

# Health Impact and Setback Guidelines for Wind Siting Council

Author: Herbert S. Coussons, MD

## Introduction

Thank you for reading and considering my comments. I hope to explain in this document the problems related to noise and health. I have all of the original studies and can give you even more as I have read through many studies from the US, Canada, New Zealand and the whole of Europe that come to the same conclusions. *Large industrial wind turbine developments do not belong in close proximity to locations where people live and work.* I hope to show valid, accepted and reproducible data that put guide lines on siting distances. At 30-40dB measurable objective sleep disturbances are seen. At 40-55dB adverse health effects are seen. Above 55dB is dangerous to public health. Experience has shown industrial wind turbines cause noise that exceeds 40 dB when in close proximity. Noise deteriorates over distance. Allowing for proper distance will mitigate the noise levels both experienced and predicted by independent research and the wind industry. *The safest minimum distance to protect the health and safety is to allow for less than 40dB which correlates to 0.5 miles or 2640 feet. The optimal distance in a rural setting would allow for no more than a 10dB increase in ambient noise which would correlate to just over one mile.*

## Background

As Wind Energy projects continue to expand across Wisconsin and as the need for energy independence becomes more urgent, controversy over siting regulations has become a dividing point in communities across the state. The recent applications for projects in northeast Wisconsin make safe siting guidelines the center of the argument. In local townships such as ours in Wrightstown, Holland, Morrison, and Glenmore, hours of emotionally charged meetings and conflicted town supervisors have lead to only more controversy. A vote of town's members as slanted as 245-18 overwhelmingly does not support the Ledge Wind project. These same conflicts are seen world wide as wind energy projects develop. It is clear that studies are presented both supporting and refuting to notion that wind turbines harm people's health. It is my opinion as a physician that the best evidence support that *building large wind energy turbines in close proximity to humans has a negative impact on the health.*

## Medical Facts

*Normal sleep is essential for health and well-being.* The science of sleep study has established the population averages for the amount of time it takes to fall asleep. The number of awakenings during the night and the number of sleep arousals that are standard. (American Academy of Sleep Medicine 2005.)

Disturbed sleep is defined as problems falling asleep, excessive awakening, excessive sleep arousals, difficulty resuming sleep after awakening, and an overall lack of

restorative sleep. Environmental sleep disorder is when outside factors such as noise cause sleep disturbance, insomnia, or results in daytime fatigue. These problems result in deficits of concentration, attention and cognitive performance, reduced vigilance, malaise, depressed mood, and irritability. The effects are seen in all ages and both genders.

*Long-term sleep disturbance has great influence on metabolic and hormonal function. C-reactive protein is an inflammatory marker associated with the development of atherosclerotic plaques in the coronary vessels and is associated with increased risks of strokes and heart attacks. CRP as a risk predictor of strokes and heart attacks increases as sleep disturbance increases. (Meier-Ewert et al., 2004)*

Leptin is secreted at night and helps to regulate appetite and glucose metabolism. When humans are sleep deprived, weight gain and impaired glucose tolerance is seen.

Cortisol has also been studied as a separate marker of disease related to environmental sleep disturbance. Higher cortisol levels are seen in individuals that are sleep deprived. Higher cortisol levels lead to increased blood pressure and impaired glucose tolerance. In fact the risk of heart attacks is two fold higher in those with insomnia. (Hyyppa and Kronholm, 1989) Many other health hazards can be directly related to sleep disturbance, including decreased immunity and susceptibility to viral illness, and many other consequences related to daytime fatigue such as work injuries, poor school performance and auto accidents. It has been shown that fatigue may impair driving more than alcohol. Work injuries may be increased, and children suffer from behavioral problems and decreased school performance. Children have problems with learning, attention and memory. These are all substantiated medical facts that stand alone as they relate to sleep disturbances. Many causes of sleep disturbance such as shift work, sleep apnea and environmental have been shown to cause the same group of adverse health effects. In summary, the overall health impact is that *death rates increase as sleep decreases* (Patel et al., 2004; Tamakoshi and Ohno, 2004) And according to Kripke et al. 1979, reduced sleep may be a greater independent risk factor for death than smoking or hypertension.

