Zoning Ordinances and Wind Turbines

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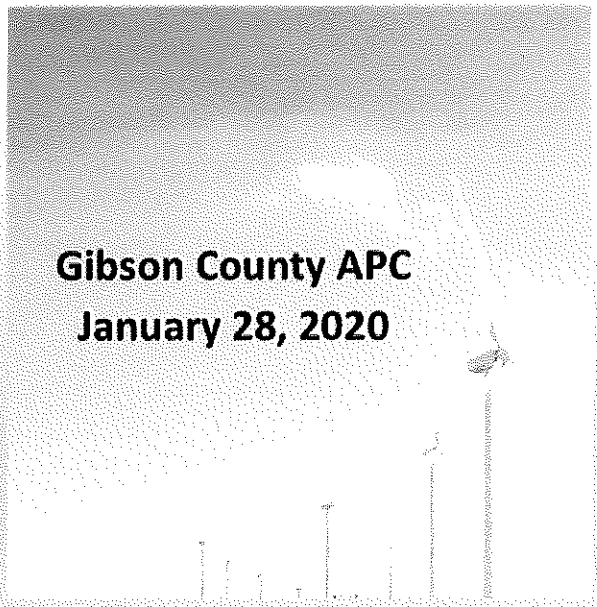


Gibson County APC
January 28, 2020

Zoning and Public Safety

At a minimum, any zoning effort in any county should be directed at the *common health, safety, and welfare of its citizens.*

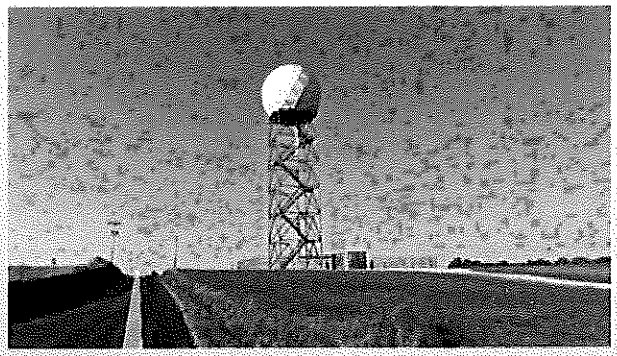
Zoning may address many issues such as waste management, adult entertainment industry, restaurant codes, sewers and drainage, etc.

While the development of wind power in general is a good thing, it must be done within the confines of existing communities in a manner that does not compromise the *health, safety, or welfare of that community.*

Issues to address via zoning regarding turbines:

- Doppler radar
- Property line setbacks
- Noise
- Shadow flicker
- Medical effects
- Property value guarantees
- Proximity to schools
- Decommissioning

Doppler Radar and Turbines



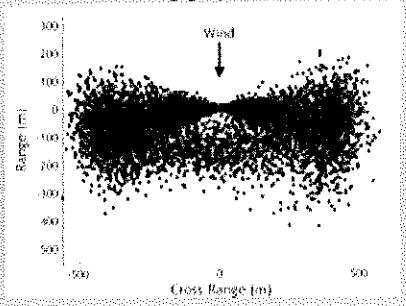
Proposed Turbine size, and design, and installation

- Specific turbine model have not been selected, but E.ON has stated the power range to be between 2.2 and 4.2MW, and has also mentioned Vestas as the possible manufacturer
- MW (megawatt, or million watts) is the measure of max power generated by the turbine during ideal conditions. Regardless of power output in the 2.2-4.2MW range, the height can be anywhere from **590-790 feet** from base to top of blade at highest point, with no contractual height limit
- The Max Turbine RPM (revolutions per minute) are generally 12-16 RPM making the speed at the tips of the blades **over 200 MPH** on most options for our area – an important factor when we discuss safety considerations, as this speed increases with blade length
- Each blade assembly weighs 36 tons on a GE 1.5MW turbine, a rotational weight of nearly 20 cars!
- Installation of a turbine is highly damaging to roadways, field tiles, and surrounding areas due to the heavy equipment required (cranes, semi trucks, etc.)

Sources: E.ON handouts at Gibson Southern High School meeting in 2018 (GBA handouts)

Determining Setback Distances

- Safety – In 2011, Wind Energy partnered with the Georgia Institute of Technology's aerospace engineering department, and University of Alabama's Mechanical and Aerospace Engineering departments to publish a research article titled *"A Method for Defining Wind Turbine Setback Standards."* [Published online in Wiley Online Library (wileyonlinelibrary.com). DOI: 10.1002/we.468]
- The following graphics from this study shows the range/spread of turbine blade fragment throws:



Using the research from this paper, a Vestas V150 turbine with a rotational speed of 12 rpm and a blade radius of 75 m would have a 100% safe throw distance of 2600 m!

