Findings and Recommendations
Orleans Citizens Wind Committee

Part One

A. Shadow Flicker/Safety Setbacks
B. Noise/Sleep Interference

August 13, 2009

After thoroughly studying the Scientific Facts this document represents the Consensus Findings and Recommendations of the Orleans of the Wind Committee concerning the Health and Safety aspects of Wind Farms concerning Shadow Flicker, Safety Setbacks, Noise and Sleep Disturbance.

The remaining Consensus Findings and Recommendations relating to ***Stray Voltage, Construction Disruption, Earthquake Seismic Effects, Fire Risks & Fire Department Needs, Ground Water Impacts & Protection of Aquifers, Lightening Protection ,Lighting Turbine Towers, Storm Water and Runoff Erosion, Road Upkeep & Repair, Security (Vandalism/Terrorism) and Radon*** are under preparation and will be added later to this initial document.

The Orleans Wind Committee strongly recommends that ***the principal Heath and Safety considerations of Shadow Flicker, Safety Setbacks, Noise and Sleep Disturbance*** be given priority in updating the current Orleans Wind Law.

The Committee fully realizes that the Town Board may want to discuss and understand the Wind Committee's Recommendations and Findings with the Committee and encourages the Board to meet with them to discuss the Findings or Recommendations.

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J. Stephen Bingeham Chair ***Judy Tubolino, Vice Chair***

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Patricia Booras-Miller ***Rosemary Forbes***

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William Di Trinco ***Darryl Hyde***

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I. Orleans Citizens Wind Committee Members 2009

Committee Background: The Orleans Wind Committee was established by the Town of Orleans two years after the town established a local wind ordinance in 2007. The Town of Orleans does not have a present wind developer application however; they do have a portion of the town in the Horse Creek Wind Project under the lead agent Town of Clayton. This committee is charged with taking a serious review of the present Health and Safety Standards for protection in the town's local law and review these Standards to see if, in their present form, still adequately protect the residents in the Town of Orleans for the future. This committee is charged to make recommendations to the town council if these Standards do not protect Town of Orleans residents adjacent to the wind turbines.

Mr. J. Stephen Bingeman (Chair): A resident of Orleans for thirty five years and resides in LaFargeville. Steve served in the U.S. Army and is a semi-retired tractor trailer driver. Steve is married and has four children and fifteen grandchildren and two great-grandchildren. Steve has served the Orleans community for 21 years on LaFargeville Volunteer Fire Department and served as a Lieutenant of the rescue ambulance squad.

Mrs. Judy Tubolino (Co-Chair): A resident of the Town of Orleans for thirty nine years. She is a family member of a third generation of land owners in Orleans. She is a Real Estate Broker and currently manages a real estate office. She is a wife, mother and grandmother. Judy has served previously for over nine years as an Assessor for the Town of Orleans.

Mrs. Patty Booras-Miller: A resident of the Town of Orleans for nine years. She moved to Orleans after retiring as a healthcare administrator for over 32 years of service in general, vascular and thoracic surgery in a practice in Watertown, NY. She recently retired as teacher in healthcare management. Before moving to Orleans, she was involved in many civic community affairs in Watertown and Jefferson County. She has been active in the Girl Scout movement serving as advisor and leader for 30 years.

Mrs. Rosemary Forbes: A resident of the Town of Orleans for forty years. She is married with three children and has grandchildren. She is a fourth generation member of landowners in the Town of Orleans. She is active with the Stone Mills Agricultural Museum, Orleans Library and is a Cub Scout Pack leader. She provides children's day care in her home for over twenty years. She is a past member of the Evans Mills Improvement League, Evans Mills Library board of trustees, and helped run the Evans Mills preschool program.

Mr. William DiTrinco: A resident of Orleans for three years after having moved from our neighboring town of Hammond where he and his family had lived for 30 years. He is a land owner and a previous dairy farmer. Bill owns and operates St. Lawrence Home Building Corporation on Wellesley Island. He is a father of two children and has grandchildren.

Mr. Darryl Hyde: A resident of the Town of Orleans all his life. Darryl and his wife of 45 years, Sue have raised four children in this community. He is strong advocate to see that our town continues to strive for the next generation of residents. "Resident must make things better for our town, for our residents, for our next generation to thrive and grow here." Darryl and Sue have nine grandchildren. Darryl was a member of LaFargeville Rescue Squad for 27 years Darryl has worked in sales for over forty years traveling to all areas of New York State.

Subjects shown in Purple will be part of a later submission to the Board

II. Environmental / Health & Safety Considerations

A. Shadow Flicker & Safety Setbacks

B. Noise/Sleep Interference

C. Electronic & Electromagnetic Interference

D. Stray Voltage AKA Ground Current

E. Construction Disruption

F. Earthquake Seismic Effects

G. Fire Risks & Fire Department Needs

H. Ground Water Impacts & Protection of Aquifers

I. Lightening Protection

J. Lighting Turbine Towers

K. Storm Water, Runoff Erosion

L. Road Upkeep & Repair

M. Security (Vandalism/Terrorism)

O. Radon

Numerous documents were reviewed by the committee to substantiate the committee's conclusion for the recommendation. (See Chapter IX) The committee offers the council two formats for referencing the documents; hardcopy and a CD.

Hardcopies are provided in a ***separate catalog*** of documents listed under each category of discussion. Each ***URL*** is referenced in dark blue and underlined. Each document referenced in light blue indicates the document is a pdf and on a CD disk.

III. Introduction and Scope

This report represents the consensus of the Orleans Wind Turbine Study Committee.

This committee submits to the Town Board the ***First Part*** of our Findings and Recommendations for revisions to Local Law No 1 2007 ***covering Noise, Safety Setbacks , Shadow Flicker and Compliance.***.

This ***First Part*** of our Findings and Recommendations document is submitted to the Town Board for your review and action.

The ***Second Submission*** will consist of Findings and Recommendations that this committee thinks could better serve both the Town and residents in protection from Health and Safety impacts. These recommendations will be listed in these categories:, Electronic & Electromagnetic Interference, Stray Voltage AKA Ground Current, Construction Disruption, Earthquake Seismic Effects, Fire Risk & Fire Department Needs, Ground Water Impacts & Protection of Aquifers, Lightening Protection, Lighting Turbine Towers, Storm Water, Runoff Erosion, Road Upkeep & Repair, Security (Vandalism/Terrorism) and Radon.

You, the elected officials of the Town are charged with the protection of the Health, Safety and Welfare of the Orleans Community.

The Wind Committee's charge was to examine the Health and Safety considerations in the present Local Law No 1 2007 for Wind Facilities. This committee is charged with making recommendation to the town board for revisions and/or adoption to this law if the present recommendations do not adequately protect residents in Orleans who reside adjacent to industrial wind turbines.

This committee is charged to review such recommendations with substantiated facts and references that demonstrate to this board the committee's recommendations do warrant change.

And we struggled to look at the big picture rather than just the little picture.

It appears to the Wind Committee that while Health and Safety are paramount considerations, the issues of Citizens' Welfare appear to us to have overriding considerations you should also consider.

The committee thinks that the ordinance should follow the spirit of:

If you break it…you must fix it

If you can't fix it ….you must provide just compensation

The Wind Companies should respond and be accountable to the town, not the other way around.

Members of this committee would encourage the Boards to Act not just React by considering also that ***Annual Operating Renewal Permits*** should be dependent on satisfactory compliance to the Town Board Ordnances.

Orleans should seriously consider establishing a Complaint Committee reporting to the Town Board to effectively and fairly deal with Citizens complaints.

Our understanding is that currently Wind Companies are provided the legal rights of real people in most Local Wind Ordinance.

Our understanding is that if you don't designate the Wind Companies as People, then you make the rules.

If you evoke the proper NYS Environmental Laws, ***Home Rule*** will provide the necessary legal protection. It is suggested that you have your revisions reviewed by a Lawyer proficient in Environmental Law and the Jefferson County Planning Department. This can be accomplished if you pay strict attention to Current NYS Environmental Law in your revision of the current Orleans Wind Law.

And that can minimize legal threats from most of your considerations.

While many of the suggested modifications to the local law may make the proposed Horse Creek wind facility impossible to implement fully, this committee believe the changes are necessary to protect the residents of our town.

Members of this committee all agree the overlay district selected was not the best location due to the number of homes and residents in such a small area. To correct this there may be two solutions:

- Establish a new overlay district or
- Have no overlay district at all, allowing the entire township for consideration

Regardless, as long as the modifications we are suggesting are incorporated into our local law, residents will be protected regardless of what area of the town a wind facility is proposed.

This committee strongly suggests the town board invite others like Keith Pittman http://www.empirestatewindenergy.com/ Empire State Wind Energy LLC and Ms. Hester Chase, a Town of Cape Vincent resident who recommends local owned wind development programs, to give a presentation of a different approach to wind development. They may give the town another option in which the town has more control over the placement of the facility and at the same time the town and the residents of the town would share in the profits and benefits.

Much of this report has been derived from other reports that the committee found very helpful to our own understanding of the facts and scientific basis for the Health and Safety recommendations regarding Wind Energy Conversion Systems (WECS) in their Towns.

Within this report are the findings of the Committee to date, outlining the consensus recommendations for dealing with the potential impact Health and Safety issues in regard to possible future wind farm development in the Town of Orleans area.

To facilitate the gathering, compilation, review and understanding of available information on WECS, the Town selected a citizens committee comprised of six (6) land owners, to represent the diverse interests, occupations and viewpoints within the Town.

Consensus Committee recommendations, written 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 the last part

of this document. ***Suggested Wording for a Revised Orleans Wind Ordinance That Follows the Spirit of the Wind Committee***

Members of this committee have invited in depth talks by professionals versed in Wind Farm Planning, Forensic Engineering, Turbine Safety and Low and High Frequency Noise which included question and answer sessions

Members of this committee studied other town ordinances including Towns like Bethany, NY and the Town of Union, WI which are similar to the Town of Orleans which is rural in nature.

Members of this committee think that the conclusions of these reports are also for the most part, applicable for the Town of Orleans, and perhaps for towns with similar configurations, 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 studied 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.

This committee does however encourage the Town not to just react to the current Wind Farm Issue but to act in a way that is a win-win for the whole community.

This 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 ongoing discussions in Albany for placing wind development in rural communities. 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 before any pending State Legislation is passed;*** and let Albany take legal liability for any actions they may override in the future.

IV. Work to Date

This committee was formed in December 2008, and had started meeting biweekly during the months of Jan to March 2009. Since April 14, 2009 we have been meeting on a weekly basis to critically examine the available information surrounding the issues of health and safety and to report our findings back to the Orleans's Town board.

To accomplish this we began by scheduling and publically advertising information presentations where everyone was welcome to participate. .

Altogether, committee members have reviewed countless documents, newspaper articles, and web pages, local, state, federal and international reports.

Committee members have served as a sounding board for each other, examining all evidence critically. We have invited and spoken with many experts with experience in industrial wind turbines safety and noise issues, including Rick James, Dr. Paul Carr, Cliff Schneider, Keith Pittman and Chuck Ebbing.

Committee members Patty Booras-Miller, Judy Tubolino, Darryl Hyde and Cindy Grant participated in many trips to Maple Ridge Wind Farm facility. During these trips committee members viewed many working turbines observing the sounds, the sights and shadow flicker. They also interviewed local residents. Darryl Hyde has made many trips to view the Cohoctan Wind Project.

Committee members Steve Bingeman, Darryl Hyde, Patty Booras-Miller, Judy Tubolino and Cindy Grant have spoken with town officials from other townships that are in different stages of industrial wind development gaining their experiences and knowledge for wind development in their communities. These committee members have also attended industrial wind informational meeting/presentations -both pro and con

This committee has identified a list of significant issues/concerns that are not adequately addressed in Orleans current wind law/ordinance. These issues/concerns are listed in this document to be considered by this board in revising Orleans Local Law No 1 2007 for Wind Facilities.

V. Information on Committee Research:

During our investigations and research in acoustics we requested the advice of many professionals and documents.

This committee is fortunate to have the help of our own retired Acoustical Engineer Chuck Ebbing. Chuck wears two hats in assisting us:

One, as our Facilitator keeping us focused on our agenda and secondly, as a Practicing Acoustical Engineer and Educator at RPI and Syracuse University. He helps this committee with interpretations and other engineering noise issues.

This committee did not only rely entirely on Chuck's interpretations and analogies of the Tocci & Cavanaugh and the Horse Creek noise reports, we also turned to other acoustic professionals. We resourced factual documents by many Federal, State and International Agencies. We viewed reports by other wind committees such as the Bethany Report bethany-windturbinestudycommittteereport.pdf and Union, WI for Large Wind Facilities Town of Union Wind Energy Licesensing Ordinance 2008-06-1.pdf. We accumulated and researched other local wind laws across NYS as well as other states.

We reviewed at length our own New York State DEC's report Assessing and Mitigating Sound Impacts DEC guidelines noise2000 .pdf and the extensive report by Kamperman & James October 28, 2008 Version 2.1 "The How To Guide to Criteria For Siting Wind Turbines to Prevent Health Risks From Sound" 08-11-02 Kamperman-James Ver 2 1 (Orleans) Noise Criteria for Siting Wind Turbines 2.1 .pdf. The committee viewed the document "Public Health Impacts of Wind Turbines" by the State of Minnesota's own Department of Public Health, Environmental Health Division dated May 22, 2009 Public Health Impacts of Wind Turbines pdf.

Rick James of E-Coustic Solutions answered questions over the phone from both the Wind Committee and a large audience.

This committee consulted with and heard presentations on acoustic impacts related to industrial turbines directly from:

Dr. Paul Carr, of Bernier & Carr
Rick James of E-Coustic Solutions
Chuck Ebbing, Ebbing Acoustics

Cliff Schneider, NYS DEC Retired

We also have read about, listened, and talked to residents living near wind facilities who face the intrusion and sleep depravations caused by excessive noise intruding into a very quiet rural community.

Unfortunately wind turbines when placed in populated areas don't co-exist easily with the people. :

VI. Summary Findings

The committee finds that WECS facilities have both positive and negative impacts on any Town. Our recommendation is that the Town work to accentuate the positive impacts while trying to eliminate significant negative impacts in consideration of any WECS project.

A preferred approach would include both the consideration of the best ways in which to locate any proposed wind farms to minimize complaints, and secondly develop ordinances that result in a win-win outcome so that the entire community and Town really benefit, not just a few.

These efforts should include examination of the applicable areas in Orleans that might be suitable for development, remembering that Industrial Sized Wind Farms and People do not coexist easily in populated areas.

Based on the information gathered, the Committee recommends that the Town of Orleans immediately work to enact zoning legislation designed to protect the Health, Safety and Quality of Life for Town of Orleans residents prior to seriously considering any WECS project(s).

This legislation should not draw a conclusion on the presence of WECS within the Town of Orleans, but rather guide any such presence along safe, secure lines. The goal should be to answer the question: In what ways can Orleans intelligently utilize wind energy rather than just reacting to permit applications?

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

In addition, the committee offers its continued assistance to assist the Planning Board and/or Town Board in creating such zoning legislation.

A. General Findings:

Wind energy is a potential renewable and nonpolluting energy resource of the Town of Orleans and its conversion to electricity, if judiciously implemented may reduce dependence on nonrenewable, conventional energy sources and decrease the pollution that results there from. However, wind energy facilities should be sited in a way that protects the health and safety needs of the Town of Orleans residents residing near the large wind turbines, as well as the general public. Populated areas and wind farms have not co-existed well together. It is wise to carefully examine the parts of Orleans that would minimize these problems.