### Environmental factors

Noise disturbs sleep. Many studies over the last 30 years show there are physical responses to noise as it disturbs sleep. EEG changes, blood pressure and heart rate, body movement and restlessness, and awakening can all be measured in the common sleep study. Environmental factors such as airport noise, road traffic, railway noise, and neighbor noise have all been reported as sources of sleep disturbance. They all follow a similar curve in that as noise levels increase so do complaints of sleep disturbance. At 40 dB less than 5% of individuals show night time sleep disturbance. At 50dB about 6% have sleep disturbance. At 55dB up to 10% have sleep disturbance. At 60dB as high as 15% have sleep disturbance. (European Commission, 2004) The neighbor induced noise is worth a closer look as up to 20% of neighbors are disturbed by voices, water running, toilets, TV, radio and music as well as neighbors pets. This is important in consideration of siting wind turbines because most locations targeted for development are rural (though

not sparsely populated in southern Brown County). These areas tend to be quieter at night than urban areas. The people that chose to live there do not have background ambient noise, making any additional noises more noticeable.

### Experience is the Best Teacher

Wind Turbine noise is disturbing to those who live close to them. Planners of wind turbine developments need to take into account the noise complaints from existing sites and the real world examples of the noise disturbance caused by wind developments.

Many of these sites have been in place for years and those that are in close proximity to people are rife with complaints, law suits and unhappy landowners. Proper siting away from people will prevent such complaints. (Hanning, 2009) Surveys of residents living in close proximity to industrial wind turbines show high levels of sleep disturbance and annoyance. In Kewaunee County 52% of individuals living within 2400 feet found noise to be problematic. 32% within 4800 feet and 4% greater than 1 mile were disturbed. 67% reported disturbed sleep if they lived within 1200 feet. (Kabas 2001) In Sweden 2 studies yield similar results with complaints of disturbance rise as the noise levels increased from 32.5 dBA to 40 dBA. (Pederson and Persson 2007) Multiple other surveys from France, New Zealand, Canada, The United Kingdom, the Netherlands, Sweden and others show similar results. The conclusion that industrial wind turbine noise is disturbing to people that live close to the developments is a fact. We should learn from others mistakes and not subject the people of Wisconsin to repeat the problems seen across the United States and the world. It is clear that proper siting by increasing the distance of the wind turbines from people will prevent the noise complaints. The deterioration of noise over distance is very predictable and several models exist for industrial wind turbines. (UK Department of Transport and Industry 2006; Kamperman and James 2008)

### What is the Best Distance?

At least 14 published recommendations follow the same logic. Wind turbines cause noise. Noise disturbs sleep. Sleep disturbance has a bad effect on health. The conclusions of many sound studies show that the noise decreases as the distance from the turbine increases. (Theriault Acoustics, 2009 for Invenergy) Figure 9 “Predicted Noise Level Contours – Area” Shows that the entire Area shaded red will exceed 40dB. To reach an ambient level of less than 35 dB a home must be at least one mile away from the nearest turbine. To the northeast of the Ledge Wind Project that distance exceeds 2 miles. This agrees with the 14 studies tabulated in Dr Hanning’s article “Sleep Disturbance and Wind Turbine Noise” (2009) Table 1 on page 33 summarizes these recommendations published between 1994 and 2009 by engineers, scientists, lawyers and physicians. The recommended setbacks vary from >0.62 miles to 1.55 miles with an average of 1.2 miles. At these distances the noise levels will be less than 45 dB. According to the WHO in their 2009 authoritative document on noise and sleep disturbance, *levels between 32 dB and 42 dB will disturb sleep and noise levels of 50dB or higher have been proven to cause health consequences*. The same study uses 21dB as a threshold for rural nighttime sleep.