There are documented blade fragment throw distances of over 1 mile during extreme cases of turbine blade failure. (Caithness)

Examples of issues related to insufficient Setback Distances

- The same study concluded:

"Wind turbine setback standards designed to protect people, property and infrastructure from impact by thrown blade fragments play an important role in wind farm planning and can often be a determining factor in the number of turbines that can be placed within a given parcel of land. Given the critical importance of these regulations, there is a desire to develop setback standards based on a physical model of blade throw rather than arbitrary rules of thumb. First, a physical model for full or partial blade throw based on rigid body dynamics was described. This model, coupled with Monte Carlo simulation techniques, was used to **simulate tens of thousands of blade throws** for three example wind turbines of varying size. **It was shown that typical current setback standards do not provide adequate protection in most cases.** Then, the importance of fragment release velocity in determining maximum throw distance was analytically demonstrated, and its effect verified through analysis of Monte Carlo results. Normalizing throw distance by fragment release velocity yielded a near-linear relationship between this normalized distance and the percentage of impacts that lie within this distance from the turbine. A final example used this relationship to determine a proper setback distance for an example turbine based on an acceptable level of risk. **Setback development using this methodology allows regulators to mitigate risk using valid engineering analysis rather than arbitrary rules that provide inconsistent and inadequate protection."**

Turbine "Shadow Flicker" Risks

- **In the legal agreement with the Wind Project company, there is the following statement:** ***"Owner acknowledges that there may be risks associated with windpower energy generation, including but not limited to electromagnetic fields, shadow, stray voltage, ice throw and health effects potentially associated with flicker, noise and air turbulence, and owner knowingly waives all claims related to such risks…."***
- Wind companies will argue they perform "flicker studies" to minimize the impact to the community, but there are many documented cases even at great distances where this issue goes on without resolution
- Based on the possible layout of turbine locations in Posey and Gibson county, many homes and properties would be within the "flicker zone" of turbines installed on properties already signed into contracts
- According to a flicker study performed for a proposed wind project in Alabama:

"At distances less than **1000 meters**, shadow flicker may be more noticeable."

That's **3280 feet** - To make matters worse, the proposed turbines in the study were significantly shorter than those proposed in Posey and Gibson county. Taller turbines = greater risk and distance of projected shadow flicker

Source:

Recommended Ordinance Language regarding Turbine installation and Noise Levels

The maximum turbine shadow flicker experienced at a Non-Participating landowner dwelling shall be zero. Measurements to assess shadow flicker shall be for all Non-Participating landowner dwellings located within 0.6 miles or 3,168 feet of a turbine. If shadow flicker will exceed this level, then a shadow flicker mitigation plan must be submitted by the Applicant for each affected Non-Participating dwelling which shall provide for zero shadow flicker for the affected Non-Participating dwelling.

Property Value Issues

- Similar to the Noise issue, Wind Project companies will argue that Property Values are not affected negatively by Industrial Turbine installations, siting a study performed by the Lawrence Berkeley National Laboratory and supported by Office of Energy Efficiency and Renewable Energy (Wind and Water Power Technologies Office) of the U.S. Department of Energy under Contract No. DE-AC02-05CH1123
- While the study deserves review, there are clear conflicts of interest in who drove the study relative to their support of Wind Energy
- Upon further research, many property value concerns are found:

McCann Appraisal performed a study in Tipton County, IN showing evidence of a negative value impact, saying:

"A wind farm creates an easement over neighboring non-participating properties that impairs the value, or a regulatory taking of private property rights, or uncompensated taking." ".. The average value loss started dropping within 2 miles of the wind farm, starting at 25 percent and going up."

Sources:

Turbine Noise Overview

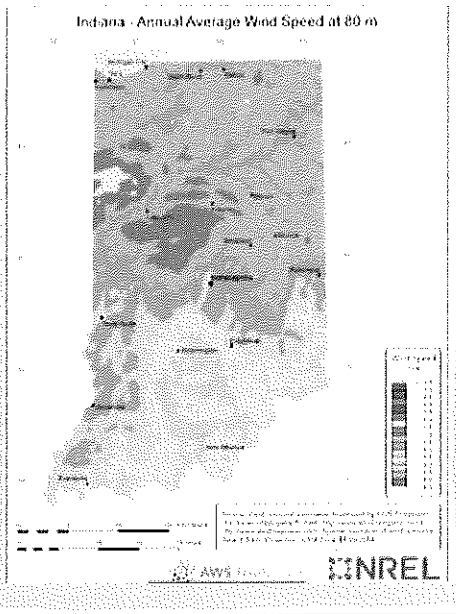
- At E.ON's informational meeting at North Posey High School on June 26th, 2019, one of their paid experts covered noise at great length. During this presentation, an attempt to discredit the 'Low Wind Speed/Higher Noise Concern' topic mentioned in the Notre Dame course
- After further research, we found additional credible supporting information around this concern
- Sandia Labs, one of the countries largest research and engineering laboratories, issued a Study documenting this topic among others, including wind turbine noise reduction technologies
- In this study, the following statement was made regarding turbine blade noise:

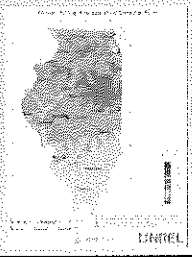
"...overall sound pressure levels were decreased by an average of 3.2 dB over a range of wind speeds from 6 m/s to 10 m/s on a 2.3MW test turbine.....However, the noise reduction was dependent on wind speed, and the lowest reduction was near the lower part of the wind speed range. **This is problematic, since wind turbine noise is often most perceptible at low wind speeds when the background noise from the wind is relatively low and ineffectively masks the turbine noise."**

Source:

Turbine Noise Overview, continued...

- See the Indiana Wind Speed map to right:
- This map shows the wind speeds in Posey and Gibson counties to be far lower than in all areas currently occupied by Industrial Wind Turbines
- The correlation between **greater noise concern** and **lower wind speeds** is an obvious problem in terms of the proposed project in our specific area of Indiana.
- The same goes for Illinois – there are no Industrial Wind Projects in operation where wind speeds (and more noise concern) are consistently this low.





Source:

Turbine Noise Overview, continued...

- Keeping in mind the proposed turbines sizes (MW output) are possibly the largest in the state, this factor needs consideration related to noise output and risk
- The "type" of noise is also a critical factor. The low frequency component of the turbine noise has been well documented to be the main problem in terms of health/sleep/annoyance issues in previous Wind Project installations
- In particular, the low frequency noise has a much greater ability to travel through houses, schools, etc. (think about bass in car stereos), making this type of noise much more intrusive than road traffic noise or other ambient noise

According to a Danish study in 2010:

*"The results confirm the hypothesis that the spectrum of **wind-turbine noise moves down in frequency with increasing turbine size**. The relative amount of emitted low frequency noise is higher for large turbines (2.3-3.6 MW) than for small turbines (≤ 2 MW). The difference is statistically significant for one-third-octave bands in the frequency range 63-250 Hz. The difference can also be expressed as a downward shift of the spectrum of approximately one third of an octave."*

From the same study:

When discussing "future" installations of increasing turbine size, they calculated ***"a turbine of double size emits more than the double sound power....." "It must be anticipated that the problems with low-frequency noise will increase with even larger turbines."***

- In late 2018, the World Health Organization (WHO) acknowledged wind turbine noise as a possible health hazard

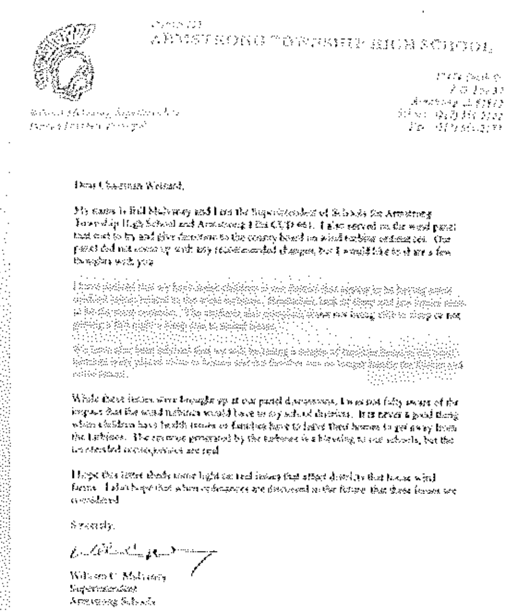
Source:

Turbine Noise Overview, continued…

Wind turbine noise concerns from school superintendent:

- See the letter to the right written by an Illinois school superintendent after an industrial wind project went online in his school district. This should be a serious concern for everyone in our community regarding the validity of the noise/health relationship with these turbines. During the approval process the superintendent was neutral. After the installation, he realized the negative impact and voices this in the following letter:

Source: [illegible]


ARMSTRONG TOWNSHIP HIGH SCHOOL

[illegible]

Dear Chairman [illegible],

My name is Bill Mulvaney and I am the Superintendent of Schools for Armstrong Township High School and Armstrong [illegible] CCSD 61. I also served on the wind panel that met to try and give direction to the county board on wind turbine ordinances. Our panel did not come up with any recommended changes, but I would like to share a few thoughts with you.

[illegible]

[illegible]

While these issues were brought up at our panel discussions, I was not fully aware of the impact that the wind turbines would have to my school district. It is never a good thing when children have health issues or families have to leave their homes to get away from the turbines. The revenue generated by the turbines is a blessing to our schools, but the unintended consequences are real.

I hope this letter sheds some light on real issues that affect districts that house wind farms. I also hope that when ordinances are discussed in the future that these issues are considered.