The regulation of the siting and installation of large wind turbines is necessary to protect the health, safety and welfare of the residents of the Town of Orleans and the general public adverse health and safety issues are likely to arise if appropriate standards, guidelines and setbacks are not followed in the siting and installation of large wind turbines.

It is appropriate to consider as relevant, recommended best practices for large wind turbines from international organizations that have more experience with the use, siting and installation of large wind turbines than the U.S.

Wind turbine accidents have occurred involving ice throws, blade disintegration, fire and tower failure. According to the Caithness Windfarm Information Forum, from 1999 through June 2008pdf there were over 500 accidents around the world, including North America, involving ice throws, blade disintegration, and fire and tower failure from large wind turbines.

There should be strict meaningful penalties for the developer should they violate these requirements and standards.

The setback distances that will be required to meet the noise provisions will significantly exceed the setback distances required by Safety and Flicker.

This has been true in all the unbiased assessments of community noise we have uncovered.

B. Findings Regarding Wind Turbine Noise Impacts:

This committee concludes that the sound pressure level ("SPL") of 50 dBA set forth in the Orleans Wind Ordinance No 1 2007 does not adequately protect town residents from the adverse health effects associated with large wind turbine noise. It also finds that in all cases that it investigated, the required setback distances required to meet the satisfactory noise safety standards was always significantly larger than those required to meet the required safety setbacks to avoid potential harm to people from ice throw or parts of failed turbine blades impacting on homes or people.

Large wind turbines are significant sources of noise, which, if improperly sited, can negatively impact the health of residents, particularly in rural areas of low ambient noise levels such as the Town of Orleans.

Large wind turbines emit two types of noise -- 1) Aerodynamic noise from the blades passing through the air, which can generate broadband noise, tonal noise and low frequency noise; and 2) Mechanical noise from the interaction of the turbine components. A dBA scale is commonly used to measure audible wind turbine noise. Low frequency noise from large wind turbines is not adequately measured with a dBA weighting. In order to evaluate the low frequency noise it will be necessary to use a dBC scale. For a better assessment of the health effects from low frequency noise, the World Health Organization ("WHO") suggests using a dBC weighting. (See Rogers 1/2006; Alberts 11/20/2005; WHO 1999 pdf)

Noise is an annoyance that can negatively impact health, producing negative effects such as sleep disturbance and deprivation, stress, anxiety and fatigue. WHO defined annoyance as a feeling of displeasure associated with any agent or condition believed by an individual to adversely affect him or her. According to

WHO, ***health*** should be regarded as a state of complete physical, mental and social wellbeing, and not merely the absence of disease or infirmity. Under this definition, noise has a significant impact on the quality of life and noise annoyance is an adverse health effect. (See WHO 1999, Ch. 3.7; Dr. Harry 2/2007; Pedersen & Waye 2/27/08 pdf)

Large wind turbines create a noise annoyance that can hinder physical and mental healing and can cause adverse health effects associated with sleep disturbance and deprivation, psychological distress, stress, anxiety, depression, headaches, fatigue, tinnitus and hypertension. Wind turbine noise can affect each person differently. Some people are unaffected by wind turbine noise, while others may develop adverse health effects from the same noise. At very low frequencies, wind turbine noise may not always be heard but rather felt as a vibration of the chest cavity. Medical research reported complaints from people who felt the noise from large wind turbines to be similar to symptoms associated with virbroacoustic disease. (See Pedersen et al 3/1/2007, 8/2003, 1/11/2008 and 6/3/2008; Pedersen 2007; Mariana Alves-Pereira and Nuno Castelo Branco 9/20/2007; WHO 1999; Kamperman & James; reports by Dr. Pierpont, Dr. Harry and Dr. Leventhal, State of Minnesota Department of Public Health "Public Health Impact of Turbines" pdf)

The risk of adverse health effects resulting from 24/7 annoying noise and the lack of adequate recuperative sleep results in symptoms. These include headaches, stress, anxiety, fatigue, depression, pain and stiffness, and decreased cognitive ability associated with sleep deprivation from wind turbine noise. These risks increases with increasing A-weighted sound pressure levels. According to wind turbine noise studies, few respondents were disturbed in their sleep by wind turbine noise at Sound Pressure Levels less than 35 dBA; however, at SPL greater than 35 dBA respondents were increasingly disturbed in their sleep by wind turbine noise. (See Pedersen et al 6/3/2008 and 8/2003 pdf)

Wind turbine noise greater than 5db over the residual ambient increases the risk for adverse health effects because an increase of 5 dB is clearly noticeable. (See Kamperman and James pdf)

Studies show that prolonged exposure to wind turbine noise resulted in adverse health effects at SPLs below those from other sources of community noise, such as road traffic noise. Noise generated 24/7 by wind turbines has characteristics that creates ***disproportionate annoyance impacts*** which result in health impacts ***far greater*** than that compared to urban, industrial or commercial noise. (See Pedersen et al 6/3/2008 and 8/2003; Soysal 2007) also Bajdek Noise-Con 2007 pdf)

Living in a rural environment, in comparison with a suburban area, increases the risk of residents being impacted by noise from nearby large wind turbines because of the low ambient SPL in rural environments. Data taken in the North

Country points to nighttime ambients typically in the range of 20-30 dBA. (See Schomer and Schneider and Pedersen and Waye, 3/1/2007, p. 485 pdf)

In 1971, the International Standards Organization was recommending community noise limits for rural areas be set at a SPL of 35 dBA during the day, 30 dBA during the evening and 25 dBA at night. (See Table 9: ISO 1996-1971 Recommendations for Community Noise Limits as cited by Acoustic Ecology Institute and Daniel Alberts of Lawrence Technological University pdf)

The Wind Industry Publication pdf points to typical rural ambients being 25 dBA with little or no wind at ground level. Schneider has shown that this occurs very frequently in the North Country on clear starry nights when the earth cools and the wind at ground level is minimal. Calm nights have little background noise to mask the 24/7 noise from turbines that are still operating because the wind at turbine height is still turning the turbines. Balloonists exploit these Stable Environmental Conditions by taking off in calm conditions on the ground and travel with the wind above treetop levels.

Eye-witnesses living near newly-constructed large wind turbines in the Town of Byron, Fond du Lac County, WI testified under oath in DeKalb Hearing that they currently experience adverse health effects from the wind turbine noise such as sleep deprivation and disturbance, headaches, nausea and dizziness. The SPL from the wind turbines in the Town of Byron is greater than 45 dBA at their residences and can be heard inside of their houses and outside in their yards.

In order to reduce the risk of negative health impacts from large wind turbine noise, Acoustical Engineers George Kamperman and Richard James recommend (a) audible sound limits based on pre-existing background sound levels plus a 5dB allowance for wind turbine noise or (b) SPL not to exceed 35 dBA L_{eq} within 100 feet of any occupied structure, whichever is lower; and (c) a dBC limit not to exceed 20 dB above nighttime ambient background levels. These sound levels are in line with numerous published guidelines such as the sound limits proposed by the United Kingdom Business Enterprise and Regulatory Reform Department, which suggest for quiet, rural areas and low noise environments, the outside levels of the L A90, 10 min. of wind farm noise should be limited to an absolute level of 35 – 40 dBA. (See Kamperman & James; United Kingdom Business Enterprise & Regulatory Reform Department document “Onshore Wind: Noise” 7/17/2008 pdf)

C. Findings Regarding Setback Distances from Wind Turbines:

The Town of Orleans Wind Committee concludes that (a) the Safety setbacks of 1250 feet set forth in the present Orleans Wind Ordinance are not based on empirical evidence relating to safety considerations. Adequate Setbacks from large wind turbines to the property line of nearest residence or other inhabited structure are necessary to protect the health and safety of Town of Orleans residents, based on the following findings.

Minimum setbacks from dwellings are necessary to mitigate noise impacts not predicted with sound models. Pre-construction sound models fail to accurately predict wind turbine noise impacts due to factors such as atmospheric conditions, temperature inversions, wind layers, geography and low frequency noise which travels further with less loss of intensity than higher frequency noise. In addition, at night when air stabilizes, wind turbine noise can travel further than expected and can be 5-15 dB(A) louder than predicted. (See Kamperman & James; Acoustic Ecology Institute Special Report: Wind Energy Noise Impacts 2008)pdf

A dBC requirement is needed to minimize adverse health effects from low frequency noise. A dBC requirement will likely result in setbacks between large wind turbines and nearby dwellings of 1km (.62 miles) or greater for 1.5 to 3 MW wind turbines if wind turbines are located in rural areas where L90A background levels are 30 dBA or lower. Such is the case for all rural townships where the preponderance of evidence is that nighttime ambient when people sleep is typical 20-30dBA. (See Kamperman & James; WHO 1999; Bajdek Noise-Con 2007; Pedersen and Waye 1/11/2008, ARI Guidelines, Measurements by Clif Schneider, Charles Ebbing, Paul Carr, and even a wind power publication).

Noise diminishes with distance. According to a sound propagation formula in the Wind Turbine Acoustic Noise White Paper by the University of Massachusetts Renewable Energy Research Lab pdf, a SPL of 35 dBA is reached at approximately ½ mile from a wind turbine based on a sound power at 102 dBA at hub height as applied to a 1.5 – 3 MW wind turbine. Therefore, at a distance of less than ½ mile, a wind turbine will create a SPL that exceeds safe levels. (See Rogers pg. 18 Figure 11; Burton 2001).

Wind Turbine Sound Propagation from the theoretical center of the noise source. This example is for a turbine of 102 dBA sound power	
Distance in Ft.	dBA reduction -6 per doubling of distance
1	102 dBA
2	96 dBA
4	90 dBA
8	84 dBA
16	78 dBA
32	72 dBA
64	66 dBA
128	60 dBA
256	54 dBA
512	48 dBA
1024	42 dBA
2048	36 dBA
4096	30 dBA
8192	24 dBA
16384	18 dBA
32768	12 dBA
65536	6 dBA
131072	0 dBA

The turbines considered for Orleans are more likely to have sound power ratings from 106 to 108 dBA.

While this model of sound propagation is descriptive of the noise generated by the machinery at the hub, the noise produced by the turbine blades is not accounted for in this model and the noise has been found to travel further. Therefore, this ordinance requires siting based not only on set-backs, but also on sound studies.

The closer people live to wind turbines the more likely they will experience noise annoyance or develop adverse health effects from wind turbines' noise. Further, the degree of difficulties resulting from the sound of wind turbines seems clearly related to the distance from the turbines, though the literature has studied a

variety of turbine sizes in a variety of locations. George Kamperman and Richard James reviewed several studies to determine the impact of wind turbine noise on nearby residents. Their review showed that some residents living as far as 2 miles complained of sleep disturbance from wind turbine noise and many residents living 1000 feet from wind turbines experienced major sleep disruption and other health problems from nighttime wind turbine noise.

G.P. Van den Berg studied a wind farm in northwestern Germany and discovered that residents living 500 m (1640 feet) from the wind turbines reacted strongly to wind turbine noise and residents up to 1900 m (1.18 miles) distance expressed annoyance. A survey conducted by Pedersen and Waye revealed that less than 10% of the respondents experienced sleep disturbance at distances of 1,984 feet to 3,325 feet ***and found that the sound from wind turbines was of greater concern in rural environments because of the lower ambient noise.*** *(Bajdek, Noise-Con 2007 ; Van den Berg 2004 ; Pedersen & Waye 2/27/08; Kamperman & James)* pdf

Adverse health effects from wind turbine noise can be exacerbated by the rotating blades and shadows from the wind turbines. As wind turbine blades rotate in sunny conditions, they cast strobe-like shadows on the windows of nearby homes and buildings causing shadow flicker that cannot be avoided by occupants. Shadow flicker can cause some people to become dizzy, nauseated or lose their balance when they see the movement of the shadow. Shadow flicker from wind turbines at greater than 3Hz poses a potential risk of inducing photosensitive seizures. Therefore, wind turbines should be sited such that shadows from wind turbine blades do not fall upon the windows of nearby dwellings or within 100 feet of dwellings for any considerable period. The Wind Energy Handbook recommends a setback of at least 10 rotor diameters to avoid shadow flicker on occupied structures. (See Acoustic Ecology Institute special report 2008; Burton 2001; UK Noise Association 6/2006, Graham Harding 2008 and Dr. Nina Pierpont 3/2/2006 and 8/1/2006)pdf

If placed too close to a road, the movement of the wind turbine blades and resulting shadow flicker can distract drivers and lead to accidents. (See NRC May 2007 report, pg. 263)pdf

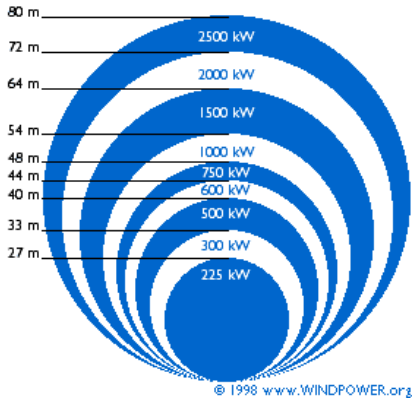
Wind turbines have been known to throw ice and debris from the turbine blades. According to Professor Terry Matilsky from the Department of Physics and Astronomy at Rutgers University, ice throws from large wind turbines can reach

up to a distance of 1750 feet and blade throws can reach 2500 feet. (See Matilsky, Terry, http://xray.rutgers.edu/~matilsky/windmills/throw.html 6/20/2008)

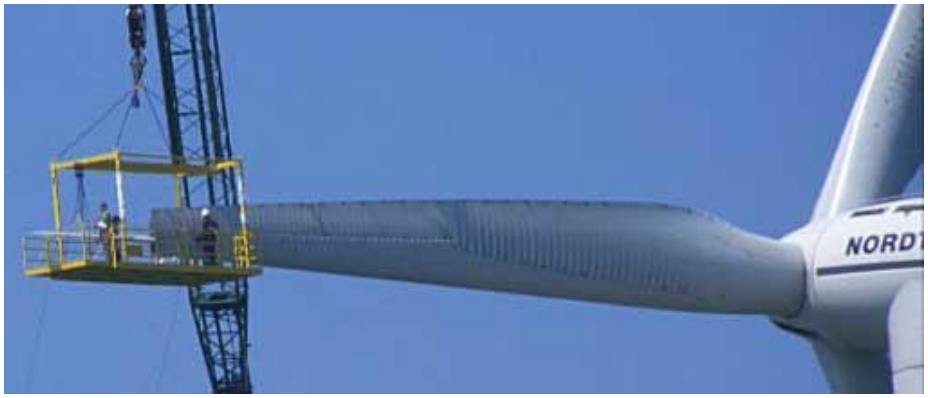
VII. Overview of Safety Setback Recommendations

A. Shadow Flicker

Shadow Flicker consultants generally agree that ***flicker is not noticeable beyond about 10 Turbine Rotor Diameters*** from a wind turbine, or 2634 ft for an 80m diameter rotor.



"A minimum spacing from the nearest turbines to a dwelling of 10 rotor blades diameters is recommended to reduce the duration of any nuisance due to light flicker (Taylor and Rand,1991) pdf. However, a spacing of this magnitude is likely to be required in any event by noise constraints and to avoid visual domination." This is cited verbatim in Wind Energy Handbook, , Wiley & Sons Ltd, New York, 2001 pdf pg. 527



One of the largest turbines to date in 2004 was 390 ft in diameter which would require a setback of 3900 ft, if the 10 times the rotor diameter rule were used.

