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Session 3aNSa: Wind Turbine Noise I

3aNSa8. Wind turbine sound prediction - the consequence of getting it wrong

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The application to permit a wind turbine power development usually involves submission of a prediction for the sound level that will occur at residences, schools, places of worship, and elsewhere people gather for restorative rest. This paper uses the example of a wind power development, and follows iterations taken to finalize the sound level prediction. The paper provides quantitative information collected since the start up of the wind power development on measured sound levels and octave band distribution; and qualitative observations on the special characteristics of the sound. Actual observations are compared to the predictions. More importantly, the paper reviews the consequences self-reported in qualitative interviews by citizens living with the changed environment after four years of operation of the wind power development. Reported impacts included difficulty sleeping, loss of jobs, and changes to social relationships, caregiving, pursuit of hobbies, leisure, learning, and overall health. Changes in measured health outcomes are identified. Both the quantitative and qualitative findings justify revision of the permitting process.

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BACKGROUND

Wind turbines are rapidly increasing in number. In this paper, the example of the province of Ontario, Canada will be used. The Global Wind Energy Council tracks the world wide installed wind turbines, showing a 10-fold increase in the 10 years from 2001 to 2011 to nearly 240,000 MW. In Ontario the wind turbine capacity has increased over one hundred-fold from about 15 MW in 2003 to about 1700 MW at the end of 2012, and anticipates to continue to more than triple the total wind capacity to 5811 MW by 2015. Health Canada has a study underway on the health effects of wind turbines that will not report before this increase in wind turbine capacity is made. This paper will look at the basis for regulation of the installed wind turbine base in Ontario and investigates consequences of the installations identified already.

How Wind Turbine Sound is assessed in Ontario

To date, the acoustic regulation of wind turbines installed in Ontario has been based on a dBA weighting of the sound level at "receptors", such as homes, schools, or places of worship. The regulations allow for a penalty if sound from the wind turbine is determined to be "tonal" but no such penalty has been applied to any installed turbine.

The regulators in Ontario have responded to questions on possible health concerns from wind turbines quoting from a report of the Ontario Chief Medical Officer of Health, *"While some people living near wind turbines report symptoms such **as dizziness, headaches,** and **sleep disturbance**, the scientific evidence to date has not demonstrated a **direct** causal link between wind turbine noise and adverse health effects. The sound level from wind turbines at common residential setbacks is not sufficient to cause hearing impairment or other **direct** health effects, although some people may find it **annoying**."* In Dec. 2011, the Ministry of the Environment, reported, *"An expert report has concluded there is no **direct** health risk from wind turbine sound at Ontario's regulated setback distance."*

It is interesting the Ontario regulators base the regulation of wind turbines on "direct" health effects. The major discussion that differentiates between direct and indirect health effects is the subject of extreme weather events, where many report that while the direct impact due to deaths due to drowning from floods may be limited, the number of indirect effects may be greater, possibly including aggravation of chronic disease due to disruption in health care, significant mental health issues and civic disruption from population displacement. Elimination of indirect health effects for wind turbines means the only subjects allowed for consideration are hearing loss, or the impact of being hit by falling bits, and dismiss any effect of dizziness, headaches, sleep disturbance, and annoyance.

Arguments for Considering Indirect Health Effects from Noise

It is informative to refer to the report titled, *"Burden of Disease from Occupational Noise (Quantification of healthy life years lost in Europe)"* issued by the World Health Organization (Europe) in 2011, beginning, *"This publication summarizes the evidence on the relationship between environmental noise and health effects, including cardiovascular disease, cognitive impairment, sleep disturbance, tinnitus, and annoyance."*All are indirect health effects. The report goes on to identify these result in a burden of disability adjusted life years in Europe as follows:

- 61,000 years – ischaemic heart disease
- 45,000 years – cognitive impairment of children
- 903,000 years – sleep disturbance
- 22,000 years – tinnitus
- 654,000 years – annoyance

