# Summary of the Public Health Impacts of Wind Turbines – May 22nd, 2009

Included in the summary are sections from key concerning statements directly out of the report. Please read the entire report for more detail. As this report makes clear, more regulation is required to protect the Health, Safety and Quality of Life of residents that are surrounded by industrial wind facilities.

**Health Issues, Page 6:**
The NRC also notes that effects of low frequency (infrasound) vibration (less than 20 Hz) on humans are not well understood, but have been asserted to disturb some people. Finally, the NRC concludes that noise produced by wind turbines is generally not a major concern beyond a half mile.

**Vestibular System, Page 8:**
It is not known what stimulus intensities are generally required for autonomic activation at relatively low frequencies, and it is likely that there is considerable human variability and capacity to adapt to vestibular challenges. Turbine sound may be sensed by the vestibular system which is responsible for balance and physical equilibrium.

**Sound Measurements, Page 11:**
The World Health Organization (WHO, 1999) suggests that A-weighting noise that has a large low frequency component is not reliable assessment of loudness. This identifies the lack of proper regulation when sound is only monitored and regulated on the dBa scale.

**Modulation of aerodynamic noise, Page 14:**
They suggest that aerodynamic modulation is typically underestimated when noise estimates are calculated. In addition, they suggest that detailed modeling of wind, terrain, land use and structures may be used to predict whether modulation of aerodynamic noise will be a problem at a proposed wind turbine site.

**Wind farm noise, Page 14:**
The noise from multiple turbines similarly distant from a residence can be noticeably louder than a lone turbine simply through the addition of multiple noise sources. Under steady wind conditions noise from a wind turbine farm may be greater than noise from the nearest turbine due to synchrony between noise from more than one turbine (van den Berg, 2005).

**Shadow Flicker, Page 14:**
Modeling conducted by the Minnesota Department of Health suggests that a receptor 300 meters, (984 ft), perpendicular to, and in the shadow of the blades of a wind turbine, can be in the flicker shadow of the rotating blade for almost 1½ hour a day. At this distance a blade may completely obscure the sun each time it passes between the receptor and the sun. With current wind turbine designs, flicker should not be an issue at distances over 10 rotational diameters (~1000 meters or 1 km (0.6 mi) for most current wind turbines. This distance has been recommended by the Wind Energy Handbook (Burton et al., 2001) as a minimum setback distance in directions that flicker may occur, and has been noted in the Bent Tree Permit Application (WPL, 2008). Ireland recommends wind turbines setbacks of at least 300 meters from a road to decrease driver distraction (Michigan State University, 2004).

**Potential Adverse Reaction to Sound, Page 15:**
Loud noise from any source can interfere with verbal communication and possibly with the development of language skills. Noise may also impact mental health. In addition, possible effects of noise on performance and cognition have also been investigated, but these health studies have not generally looked at impacts specifically from low frequency noise. Noise has also been shown to impact sleep and sleep patterns.

**Studies of Wind Turbine Noise Impacts on People, Page 17:**
Combining the data from the two studies, when noise measurements were greater than 40 dB(A), about 50% of the people surveyed (22 of 45 people) reported annoyance. In one of the studies, 64% respondents who reported noise annoyance also reported sleep disturbance.

**Case Reports, Page 18:**
Harry (2007) describes a meeting with a couple in Cornwall, U.K. who live 400 meters from a wind turbine, and complained of poor sleep, headaches, stress and anxiety. Harry subsequently investigated 42 people in various locations in the U.K. living between 300 meters and 2 kilometers (1000 feet to 1.2 miles) from the nearest wind turbine. The most frequent complaint (39 of 42 people) was that their quality of life was affected. Headaches were reported by 27 people and sleep disturbance by 28 people. Some people complained of palpitations, migraines, tinnitus, anxiety and depression.

**Case Reports, Page 19:**
Pierpont (2009) postulates wind turbine syndrome, consisting of a constellation of symptoms including headache, tinnitus, ear pressure, vertigo, nausea, visual blurring, tachycardia, irritability, cognitive problems and panic episodes associated with sensations of internal pulsation. She studied 38 people in 10 families living between 1000 feet and slightly under 1 mile from newer wind turbines.

**Low frequency noise assessment and regulation, Page 22:**
In their noise guidance, the WHO (1999) recommends 30 dB(A) as a limit for "a good night's sleep". However, they also suggest that guidance for noise with predominating low frequencies be less than 30 dB(A).

We along with the majority of my neighbors strongly urge you to draft county specific regulations ,including minimum 0.6 mile setbacks from property lines, to protect the local residents. The MNPUC gives every county the right to create more stringent regulation. This report from the Department of Health provides many reasons on why such regulation is required. Please do not delay getting this process moving forward. Once construction begins it will be too late and the communities will be irreversibly negatively affected.

**VI. Conclusions**
Wind turbines generate a broad spectrum of low-intensity noise. At typical setback distances higher frequencies are attenuated. In addition, walls and windows of homes attenuate high frequencies, but their effect on low frequencies is limited. Low frequency noise is primarily a problem that may affect some people in their homes, especially at night. It is not generally a problem for businesses, public buildings, or for people outdoors.

The most common complaint in various studies of wind turbine effects on people is annoyance or an impact on quality of life. Sleeplessness and headache are the most common health complaints and are highly correlated (but not perfectly correlated) with annoyance complaints. Complaints are more likely when turbines are visible or when shadow flicker occurs. Most available evidence suggests that reported health effects are related to audible low frequency noise. Complaints appear to rise with increasing outside noise levels above 35 dB(A). It has been hypothesized that direct activation of the vestibular and autonomic nervous system may be responsible for less common complaints, but evidence is scant.

The Minnesota nighttime standard of 50 dB(A) not to be exceeded more than 50% of the time in a given hour, appears to underweight penetration of low frequency noise into dwellings. Different schemes for evaluating low frequency noise, and/or lower noise standards, have been developed in a number of countries.

For some projects, wind velocity for a wind turbine project is measured at 10 m and then modeled to the height of the rotor. These models may under-predict wind speed that will be encountered when the turbine is erected. Higher wind speed will result in noise exceeding model predictions.

Low frequency noise from a wind turbine is generally not easily perceived beyond ½ mile. However, if a turbine is subject to aerodynamic modulation because of shear caused by terrain (mountains, trees, buildings) or different wind conditions through the rotor plane, turbine noise may be heard at greater distances.

Unlike low frequency noise, shadow flicker can affect individuals outdoors as well as indoors, and may be noticeable inside any building. Flicker can be eliminated by placement of wind turbines outside of

the path of the sun as viewed from areas of concern, or by appropriate setbacks.

Prediction of complaint likelihood during project planning depends on: 1) good noise modeling including characterization of potential sources of aerodynamic modulation noise and characterization of nighttime wind conditions and noise; 2) shadow flicker modeling; 3) visibility of the wind turbines; and 4) interests of nearby residents and community.

## VII. Recommendations

To assure informed decisions:

· Wind turbine noise estimates should include cumulative impacts (40-50 dB(A) isopleths) of all wind turbines.

· Isopleths for dB(C) - dB(A) greater than 10 dB should also be determined to evaluate the low frequency noise component.

· Potential impacts from shadow flicker and turbine visibility should be evaluated.

"Any noise criteria beyond current state standards used for placement of wind turbines should reflect priorities and attitudes of the community."