"May 12, 2004 - The new LM Glasfiber wind **turbine rotor** blade is being launched today at the WindEnergy 2004 trade fair in Hamburg, Germany. With a **rotor** diameter of 126 metres (390 feet), the blade set of three generates sufficient power from the wind to cover the annual power consumption of about 5,000 households. Today at the WindEnergy 2004 trade fair in Hamburg, LM Glasfiber launches the world's largest blade to date - measuring 61.5 meters in length. The composition of materials, a new design and new manufacturing processes have enabled LM to reduce the weight to less than 18 tonnes (40K lbs) for one blade." http://www.highbeam.com/doc/1G1-119158764.html

Recommendation:

The consensus of the Orleans Wind Committee is that the Turbines be set back at least 3000 ft or 10 Turbine Rotor Diameters (whichever is greater) from the property lines and from nearby affected roads/intersections to avoid significant Flicker Problems.

B. Turbine Ice and Debris Throw Distances

1. Ice Throw

As in the design of all structures like bridges and buildings, we recommend that the Board plans ***for the worst, hoping for the best.***

Ice throws results in falling lumps of ice – usually described as about the size of tennis balls. Ice may be thrown as far as 1,800 feet, possibly into roads and highways in the area as well as causing potential harm to individuals.
bethany-windturbinestudycommitttereport.pdf

There is of course a big difference between how far debris from a failed turbine blade can fly in the case of a turbine operating under control at normal speed,

and one that is out of control and spins at increasing speed until it shatters the blades or one of the blades hits the lower part of the tower causing it to topple.

You all have seen the reports of such out of control failures recently in the newspaper.

2. Debris Throw

Vestas the largest and oldest wind turbine manufacturer's safety manual, "Mechanical Operating and Maintenance Manual" s, (written to limit their liability) states;

"For a 500' tall Turbine do not stay within a radius **of 1,640 feet** (about a ¼ mile) or **1300 ft for a 400 ft turbine** from the turbine unless it is necessary".

Their text from the: Vestas_complete_manual 400 ft tall.pdf

"Do not stay within a radius of 400m (1300ft) from the turbine unless it is necessary. If you have to inspect an operating turbine from the ground, do not stay under the rotor plane but observe the rotor from the front.

Make sure that children do not stay by or play nearby the turbine. If necessary, fence the foundation. The access door to the turbine must be locked in order to prevent unauthorized persons from stopping or damaging the turbine due to mal-operation of the controller"

3. High Wind Failure

Turbine Structural failure in Western Germany

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 a turbine blade 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.
A well documented Turbine failure is discussed in the Bethany Report *Page 20 .*
bethany-windturbinestudycommitttereport.pdf

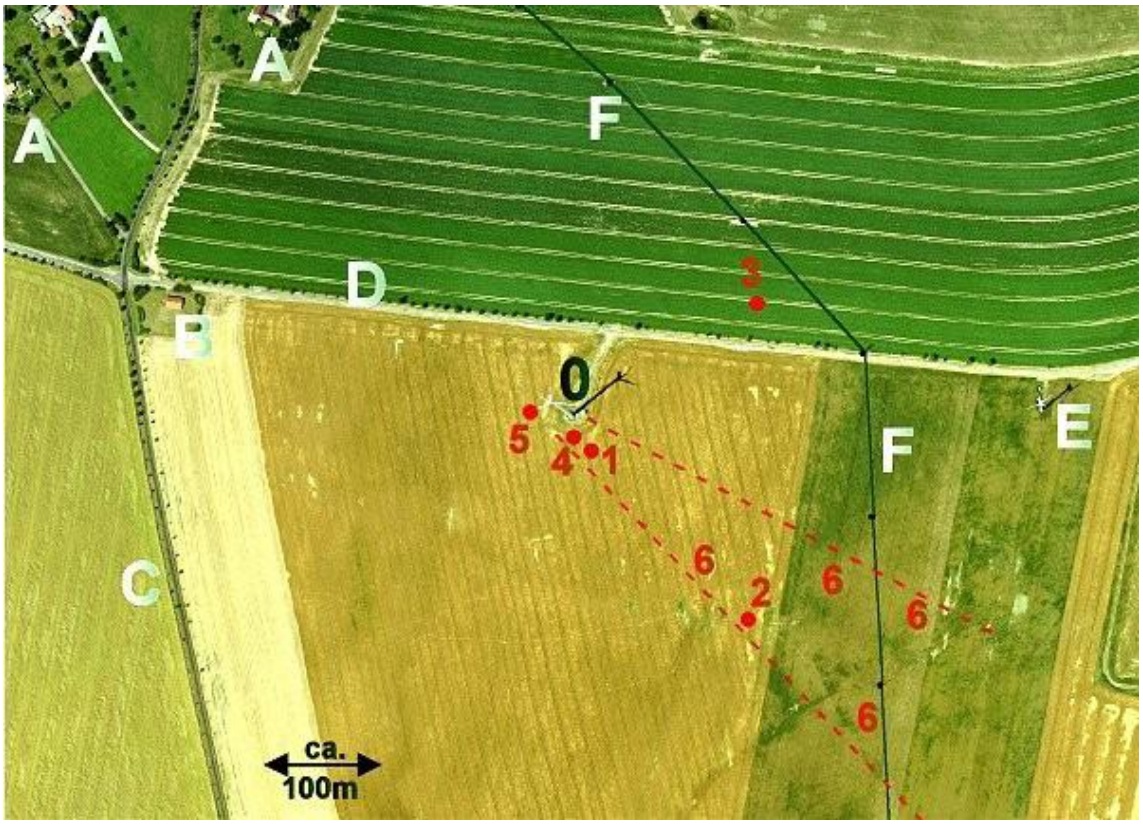


Figure E.9.1: aerial view of a turbine which suffered high wind failure. Significantly-sized debris is plotted in numerals

Notice how far the debris field extends from the turbine at **O** and what could have happened if the wind was blowing the debris toward the road **D** or at the house at **B**. One piece **3** did travel over the adjunct road.

Also a recent Vestas Over speed Turbine Failure was documented by the Danish Government Body, the Energy Agency of Failure Investigation. Danish Report *Endelig redegørelse for haveriforløb ved Halling og Sidinge2.pdf*

A windmill in Denmark collapsed during a storm in Denmark on Feb 22, 2008. The mill was commissioned on 12/23/1996. The wind turbine was a Vestas (North Tank NKT600-180/43) 600 kW the braking system failed while two technicians worked in the turret at the top. The technicians were able to get out before the collapse. Pieces of the shattered turbine were thrown more than 500 meters away. Results of the accident was that the 3 blades literally exploded when the tower was hit and wing pieces from all three wings and the other debris was widely spaced almost 180 degrees.

The Turbine and the top half of the tower crashed to the ground and the generator fell out so that it lied alongside the tower. Larger pieces of wings landed 2-300 meters (***6.58-984 ft***) away, while the smaller pieces landed up to 500 meters (***1640 ft***) away. Even smaller pieces landed in a courtyard over 700 meters (***2297*** ft) away. These could have been both thrown and blown to this location because of the extreme wind.

For the same rpm of the turbine, taller turbines result in throw distance proportional to the height. If this were a modern 400'-500'-600' turbine the throws would be significantly larger.

Recommendation:

For these reasons the Wind Committee recommends a 3000 ft Setback or 10 Turbine Rotor Blade Diameters (whichever is greater) from the property lines for the Turbines.

C. Noise Setback Implications

If you review the previous studies of turbine setbacks required to successfully operate in very quiet rural settings in North Country, and meet the NYS DEC recommendations, the required Noise Setbacks exceed those of Flicker or Ice/Debris Throw Setbacks.

Our finding is that the controlling setback requirements will be due to **Noise.**

Setbacks required to meet the ***noise requirements*** recommended in this ordinance ***will exceed the required setback distances required by Safety and Flicker*** typically ***by two or more times*** depending on the specific turbine Sound Power Level and the Rural Night Time Ambient.

VIII. Details of Overall Health & Safety Recommendations

A. Shadow Flicker/Safety Setback

Flicker takes two forms:

Shadow Flicker - aka the Disco Effect or Strobe Effect

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.windpowerorg/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
- Wind Turbine Shadow: 1.25-5Hz

1. 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. 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. pdf

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

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.

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.

2. Reducing Flicker

Shadow Flicker consultants generally agree that ***flicker is not noticeable beyond about 10 Turbine Rotor Diameters*** from a wind turbine.
"A minimum spacing from the nearest turbines to a dwelling of 10 rotor blades diameters is recommended to reduce the duration of any nuisance due to light flicker (Taylor and Rand, 1991). However, a spacing of this magnitude is likely to be required in any event by noise constraints and to avoid visual domination."
This is cited verbatim in Wind Energy Handbook, Wiley & Sons Ltd, New York, 2001 pg. 527

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.

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. An inexpensive solution is to request developers to survey residents for chronic health effects in order to ensure that turbine placement will not exacerbate people with pre-existing conditions.

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) Land Use and Zoning Issues Related to Site Development for Utility Scale Wind Turbine Generators

depending on circumstances. A report by the Michigan State University Extension, pdf; suggests that a shadow flicker study be commissioned and included with each turbine permit application: http://web1.msue.msu.edu/cdnr/otsegowindflicker.pdf

It is possible to predict the effects of shadow flicker on sensitive locations, such as roads or residences around proposed developments. The potential for shadows to affect locations are site-specific, and depend on prevailing wind patterns among other factors. Developers can use software during the site planning process to avoid possible problems. One example is "Wind Farmer: The Wind Farm and Design and Optimization software" (www.garradhassan.com/windfarmer/flicker.htm).

Another is "WindFarm from ReSoft". The output from this software shows results for a specific window of a specific house from all turbines located nearby. (http://members.aol.com/resoft/shadflik.htm)

There is also a shadow calculator on the Danish wind power site. Information regarding the specifications of the turbines, site plan details, a wind rose, and other technical data are required to use this site (which is Copyright protected): www.windpower.dk/tour/env/shadow/shadowc.htm

Shadow Flicker/Safety Setback Recommendation:

Recommendation:

The consensus of the Orleans Wind Committee is that the Turbines be set back at least 3000 ft or 10 Turbine Rotor Blade Diameters (whichever is greater) from the property lines and from nearby affected roads/intersections to avoid significant Flicker Problems.

Our findings are that Visual Flicker from Turbine Blades casting shadows can cause significant problems. Experience has shown that a setback at least 10 turbine rotor diameters or greater in most cases alleviates this problem.

Recommendation:

It is also recommended that the Town shall specify coating materials or effects in zoning.

The Town should also specify a setback distance from property lines and roadways to eliminate shadow flicker.

The Town should also require shutdown of the turbines during periods of peak flicker if that becomes a problem.

The Town should require the WECS developer to mitigate any unexpected shadow flicker effects promptly at its own expense.

It is possible to predict the effects of shadow flicker on sensitive locations, such as roads or residences around proposed developments.

B. Noise/Sleep Interference

The study of noise impacts from industrial wind machines has been a long process for this committee to analyze. This committee has had to learn about the methodology of the collection of sound data and the science of measuring sound.

One of the key assignments of this committee was to analyze existing Orleans Noise Ordinance in Local Law No 1 2007 for Wind *Facilities as to whether the current level of 50 dBA adequately protects the residents* in the overlay district. (Orleans Wind Ordinance.pdf)

In fact, the acoustic peer review of the Horse Creek Wind project performed at the request of the Town of Clayton by Tocci & Cavanaugh Acoustics indicates that Atlantic Wind/ Iberdola's CH2MHILL report is flawed and will not adequately

protect residents adjacent to the turbines in the overlay district. (Clayton Tocci Report & Summary.pdf)

Review of the Tocci & Cavanaugh report led to the organization of this committee by the town council. (Ebbing Presentation to Orleans Board on Wind Farm Noise Final.pdf)

Through extensive research we have found:

- Large wind turbines emit two types of noise -- 1) Aerodynamic noise from the blades passing through the air, which can generate broadband noise, tonal noise and low frequency noise; and 2) Mechanical noise from the interaction of the turbine components. A dBA scale is commonly used to measure audible wind turbine noise. Low frequency noise from large wind turbines is not adequately measured with a dBA weighting. For a better assessment of the health effects from low frequency noise, the World Health Organization ("WHO") suggests using a dBC weighting. http://www.who.int/docstore/peh/noise/guidelines2.html

- Orleans, as well as rural areas throughout our north country with little industry and traffic, has ambient noise levels, particularly at night when people sleep, in the range of 20 - 30 dBA. This is documented in: Clif Schneider's recent Inter Noise 2009 paper "Measuring Background Noise with an Attended, Mobile Survey during Nights with Stable Atmospheric Conditions". (C Schneider Inter Noise 2009 Report.pdf)

- And "Background Sound Measurements And Analysis In The Vicinity Of Cape Vincent", New York May 11, 2009 by Schomer and Associates. Inc. (Paul Schomer Cape Vincent Measurement Report v5-2.pdf Resume Paul Schomer.pdf)

- Our own CH2MHILL report shows that even though Mark Bastasch did very limited testing he too shows Horse Creek nighttime "cut in low speed" ambient as a 28 dBA, page 14. http://www.iberdrolarenewables.us/horsecreek/AppendixI_Noise_05030/Noise_CH2MHILL_05030.pdf

- "Guideline L For Assessing The Impact Of Air-Conditioning Outdoor Sound Levels in the Residential Community" (ARI Guideline L-1997.pdf)

- National Estimate of Outdoor Background Noise Based on General Type of Community Area and Nearby Automotive Traffic Activity, Rick James. (Typical Land-Use Situations and Associated Sound dBA.pdf)

- These facts have also been confirmed by measurements from Engineers and Professionals in Acoustics; Dr. Paul Carr, Charles Ebbing, John Earshen, Rick James and interestingly in the acoustic primer developed for use by the Wind Industry ("Noise Standards for Wind Turbines Background documents for New York" by RSG Inc Environment, Energy & Acoustics.)

- See Wind Industry Bulletin RSG INC. Noise Standards for Wind Turbines Background document for New York Feb 2009
  Page 2 of (Noise_primer_for_wind_turbines.pdf).