Sincerely,

William C. Mulvaney
Superintendent
Armstrong Schools

Audible vs. Inaudible Sound

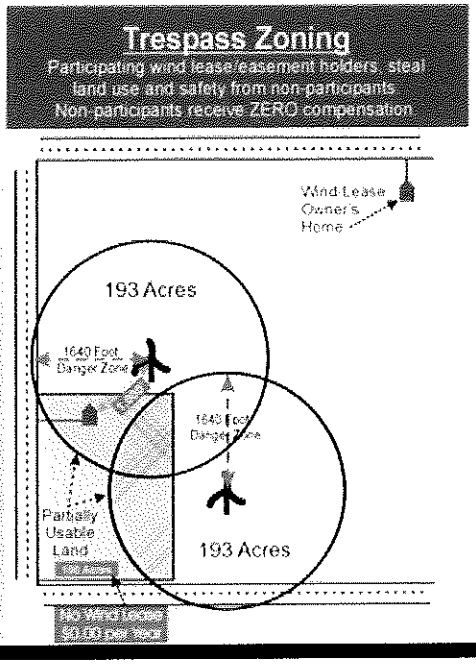
- Audible sound ranges from low pitch to high pitch 20-20,000 Hz
  - This is the range of sound the human ear can hear
- Inaudible sound ranges from 0-20 Hz
  - While the human ear cannot hear this range, the energy from the sound source is still present and can be perceived by the human body
  - Research has shown that inaudible sound can induce neural activity in the brain increasing the risk for seizure for those prone to it.

Recommended Ordinance Language regarding Turbine installation and Noise Levels

At any Non-Participating Landowner's residential lot, public school, public library, or recreational area within one-half mile of the project boundaries, the audible (20-20,000 Hz) and inaudible (0-20 Hz) sound pressure levels as a result of the sound emitted by the project shall not exceed either, the lesser of 40 dB(A) for audible sound and 85 dB(G) for inaudible sound or the Ambient Baseline Sound Pressure Level of the project at Critical Wind Speeds. Audible sounds will be measured in A-weighted units and inaudible sounds in G-weighted units. The Ambient Baseline Sound Pressure Level, if used, shall be determined by a baseline acoustic emissions study conducted by the County Commission and funded by the Applicant. Measurement of sound and vibration levels shall be conducted by certified acoustic professionals using equipment calibrated to NIST standards for sound measurement and in compliance with all other applicable county, state and federal regulations.

What is Trespass Zoning?

- Trespass zoning is a situation where "non-participant" land owners have Property Rights effectively violated by the safety evacuation range being projected onto their property. This limits future uses, and in many cases puts people at a safety risk when present in these areas on their own property.
- This situation is avoided with safety setbacks measured from PROPERTY LINES. Keep in mind, the 1640 ft. setback suggested by RWE is the MINIMUM requirement from Vestas for turbines much smaller than those proposed for Gibson County, with engineering studies suggesting increased setbacks as a safety requirement.
- **Setback distances for turbines should be from property lines, not residences.**



Recommended Ordinance Language regarding Turbine installation and Setbacks

To protect property, structures, and landowners from turbine throw, no turbine may be located less than 4.5 times the height of the turbine, including the blade at its highest point to any Non-Participating landowner property line.

Additionally for all turbine installations, requirements include:

- 2 mile setback from incorporated town limits.
- 2 mile setback from clearly defined unincorporated town
- 2 mile setback from all schools
- 2 mile Property Value Guarantee for residents who decide to sell their home and leave

Note: The 4.5x value was reached by calculation from the aforementioned paper using a blade radius of 75 m and a nominal rotational speed of 12 rpm.

- Sources: http://camm.gatech.edu/images/7/7a/Wind_Turbine.pdf

Noise and Wind Turbines

- Wind turbine noise concerns are likely the most difficult to explain and discuss due to hundreds of reports on both sides of the argument. There are reports suggesting noise is simply an annoyance, and reports suggesting significant health risks related to cardiovascular issues, insomnia, etc.
- In the legal agreement with the Wind company, there is the following statement: "Owner acknowledges that there may be risks associated with windpower energy generation, including but not limited to electromagnetic fields, shadow, stray voltage, ice throw and health effects potentially associated with flicker, **noise and air turbulence**, and owner knowingly waives all claims related to such risks...."
- Two key facts for Posey and Gibson Counties, according to a University of Notre Dame "Wind Turbine Acoustics" course [AME 40530], "Wind turbine noise is **more commonly a concern at lower wind speeds.**" And, **"In general, sound pressure levels [increase] with the rotor diameter."**
- There are literally hundreds of reports of complaints from citizens who live around Industrial Wind Projects, often resulting in lawsuits and people moving from their homes to avoid the exposure to noise issues.