

## **DELAY DENIAL AND DISAPPOINTMENT**

### **An Analysis of the Chief Medical Officer of Health (CMOH) of Ontario “The Potential Health Impacts of Wind Turbines May 2010”**

**Prepared by  
The Society for Wind Vigilance**

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## **NOTICE TO READER**

The Society for Wind Vigilance uses authoritative references to support the assertions contained within this analysis. This analysis also contains statements and citations from individuals and or organizations associated with the wind energy industry.

Most of the citations used in this analysis are from references contained in “The Potential Health Impacts of Wind Turbines May 2010” (CMOH Review).

The Society for Wind Vigilance has made repeated attempts to contact the Chief Medical Officer of Health of Ontario to clarify information about or contained in the CMOH Review. To date the Chief Medical Officer of Health of Ontario has failed to provide answers to our queries.

The Society for Wind Vigilance has made every reasonable attempt to ensure the accuracy of this analysis. Accordingly any errors or omissions contained within this analysis are unintentional.

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## **EXECUTIVE SUMMARY**

“The Potential Health Impacts of Wind Turbines May 2010” (CMOH Review) is a literature review and contains no original research. As a consequence the report has little relevance to addressing the issues of adverse health effects of an emerging technology. The report does acknowledge the relative paucity of existing medical evidence but paradoxically declines to offer any remedial action – to wit further research.

In addition the conclusions of the CMOH Review are not supported by the content of the references cited and other relevant authoritative references.

Studies of European wind turbine facilities have consistently concluded that wind turbine noise is more annoying than other commonly experienced noise sources such as traffic, aircraft and rail. <sup>1, 2, 3, 4</sup>

Current research demonstrates that annoyance must not be trivialized. Annoyance is acknowledged to be an adverse health effect <sup>5</sup> which contributes to stress, <sup>6</sup> sleep disturbance <sup>7</sup> and an increased risk of regulation diseases. <sup>8</sup>

“Annoyance with wind turbine noise was associated with psychological distress, stress, difficulties to fall asleep and sleep interruption.” <sup>9</sup>

Instead the CMOH Review misleadingly asserts “40 dB... limit is consistent with limits used to control noise from other commonly experienced environmental sources.” <sup>10</sup>

Unfortunately current Ontario noise guidelines for industrial wind turbines permit, in principle, levels up to 51 dBA at a family home 24 hours a day. <sup>11, 12</sup> These noise levels are significant as an increase of 10 dBA is a 10-fold increase in acoustic energy.

The CMOH Review acknowledges that Ontario does not have a protocol to verify compliance with these wind turbine noise limits nor has Ontario determined appropriate guidelines for wind turbine low frequency noise. <sup>13</sup>

The CMOH Report appears to be a government-convened attempt to justify unsound practices of wind turbine development while denying the adverse health effects being reported by Ontario families.

The Society for Wind Vigilance does concur with the CMOH Review on one point. World Health Organization guidance on noise and health is authoritative

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and must be adhered to in order to protect human health. In view of this accord many of the references contained in this analysis are direct citations from the World Health Organization.

This acknowledgement by the CMOH Review puts to rest the wind energy industry's position that World Health Organization standards regarding community noise are irrelevant to industrial wind turbine regulations.<sup>14</sup>

World Health Organization endorses the precautionary principle to protect human health and well-being in the presence of potential health threats.<sup>15</sup> However the CMOH Report does not reference the precautionary principle. In addition the report ignores authoritative recommendations such as "The need for guidelines for maximum exposure to wind turbine noise is urgent..."<sup>16</sup>

It is imperative that development of authoritative setbacks and noise guideline be based on independent third party clinical research. It is remarkable that a public health authority denies the need for evidence-based regulations.

## **INTRODUCTION**

There are over one hundred Ontario residents who are reporting adverse health from exposure to industrial wind turbines. <sup>17</sup> Some of these victims are currently being or have been billeted by wind energy developers at the developer's expense. <sup>18</sup> Others have had their homes bought out by the wind energy and are now silenced by non disclosure clauses. Other victims live in self funded safe houses or have abandoned their homes to protect their health. The balance continues to suffer in their existing homes. These statements cannot be denied.

In the fall of 2009 Dr. Arlene King, Chief Medical Officer of Health for Ontario (CMOH), took on the task of investigating the issue of industrial wind turbines and potential adverse health effects.