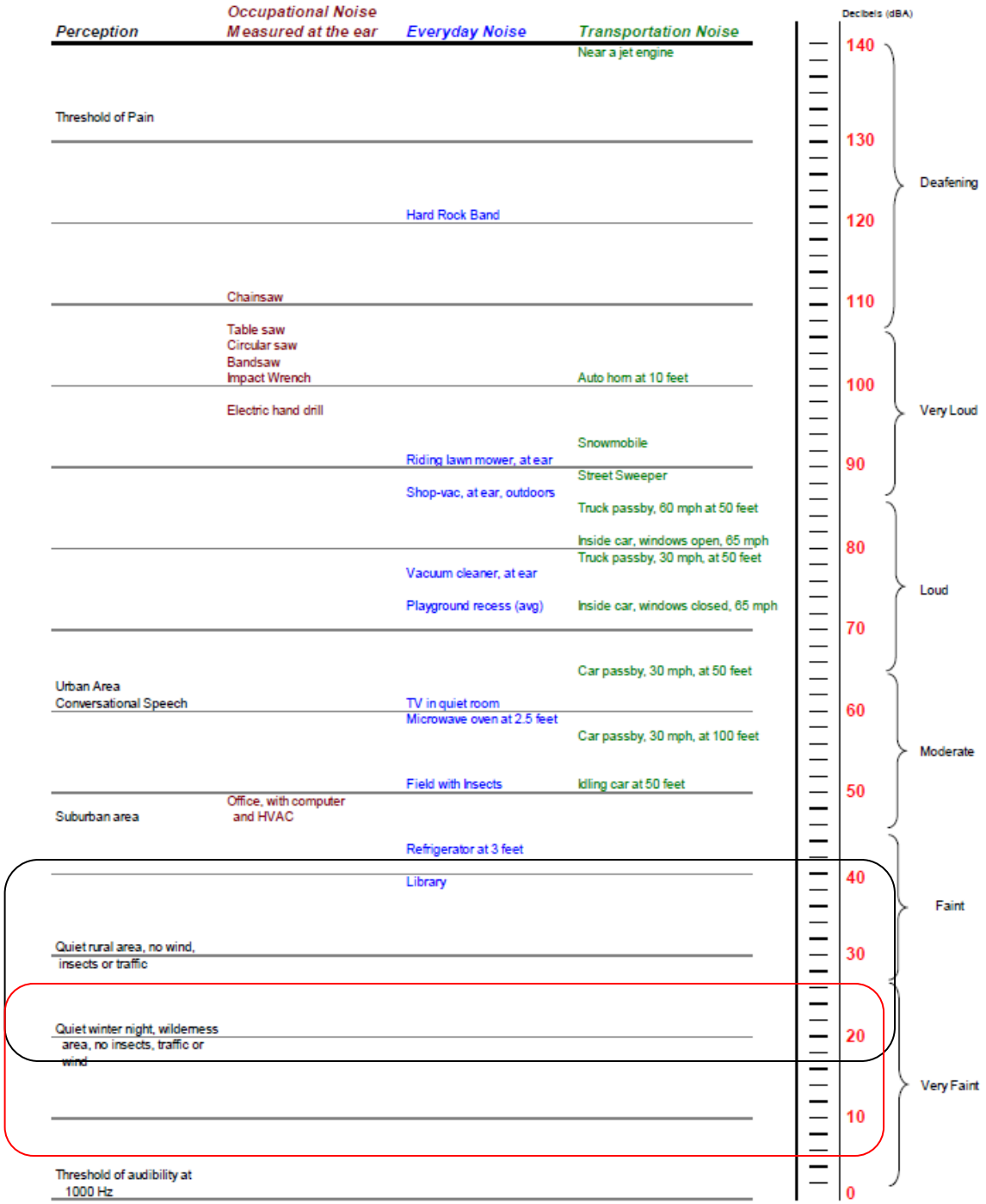
  - This Publication lists typical ambients of:

    Quiet rural area, no wind, insects or traffic as 30 dBA

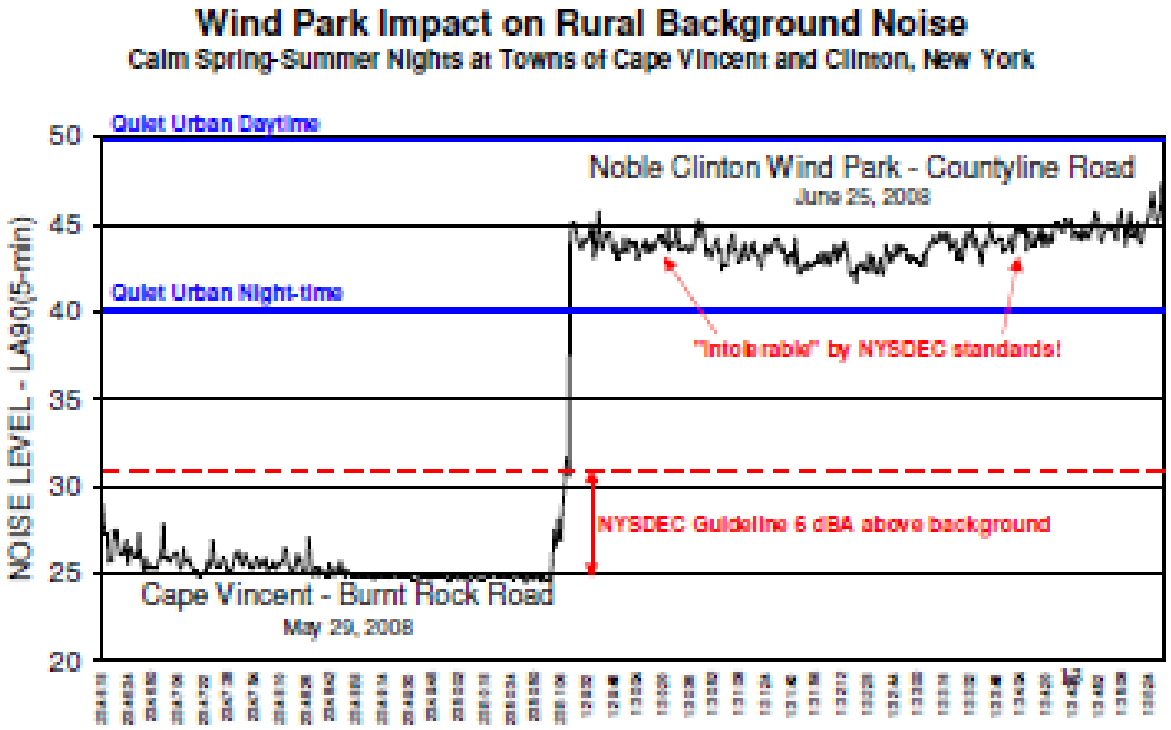
  - ***Quiet Wilderness winter night no insects, traffic or wind 20 dBA***

The existing ambient noise levels of rural areas inside proposed Wind Farms ***at night*** are now ***often 20-30 dBA*** on clear nights with little or no wind. The wind industry will produce ***45-55 dBA noise levels for 24/7 when the Turbines are working***. (Maple Ridge Clif Schneider study.pdf)

Figure 1: Basic Theory: Common Sounds in Decibels



Typical Residual Noise Compared to Wind Farm Noise



Large wind turbines create a noise annoyance that can hinder physical and mental healing and can cause adverse health effects associated with sleep disturbance and deprivation, psychological distress, stress, anxiety, depression, headaches, fatigue, tinnitus and hypertension. Wind turbine noise can affect each person differently. Some people are unaffected by wind turbine noise, while others may develop adverse health effects from the same noise. At very low frequencies, wind turbine noise may often not be heard but rather is felt as a vibration. Medical research reported complaints from people who felt the noise from large wind turbines, similar to symptoms that can be associated with virbroacoustic disease. (See Pedersen et al 3/1/2007, 8/2003, 1/11/2008 and 6/3/2008; Pedersen 2007; Mariana Alves-Pereira and Nuno Castelo Branco 9/20/2007; WHO 1999; Kamperman & James; reports by Dr. Pierpont, Dr. Harry and Dr. Leventhal, pdf)

The International Standards Organization (ISO pdf) recommends setting a base limit of 35– 40 dBA) for intruding noise and adjusting the limit by district type and

time of day. Table 9 lists the adjusted limits from a base of 35 dBA. Notice that for Rural Districts they recommend night limit of 25 dBA.
World Health Organization Sleep Disturbance.pdf

Table 9. ISO 1996-1971 Recommendations for Community Noise Limits

District Type	Daytime Limit	Evening Limit (7 -11 PM)	Night limit (11 PM – 7 AM)
Rural	35 dB(A)	30 dB(A)	25 dB(A)
Suburban	40 dB(A)	35 dB(A)	30 dB(A)
Urban residential	45 dB(A)	40 dB(A)	35 dB(A)
Urban Mixed	50 dB(A)	45 dB(A)	40 dB(A)

NYS DEC Noise Guidelines

c. Thresholds for Significant Sound Pressure Level (SPL) Increase

The goal for any permitted operation should be to minimize increases in sound pressure level above ambient levels at the chosen point of sound reception. Increases ranging from 0-3 dB should have no appreciable effect on receptors. Increases from 3-6 dB may have potential for adverse noise impact only in cases where the most sensitive of receptors are present. Sound pressure increases of more than 6 dB may require a closer analysis of impact potential depending on existing SPLs and the character of surrounding land use and receptors. SPL increases approaching 10 dB result in a perceived doubling of SPL. The perceived doubling of the SPL results from the fact that SPLs are measured on a logarithmic scale. An increase of 10 dB(A) deserves consideration of avoidance and mitigation measures in most cases. The above thresholds as indicators of impact potential should be viewed as guidelines subject to adjustment as appropriate for the specific circumstances one encounters.

The goals of the NYS-DEC Guidelines NYS DEC (DEC noise guidelines 2001 .pdf)

are to minimize the increase in the ambient background to not more than 3-6 dB to minimize the adverse effect of intruding noise sources. The table below was taken from the same publication. Typical human reactions to increasing the ambient noise by 5-10 dB are that the ***new noise is intrusive***.

The expected frequent intrusions from the currently proposed wind farm at night in rural Orleans area, based on data taken by Clif Schneider, (Maple Ridge Clif Schneider study.pdf) in several operating wind farms is in the order of 45dB – 25dBA = 20dB with an expected ***Human Reaction of Intolerable***.

Table B

HUMAN REACTION TO INCREASES IN SOUND PRESSURE LEVEL

Increase in Sound Pressure (dB)	Human Reaction
Under 5	Unnoticed to tolerable
5 - 10	Intrusive
10 - 15	Very noticeable
15 - 20	Objectionable
Over 20	Very objectionable to intolerable

(Down and Stocks - 1978)

Conclusions:

The members of the Orleans Wind Committee unanimously agree that the most important regulation to be considered in any Local Law for Industrial Wind Turbines is the allowable noise. Our current law does not protect the residents of the Town of Orleans, and if not changed, will cause unnecessary complaints and potential health issues that could easily have been avoided with the proper regulations. Numerous studies by acoustical engineers have proven that the noise predicted by Wind Companies is often grossly underestimated due to incorrect and too few collection points, the wrong equipment and wrong time of the year. We, on this committee, sincerely hope the Town Board has trust in our recommendation that we have thoroughly studied the science and facts. The members of the wind committee cannot stress enough the need to change the noise limits and strongly suggest the amendment be written exactly as written at the end of this document to protect the residents of our Town.

Recommendation:

The Wind Committee's consensus is that the Town of Orleans adopt a new noise ordinance in Local Law No 1 2007 for Wind Facilities that follows the spirit of the Guidelines written pro-bono by two well known and respected Acoustical Engineers, George Kamperman and Richard James put forth in the "Simple Guidelines for Siting Wind Turbines to Prevent Health Risks". Kamperman-James Ver 2.1 (Orleans) Noise Criteria for Siting Wind Turbines.pdf

Kamperman and James recommendations have 3 major parts:

- Establishing pre-construction long term background noise levels that exist now.
- Establishing wind turbine sound immersion limits that the wind farm must meet.
- Post construction wind farm noise compliance testing.

Audible Noise Limit dBA

No wind turbine or group of turbines shall be located in Town of Orleans wind district that cause an exceedance of the pre-construction night-time background sound levels by more than 5 dBA.

Test sites are to be located at the property line(s) of the receiving non-participating property(s).

Not to exceed 35 dBA ($L_{Aeq)}$ within 100 feet of any occupied structure**.**

Low Frequency Noise Limit dBC

Low Frequency Noise Limit $L_{Aeq} - L_{A90}$ = 20 dB or less

NOISE CRITERIA FOR SITING WIND TURBINES TO PREVENT HEALTH RISKS[29]

1. Establishing Long-Term Background Noise Level

a. Instrumentation: ANSI or IEC Type 1 Precision Integrating Sound Level Meter plus meteorological instruments to measure wind velocity, temperature and humidity near the sound measuring microphone. Measurement procedu must meet ANSI S12.9, Part 3 except as noted in Section 4. below.

b. Measurement location(s): Nearest property line(s) from proposed wind turbines representative of all non-participating residential property within 2.0 miles.

c. Time of measurements and prevailing weather: The atmosphere must be classified as stable with no vertical heat flow to cause air mixing. Stable conditions occur in the evening and middle of the night with a clear sky and very lit wind near the surface. Sound measurements are only valid when the measured wind speed at the microphone is l than 2 m/s (4.5 mph).

d. Long-Term Background sound measurements: All data recording shall be a series of contiguous ten (10) minute measurements. The measurement objective is to determine the quietest ten minute period at each location of interest. Nighttime test periods are preferred unless daytime conditions are quieter. The following data shall be recorded simultaneously for each ten (10) minute measurement period: dBA data includes L_{A90}, L_{A10}, L_{Aeq} and dBC data includes L_{C90}, L_{C10}, and L_{Ceq}. Record the maximum wind speed at the microphone during the ten minutes, a sir measurement of temperature and humidity at the microphone for each new location or each hour whichever is oftener shall also be recorded. A ten (10) minute measurement contains valid data provided: Both L_{A10} minus L_{A90} a L_{C10} minus L_{C90} are not greater than 10 dB and the maximum wind speed at the microphone is less than 2 m/s duri the same ten (10) minute period as the acoustic data.

2. Wind Turbine Sound Immission Limits

No wind turbine or group of turbines shall be located so as to cause wind turbine sound immission at any location non-participating property containing a residence in excess of the limits in the following table:

Table of Not-To-Exceed Property Line Sound Immission Limits [1]

Criteria	Condition	dBA	dBC
A	Immission above pre-construction background:	$L_{Aeq} = L_{A90} + 5$	$L_{Ceq} = L_{C90} + 5$
B	Maximum immission:	35 L_{Aeq}	55 L_{Ceq} for quiet[2] rural environment 60 L_{Ceq} for rural-suburban environment
C	Immission spectra imbalance	L_{Ceq} (immission) minus (L_{A90} (background) +5) $\leq$ 20 dB	
D	Prominent tone penalty:	5 dB	5 dB

Notes	
1	Each Test is independent and exceedances of any test establishes non-compliance. Sound "immission" is the wind turbine noise emission as received at a property.
2	A "Quiet rural environment" is a location >2 miles from a major transportation artery without high traffic volume during otherwise quiet periods of the day or night.
3	Prominent tone as defined in IEC 61400-11. This Standard is not to be used for any other purpose.

[1] Procedures provided in Section 7. Measurement Procedures (ANSI 12.9 Part 3 with Amendments) of the most recent version of "**The How To Guide To Siting Wind Turbines To Prevent Health Risks From Sound**" by Kamperman and James and the apply to this table.

3. Wind Farm Noise Compliance Testing

All of the measurements outlined above in 1. Establishing Nighttime Background Noise Level must be repeated t determine compliance with 2. Wind Turbine Sound Immission Limits. The compliance test location is to be the pre-turbin background noise measurement location nearest to the home of the complainant in line with the wind farm and nearer t the wind farm. The time of day for the testing and the wind farm operating conditions plus wind speed and direction mus replicate the conditions that generated the complaint. Procedures of ANSI S12.9- Part 3 apply except as noted in Section The effect of instrumentation limits for wind and other factors must be recognized and followed.

2. Wind Turbine Sound Immission Limits

No wind turbine or group of turbines shall be located so as to cause wind turbine sound immission at any location on non-participating property containing a residence in excess of the limits in the following table:

Table of Not-To-Exceed Property Line Sound Immission Limits [1]			
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C. Complaint Resolution Recommendations

A major concern found by the members of this committee is that residents who live in wind developments state that towns and developers ignore and do not take serious their complaints.

After discussion by the Orleans Wind Committee members, we have agreed to and suggest the town add to Local No 1 2007 the following procedures for the handling of complaints by residents. Each complaint will have different fines and time frames for mitigation dependent on which section of the Local law has been violated. Below are the suggested fines and time frames for each violation.

Since there have been many townships that did not have a complaint process in place and residents have been ignored by the licensee with no help from the towns, the following process should make the developers accountable.

This committee believes that if the Safety Setback and Noise recommendations by this Wind Committee are adapted to our Local Law, the complaints by citizens in the Town Orleans should be very minimal.

The Orleans Wind Committee recommends the following:

The Town Board shall select four residents from the Town of Orleans to serve as a Complaint Board. In addition to the four residents there shall be one member of the Town Board, Planning Board and Zoning Board of Appeals.