The report concludes, *"There is sufficient evidence from large-scale epidemiological studies linking the population exposure to environmental noise with adverse health effects. Therefore, environmental noise should be considered not only as a cause of nuisance but also as concern for public health and environmental health."*

Sleep Disturbance as an effect of Environmental Noise

Other studies have shown the linkage between noise and adverse consequences. The *"Sound Sleep Study"* issued in 2010 by Solet and others reviews the subject of sleep disruption and its consequences on adverse health. The report identifies that arousals may occur that are not recalled during the night, but result in sleep deprivation. While the report was not able to simulate the impact of vibration, it does identify that vibrational changes (as caused by rotating equipment) may well be a factor in arousals. The impact of sleep disruption on adverse health effects is summarized in TABLE 1.

TABLE 1: Consequences of Insufficient or Disordered Sleep identified in the "Sound Sleep Study" (2010)

Cognitive Impacts	Health Care System Impacts	Physical Impacts
Impaired Attention and Reaction Times	Increased Consumption of Healthcare Resources	Risk of Injuries, Falls
Decreased Memory and Concentration		Increased Incidence of Pain
Worse Mood, Depression		Weight Gain
Impaired Task Concentration		Diabetes Inflammation
Psychological Difficulties		Cardiovascular Disease

Other reports have also noted that weight loss due to abdominal discomfort may also be a consequence.

The Specific Case of Wind Turbines as a Source of Environmental Noise

While the WHO *"Burden of Disease from Occupational Noise"* paper identifies the link between environmental noise and adverse health effects, the study by Nissenbaum, Aramini, and Hanning, *"The effects of industrial wind turbine noise on sleep and health"* extends the generic data to the specific subject of wind turbines. *"The effects of industrial wind turbine noise on sleep and health"* refers to the factor identified in the *"WINDFARM Perception"* report by Van den Berg, Pedersen, and Bouma, *"From this and previous studies it appears that sound from wind turbines is relatively annoying: at the same sound level it causes more annoyance than sound from air or road traffic,"* noting that a reason for the difference may be the impulsive nature of the wind turbine sound. The report concludes in part, *"We conclude that the noise emissions of IWTs disturbed the sleep and caused daytime sleepiness and impaired mental health in residents living within 1.4 km of the two IWT installations studied. Industrial wind turbine noise is a further source of environmental noise, with the potential to harm human health."*

The Specific Case of Annoyance from Environmental Noise

Further background was provided in a tutorial *"Some People are More Sensitive than Others"* by Luz at the 161st ASA Conference. It provided a review of the subject of variable sensitivity of individuals to noise, noting that about 1 in 5 persons is noise sensitive and showed that noise sensitivity had a noted impact on annoyance from sound.

The Impact of Sound Quality on Annoyance

Finally, a number of Acoustics texts identify that annoyance is related to more than loudness, even though loudness (A weighted) is the only criterion Ontario uses to assess the acceptability of wind turbines. Various texts, including the Springer Handbook of Acoustics (Rossing), and the Handbook of Acoustics (Crocker) identify that sound quality has been identified as a significant contributor to annoyance. From the Springer Handbook of Acoustics, page 1003, *"Noise often has characteristics that may make the sound more annoying than sounds of equivalent level using conventional measures."* Or from the Handbook of Acoustics (Crocker), page 1200 *"The magnitude of that annoyance does depend to some extent on the level of the sound, On average, the higher the level, the greater the interference with speech communication, mental concentration, task performance, recreational activities and sleep, and hence the greater annoyance. However, there are so many other factors that determine the annoyingness of a sound (its spectrum, duration, and temporal pattern, perceived avoidability, expectedness, meaningfulness, inter alia) that the level per se remains expressible only in qualitative terms."*

Fastl and others provide considerable further definition of the subject of the Quality of Sound and its impact on annoyance. The text *"Psychoacoustics: Facts and Models"* identifies loudness, sharpness, fluctuation strength, roughness, subjective duration, and rhythm as factors defining the quality of sound. The paper, *"Psychoacoustical Basis of Sound Quality Evaluation and Sound Engineering"* notes, *"In R&D departments of companies, the evaluation of sounds usually is based on physical measurements. However, in "real life", the ultimate judge for sound is the human hearing system. A customer evaluates the sound of a product not only by physical measurement tools, whatever their sophistication may be."* The paper *"Significance of Meaning in Sound Quality Evaluation"* notes source identification was not importance for loudness evaluation, but was for annoyance judgments.

