Wind turbine noise, an independent assessment

By Stephen Ambrose and Robert Rand
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Stephen Ambrose and Robert Rand are members of the Institute of Noise Control Engineering. In 2009, they became concerned about the negative comments from residents living near wind turbine sites and, the apparent lack of regulatory action to address the potential for adverse health impacts from wind

turbine generator noise in Mars Hill. They launched their own evaluation, and came to the following conclusions in a series of guest columns.

Wind turbines larger than one megawatt of rated power have become an unexpected surprise for many nearby residents by being much louder than expected. The sounds produced by blades, gearing, and generator are significantly louder and more noticeable as wind turbine size increases. Long blades create a distinctive aerodynamic sound as air shears off the trailing edge and tip. The sound character varies from a “whoosh” at low wind speeds to "a jet plane that never lands" at moderate and higher wind speeds. Blade-induced air vortices spinning off the tip may produce an audible “thump” as each blade sweeps past the mast. Thumping can become more pronounced at distance, described as "sneakers in a dryer," when sounds from multiple turbines arrive at a listener's position simultaneously.

Wind turbines are not synchronized and so thumps may arrive together or separately, creating an unpredictable or chaotic acoustic pattern. The sounds of large industrial wind turbines have been documented as clearly audible for miles. They are intrusive sounds that are uncharacteristic of a natural soundscape.

Studies have shown that people respond to changes in sound level and sound character in a predictable manner. A noticeable change in sound level of 5 decibels (dB) may result in “no response” to “sporadic complaints." An increase of 10 dB may yield “widespread complaints,”; a 15 dB increase “threats of legal action."

The strongest negative community response occurs with an increase of 20 dB or more, resulting in “vigorous objections." Audible tones, variability in sound level, and an unnatural sound character can amplify the public response. For a distinctive or unpleasant sound, a small change in sound level, or the sound simply being audible, may provoke a strong community response. Community response can intensify further if sleep is disturbed and quality of life or property is degraded.

Weather conditions influence the sound level generated and how it travels to nearby homes. Sound waves expand outward from the wind turbine with the higher frequencies attenuating at a faster rate than low frequencies. Locations beyond a few thousand feet may be dominated by low frequency sounds generated by the wind turbines. Wind turbulence and icing, both common in New England due to topography and latitude, increase aerodynamic noise from intensified or chaotic dynamic stall conditions along the blade surfaces. Atmospheric conditions at night and downwind enhance sound propagation toward the ground by increasing levels over longer distances. Wind turbines are elevated hundreds of feet to receive stronger winds yet winds down on the ground or in nearby valleys may be non-existent with correspondingly low background sound levels, accentuating the impact of the intrusive sounds.

Other professionals have developed thresholds, or criteria, for sound level to protect public health that may be applied to planning for wind turbine permitting. Recommendations from Hayes McKenzie Partnership in 2006 limited *maximum* wind turbine sound levels at residences to 38 dBA and no more than 33 dBA when “beating noises" are audible when the turbines spin.

Dan Driscoll presented his analysis in 2009 (Environmental Stakeholder Roundtable on Wind Power, June 16, 2009) with a Composite Noise Rating analysis of 33 dBA to reduce rural community response to the level of "sporadic complaints."

Michael Nissenbaum issued his findings in 2010 from his medical study at Mars Hill, recommending a 7000-foot setback for public health. The World Health Organization published sound level thresholds of sleep disturbance and adverse health effects from peer-reviewed medical studies (Night Noise Guidelines for Europe, October 2009).

Our next column will compare our sound level versus distance data with these medical, health, and community response criteria and show what distances are necessary to protect public health.

Currently there is no effective, reliable noise mitigation for wind turbines of this size other than shutdown. Therefore, at this time it appears appropriate that proposed wind turbine sites should position wind turbines at least one mile away from residential properties and further for sites with more than one wind turbine. Smaller wind turbines (under one megawatt power rating) produce less noise than those currently being marketed and installed for grid power in Maine; these may be an option when distance is an issue.