The WECS licensee will keep in an interest bearing escrow account, at a local bank, the amount of $100,000.00 in which to pay for the services of experts that may be employed by the Town to study or verify complaints by non participating residents. The balance of $100,000.00 will be maintained at all times and the Town will control the use of the funds.

Should a non-participating resident have a complaint against the WECS licensee, they shall first bring their complaint to the Town Clerk who will notify the Town Board. The Town Board will refer the complaint to the Complaint Board. If the complaint Board finds it to be valid, they will notify the WECS licensee of the complaint. The licensee shall have the opportunity to mitigate the complaint. The time frame of mitigation and any fines assessed will be dependent on the nature of the complaint and how it is specified in this local law. The complaints may include, but will not be limited to: excessive noise, flicker or shadow effect, change in water quantity or quality, loss of or diminished telephone, TV, radio reception, interference with a medical device, changes in value to the residence, new presence of radon gas. Should it be necessary for the complaint to be verified by an expert, the Town shall select and employ a non biased firm to do testing, collect data or whatever else may be deemed necessary to determine the validity of the complaint. The funds for payment of these services will come from the established escrow account.

Should the WECS licensee be unable to mitigate the complaint in the time frame established for each complaint per the local law, fines to the Town and payments to the resident will be made by the licensee at the direction of the Complaint Board.

Recommendations for consideration of Compliance process on the following categories:

1. Shadow Flicker Complaint Resolution Process:

If a written complaint along with a video is received by the Town Complaint Resolution Board (CRB) from a non-leaser identifying said turbine(s) (number) in the wind development project with a complaint of impact disturbance caused by shadow flicker the developer is to be notified within 72 hours by the CRB. The developer must then mitigate the complaint within 48 hours, if not sooner. This can be accomplished by shutting down of said offending turbine(s) during peak flicker hours. If the developer does not comply within said time limits, the Town Board will impose a fine of no less than $500.00 per day, starting from first day of complaint, and no more than $1000.00 per day, starting from first day of complaint. If not mitigated in seven days from date developer is notified, or at Towns discretion, permit to operate said turbines in question will be withdrawn.

2. Setbacks Complaint Resolution Process:

If a written complaint is received by the Town Complaint Resolution Board (CRB) from a non-leaser in the wind development project identifying that a setback requirement was non-compliant and found to be valid, meaning said setback does not meet requirement in the local law/ordinance the developer must comply immediately to correct the non-compliant problem. If the developer fails to comply, the Town will either fine developer not less than $1,000.00 per day of violation and/or revoke the permit to operate.

3. Noise/Sleep Interference Complaint Resolution Process:

If a written complaint with a recorded time noise log of turbine(s) is made to the Town Complaint Resolution Board (CRB) from a non-leaser in the Town of Orleans with a charge of a noise disturbance the Town will notify the developer within five days after verification of said complaint. The Town may retain an independent acoustic investigation paid for with the funds in the escrow account, for verification. Copy of acoustic investigation will be given to person making complaint, the Town and the developer. If the developer is found to be non-compliant with the Town's local law noise ordinance, the developer will be made to shut down the turbine(s) during normal sleep hours, hours to be set by Town Board in the local law. Also if said complaint is found to be in non-compliance of

local law/noise ordinance, the developer will be fined not less than $500.00 per day, starting from the first day of complaint and not more than $1000.00 per day for each turbine in non-compliance and/or revoke permit to operate.

4. Electromagnetic/Stray Voltage Complaint Resolution Process:

If a written complaint is received by the Town Complaint Resolution Board (CRB) from a resident due to an electromagnetic inference or stray voltage, the town will notify the developer within 48 hours of the complaint. The Town will hire a stray voltage investigation or electromagnetic interference investigation by a certified electrical engineer, at the costs of the developer, to validate said complaint. Should the complaint be valid, the developer will have one week (7 days) to rectify complaint. Should developer fail to satisfy complaint in this time frame, the fine would be, not less than $500.00 per day, starting the first day of the complaint and not more than $1000.00 per day, per turbine found in violation.

5. Protection of Aquifers, Ground Water and Wells:

If a complaint (either written or phoned in) is received by the Town Complaint Resolution Board (CRB) from a resident for disturbance of an aquifer, ground water or well water, the Town will notify the developer the same day. Water is a most basic need. The developer will have 24 hours to verify the complaint is due to development impact. If developer is the fault of the complaint the developer must make portable water available to resident(s) immediately along with a course of action to resolve the complaint.

If the developer determines the complaint is not related to the development, the Town may choose to hire a qualified engineer at the expense of the developer, to verify validly of the complaint. If the complaint is verified that the well is toxic then the developer and/or town is to notify the Department of Conservation (NYS DEC) immediately of such occurrence/accident. If such accident is under the jurisdiction of the NYS DEC policies then the NYS DEC will follow their protocol for correcting this occurrence. If the occurrence is not of a toxic contaminated spill then the developer will have five days after receiving findings that they are at fault of this disturbance to rectify the complaint. If developer fails to comply, the fine will be not less than $1000.00 per day, starting from day of complaint and not more than $2000.00 per day starting from the first day of complaint. These fines will be paid to the land owner that filed complaint. If a satisfactory solution cannot be made to rectify situation, the developer will be required to purchase the landowners property at fair market value, set prior to start of construction.

The consensus of the committee is that all fines be paid to the Town of Orleans in all cases except the cases with well water impacts. Those fines that may be levied will go to the landowner only.

The Town does have the option of setting an additional fine to the developer as well.

IX. Catalog of Referenced Document Attachments

(Research is listed according to categories)

Numerous documents were reviewed by the committee to substantiate the committee's conclusion for the recommendation. (See Chapter IX) The committee offers the council two formats for referencing the documents; hardcopy and a CD.

Hardcopies are provided in a ***separate catalog*** of documents listed under each category of discussion. Each URL is referenced in dark blue and underlined. Each document referenced in light blue indicates the document is a pdf and on a CD disk.

A Shadow Flicker & Safety Setbacks

A:1 Wind Energy Handbook, Burton, Sharpe, Jenkins, Bossanyi, Wiley & Sons Ltd, New York, 2001 pg. 527, (pdf)

A:2 Ice Throw: Page 22-23 bethany-windturbinestudycommittteereport.(pdf)

A:3 Taylor & Rand 1991 Guidelines for Wind Energy:(pdf), http://www.ifc.org/ifcext/enviro.nsf/AttachmentsByTitle/gui_EHSGuidelines2007_WindEnergy/$FILE/Final+-+Wind+Energy.pdf

A:4 Vestas_complete_manual 400 ft tall. (pdf)

A:5 High Wind Failure “Bethany Report" Page 20 (pdf)

A:6 "Danish turbine failure": Endelig redegørelse for haveriforløb ved Halling og Sidinge2 (pdf)

A:7 "Image Shadow Casting from Wind Turbines" is available at http://www.windpower.org/en/tour/env/shadow/index.htm

A:8 "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 WECS facilities.(pdf)

A:9 Michigan State University; "Wind Turbine Acoustic Noise White Paper" (pdf) (http://web1.msue.msu.edu/cdnr/otsegowindflicker.pdf)

A:10 "Wind Farmer: The Wind Farm and Design and Optimization software" (www.garradhassan.com/windfarmer/flicker.htm).

A:11 "WindFarm from ReSoft" (http://members.aol.com/resoft/shadflik.htm)

A:12 Shadow calculator on the Danish wind power site (copyright protected) www.windpower.dk/tour/env/shadow/shadowc.htm

A:13 "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.(pdf)

A:14 "Public Health Impacts of Wind Turbines", Minnesota Dept of Health 2009 (pdf)

B: NOISE/Sleep Interference References

B1: Orleans Noise Ordinance in Local Law No 1 2007 for Wind Facilities (pdf)

B:2 Clayton Tocci Report & Summary.pdf Report on Clayton Farm Project, Clayton, NY, Report date 2/15/08; "Comments on Noise Analysis PPM Clayton Wind Farm" and Report date 8/25/08; "Executive Summary" (pdf)

B:3 Charles Ebbing "Presentation to Orleans CWC/Public and Town Boards on Wind Farm Noise" (pdf)

B:4 World Health Organization ("WHO") suggests using a dBC weighting.(pdf) http://www.who.int/docstore/peh/noise/guidelines2.html

B:5 "Measuring Background Noise with an Attended, Mobile Survey during Nights with Stable Atmospheric Conditions". C Schneider Inter Noise 2009 Report (pdf)

B:6 “Background Sound Measurements And Analysis In The Vicinity Of Cape Vincent”, New York May 11, 2009 by Schomer and Associates. Inc. Paul Schomer Cape Vincent Measurement Report v5-2.(pdf)
Resume Paul Schomer.(pdf)

B:7 “Guideline L For Assessing The Impact Of Air-Conditioning Outdoor Sound Levels in the Residential Community” ARI Guideline L-1997.(pdf)

B:8 National Estimate of Outdoor Background Noise Based on General Type of Community Area and Nearby Automotive Traffic Activity, Rick James. "Typical Land-Use Situations and Associated Sound dBA" (pdf)

B:9 Wind Industry Bulletin RSG INC. "Noise Standards for Wind Turbines Background document for New York Feb 2009" (pdf) page 2 of Noise_primer_for_wind_turbines.pdf

B:10 "Maple Ridge Post Construction Noise Study" Cliff Schneider study (pdf)

B:11 "World Health Organization Sleep Disturbance" (pdf)
http://www.who.int/docstore/peh/noise/guidelines2.html

B: 12 International Standards Organization (ISO) recommendations; "1996-1971 report Table 9" (pdf)

B:13 New York State DEC's report Assessing and Mitigating Sound Impacts DEC guidelines noise2000 (pdf)
http://www.dec.ny.gov/regulations/2374.html

B:14 Kamperman & James October 28, 2008 Version 2.1 "The How To Guide to Criteria For Siting Wind Turbines to Prevent Health Risks From Sound" 08-11-02 Kamperman-James Ver 2 1 (Orleans) Noise Criteria for Siting Wind Turbines 2.1 (pdf)
http://www.myotherdrive.com/dyn/pv/547.570910.02122008.28928.6a64fi/How%20to%20Guide%20for%20Siting%20Wind%20Turbines%20Kamperman%20and%20James.pdf?sort=0

B:15 Town of Clayton (Lead Agent) "Horse Creek Noise Analysis called CH2MHILL Report" (includes portions of Orleans Township) (pdf) http://www.iberdrolarenewables.us/horsecreek/AppendixI_Noise_05030/Noise_CH2MHILL_05030.pdf

B:16 Fritz Van den Berg, G.P. 2003 Paper ID 160 "Wind Turbines at Night: Acoustical Practice and Sound Research" Effects of wind farm at night (pdf) http://www.myotherdrive.com/dyn/pv/500.431610.02122008.29196.6a64fi/g.p.%20van%20den%20berg%20effects%20of%20wind%20profile%20at%20night.pdf?sort=0

B:17 "Environmental Protection Agency Identifies Noise Levels Affecting Health and Welfare"; Noise Control Act of 1972 and the Quiet Communities Act of 1978: (pdf) http://www.nonoise.org/library/envnoise/index.htm

B:18 "Environmental impacts of wind-energy projects" (pdf) : http://www.nap.edu/catalog/11935.html planning for and regulating wind-energy development 209

B:21 Dr. Alves-Pereira and Dr. Nuno Branco; "Wind Turbine Noise is Conducive to Vibroacoustic Disease" September 20, 2007 (pdf) http://www.garyabraham.com/files/wind/Public_health_and_noise_exposure.pdf

B:19 Dr. Amanda Harry, "Wind Turbines, Noise and Health" February 2007 (pdf) http://www.windturbinenoisehealthhumanrights.com/wtnoise_health_2007_a_barry.pdf

B:20 Geoff Leventhall, (pdf) "Published Research on Low Frequency Noise and Its Effects" Department for Environment UK 2003

B:21 Rick Bolton Acoustics; Bolton Report: (pdf) "Review of PPM energy noise assessment" http://www.garyabraham.com/ECCOdocs.html

B:22 UK Noise Association, pdf "Location, Location, Lociation": An Invesitgation Into Wind Farms and Noise (2006) (pdf) http://www.garyabraham.com/ECCOdocs.html

B:23 "Industrial Wind Power Plants Public Participation and the Legal Requirements that Apply" http://www.garyabraham.com/files/Industrial_Wind_Power_Plants_OUTLINE_8-13-07.pdf

B:24 “Noise Radiation from Wind Turbines Installed Near Homes: Effects on Health.” with an annotated review of the research and related issues by Barbara J Frey, BA, MA and Peter J Hadden, BSc, FRICS (pdf) http://www.windturbinenoisehealthhumanrights.com/wtnhhr_june2007.pdf

B:25 "Communicating the Noise Effects of Wind Farms" by Christopher Bajdek (pdf)http://www.myotherdrive.com/dyn/pv/313.090310.02122008.28663.6a64fi/Bajdek_NC07.pdf?sort=0

B:26 AEI Special Report: "Wind Energy Noise Impacts" (pdf) http://www.acousticecology.org/srwind.html

B:27 Presentations to Wind Committee
Charles Ebbing, Acoustic Engineer pdf Resume pdf
Richard R. James, E-Coustic Solutions Resume
Dr. Paul Carr, Engineer Resume
Clifford P. Schneider "Accuracy of Model Predictions and the Effects of Atmospheric Conditions" pdf

C Referenced: Community Wind Law/Ordinances

C:1 Town of Union Rock County, Wisconsin Ordinance No 2008-06 (pdf) http://betterplan.squarespace.com/town-of-union-wind-ordinance/

C:2 Town of Lyme NY Wind Ordinance 2008 (pdf) http://www.townoflyme.com/old%20site/forms/Windlaw.htm

C:3 Trempeleau County Chapter 21 Law (pdf) http://betterplan.squarespace.com/the-trempeleau-county-wind-ord/

C:4 Town of Allegany, New York Wind Energy Regulations Aug 2007 (pdf) http://www.garyabraham.com/files/wind_laws/town_allegany_wind_energy law_adopted_8-28-07.pdf

C:5 Town of Orleans, Local Law No 1 2007 for Wind Facilities (pdf)

D Referenced: Communities: Citizens Moratorium and/or Wind Committee Reports

D: 1 The Bethany Report Citizens Wind Committee pdf http://www.townofbethany.com/other%20pdf%20files/Wind%20Turbine%20Committee%20Report.pdf

D:2 Town of Union Large Wind Turbine Citizens Committee Report "setback and noise recommendations (347 pages) pdf http://betterplan.squarespace.com/town-of-union-final-report/

E Research Wind Industry Websites

E:1 NYSERDA: http://www.nyserda.org/
E:2 AWEA: http://www.awea.org/

The wind committee struggled with how best to describe the requirements for noise limitations that would protect people living in and adjacent to wind turbines. Understanding the overall noise concepts to accomplish this was presented in the first part of this report. ***Codifying*** these ideas into "written language" in the wind ordinance will be the difficult part for the Board. To that end, this committee includes Chapter X: ***a reference of Suggested Wording to aid this Board***.

We have included a table of contents which gives a clearer overview of the subjects that should be included to achieve the ***spirit*** of the Findings and Recommendations on Noise.

X: Suggested Wording for an Orleans Wind Ordinance That Follows the Spirit of the Wind Committee Findings and Recommendations

The Town of Orleans appointed a Wind Committee that has been meeting since January 15, 2009 to study and recommend Health and Safety aspects of Wind Energy Systems and make written recommendations to the Town Boards in order that they may expeditiously update the existing Wind Ordnance.

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TOWN OF ORLEANS WIND ENERGY SYSTEMS LICENSING ORDINANCE

RECITALS

WHEREAS, the Town of Orleans appointed an Orleans Citizens Wind Committee on Jan 15, 2009 to study and research Orleans present Local Law No 1 2007 for Wind Facilities on Health and Safety requirements and make written recommendations to the Town Board for amendments to adopt.

