Warehouse Supervisor for Oatka Milk Cooperative in Batavia and has served four years on the Batavia City Council. He has two grown daughters, both schoolteachers.

Geoffrey A. Briggs: a resident of Little Canada for thirty-six years, Geoff is a retired Junior-Senior High School Earth Science teacher; a science writer, curriculum writer, and consultant for The New York State Education Department; and an American Meteorological Society Atmospheric Education Resource Agent. His research includes many interviews of local residents at Tug Hill, Wethersfield and others; he has produced a 28-minute DVD of interviews regarding the effects of turbines on nearby residents. Geoff is a former President of the *Genesee County Landmark Society* and currently sits on the *Black Rock Watershed* committee.

Ramon J. Cipriano: a resident of East Bethany for fifty-two years, Ray received his MS and PhD in Atmospheric Science from *State University of New York at Albany*, adding research credentials to his teaching certifications B.A. Physics and M.S. Secondary Education, Physics from *State University of New York at Geneseo*. Ray served with the US Army at NATO Supreme Headquarters in Belgium from 1969-1971. He is active with the *Bethany Fire Department* and a volunteer for *LeRoy Ambulance*, as well as serving on the *Bethany Planning Board* and *Assessors Review Board*.

Loy Ellen Gross: a resident of Little Canada for nine years, Loy is a computer consultant by trade with experience in a wide variety of technology. Relevant experience includes ten years as Marketing Director for a technology firm, newspaper editor in Niagara Falls and technical writer for several publishers of training material. Her research on commercial wind turbines spans at least two years. She is a mother of two, active in the local church and the PTO; as well as a member or former member of the *Wyoming County Chamber of Commerce*, *GO-Art Grant Advisory Committee*, *Greenpeace, World Wildlife Fund*, *Sierra Club* and the *Trust for Public Land*.

Jim Hinkson: a resident of Bethany for eighteen years, Jim works for *Gottogo Electric* in customer service, inside sales, inventory maintenance, and billing/receiving. *Gottogo* has and does work with distributors that provide materials (primarily cable) to some wind farms. He is a former member of the *Bethany Fire Department*.

Paul A Lewis: a resident in Bethany for over fifty-seven years, Paul has a degree in Mechanical Engineering and retired in 2005 as Director of Inspection Services at *Constellation Energy's* Ginna Station Nuclear plant. Paul is the *Quality Inspection Services* Operations Manager for the Rochester facility and Director of Nuclear Services for all plants in the US. His involvement with wind turbines has led to many hours of research over the past two years. Paul has a wife and one son and is active as the Scoutmaster for *Boy Scout Troop 650* and active in the church as well as many other business and community organizations.

K) Acknowledgments / Signoff

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Scott Rowland, VP Construction and Engineering, UPC Wind Partners
Chris Swartley, UPC Wind Partners

And many others. This report is factual to the best of our knowledge on the date it was completed.

Respectfully submitted,

Francis Ashley – Chair	Geoffrey A. Briggs
Ramon J. Cipriano – Planning Board	Loy Ellen Gross
Steve Breckenridge	Jim Hinkson
	Paul A. Lewis