My personal favorite example to simply explain the importance of sound quality was attributed by Jo Solet to Bridgitte Shulte-Fortkamp, then VP of the ASA. "Evaluation of sound by loudness alone is like assessing soup by temperature alone. In fact it is only after you put it into your mouth that you decide if you want to savour a pleasant taste, or to spit it out."

PREDICTION AND ASSESSMENT OF WIND TURBINE SOUND IN ONTARIO

While the Independent Electricity System Operator (IESO) lists 15 industrial wind power developments in service and 28 more as under development (plus a number of other developments supplying directly to the electrical distribution system), one development, now identified by the IESO as the Underwood Wind Power Development will be used as an example. Although the regulatory process has evolved and the names of some steps have been changed, the differences with respect to submission of an environmental noise report are minor.

When the Underwood project applied for approval, part of the Environmental Screening (ESR) submission included an Environmental Noise Assessment to show that the sound levels at any receptor met the regulations. Table 2 shows the sound levels identified by the developer for 24 residences, identified in the first column. The sound levels are identified for a 10-metre reference wind speed of 6 m/s.

TABLE 2: The evolution of sound at sample residences shown in environmental noise assessments filed with the regulator

Residence	**ESR dBA** *Issued for 30 day Public Comment*	**Revision 1 dBA** *Revised Layout*	**Revision 2 dBA** *Turbines >1000m Included*	**Final Adjusted dBA** *Reduced Impact 8dBA for Some*
AAA – A	40.7	40.2	41.0	39.5
AAB - A	38.4	38.9	40.7	39.6
AAC - A	36.7	40.3	40.6	39.2
AAD - A	38.0	39.5	40.8	39.8
AAE - A	37.7	39.2	40.6	38.9
AAF	36.7	39.4	40.0	40.0
AAG	32.5	37.8	40.3	40.3
AAH - A	33.0	39.5	40.9	39.9
ABA	34.2	38.1	38.7	38.7
ABB	30.8	38.2	39.8	39.8
ABC	38.4	37.5	39.3	39.3
ABD	35.8	37.4	38.3	38.3
ABE	39.5	37.5	38.1	38.1
ABF	32.7	35.1	37.2	37.2
ABG	28.4	35.1	37.4	37.4
ABH	30.9	33.2	36.6	36.6
ACA	31.1	33.1	36.0	36.0
ACB	-88.0	-88.0	34.7	34.7
ACC	32.1	30.7	33.7	33.7
ACD	27.8	-88.0	33.2	33.2
ACE	-88.0	-88.0	31.5	31.5
ACF	-88.0	-88.0	31.5	31.5
ACG	35.6	-88.0	30.1	30.1
ACH	32.0	-88.0	30.0	30.0

After submission of the first report, members of the public had 30 days to file comments. Only one of the 24 residences had an identified sound level exceeding a “rounded” 40 dBA (the limit). The report discounted that case noting it was within 1 dB of the limit, and the sound could not be as high as shown because wind turbines were arrayed around the residence so some turbines would be downwind and contribute less than calculated by the ISO 9613-2 models which assume the residence was simultaneously downwind of all turbines. The report calculated the sound level for turbines within 1000 metres of a residence. Any residence with the nearest turbine further than 1000 metres was identified as having a sound level impact of -88 dBA. For the example residences shown in this table, 3 showed an impact of -88 dBA in the filing with the ESR. The arithmetic average of those showing any contribution was 34.4 dBA. As many were considered to have no effect, and the average from the remainder was less than 35 dBA, it suggested that the project would be very quiet.