According to Invenergy, the sample data from the Theriault study, the ambient noise in 8 locations in rural Brown county were measured. The highest noise recorded was an isolated 56 dBA and the predominant level of daytime noise was 32dB. The ambient nighttime noise averaged 25 dBA. According to the WHO standards, between 32 and 42dB or a 10dB level above ambient sound will be disruptive. *If we use Invenergy's sound contour map, then a setback of one mile will be required to safely fall within these standards.*

Best Choice

The council has a decision to make. With the known data on sound and sleep disturbance, with other wind farm failures by close siting, and with the wind industries predictions of sound in the wind farm – *will the council make the best recommendation for the people living in Wisconsin and take steps to be conservative by placing a setback of one mile from where people live, work, and attend school? This is the best choice based on the current data to ensure the safety of those living within a development by keeping the noise levels less than 40dBA*

Or will the council compromise the standards knowing that up to 50% people will experience disrupted sleep and 5% may suffer health effects if ½ mile is used? Or worse yet if 1250 feet is used, then up to 67% will complain of disturbed sleep and up to 15% will see adverse health effects.

TABLES

Table 1 From Hanning 2009; Recommendations for setback of residential properties from industrial wind turbines.

<u>Authority</u>	<u>Year</u>	<u>Notes</u>	<u>Rec'd miles</u>	<u>Rec'd Kilometers</u>
Frey and Hadden	2007	Scientists. Turbines >2MW	>1.24	>2
Frey and Hadden	2007	Scientists. Turbines <2MW	1.24	2
Harry	2007	UK Physician	1.5	2.4
Pierpont	2008	US Physician	1.5	2.4
Welsh Affairs Select Committee	1994	Recommendation for smaller turbines	0.93	1.5
Scottish Executive	2001	Visual recommendation included	1.24	2
Adams	2008	US Lawyer	1.55	2.5
Bowdler	2007	UK Noise engineer	1.24	2
French National Academy of Medicine	2006	French physicians	0.93	1.5
The Noise Association	2006	UK scientists	1	1.6
Kamperman and James	2008	US Noise engineers	>0.62	>1

Kamperman	2008	US Noise engineers	>1.24	>2
Bennet	2008	NZ scientist	>0.93	>1.5
Acoustic Ecology Institute	2009	US Noise engineers	0.93	1.5

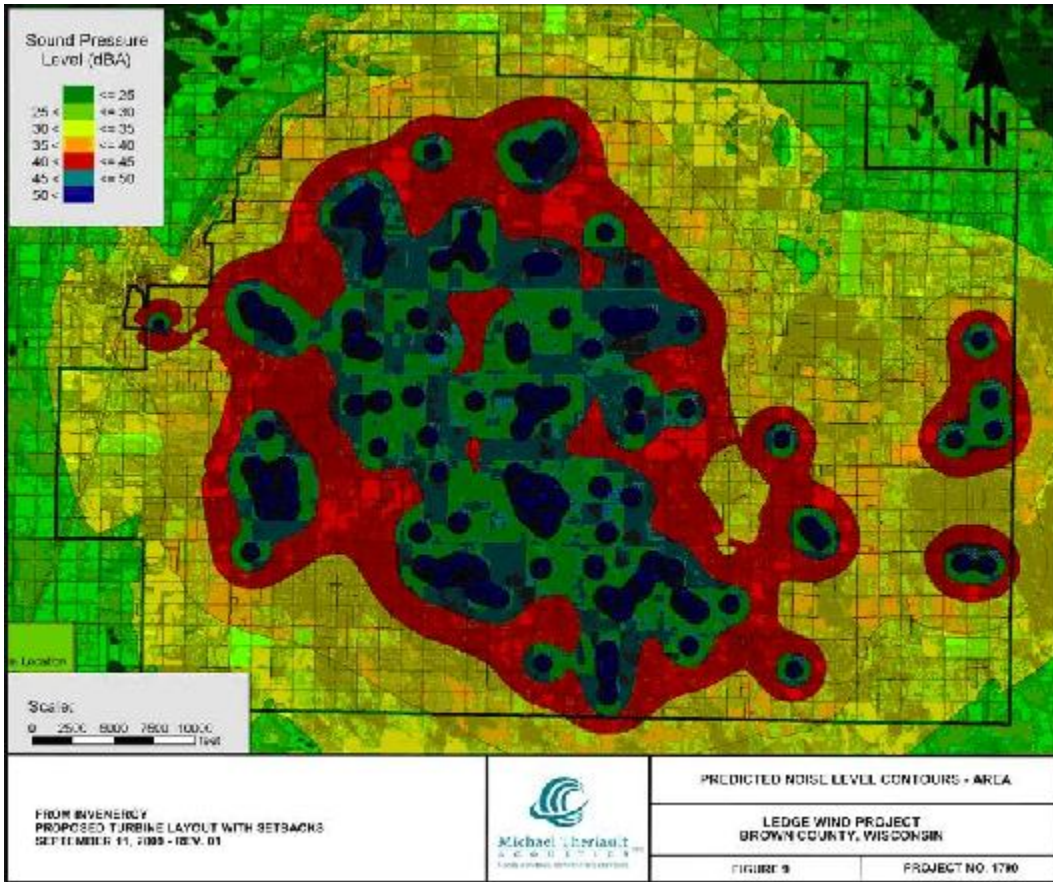
Table 3 from World Health Organization 2009; Effects of different levels of night noise on the population's health.