WHEREAS, the Orleans Wind Committee held public meetings from Jan 15, 2009 through July 2009 to research the health and safety effects of large wind turbines.

WHEREAS, reputable studies and research projects have been conducted regarding the Health and Safety aspects of Large Wind Turbines.

WHEREAS, the Orleans Wind Committee researched and reviewed many documents related to the sighting of large wind turbines, including but not limited to the following documents, reports and studies have been determined by the Town Board to be reasonably accurate, reliable and relevant to the health and safety effects of large wind turbines:

REFERENCES:

Town of Union Wind Energy Licesensing Ordnance 2008-06-1.(pdf) http://betterplan.squarespace.com/town-of-union-final-report/

Acoustic Ecology Institute, “AEI Special Report: Wind Energy Noise Impacts”, July 7, 2008, pdf available at http://www.acousticecology.org/srwind.html

Alberts, Daniel, pdf “A Primer for Addressing Wind Turbine Noise”, Lawrence Technological University, November 20, 2005.

Alves-Pereira, Mariana and Branco, Nuno A.A. Castelo. “In-home Wind Turbine Noise is Conducive to Vibroacoustic Disease”, Wind Turbine Noise Conference, September 20, 2007. pdf

Bajdek, Christopher, “Communicating the Noise Effects of Wind farms to Stakeholders”, Noise-Con 2007, October 22-24, 2007. pdf

Berglund B., Lindvall, T. and Schwela D., “Guidelines for Community Noise”, World Health Organization 1999, pdf and available at http://www.who.int/docstore/peh/noise/guidelines2.html

Burton, Tony, et al., “Wind Energy Handbook”, 2001 pdf.

Department of Health, State of Minnesota: May 2009 "Public Health Impacts of Wind Turbines"; pdf

Caithness Windfarm Information Forum, Summary of Wind Turbine Accident data to March 31st 2009 pdf available at: http://www.caithnesswindfarms.co.uk/page4.htm

Department for Business Enterprise & Regulatory Reform, United Kingdom. “Onshore Wind: Noise”, 7/17/2008, pdf available at http://www.berr.gov.uk/energy/sources/renewable/planning/onshore-wind/noise/page18728.html

French National Academy of Medicine, Report and Recommendations from Work Group, pdf “The Repercussions of Wind turbine Operation on Human Health”, March 14, 2006.

Frey, Barbara J. and Hadden, Peter J., “Noise Radiation from Wind turbines Installed Near Homes: Effects on Health”, February 2007. pdf

Harding, Graham, et al. “Wind Turbines, Flicker, and Photosensitive Epilepsy: Characterizing the Flashing that may Precipitate Seizures and Optimizing Guidelines to Prevent Them”, Epilepsia:1-4, 2008. pdf

Harry, Amanda, MD. “Wind Turbines, Noise and Health”, February 2007. pdf

International Standards Organization, 1996-1971 Recommendations for Community Noise Limits. pdf

James, Richard. Testimony of Richard James, noise control consultant and acoustical consultant, Tazewell County Illinois Zoning Board of Appeals Hearing, May 1, 2008. pdf

Kamperman, George and James, Richard, “Simple Guidelines for Siting Wind turbines to Prevent Health Risks”, Noise-Con 2008, October 28, 2008. pdf

Kamperman, George and James, Richard, “The How To Guide to Criteria For Siting Wind turbines to Prevent Health Risks From Sound”, July 30, 2008. pdf

Leventhall, Geoff, “A Review of Published Research on Low Frequency Noise and its Effects”, Department for Environment, Food and Rural Affairs, UK (2003). http://www.defra.gov.uk/environment/noise/research/lowfrequency/pdf/lowfreqnoise.pdf

Matilsky, Terry, http://xray.rutgers.edu/~matilsky/windmills/throw.html (6/20/2008) pdf

National Research Council, National Academy of Sciences, “Environmental Impacts of Wind Energy Projects”, May 2007. pdf

Meyers, Gerry, Daily Log of Living Next to Wind Turbines, available at http://www.betterplan.squarespace.com/the-brownsville-diary-wind-tu/

National Wind Coordinating Committee, “Permitting of Wind Energy Facilities”, 1998. pdf

Pedersen, E., et al., “WINDFARM perception – Visual and Acoustic Impact of Wind Turbine Farms on Residents, Final Report”, June 3, 2008.pdf

Pedersen, Eja and Person Waye, Kerstin, “Wind Turbine Noise, Annoyance and Self-Reported Health and Well-being in Different Living Environments”, Occup Environ Med, Mary 1, 2007, 64:480-486. pdf

Pedersen, Eja, “Human Response to Wind Turbine Noise – Perception, Annoyance and Moderating Factors”, Goteburg University, 2007.pdf

Pedersen, Eja, et al., “Noise Annoyance from Wind Turbines – a Review”, Swedish Environmental Protection Agency Report 5308, August 2003. pdf

Pedersen, Eja and Persson Waye, Kerstin, “Wind Turbines – Low Level Noise Sources Interfering with Restoration?” Environmental Research Letter Journal 3 (January – March 2008), published January 11, 2008 pdf

Pierpont, Nina, MD, PhD,“Health Effects of Wind Turbine Noise”, March 2, 2006.pdf

Pierpont, Nina MD, PhD, “Wind Turbine Syndrome: Noise, Shadow Flicker and Health”, August 1, 2006. pdf

Rogers, Anthony L., PhD., et al., “Wind Turbine Acoustic Noise White Paper”, University of Massachusetts Renewable Energy Research Lab, June 2002, amended January 2006.pdf

Soysal, H., “Wind Farm Noise and Regulations in the Eastern US”, 2nd International Meeting on Wind Turbine Noise, 9/2007 pdf

Stewart, John, “Location, Location, Location – An Investigation into Wind Farms and Noise by the Noise Association”, UK Noise Association, June 2006.pdf

Van den Berg, G.P., “Effects of the wind profile at night on wind turbine sound”, Journal of Sound and Vibration Volume 277 (2004) 955-970. pdf

"Environmental Protection Agency Identifies Noise Levels Affecting Health and Welfare"; Noise Control Act of 1972 and the Quiet Communities Act of 1978: (pdf) http://www.nonoise.org/library/envnoise/index.htm

"World Health Organization Sleep Disturbance" (pdf) http://www.who.int/docstore/peh/noise/guidelines2.html

PURPOSE AND INTENT

Suggestions **for revising Orleans Local Law No 1 2007 for Wind Facilities**

This committee has identified a list of significant issues/concerns that are inadequate nor have been addressed in the Orleans present wind and should be considered in revising Orleans Local Law No 1 2007 for Wind Facilities.

A. License Required For Wind Energy System

No Wind Energy System over 100 KW shall be constructed or operated in the Town without first obtaining a WES License in accordance with this Ordinance.

APPLICATION AND LICENSING REQUIREMENTS AND STANDARDS

Sound Modeling, Sound Standards and Sound-Related Enforcement Procedures.

B. Applicant's Pre-licensing Sound Studies and Modeling

An application for a CEF License shall include a sound prediction model that includes the information and meets the requirements in section _____ (insert section) of this ordinance:

Information regarding the make and model of the turbines, Sound Power Levels (Lw) for each one-third octave band from 6.3 Hz up through 10,000 Hz, and a projection showing the expected dBA and dBC sound levels computed using the one-third octave band sound power levels (Lw) with appropriate corrections for modeling and measurement accuracy tolerances and directional patterns of the WTi for all areas within and to one (1) mile from the project boundary for the wind speed, direction and operating mode that would result in the worst case WTi sound emissions.

The prediction model shall assume that the winds at hub height are sufficient for the highest sound emission operating mode even though the enforcement tests will be with ground level winds of 10 mph or less. This is to accommodate enforcement under weather conditions where there is significant difference in the wind speed between ground and hub heights. This condition often occurs during summer evenings when wind shear is affected by the reduction in solar heating of the earth's surface between sunset and sunrise.

The projection may be by means of computer model but shall include a description of all assumptions made in the model's construction and algorithms. If the model does not consider the effects of wind direction, geography of the terrain, and/or the effects of reinforcement from coherent sounds or tones from the turbines these should be identified and other means used to adjust the model's output to account for these factors. These results may be displayed as a contour map of the predicted levels, but should also include a table showing the predicted levels at noise-sensitive receptor sites and residences within the model's boundaries. The predicted values must include dBA and dBC values but shall also include un-weighted octave band sound pressure levels from 8 Hz to 10k Hz in data tables.

The Town will refer the applicant's information and sound studies to the Town engineer (if qualified in acoustics) or an Qualified Independent Acoustical Consultant for review and a determination whether the proposed WES will, based on pre-licensing studies and sound modeling, comply with the sound limits set forth in this Ordinance.

C. Independent Pre-licensing Sound Modeling

In any case in which a WES is located within one mile of a sensitive receptor the Town shall, and in other cases the Town may, require the preparation of an independent preconstruction noise study for each proposed Wind Turbine location conducted by a Qualified Independent Acoustical Consultant, in accordance with the procedures provided in this section and in the Appendix showing background dBA and dBC sound levels (L90 (10min)) over one or more valid ten (10) minute continuous measurement periods. The preconstruction baseline studies shall be conducted by an Independent Qualified Acoustical Consultant selected by the Town. The Qualified Independent Acoustical Consultant shall be selected and retained by the Town. The applicant shall be

responsible for paying the Independent Qualified Acoustical Consultant's fees and all costs associated with conducting the study. The applicant shall provide financial security and reimburse the Town for the cost of the study in accordance with section _____(insert section) of this ordinance.

D. Sound Limits.

No license shall be issued unless the pre-licensing information and sound modeling shows that the proposed WES will comply with the following sound limits and requirements.

1. Audible Sound Limit

No WTi or WES shall be located so as to cause an exceedance of the preconstruction/operation background sound levels by more than 5 dBA. The background sound levels shall be the L90A sound descriptor measured during a preconstruction noise study during the quietest time of night (10pm until 4am). All data sampling shall be one or more contiguous ten (10) minute measurements. L90A results are valid when L10A results are no more than 10 dBA above L90A for the same time period and L10C less L90C is no more than 15 dBC. Noise sensitive sites are to be selected based on wind development's predicted worst-case sound emissions (in LeqA and LeqC) which are to be provided by Applicant.

Test sites are to be located along the property line(s) of the receiving nonparticipating parcels.

A 5 dB penalty is applied for tones as defined in IEC 61400-11.

2. Low Frequency Sound Limit

The LeqC and L90C sound levels from the wind turbine at the receiving property shall not exceed the lower of either:

LeqC-L90A greater than 20 dB outside any occupied structure, or

A maximum not-to-exceed sound level of 50 dBC (L90C) from the wind turbines without contribution from other ambient sounds for properties located one mile or

more away from state highways or other major roads or 55 dBC (L90C) for properties closer than one mile from a state highway or other major road.

These limits shall be assessed using the same nighttime and wind/weather conditions required in section _____(insert section(s)). Turbine operating sound emissions shall represent worst case sound emissions for stable nighttime conditions with low winds at ground level and winds sufficient for full operating capacity at the hub.

General Standard

Not to exceed 35 $dBA_{Leq\ 10\ min.}$ within 100 feet of any occupied structure.

Sound Study and Measurement Requirements.

All instruments must meet ANSI or IEC Type 1 Precision integrating sound level meter performance specifications.

Procedures must meet ANSI S12.9 Part 3 including the addendum in the Appendix to this document. Where there are differences between the procedures and definitions of this document and ANSI standards the procedures and definitions of this document shall be applied. Where a standard's requirements may conflict with other standards the most stringent requirement shall apply.

Measurements for background sound levels shall be made when ground level winds are 2 m/s (4.5 mph) or less with wind speeds at the hub at or above nominal operating requirements and for other tests when ground level winds are 4 m/s (9 mph). Weather in the night often results in low ground level wind speed and nominal operating wind speeds at wind turbine hub heights.

IEC 61400-11 procedures are not suitable for enforcement of these requirements except for the presence of tones.

E. Post-construction Sound Measurements

Within twelve months after the date when the project is fully operational, and within four weeks of the anniversary date of the pre-construction background noise measurements, the Licensee shall repeat the existing sound environment measurements taken before the project approval. Post-construction sound level

measurements shall be taken both with all WES's running and with all WES's off. At the discretion of the Town, the preconstruction background sound levels (L90A) can be substituted for the "all WES off" tests if a random sampling of 10% of the pre-construction study sites shows that background L90A and C conditions have not changed more than +/- 5 dB (dBA and dBC) measured under the preconstruction nighttime meteorological conditions. The post-construction measurements shall be reported to the Town (and available for public review) using the same format as used for the preconstruction sound studies. Post-construction noise studies shall be conducted by a firm chosen by the Town. Costs of these studies shall be reimbursed by the Licensee. The security required by section_____(insert section) shall include these costs. The Licensee's consultant may observe the Town's consultant. The WES Licensee shall provide all technical information and wind farm data required by the Independent Qualified Acoustical Consultant before, during, and/or after any acoustical studies required by this document and for local area acoustical measurements.

F. Site Plan and Set-Back Requirements.

Site Plan Requirements. An application for a CEF License shall include a site plan containing the following information and meeting the following requirements:

The boundaries of all Project Parcels and Participating Parcels.

The boundaries of all Non-Participating Parcels located within 3,000 feet of any boundary of a Project Parcel.

The names, addresses and phone numbers of the owners of all Project Parcels, Participating Parcels, and Non-Participating Parcels located within 3,000 feet of any boundary of a Project Parcel.

An aerial photo showing all Project Parcels, Participating Parcels, and Non-Participating Parcels located within 3,000 feet of any boundary of a Project Parcel.

Existing zoning of each Project Parcel and all required zoning setbacks on each Project Parcel.

The proposed location of all components of the proposed CEF, including but not limited to the wind turbine, tower, access roads, control facilities, meteorological towers, maintenance and all power collection and transmission systems.

The location and description of all structures located on Project Parcels, Participating Parcels, and any Non-Participating Parcel located within 3,000 feet of any boundary of a Project Parcel.

The location of all above-ground utility lines, telephone lines, and railroad rights-of-way located within 3000 feet of, or six times the diameter of rotor blades of a proposed Wind Turbine, whichever is greater.

The location of all public roads located within 3000 feet of, or six times the diameter of rotor blades of a proposed Wind Turbine, whichever is greater.

Dimensional representation and sizes of the structural components of the tower construction including the base, footings, tower, and blades.

The distance between each WES tower and each of the following shall be shown on the site plan: structures on all Project Parcels and Participating Parcels; structures on all Non-Participating Parcels located within 3,000 feet of any boundary of a Project Parcel; above ground utility lines, telephone lines, railroad rights of way, and public roads located within 3000 feet of, or six times the diameter of rotor blades of any proposed Wind Turbine, whichever is greater.

Schematic of electrical systems associated with the proposed CEF including all existing and proposed electrical connections.

Manufacturer’s specifications and installation and operation instructions.

The size and scale of the site plan shall be as determined by the Town engineer. The scale map shall include a north arrow, the date, the scale, and reference to a section corner.

The site plan shall include such additional information as the Town engineer or Town Board may require.

NOTE: This committee has recommended to the Town Board a solution to handle resident's complaints (Section VIII. C) Orleans Complaint Resolution Board. In addition, the following are examples of complaint and permit violations to assist the town in implementing language into the local law:

The Town Board shall retain continuing jurisdiction to modify, suspend or revoke all CEF Licenses in accordance with this section. Such authority shall be in addition to the Town's authority to prosecute violations and take other enforcement action.