Five months after the submission of the first report, and four months after the opportunity for comment on the application had closed, the second of four complete revisions of the environmental noise assessment was filed, as the turbine layout had changed. All turbines were moved from Saugeen Shores into Kincardine. In this first revision of the data shown in the column headed “Revision 1 dBA”, all of the 24 residences met the criteria of being under a “rounded” 40 dBA. 6 residences were shown to have an impact of -88 dBA, and the arithmetic average of the remaining 18 was 37.3 dBA. The calculation still only included turbines within 1000 metres of any residence.

The Ministry of the Environment directed the acoustical consultant to recalculate the data so that if a residence had any turbine within 1000 metres, then the contribution of all turbines in the project would have to be considered. This resulted in two further recalculations. When the contribution of all turbines was included, those sample residences on the table that had been previously shown as having no sound impact (-88 dBA) rose to as high as 34.7 dBA, and in the case of the 24 residences in the sample, 6 rose above a "rounded" 40 dBA, making the project non-compliant, as shown in the column headed "Revision 2 dBA".

The representative of the acoustical consulting company that prepared the environmental noise assessment, testified before the Ontario Municipal Board that staff of the Ministry of Environment suggested that he redo the calculation lowering the impact of some turbines by reducing the contribution of turbines considered to be downwind of the receptor. The method chosen was to select the bearing of the closest wind turbine as a 0 degree vector, and to give full credit for all wind turbines within 90 degrees on either side of that vector, while the contribution of any turbine in the 180 degrees "behind" the direction of the vector would be reduced from -1.5 dB for a turbine at 90 degrees away from the vector to – 8 dB for a turbine at 180 degrees away from the vector. Only the non-compliant values were "Adjusted." As a result the column headed "Final Adjusted dBA" showed the project was in full compliance. On this basis the Ministry of Environment granted a "Certificate of Approval" to the project. As a condition of approval of the project a complaint protocol was developed to deal with complaints that might arise from the project.

Specific Comment on the Effectiveness of the Example Environmental Noise Assessment

The wind turbine array evaluated in the report filed for public comment was significantly different than the final array configuration as shown in Table 3. The final configuration shows many cases of more turbines within a 1 or 2 km radius, and in having the nearest turbine closer, both of which increase the impact. This identifies that the public should be given a full opportunity to comment on the final array configuration not on a draft.

TABLE 3: Changes in Wind Turbine Proximity to Residences from Public Comment version to Final

Code	Information Provided to Public For Comment			Final Turbine Placement – No Public Input		
	Closest (m)	#WT 0to1km	#WT 1to2km	Closest (m)	#WT 0to1km	#WT 1to2km
AAA	537	8	10	571	7	7
AAB	591	6	14	488	6	12
AAC	618	3	9	500	6	5
AAD	591	4	10	453	6	7
AAE	657	5	11	647	8	7
AAF	602	4	6	486	5	7
AAG	809	2	12	522	4	10
AAH	775	2	13	495	3	10
ABA	797	3	3	537	4	7
ABB	984	0	11	530	3	10
ABC	561	4	12	500	4	8
ABD	583	2	8	518	2	8
ABE	492	5	5	714	5	4
ABF	795	2	5	658	4	2
ABG	939	1	10	560	1	9
ABH	976	1	11	616	1	8
ACA	795	1	12	617	1	9
ACB	1066	0	9	1109	0	10
ACC	847	2	5	907	1	4
ACD	989	0	11	1013	0	5
ACE	1306	0	4	1342	0	3
ACF	1312	0	4	1580	0	4
ACG	583	2	10	1544	0	3
ACG	856	0	13	1848	0	1

The fact that the environmental noise assessment that was issued for public comment included the impact only of turbines within 1000 metres of a residence, and entered a value of -88 dBA for any home with the nearest turbine at a distance of 1000 metres or greater distorted the public perception of the impact of the array. Yet, the public was not given an additional opportunity to comment after the error was eventually corrected a year after initially set before the public. The fact that incorporating the effect of turbines at distances over 1000 metres made the