Average night noise level over one year	Health effect observed in the population
Up to 30dB	Although individual sensitivities and circumstances may differ, it appears that up to this level no substantial biologic effects are observed.
30 to 40 dB	A number of effects on sleep are observed; body movements, awakening, self-reported sleep disturbance, arousals. The intensity of the effect depends on the nature of the source and the number of events. Vulnerable groups (elderly, children and chronically ill) are more susceptible.
40-55 dB	Adverse health effects are observed among an exposed population. Many people have to adapt their lives to cope with the noise at night.
Above 55 dB	The situation is considered increasingly dangerous for public health. Adverse health effects occur frequently, a sizeable portion of the population is highly annoyed and the sleep disturbed. There is evidence that the risk of cardiovascular disease increases.

Table 2 from Theriault 2009 for Invenergy; Summary of ambient noise levels in the Ledge Wind project assessment

Location	Description	0600-0800	1200-1400	1800-2000	2200-2400
1	Blake Rd	26	26	24	19
2	Cooperstown	31	33	34	29
3	Mill Road	34	36	34	27
4	Dickenson Road	29	37	34	31
5	Morrison Road	29	34	29	28
6	Park Road	31	31	28	20
7	Refuge Road	35	36	56	27
8	Mill/Blake Road	31	32	28	23

According to subsequent predictions, the rise in ambient noise will be 15-24 dBA based on 1000 ft setbacks. This exceeds the WHO guidelines for absolute noise levels and relative rise in noise in noise levels. The solution to keep the noise levels within acceptable range is to increase the setback.