In this section, "violation" means a violation of this Ordinance, or a violation of a CEF License issued under this Ordinance, or a violation of a CEF License Agreement entered into under this Ordinance.

Any resident of the Town or Town official may file a written complaint with the Town Clerk alleging that a CEF Licensee has committed or is committing a violation. Such complaints shall be forwarded to the Orleans Wind Turbine Complaint Board.

The Orleans Wind Turbine Complaint Board shall preliminarily review the complaint. In connection with its preliminary review, they may require the Town building inspector, engineer, attorney or other person or persons to conduct such investigations and make such reports as the Town Plan Board may direct. The Plan Board may request information from the holder of a CEF License, the complainant, and any other person or entity to assist with its preliminary review.

Following its preliminary review, the Orleans Wind Turbine Complaint Board may:

Dismiss the complaint;

Refer the complaint to the Town attorney for prosecution; or

Conduct a hearing to determine whether the alleged violation(s) have occurred, and what remedial action should be taken. Prior to such hearing, notice of the hearing shall be given to the holder of the CEF Licensee and the complainant, and in accordance with the Open Meeting Law. The holder of the CEF License and the complainant, and any other person, may appear at the hearing and may offer testimony and other relevant evidence, and may be represented by any attorney. If the Orleans Wind Turbine Complaint Board concludes that violations have occurred, the Board may:

Impose conditions on the CEF License to the extent reasonably necessary to discontinue the violation(s) or avoid any recurrence thereof; or

Suspend the CEF License until such time as the CEF License holder presents a plan, satisfactory to the Planning Board that will discontinue the violation(s) or prevent any recurrence thereof, and on such further conditions as the Town Planning Board deems appropriate to discontinue and prevent further violations; or

Revoke the CEF License and direct decommissioning of the CEF, if the Town Planning Board concludes that no reasonable modification can be made to the CEF to discontinue or prevent violations; or

Refer the matter to the Town attorney for prosecution, subject to Town Board approval; or

Take no action, if the Town Planning Board concludes that no further action is needed to discontinue or prevent violations, and that prosecution is unwarranted.

Following any such hearing, the Planning Board's written decision shall be furnished to the CEF License holder and to the complainant. An appeal from a decision of the Town Planning Board may be taken to the Town Board as provided in this section.

An appeal from the decision of the Orleans Wind Turbine Complaint Board may be taken to the Town Board by the CEF License holder or a complainant. Such appeal must be in writing and must specify the grounds thereof, and must be filed with the Town Clerk within ten days after the final action of the Orleans Wind Turbine Complaint Board. The Town Clerk shall provide any appeal to the Town Board. The Town Board shall fix a reasonable time for the hearing of the appeal, and shall give public notice thereof as well as due notice to the CEF Licensee and the complainant. The action of the Orleans Wind Turbine Complaint Board shall be sustained unless the Town Board, by a favorable vote of the majority of all members of the Town Board, reverses or modifies the Town Planning Board’s determination. An appeal from a decision of the Town Board shall be by certiorari review, which shall be commenced within 30 days after the decision of the Town Board.

G. Introduction

The potential impact of sound and sound induced building vibration associated with the operation of wind powered electric generators is often a primary concern for citizens living near proposed wind energy systems (WES(s)). This is especially true of projects located near homes, residential neighborhoods, businesses, schools, and hospitals in quiet residential and rural communities. Determining the likely sound and vibration impacts is a highly technical undertaking and requires a serious effort in order to collect reliable and meaningful data for both the public and decision makers.

This protocol is based in part on criteria published in American National Standards S12.9 - Quantities and Procedures for Description and Measurement of Environmental Sound, and S12.18 and for the measurement of sound pressure level outdoors.

The purpose is to first, establish a consistent and scientifically sound procedure for evaluating existing background levels of audible and low frequency sound in a WES project area, and second to use the information provided by the Applicant in its Application showing the predicted over-all sound levels in terms of dBA and dBC[1] as part of the required information submitted with the application.

These values shall be presented as overlays to the applicant's iso-level plot plan graphics (dBA and dBC) and in tabular form with location information sufficient to permit comparison of the baseline results to the predicted levels. This comparison will use the level limits of the ordinance to determine the likely impact operation of a new wind energy system project will have on the existing community soundscape. If the comparison demonstrates that the WES project will not exceed any of the level limits the project will be considered to be within allowable limits for safety and health. If the Applicant submits only partial information required for this comparison the application cannot be approved. In all cases the burden to establish the operation as meeting safety and health limits will be on the Applicant.

[1] Calculated from one-third octave band sound power levels (LW per IEC 61400-11) provided by the wind turbine manufacturer covering the frequency range from 6.3 Hz to 10,000 HZ or higher.

Next it addresses requirements for the sound propagation model to be supplied with the application.

Finally, if the project is approved, this Appendix covers the study needed to compare the post-build sound levels to the predictions and the baseline study. The level limits in the ordinance apply to the post-build study. In addition, if there have been any complaints about WES sound or low frequency noise emissions by any resident of an occupied dwelling that property will be included in the post-build study for evaluation against the rules for sound level limits and compliance.

The characteristics of the proposed WES project and the features of the surrounding environment will influence the design of the sound and vibration study. Site layout, types of WES(s) selected and the existence of other significant local audible and low frequency sound sources and sensitive receptors should be taken into consideration when designing a sound and vibration study. The work will be performed by an independent qualified acoustical consultant for both the pre-construction background and post-construction sound studies as described in the body of the ordinance.

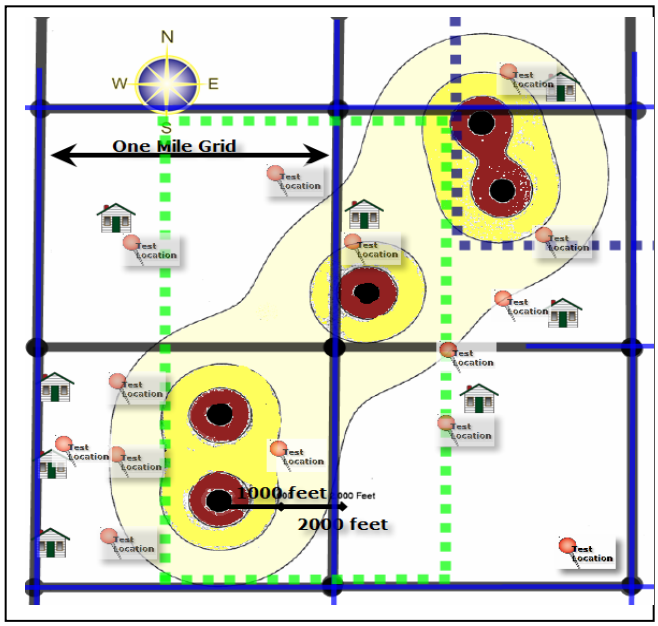
H. Instrumentation

All instruments and other tools used to measure audible, inaudible and low frequency sound shall meet the requirements for ANSI or IEC Type 1 Integrating Averaging Sound Level Meter with frequency range from 6.3 Hz to 20k Hz and capability to simultaneously measure dBA LN and dBC LN. The instrument must also be capable of measuring low level background sounds down to 20 dBA. Measurements shall only be made with the instrument manufacturer's approved wind screen. A compatible acoustic field calibrator is required with certified ± 0.2 dB accuracy. Portable meteorological measurement requirements are outlined in ANSI S12.9 Part 3 and are required to be located within 5m of the sound measuring microphone. The microphone shall be located at a height of 1.2 to 1.5 meters for all tests unless circumstances require a different measurement position. In that case, the reasons shall be documented and include any adjustments needed to make the results correspond to the preferred measurement location.

I. Measurement of Pre-Construction Sound Environment (Base-lines)

An assessment of the proposed WES project areas existing sound environment is necessary in order to predict the likely impact resulting from a proposed project. The following guidelines must be used in developing a reasonable estimate of an area's existing background sound environment. All testing is to be performed by an independent qualified acoustical consultant approved by the Town. The WES applicant may file objections detailing any concerns it may have with the Town's selection. These concerns will be addressed in the study. Objections must be filed prior to the start of the noise study. All measurements are to be conducted with ANSI or IEC Type 1 certified and calibrated test equipment per reference specification at the end of this Appendix. Test results will be reported to the Town or its appointed representative.

Sites with No Existing Wind Energy Systems (Base-line Sound Study)



J. Sound level measurements shall be taken as follows:

The results of the model showing the predicted worst case dBA and dBC sound emissions of the proposed WES project will be overlaid on a map (or separate dBA and dBC maps) of the project area. An example (above) shows an

approximately two (2) mile square section with iso-level contour lines prepared by the applicant, sensitive receptors (homes) and locations selected for the baseline dBA and dBC sound tests whichever are the controlling metric. The test points shall be located at the property line bounding the property of the turbine's host closest to the wind turbine. Additional sites may be added if appropriate. A grid comprised of one (1) mile boundaries (each grid cell is one (1) square mile) should be used to assist in identifying between two (2) to ten (10) measurement points per cell. The grid shall extend to a minimum of one (1) mile beyond the perimeter of the project boundary. This may be extended to more than one mile at the discretion of the Town. The measurement points shall be selected to represent the noise sensitive receptor sites based on the anticipated sound propagation from the combined WTi in the project. Usually, this will be the closest WTi. If there is more than one WTi near-by then more than one test site may be required.

The intent is to anticipate the locations along the bounding property line that will receive the highest sound emissions. The site that will be most likely negatively affected by the WES project's sound emissions should be given first priority in testing. These sites may include sites adjacent to occupied dwellings or other noise sensitive receptor sites. Sites shall be selected to represent the locations where the background soundscapes reflect the quietest locations of the sensitive receptor sites. Background sound levels (and one-third octave band sound pressure levels for the sound measuring consultants file) shall be obtained according to the definitions and procedures provided in the ordinance and recognized acoustical testing practice and standards.

All properties within the proposed WES project boundaries will be considered for this study.

One test shall be conducted during the period defined by the months of April through November with the preferred time being the months of June through August. These months are normally associated with more contact with the outdoors and when homes may have open windows during the evening and night. Unless directed otherwise by the Town the season chosen for testing will represent the background soundscape for other seasons. At the discretion of the Town, tests may be scheduled for other seasons.

All measurement points (MPs) shall be located with assistance from with the Town staff and property owner(s) and positioned such that no significant obstruction (building, trees, etc.) blocks sound and vibration from the nearest

proposed WES site. Duration of measurements shall be a minimum of ten continuous minutes for each criterion at each location. The duration must include at least 6 minutes that are not affected by transient sounds from near-by and non-nature sources. Multiple 10 minute samples over longer periods such as 30 minutes or one (1) hour may be used to improve the reliability of the L90 values. The ten minute sample with the lowest valid L90 values will be used to define the background sound.

The tests at each site selected for this study shall be taken during the expected 'quietest period of the day or night' as appropriate for the site. For the purpose of determining background sound characteristics the preferred testing time is from 10 pm until 4 am. If circumstances indicated that a different time of the day should be sampled the test may be conducted at the alternate time if approved by the Town.

Sound level measurements must be made on a weekday of a non-holiday week. Weekend measurements may be taken at selected sites where there are weekend activities that may be affected by WTi sound.

Measurements must be taken at 1.2 to 1.5 meters above the ground and at least 15 feet from any reflective surface following ANSI 12.9 Part 3 protocol including selected options and other requirements outlined later in this Section.

1. Reporting

For each Measurement Point and for each measurement period, provide each of the following measurements:

(a) LAeq, L10, and L90, in dBA
(b) LCeq , L10, and L90, in dBC

A narrative description of any intermittent sounds registered during each measurement. This may be augmented with video and audio recordings.

A narrative description of the steady sounds that form the background soundscape. This may be augmented with video and audio recordings.

Wind speed and direction at the Measurement Point, humidity and temperature at time of measurement will be included in the documentation. Corresponding

information from the nearest 10 meter weather reporting station shall also be obtained.

Measurements taken when wind speeds exceed 2m/s (4.5 mph) at the microphone location will not be considered valid for this study. A windscreen of the type recommended by the monitoring instrument's manufacturer must be used for all data collection.

Provide a map and/or diagram clearly showing (using plot plan provided by Town or Applicant):

The layout of the project area, including topography, the project boundary lines, and property lines.
The locations of the Measurement Points.
The minimum and maximum distance between any Measurement Points.
The location of significant local non-WES sound and vibration sources.
The distance between all MPs and significant local sound sources. And,
The location of all sensitive receptors including but not limited to: schools, day-care centers, hospitals, residences, residential neighborhoods, places of worship, and elderly care facilities.

2. Sites with Existing Wind Energy Systems

Two complete sets of sound level measurements must be taken as defined below:

One set of measurements with the wind generator(s) off unless the Town elects to substitute the sound data collected for the background sound study collected as part of an earlier baseline study. Wind speeds must be suitable for background testing.

One set of measurements with the wind generator(s) running with wind speed at hub height sufficient to meet nominal power output or higher and at 2 m/s or below at the microphone location. Conditions should represent the worst case sound emissions from the WES project. This will normally involve tests taken during the evening or night when winds are calm (2m/sec or less) at the ground surface yet, at hub height, sufficient to operate the turbines.

Sound level measurements and meteorological conditions at the microphone shall be taken and documented as discussed above.

3. Sound Level Estimate for Proposed Wind Energy Systems (when adding more WTi to existing project)

Sound Level Estimate for Proposed Wind Energy Systems (when adding more WTi to existing project)

In order to estimate the sound impact of the proposed WES project on the existing environment an estimate of the sound produced by the proposed WES(s) under worst-case conditions for producing sound emissions must be provided. This study may be conducted by a firm chosen by the WES operator with oversight provided by the Town.

The qualifications of the firm should be presented along with details of the procedure that will be used, software applications, and any limitations to the software or prediction methods.

Provide the manufacturer's sound power level (Lw) characteristics for the proposed WES(s) operating at full load utilizing the methodology in IEC 61400-11 Wind Turbine Noise Standard. Provide one-third octave band Lw sound power level information from 6.3 Hz to 10k Hz. Furnish the data with and without A-weighting. Provide sound pressure levels predicted for the WES(s) in combination and at full operation and at maximum sound power output for all areas where the predictions indicate dBA levels of 30 dBA and above. The same area shall be used for reporting the predicted dBC levels. Contour lines shall be in increments of 5 dB.

Present tables with the predicted sound levels for the proposed WES(s) in dBA, dBC and at all octave band centers (8 Hz to 10k Hz) for distances of 500, 1000, 1500, 2000, 2500 and 5000 feet from the center of the area with the highest density of WES(s). For projects with multiple WES(s), the combined sound level impact for all WES(s) operating at full load must be estimated.

The above tables must include the impact (increased dBA L_{eq} and dBC L_{eq} above baseline L90 Background sound levels) of the WES operations on all residential and other noise sensitive receiving locations within the project boundary. To the

extent possible, the tables should include the sites tested in the background study.

Provide a contour map of the expected sound level from the new WES(s), using 5 dBA and 5 dBC increments created by the proposed WES(s) extending out to a distance of at least 3000 feet from the project boundary or the 35 dBA or 50 dBC boundary whichever is greater.

Provide a description of the impact of the proposed sound from the WES project on the existing environment. The results should anticipate the receptor sites that will be most negatively impacted by the WES project and to the extent possible provide data for each MP that are likely to be selected in the background sound study (note the sensitive receptor MPs):

Report expected changes to existing sound levels for LAeq, L10 and L90, in dBA

Report expected changes to existing sound levels for LCeq, L10 and L90, in dBC

Report the predicted sound pressure levels for each of the 1/1 octave bands as un-weighted dB in tabular form from 8 Hz to 10k Hz.