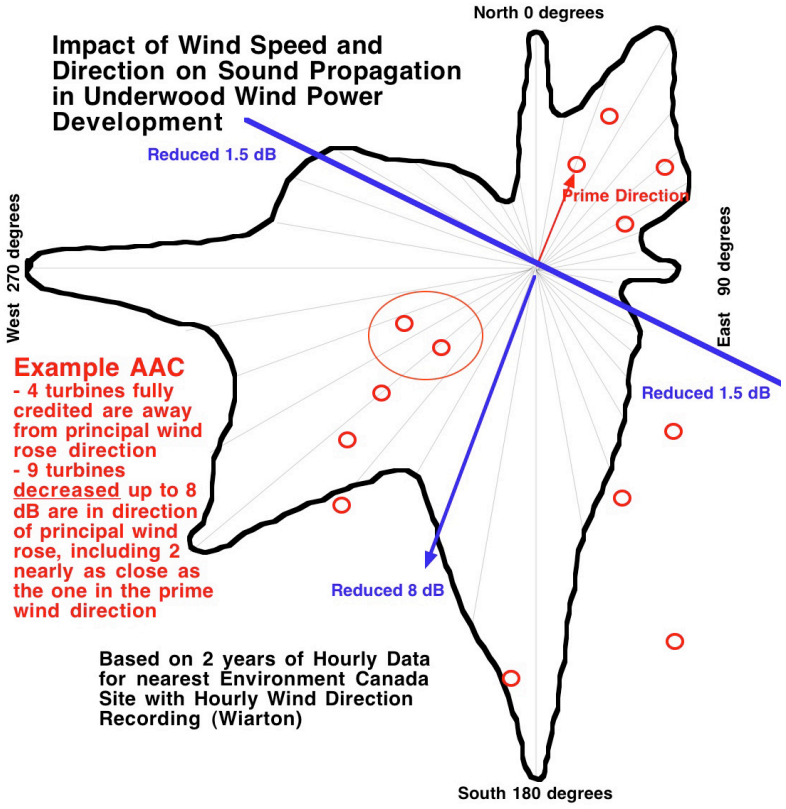
submission non compliant should have raised concerns at the Ministry, rather than having the Ministry staff suggest to reduce the impact of some turbines.

The Ministry guidelines for approval of the environmental noise assessment specify that it was (and is) to be done in compliance with ISO 9613-2, which requires that propagation of sound "under meteorological conditions favourable to propagation from sources of known sound emission, These conditions are for downwind propagation." The suggestion by the Ministry staff to do the calculation in a way to reduce the impact of some turbines due to upwind propagation (as testified under oath by the representative of the firm that did the environmental noise assessment was not in compliance with the guidelines. The intent of specifying that all evaluations be conducted in a manner consistent with a code means that the public can anticipate that the results from all evaluations will be consistent. Deviating from the code means the results are not directly comparable.

Permitting a reduction factor of -8dB for a turbine "behind" a residence in terms of wind direction regardless of the distance is not consistent with modern codes. Admittedly some codes are considering the reduction of effect for a turbine downwind of a residence, but the NORD 2000 code for example shows that an 8 dB reduction would only apply for a turbine over 3000m distant while a distance of 1000m would only result in a reduction of less than 1 dB.

Applying the reduction factor only based on the proximity of the nearest turbine, and ignoring the effect of the predominant wind direction, or the actual turbine configurations did not produce results that were either representative and certainly not ones consistent with the objective of the Ontario noise regulations that identify, "The sound level limit at a point of reception must be established based on the principle of "predictable worst case" noise impact." (Ontario Regulation NPC232). Figure 1 shows that in some cases applying the adjustment factor permitted two turbines at only slightly greater distance than the closest turbine be each reduced by nearly 8 dB, even though they were in the predominant wind rose direction.

FIGURE 1: Applying an "Adjustment" based only on the distance of the closest wind turbine ignoring the actual turbine configuration and the predominant wind rose results in an assessment that is not consistent with "predictable worst case". Red circles show wind turbine locations scaled at distance from the residence located at the centre of the wind rose. The black contour shows the effect of combining the effect of wind speed and direction applicable to the wind power development, including the probability the wind blows from a particular direction in hours per year, and the intensity of the wind speed during each hour of the year. The contour is derived from a 2-year average.