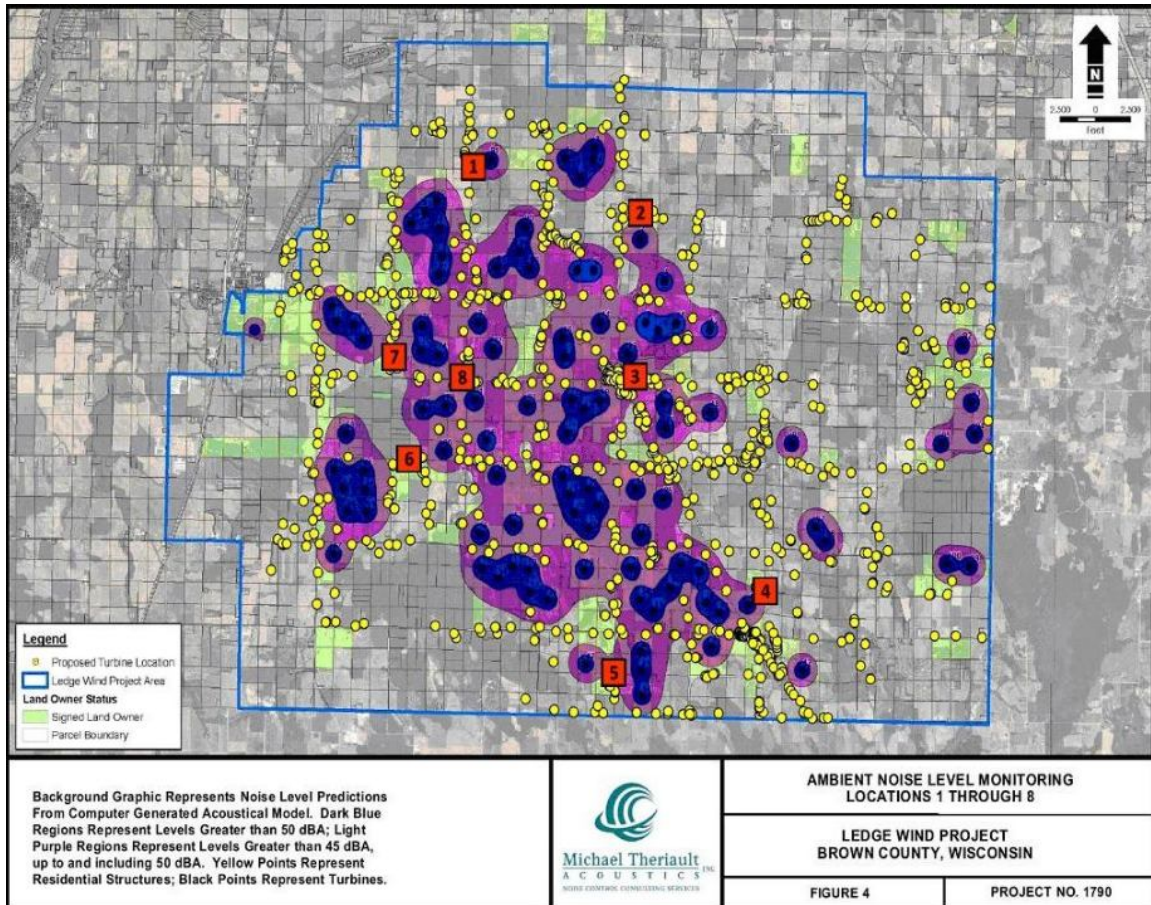


This Invenery map supports the setbacks recommended in the chart and my opinions above.

The goal is to have noise that disturbs sleep and impacts health eliminated.

As you can see, all areas shaded red exceed 40 dBA. And all areas shaded Orange will exceed 35dBA. To be outside of the 40 dBA ring, one must live 2500 feet from the nearest turbine. To be outside of the 35 dBA ring one must live over one mile from the nearest turbine. This agrees with the summary in the Hanning paper.

In the chart below consider all of the homes in the areas of 45 to >50 dBA. Then consider the WHO statement on noise from 40-55 dBA *“Adverse health effects are observed among an exposed population. Many people have to adapt their lives to cope with the noise at night.”*



Also consider the schools and businesses located in this area. Clearly the solution to this problem is in PROPER, SAFE siting. That siting guideline should include a minimum distance of ½ to 1 mile based on independent research and data from the wind industry.

*“There is no medical doubt that audible noise such as emitted by modern upwind industrial wind turbines sited close to human residences causes significant adverse health effects. These effects are mediated through sleep disturbance, physiological stress and psychological distress. This is settled medical science.”*

An Analysis of the American/Canadian Wind Energy Association sponsored “Wind Turbine Sound and Health Effects An Expert Panel Review, December 2009.” Peer reviewed and published January 2010.

### Summary and Conclusion

Sleep is basic and important to human health. When sleep is disturbed, health suffers.

Noise disturbs sleep.

Above 30dB sensitive individuals complain.

At 30-40dB measurable objective sleep disturbances are seen.

At 40-55dB adverse health effects are seen.

Above 55dB is dangerous to public health.

Experience has shown industrial wind turbines cause noise that exceeds 40 dB when in close proximity.

Noise deteriorates over distance.

Allowing for proper distance will mitigate the noise levels both experienced and predicted by independent research and the wind industry.

The safest minimum distance to protect the health and safety is to allow for less than 40dB which correlates to 0.5 miles or 2640 feet.

The optimal distance in a rural setting would allow for no more than a 10dB increase in ambient noise which would correlate to just over one mile.

As a physician and resident of Wisconsin in an area targeted for large industrial wind turbines, I ask the committee to *make the best recommendation for the people living in Wisconsin and take steps to be conservative by placing a setback of one mile from where people live, work, and attend school. This is the best choice based on the current data to ensure the safety of those living within a development.*

Or will the council compromise the standards knowing that at 2640 feet sleep complaints will develop? What percentage of residents is an acceptable compromise when action now by proper siting will prevent these problems?

Respectfully, Herbert S. Coussons, MD