An October 21 2009 memorandum addressed to Medical Officers of Health and Environmental Health Directors issued by Dr Arlene King advised:

"...sound produced by wind turbines is sometimes found to be annoying to some people which may result in stress and sleep disturbance." <sup>19</sup>

An August 2009 peer reviewed article had already determined that "Wind turbines are a new source of community noise to which relatively few people have been exposed.... No generalized dose-response curves have yet been modeled for wind turbines primarily due the lack of results of published field studies....The need for guidelines for maximum exposure to wind turbine noise is urgent..." <sup>20</sup>

Rather than calling for the development of authoritative setbacks and noise guidelines based on independent third party clinical research Dr. King decided to invest approximately seven months to produce a 14 page literature review. Repetitive literature reviews are of little value when dealing with emerging technologies particularly when there is an acknowledged "...lack of results of published field studies." <sup>21</sup>

On May 20, 2010, the Chief Medical Officer of Health of Ontario (CMOH) issued "The Potential Health Impacts of Wind Turbines May 2010" (CMOH Review).

In response, an analysis was conducted by The Society for Wind Vigilance of the CMOH Review. Details of the analysis are included in Tables 1 to 10 of this document.

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The summary and related points cover a broad spectrum of claims. For convenience the remainder of the analysis and critique is done in a tabulated format of point - counter point. The volume of material necessitated this approach and hopefully will enhance the clarity of the critique being put forward.

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## **PRINCIPLE FINDINGS**

The CMOH Review is a document fraught with inaccuracies, contradictions and misinformation:

Specifically the CMOH Review

- is not a study: it is an incomplete literature review.
- contains conclusions which contradict the content of the CMOH Review.
- contains conclusions which contradict listed and cited references.
- contains conclusions which contradict authoritative research on noise and health including that of the World Health Organization.
- contains conclusions which have no references to support their scientific validity.
- displays selective bias in the presentation of the referenced material.
- displays selective bias by omission of relevant references including recent research on issues related to noise and health.
- contains misleading statements.
- contains statements without appropriate supporting references.
- exhibits a deficient understanding of Ontario setback regulations and noise guidelines for wind turbines.
- exhibits a deficient understanding of the authoritative research and noise guidelines of the World Health Organization.

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## **CONCLUSIONS**

1. The CMOH Report is a literature review with no original research.
2. There are a number of errors of commission and omission.
3. The reality of global reports of adverse health effects has not been addressed.
4. The report does acknowledge the World Health Organization as a definitive authority broadly writ as well as on the subject of community noise.
5. Crucial evidence gaps remain unaddressed but paradoxically the widely affirmed and urgent need for further research is not acknowledged.
6. The Society for Wind Vigilance expresses both its surprise and disappointment with the quality of the CMOH's report. The victims deserve consideration not denial.

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## **DETAILED ANALYSIS**

The following tables contain a detailed analysis of the CMOH Paper in a point-counter-point format.

The method utilized was to excerpt each of the claims and place it in the context of authoritative and contrary information. In addition an effort has been made to identify the errors of omission as well as those of commission.

The analysis is presented in 10 tables grouped by topic:

Table 1 - Analysis of CMOH Review Conclusions

Table 2 - Analysis of Research Gaps

Table 3 - Analysis of CMOH Review Summary and Introduction

Table 4 - Analysis of CMOH Review Section on Sound and Noise

Table 5 - Analysis of CMOH Review Section on Low Frequency Sound, Infrasound

Table 6 - Analysis of CMOH Review Section on Vibro-Acoustic Disease

Table 7 - Analysis of CMOH Review Section on Shadow Flicker

Table 8 - Analysis of CMOH Review Section on Ice Throw and Structural Hazards

Table 9 - Analysis of CMOH Review Section on Setbacks

Table 10 - Analysis of CMOH Review Section on Community Consultation

<b>Reference</b>	<b>Table 1</b>  <b>Analysis of CMOH Review Conclusions</b>  <b>CMOH Review contents in <i>italics</i></b> <b>SWV Analysis in non italics</b>
<b>1</b>	<p><b><i>CMOH Review statement (Conclusions - page 10):</i></b></p> <p><i>“While some people living near wind turbines report symptoms such as dizziness, headaches, and sleep disturbance, the scientific evidence available to date does not demonstrate a direct causal link between wind turbine noise and adverse health effects.”</i></p> <p><b>SWV Analysis</b></p> <p>The above stated conclusion contradicts relevant references including those contained in the CMOH Review.</p> <p>The CMOH Review conclusion directly contradicts an October 21 2009 memorandum issued by Dr Arlene King. The memorandum addressed to Medical Officers of Health and Environmental Health Directors states:</p> <p>“...sound produced by wind turbines is sometimes found to be annoying to some people which may result in stress and sleep disturbance.”<sup>22</sup></p> <p>Recent literature reviews on wind turbines<sup>23, 24, 25, 26</sup> acknowledge that wind turbine noise may cause annoyance, stress and sleep disturbance.</p> <p>“The sound level associated with wind turbines at common residential setbacks is not sufficient to damage hearing, but may lead to annoyance and sleep disturbance.”<sup>27</sup> and evidence demonstrates “Annoyance and sleep disruption are common when sound levels are 30 to 45 dBA.”<sup>28</sup></p> <p>The American Wind Energy Association and Canadian Wind Energy Association sponsored literature review entitled “Wind Turbine Sound and Health Effects” acknowledges wind turbine noise, including low frequency noise, may cause annoyance, stress and sleep disturbance and as a result people may experience adverse physiological and psychological symptoms.<sup>29</sup></p>

Reference	<p style="text-align: center;"><b>Table 1</b></p> <p style="text-align: center;"><b>Analysis of CMOH Review Conclusions</b></p> <p><b>CMOH Review contents in <i>italics</i></b>  <b>SWV Analysis in non italics</b></p>
<p><b>2</b></p>	<p><b><i>CMOH Review statement (Conclusions - page 10):</i></b></p> <p><i>"The sound level from wind turbines at common residential setbacks is not sufficient to cause hearing impairment or other direct adverse health effects. However, some people might find it annoying. It has been suggested that annoyance may be a reaction to the characteristic</i></p>

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3	<p><b><i>CMOH Review statement (Conclusions - page 10):</i></b></p> <p><i>“Low frequency sound and infrasound from current generation upwind model turbines are well below the pressure sound levels at which known health effects occur. Further, there is no scientific evidence to date that vibration from low frequency wind turbine noise causes adverse health effects.”</i></p> <p><b>SWV Analysis</b></p> <p>The above stated conclusion contradicts relevant references including those contained in the CMOH Review.</p> <p>The above stated conclusion is not supported the contents of the CMOH Review.</p> <p>Wind turbines emit audible and inaudible low frequency noise.<sup>75, 76</sup></p> <p>Audible low frequency noise may cause adverse health effects.<sup>77, 78</sup></p> <p>As stated earlier annoyance is an adverse health effect.<sup>79, 80</sup></p> <p>The CMOH Review acknowledges that wind turbine low frequency noise may cause annoyance.<sup>81</sup></p>



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4	<p><b>CMOH Review statement (Conclusions - page 10):</b></p> <p><i>“Community engagement at the outset of planning for wind turbines is important and may alleviate health concerns about wind farms.”</i></p> <p><b>SWV Analysis</b></p> <p>The CMOH Review does not provide any scientific basis for this conclusion. This policy statement contributes no insight into the issue of protecting human health from wind turbine noise exposure.</p> <p>Strong noise regulation is the foundation for health protection. Weak or no noise regulation results in high negative impact to the community. Strong noise regulation results in low negative impact to the community.<sup>98</sup></p>

Reference	<p style="text-align: center;"><b>Table 1</b></p> <p style="text-align: center;"><b>Analysis of CMOH Review Conclusions</b></p> <p><b>CMOH Review contents in <i>italics</i></b>  <b>SWV Analysis in non italics</b></p>
5	<p><b><i>CMOH Review statement (Conclusions - page 10):</i></b></p> <p><i>“Concerns about fairness and equity may also influence attitudes towards wind farms and allegations about effects on health. These factors deserve greater attention in future developments.”</i></p> <p><b>SWV Analysis</b></p> <p>See discussion in SWV Analysis Table 1 Reference 4 regarding “community engagement”.</p> <p>The SWV has no further comment.</p>

Reference	<p style="text-align: center;"><b>Table 2</b></p> <p style="text-align: center;"><b>Analysis of Research Gaps</b></p> <p><b>CMOH Review contents in <i>italics</i></b>  <b>SWV Analysis in non italics</b></p>
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Reference	<p style="text-align: center;"><b>Table 2</b></p> <p style="text-align: center;"><b>Analysis of Research Gaps</b></p> <p>CMOH Review contents in <i>italics</i> SWV Analysis in non italics</p>