Another way that the environmental noise assessment did not comply with the principle of "predictable worst case" was that it used a "wind shear" factor of 0.22, which is well under the value of wind shear of 0.4 + identified by the test towers of the developer. As a result, the noise emitted by the turbines would be underestimated, since a 6 m/s reference wind speed in conjunction with a 0.22 wind shear results in a hub height wind speed of 9.5 m/s, which is not full power of the turbine, while if a wind shear of 0.4 had been used, the same reference wind speed of 6 m/s would result in a hub height wind speed of 13.8 m/s and the turbine would have been at full power and full noise output. As a result, the environmental noise assessment underestimated the sound power of the turbines before applying a propagation factor. Although Ontario now requires a wind developer to do the environmental noise assessment considering the average night time wind spear for the site, there is no transparency for the selection of wind shear values, and as a result some developers still use wind shear values of under 0.3 even though the majority of assessment show the average summer night time wind spear is 0.4 or higher.

Ministry guidelines permit a developer to calculate the ground attenuation loss factor assuming an average ground effect of 0.7. This value does not generate a predictable worst case in winter time in Ontario when it is probable that wind packed snow and ice may are between a turbine and a residence, instead of a soft field of attenuating crops.

The effect of a recalculation using predictable worst-case estimates

The noise at residences for the example wind power development was recalculated using appropriate factors to represent predictable worst case estimates, including considering the impact of all turbines within 3 km, using a 0.44 average wind shear value, calculating the effect of all turbines as required by ISO 9613-2. Additionally, a ground attenuation propagation factor appropriate in the winter time was calculated. As a result the results shown in TABLE 4 were produced, shown in comparison to the values given as the final approved values in the project environmental noise assessment. Had a winter ground attenuation factor been used, the sound would be about 2dB higher yet.

TABLE 4: Calculating sound levels at residences based on predictable worst case reasonable estimates

CODE	Final dBA approved for Project	Calculated dBA as described in text	Unweighted (dBG) sound levels
AAA	39.5	50.1	61.3
AAB	39.6	49.9	61.2
AAC	39.2	49.8	60.7
AAD	39.8	49.6	60.9
AAE	38.9	49.5	60.9
AAF	40.0	49.2	60.2
AAG	40.3	48.9	60.3
AAH	39.9	48.8	60.3
ABA	38.7	48.4	59.6
ABB	39.8	48.4	59.9
ABC	39.3	48.2	58.6
ABD	38.3	47.3	58.6
ABE	38.1	47.2	58.6
ABF	37.2	46.5	56.2
ABG	37.4	46.3	57.8
ABH	36.6	45.8	57.4
ACA	36.0	44.8	56.4
ACB	34.7	44.1	56.4
ACC	33.7	42.6	54.8
ACD	33.2	41.6	53.3
ACE	31.5	39.2	51.8
ACF	31.5	39.1	51.7
ACG	30.1	37.3	49.8
ACH	30.0	37.2	50.3

The Bottom Line – People Are Impacted

To this point this report has focused on issues in the measurement of noise. It is necessary though to reconnect with the point made earlier that it is not the measurement of sound that matters in the long term, it is what is the effect on people. Through a freedom of information request, correspondence between staff in the Ministry of the Environment dated from 2009 was recently released. One MOE staff person in correspondence to another regarding wind turbines notes, "MOE Provincial Officers have attended at several of the complainants residences and have confirmed that despite the noise emissions apparently complying with the applicable standard – C of A (Air) limits, that the noise emissions are, in fact causing material discomfort to the residents in and around their homes." This by itself suggests that the standards are inadequate to protect residents. This paper has shown so far that there are many deficiencies in applying the standard. However it is necessary to leave the last word to the citizens themselves.