Report all assumptions made in arriving at the estimate of impact, any limitations that might cause the sound levels to exceed the values of the estimate, and any conclusions reached regarding the potential effects on people living near the project area. If the effects of blade swish, worst case weather, or operating conditions are not reflected in the model a discussion of how these factors could increase the predicted values is required.

Include an estimate of the number of hours of operation expected from the proposed WES(s) and under what conditions the WES(s) would be expected to run. Any differences from the information filed with the Application should be addressed.

4. Post-Construction Measurements

Post Construction Measurements should be conducted by a qualified noise consultant selected by and under the direction of the Town. The requirements of this Appendix for Sites with Existing Wind Energy Systems shall apply

Within twelve months of the date when the project is fully operational, and within one month of the anniversary date of the Pre-construction ambient noise measurements, repeat the existing sound environment measurements taken before the project approval. Post-construction sound level measurements shall be taken both with all WES(s) running and with all WES(s) off except as provided the ordinance.

Report post-construction measurements to the Town using the same format as used for the background sound study.

Project Boundary: A continuous line encompassing all WES(s) and related equipment associated with the WES project.

K. Terms and Definitions

Aerodynamic Sound means a noise that is caused by the flow of air over and past the blades of a WES.

Ambient Sound. Ambient noise encompasses all sound present in a given environment, being usually a composite of sounds from many sources near and far. It includes intermittent noise events, such as, from aircraft flying over, dogs barking, wind gusts, mobile farm or construction machinery, and the occasional vehicle traveling along a nearby road. The ambient also includes insect and other nearby sounds from birds and animals or people. The near-by and transient events are all part of the ambient sound environment but are not to be considered part of the background sound. If present, a different time or location should be selected for determining the L90 background sound levels.

Anemometer means a device for measuring the speed and direction of the wind.

Applicant means the individual or business entity that seeks to secure a license under this Ordinance.

A-Weighted Sound Level (dBA). A measure of over-all sound pressure level designed to reflect the response of the human ear, which does not respond equally to all frequencies. It is used to describe sound in a manner representative of the human ear's response. It reduces the effects of the lower frequency sound energy with respect to the frequencies from Hz to 1000 Hz and above . The

resultant sound level is said to be A-weighted and the units are dBA. Sound level meters have an A-weighting network for measuring A-weighted sound levels (dBA) meeting the characteristics and weighting specified in ANSI Specifications for Integrating Averaging Sound Level Meters, S1.43-1997 for Type 1 instruments and be capable of accurate readings (corrections for internal noise and microphone response permitted) at 20 dBA or lower.

Background Sound (L90) refers to the sounds that would normally be present at least 90% of the time. Background sounds are those heard during lulls in the ambient sound environment. That is, when transient sounds from flora, fauna, and wind are not present. Background sound levels vary during different times of the day and night. Because a WES operates 24/7, the background sound levels of interest are those during the quieter periods which are often the evening and night. Sounds from near-by birds and animals or people must be excluded from the background sound test data.

Background sound level (dBA and dBC (as L90)) is the sound level present for at least 90% of the time during a period of observation that is representative of the quiet time for the soundscape under evaluation and with duration of ten (10) continuous minutes. Several contiguous ten (10) minute tests may be performed in one hour to determine the statistical stability of the sound environment. Longer term tests, such as 24 hours or multiple days are not appropriate since the purpose is to define the quiet time background sound level. It is defined by the L90A and L90C descriptors. It may be considered to be the quietest one (1) minute during a ten (10) minute test. L90A results are valid only when L10A results are no more than 10 dBA above L90A for the same time period. L10C less L90C should not exceed 15 dBC to be valid.

Measurement periods such as at dusk when bird and insect activity is high or the early morning hours when the ‘dawn chorus’ is present are not acceptable measurement times. Further, background L90 sound levels documenting the pre-construction baseline conditions should be determined when the ten minute average wind speed is 2 meters per second (4.5 mph) or less at the ground level/microphone location.

Blade Passage Frequency (BPF) means the frequency at which the blades of a turbine pass a particular point during each revolution (e.g. lowest point or highest point in rotation) in terms of events per second. A three bladed turbine rotating at 28 rpm would have a BPF of 1.4 Hz. [E.g. ((3 blades times 28rpm)/60 seconds per minute = 1.4 Hz BPF)]

C-Weighted Sound Level (dBC). Similar in concept to the A-Weighted sound Level (dBA) but C-weighting does not de-emphasize the frequencies below 1k Hz as A-weighting does. It is used for measurements that must include the contribution of low frequencies in a single number representing the entire frequency spectrum. Sound level meters have a C-weighting network for measuring C-weighted sound levels (dBC)meeting the characteristics and weighting specified in ANSI S1.43-1997 Specifications for Integrating Averaging Sound Level Meters for Type 1 instruments.

Decibel (dB). A dimensionless unit which denotes the ratio between two quantities that are proportional to power, energy or intensity. One of these quantities is a designated reference by which all other quantities of identical units are divided. The sound pressure level (Lp) in decibels is equal to 10 times the logarithm (to the base 10) of the ratio between the pressure squared divided by the reference pressure squared. The reference pressure used in acoustics is 20 MicroPascals.

Distance attenuation. Means the reduction of a sound or attenuation by distance. The effect of distance attenuation depends on the type of sound sources. Most sounds or noises we encounter in daily life are from sources which can be characterized as either point or line sources. If a sound source produces spherical spreading of sound in all directions, it is a point source. For a point source, the noise level decreases by 6 dB per doubling of distance from the source. If the sound source produces cylindrical spreading of sound such as a stream of motor vehicles on a busy road at a distance, it may be considered as a line source. For a line source, the noise level decreases by 3 dB per doubling of distance from the source. Turbines mounted in a row should be considered as a line source.

Frequency. The number of oscillations or cycles per unit of time. Acoustical frequency is usually expressed in units of Hertz (Hz) where one Hz is equal to one cycle per second.

Good Utility Practice. Means any of the practices, methods and acts with respect to the safe operation of a CEF engaged in or approved by a significant portion of the electric utility industry and, in particular, those portions of the industry with experience in the construction, operation and maintenance of wind turbines during the relevant time period; or any of the practices, methods and acts which, in the exercise of reasonable judgment in light of the facts known at the time the

decision is made, could be expected to accomplish the desired result at a reasonable cost consistent with good business practices, reliability, safety and expedition. Good Utility Practice is not intended to be limited to the optimum practice, method or act to the exclusion of all others, but rather to be acceptable practices, methods or acts generally accepted in the region.

Health means a state of complete physical and mental well being, not merely the absence of disease or infirmity. This definition was adapted from the World Health Organization definition of health in "Guidelines for Community Noise", pages 19 and 20.

Height means the total distance measured from the grade of the property as existed prior to the construction of the wind energy system, facility, tower, turbine, or related facility at the base to its highest point.

Hertz (Hz). Frequency of sound expressed by cycles per second.

Impulsive Sound refers to short-term acoustical impulses typically lasting less than one second each. It may be the only sound emitted from a noise source or it may be a component of a more complex sound. For evaluation of wind turbines, impulsive sound includes swishing or thumping sounds.

INCE means Institute of Noise Control Engineers. The Institute of Noise Control Engineering of the USA ("INCE/USA") is a non-profit professional organization incorporated in Washington, DC. A primary purpose of the INCE/USA is to promote engineering solutions to environmental, product, machinery, industrial and other noise problems. INCE/USA is a Member of the Society of the International Institute of Noise Control Engineering, an international consortium of organizations with interest in acoustics and noise control.

Infra-Sound. Sound with energy in the frequency range of 20 Hz and below is considered to be infrasound is normally considered to not be audible unless in relatively high amplitude. The most significant exterior noise-induced dwelling vibration occurs in the frequency range between 5 Hz and 50 Hz. Moreover, even levels below the threshold of audibility can still cause measurable resonances inside dwelling interiors. Conditions that support or magnify resonance may also exist in human body cavities and organs under certain conditions, although no specific test for infrasound is provided in this document, its presence will be accounted for in the comparison of dBA and dBC sound levels for the complaint

test provided later in this document. See low-frequency sound (LFN) for more information.

Low Frequency Sound (LFN) refers to sounds with energy in the lower frequency range of 20 to 200 Hz. LFN is deemed to be excessive when the difference between a C-weighted sound pressure level and an A-weighted sound pressure level is greater than 20 decibels at any measurement point outside or inside a noise sensitive receptor site, residence, or other occupied structure. E.G. C-A>20 dB.

Measurement Point (MP) means location where sound and/or vibration measurements are taken such that no significant obstruction blocks sound and vibration from the site. The Measurement Point should be located so as to not be near large objects such as buildings and in the line-of-sight to the nearest turbines. Proximity to large buildings or other structures should be twice the largest dimension of the structure, if possible.

Measurement of Wind Speed. For measurements conducted to establish the background sound pressure levels (dBA, dBC, L90 10 min, and etc.) the wind speed at the microphone's Measurement Point shall average 2 m/s (4.5 mph) or less for valid background measurements. For valid measurements conducted to establish the post-construction sound level the wind speed at the microphone's Measurement Point shall not exceed 4 m/s (9 mph) average and the wind speed at the WES blade height shall be at or above the nominal rated wind speed. For purposes of enforcement, the wind speed and direction at the WES blade height shall be selected to reproduce the conditions leading to the enforcement action while also restricting wind speeds at the microphone to 4 m/s (9 mph).

For purposes of models used to predict the sound levels and sound pressure levels of the WES to be submitted with the Application, the Wind Speed shall be the speed that will result in the worst-case dBA and dBC sound levels in the community adjacent the nearest WES. For the purpose of constructing the model the wind direction shall consider the dominant wind direction for the seasons from the late Spring to early Fall. If other wind directions may cause levels to exceed those of the predominant wind direction at nearby sensitive receptors, these levels and conditions shall be included in the Application.

Mechanical Noise means sound produced as a byproduct of the operation of the mechanical components of a WES(s) such as the gearbox, generator and transformers.

Noise means any unwanted sound. Not all noise needs to be excessively loud to represent an annoyance or interference.

Non-Participating Parcel means a parcel of real estate that is neither a Project Parcel nor a Participating Parcel.

Occupied Structure means a building in which people live, work or frequent.

Participating Parcel means a parcel of real estate that is not a Project Parcel, but is subject to an agreement between the owner and applicant allowing the construction of all or part of a CEF closer to a Participating Parcel property line or structure on the Participating Parcel than would be permitted under this Ordinance in the absence of such an agreement. To qualify as a Participating Parcel, the agreement between the owner and the applicant must be approved by the Town Board under this Ordinance.

Project Boundary means the boundaries of the CEF as shown on the site plan submitted to and approved by the Town in accordance with this Ordinance.

Project Parcel or Project Parcels means the parcel or parcels of real estate on which all or any part of a CEF will be constructed.

Property Line means the recognized and mapped property parcel boundary line.

Pure Tone. A sound for which the sound pressure is a simple sinusoidal function of the time, and characterized by its singleness of pitch. Pure tones can be part of a more complex sound wave that has other characteristics.

Qualified Independent Acoustical Consultant. Qualifications for persons conducting baseline and other measurements and reviews related to the application for a WES or for enforcement actions against an operating WES include, at a minimum, demonstration of competence in the specialty of community noise testing and Full Membership in the Institute of Noise Control Engineers (INCE). Certifications such as Professional Engineer (P.E.) do not test for competence in acoustical principles and measurement and are thus not, without further qualification, appropriate for work under this Ordinance. The Independent Qualified Acoustical Consultant can have no direct or indirect financial or other relationship to an Applicant.

Sensitive Receptor means places or structures intended for human habitation, whether inhabited or not, public parks, state and federal wildlife areas, the manicured areas of recreational establishments designed for public use, including but not limited to golf courses, camp grounds and other nonagricultural state or federal licensed businesses. These areas are more likely to be sensitive to the exposure of the noise, vibration, shadow or flicker, etc. generated by a WES or CEF. These areas include, but are not limited to: schools, daycare centers, elder care facilities, hospitals, places of seated assemblage, non-agricultural businesses and residences.

Sound. A fluctuation of air pressure which is propagated as a wave through air

Sound Power. The total sound energy radiated by a source per unit time. The unit of measurement is the watt. Abbreviated as Lw. This information is determined for the WES manufacturer under laboratory conditions specified by IEC 61400-11 and provided to the local developer for use in computer model construction. It cannot be assumed that these values represent the highest sound output for any operating condition. They reflect the operating conditions required to meet the IEC 61400-11 requirements. The lowest frequency is 50 Hz for acoustic power (Lw) requirement in IEC 61400-11. This Ordinance requires wind turbine certified acoustic power (Lw) levels at rated load for the total frequency range from 6.3 Hz to 10k Hz in one-third octave frequency bands tabulated to the nearest 0.1 dB. The frequency range of 6.3 Hz to 10k Hz shall be used throughout this Ordinance for all sound level modeling, measuring and reporting.

Sound Pressure. The instantaneous difference between the actual pressure produced by a sound wave and the average or barometric pressure at a given point in space.

Sound Pressure Level (SPL). 20 times the logarithm, to the base 10, of the ratio of the pressure of the sound measured to the reference pressure, which is 20 micronewtons per square meter. In equation form, sound pressure level in units of decibels is expressed as SPL (dB) = 20 log p/pr.

Spectrum. The description of a sound wave's resolution into its components of frequency and amplitude. The WES manufacturer is required to supply a one-third octave band frequency spectrum of the wind turbine sound emission at 90% of rated power. The published sound spectrum is often inappropriately presented as A-weighted values rather than dBC or dBZ. This information is used to project

the wind farm sound levels at all locations of interest. Confirmation of the projected sound spectrum can be determined with a small portable one-third octave band frequency (spectrum) analyzer. The frequency range of interest for wind turbine noise is approximately 10 Hz to 10k Hz.

Statistical Noise Levels. Sounds that vary in level over time, such as road traffic noise and most community noise, are commonly described in terms of the statistical exceedance levels LAN, where LAN is the A-weighted sound pressure level exceeded for N% of a given measurement period. For example, L10 is the noise level exceeded for 10% of the time. Of particular relevance, are: LA10 and LC10 the noise level exceed for 10% of the ten (10) minute interval. This is commonly referred to as the average maximum noise level. LA90 and LC90 the noise level exceeded for 90% of the ten (10) minute sample period. The L90 noise level is described as the average minimum background sound level (in the absence of the source under consideration), or simply the background level. Leq is the frequency-weighted equivalent noise level (basically the average noise level). It is defined as the steady sound level that contains the same amount of acoustical energy as the corresponding time-varying sound.

Tonal Sound (sometimes referred to as Pure Tone). A sound for which the sound pressure is a simple sinusoidal function of the time, and characterized by its singleness of pitch. Tonal sound can be simple or complex.

Wind Energy Systems (WES) means equipment that converts and then transfers energy from the wind into usable forms of energy on a large, industrial scale for commercial or utility purposes. Small scale wind systems of less than 170 feet in height with a 60-foot rotor diameter and a nameplate capacity of less than 100 kilowatts or less are exempt from this definition and the provisions of this Ordinance.

Wind Energy Systems Facility or Facility or CEF means all of the land and equipment used by the Wind Energy System and its support facilities including the wind turbine, tower, access roads, control facilities, meteorological towers, maintenance and all power collection and transmission systems.

Wind Energy Systems Facility License or CEF License means a license to construct and operate a Wind Energy System issued by the Town of Orleans in accordance with this Ordinance.

Wind Turbine or Turbine (WTi) means a mechanical device which captures the kinetic energy of the wind and converts it into electricity. The primary components of a wind turbine are the blade assembly, electrical generator and tower.