This section extracts from a presentation made to the Grey Bruce Medical Officer of Health, and to the Municipal Council of Kincardine. The entire presentation is available on line at the link shown in the references, and only a few points from the document can be extracted here. These are the words of the actual citizens as recorded by Catharine Crawford, M. Ed. (Counseling Psychology), Psychotherapist, OACCP certified. It is a review of consequences self-reported in qualitative interviews by citizens living with the changed environment after four years of operation of the wind power development. These are the words of people living in the homes identified in the tables presented earlier.

- I began to notice pressure in m ears after being outside for any extended period of time … we began to notice headaches, which have increased in frequency. The symptoms are more severe in the winter.
- The sound of the turbines comes through the pillow. Sleep is disrupted 50% of the time. It is a roaring freight train going through our home. Electrical issues have been noted in the home.
- The noise level is very high and sleeping is a problem. The home vibrates. One member has developed headaches, dizziness and light-headedness. The quiet county property is now completely changed by indoor and outdoor noise; sleep deprivation, flicker, and disturbing health symptoms that did not exist before.
- Jim (not real name) often sits up all night and cannot sleep. He has taken dizzy spells and is prone to falling. He has become forgetful and disorganized. When away, he sleeps like before, but on returning home the problems recur. The complaint protocol has been of no help in resolving the issue.
- Since the turbines started up she is tired all the time, and never feels rested and relaxed. Her husband has headaches frequently now, but never had them before. Teenaged children are constantly tired and have headaches that go away when away from the home.
- She finds her body began to vibrate with the onset of the turbines, has developed ringing in the ears, loss of concentration and heart palpitations. Up two or three times a night due to sleep disruption. Son gets sharp spiking headaches.
- Noted sound increase inside and outside home. Headaches, taken to spending time in the basement for respite. Headaches leave when away from home, but developed nausea and lowered appetite. Up half the night tossing and turning, and walking around due to the noise.
- Need to have television volume up higher to mask the whoosh, whoosh, whoosh. Developed ringing in ears and chest tension. Work difficulties resulted in loss of regular employment. Fears going to a doctor as he might take away driving license - tired and fall asleep at the wheel. Would lose my job and then our home.
- Sleep deprivation, headaches, and sensation in ears, pressure in head, restlessness, nausea, and motion sensitivity. All developed over time. Can no longer work. Nausea, lost weight, migraines.
- Pain in ears, toss and turn at night, sleep disturbed. Senses vibration in body when at home. Removed ability to enjoy their property.
- Flicker, noise, vibration in their bodies. Migraines, blood pressure problems. Stress. Tinnitus.
- Sleep disturbance, headaches, tinnitus, and stomach upset.
- Child tired, irritable, complains head hurts and tummy hurts. Home is a nightmare. Symptoms did not exist before turbines include headaches, dizziness, pressure in ears, sleep disruption, tingling in head and face. Increased confusion, irritability. Mental instability. Visitor taken to hospital with vertigo. Family member with stroke like symptoms,
- Flicker, electrical interference that did not exist before. Complaint protocol ineffective.
- No longer live in home – walked away. Migraines sleep disruption, vibration. Tried to sell property – no offers. Bank foreclosed – lost home.
- Vertigo, unless away from home.

In four of the homes on the list, a family member died from a sudden cardiac arrest, unexpectedly, and traumatically. These families grieve, and we can only speak for them. One person in her 30's, one in his 50's, who reported not a week before his death that his health was not impacted, and two in their sixties who died unexpectedly. No, there is not "direct" proof to link these deaths to wind turbines, but the frequency exceeds provincial average, and begs a detailed evaluation of all deaths surrounding turbines.

CONCLUSION

One can only say that the system to protect people is not working. People are suffering. International experience suggests that monitoring direct health effects alone is inadequate. A system that requires proving a direct health effect before the turbine even exist is no protection at all. Has society simply become uncaring? I personally know many of the suffering individuals. I have no medical qualifications, but as a human being, I can testify that in my opinion they are indeed suffering. In Luke 10 the story of the Good Samaritan is told. The story ends, with the Lord asking, "and who was the good neighbour?" "Why the one who helped the one who was hurting," was the reply. "Go then and do likewise," were the Lord's last words.

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