<b>Table 3</b>	
<b>Reference</b>	<b>Analysis of CMOH Review Summary and Introduction</b>  <b>CMOH Review contents in <i>italics</i></b> <b>SWV Analysis in non italics</b>
<b>7</b>	<p><b>CMOH Review statement (Summary of Review – page 3):</b></p> <p><i>“The review concludes that while some people living near wind turbines report symptoms such as dizziness, headaches, and sleep disturbance, the scientific evidence available to date does not demonstrate a direct causal link between wind turbine noise and adverse health effects.”</i></p> <p><b>SWV analysis</b></p> <p>The above statement contradicts relevant references including those contained in the CMOH Review.</p> <p>See discussion in SWV Analysis Table 1 Reference 1.</p>
<b>8</b>	<p><b>CMOH Review statement (Introduction – page 4):</b></p> <p><i>“In general, published papers in peer-reviewed scientific journals, and reviews by recognized health authorities such as the World Health Organization (WHO) carry more weight in the assessment of health risks than case studies and anecdotal reports.”</i></p> <p><b>SWV analysis</b></p> <p>The Society for Wind Vigilance concurs with the CMOH Review on this statement. World Health Organization guidance on noise and health is authoritative and must be adhered to in order to protect human health.</p> <p>This acknowledgement by the CMOH Review puts to rest the wind energy industry’s position that World Health Organization standards regarding community noise are irrelevant to industrial wind turbine regulations.<sup>127</sup></p> <p>SWV notes that the CMOH Review does cite Night Noise Guidelines for Europe, 2009 but neglects to cite World Health Organization, Guidelines</p>

<b>Reference</b>	<p><b>Table 3</b></p> <p><b>Analysis of CMOH Review Summary and Introduction</b></p> <p><b>CMOH Review contents in <i>italics</i></b>  <b>SWV Analysis in non italics</b></p>
	<p>for Community Noise, 1999 – a conspicuous omission.</p> <p>The 2009 Night Noise Guidelines for Europe states:</p> <p>“...Night noise guidelines for Europe complements the 1999 guidelines. This means that the recommendations on government policy framework on noise management elaborated in the 1999 guidelines should be considered valid and relevant for the Member States to achieve the guideline values of this document.” <sup>128</sup></p> <p>For example the 2009 guidelines state adverse health effects occur at sound pressure levels above 40 dB but also stipulates:</p> <p>“Closer examination of the precise impact will be necessary in the range between 30 dB and 55 dB as much will depend on the detailed circumstances of each case.” <sup>129</sup></p> <p>Wind turbine noise is more annoying than other sources of noise. <sup>130, 131, 132, 133</sup></p> <p>World Health Organization, Guidelines for Community Noise, 1999 states noise level limits “...should be based on annoyance responses to noise.” <sup>134</sup></p> <p>The CMOH review acknowledges that low frequency components and the fluctuating nature of the wind turbine noise contribute to the high level of annoyance.</p> <p>Therefore, “Noise with low-frequency components require lower guideline values.” <sup>135</sup></p> <p>World Health Organization, Guidelines for Community Noise, 1999 specifies that lower guideline values are required for noise sources which fluctuate and have low frequency components. <sup>136</sup></p>



<b>Table 3</b>	
<b>Reference</b>	<b>Analysis of CMOH Review Summary and Introduction</b>  <b>CMOH Review contents in <i>italics</i></b> <b>SWV Analysis in non italics</b>
	Based on World Health Organization guidance on noise management and health protection the World Health Organization 2009 guideline of 40 dB is too high for wind turbine noise.
<b>9</b>	<p><b><i>CMOH Review statement (2.1 Overview – page 5):</i></b></p> <p><i>“The researcher (Pierpont) suggested that the symptoms were related to wind turbine noise, particularly low frequency sounds and infrasound, but did not investigate the relationships between noise and symptoms. It should be noted that no conclusions on the health impact of wind turbines can be drawn from Pierpont’s work due to methodological limitations including small sample size, lack of exposure data, lack of controls and selection bias.”</i></p> <p><b>SWV analysis</b></p> <p>It is relevant to note that the American Wind Energy Association and Canadian Wind Energy Association sponsored report entitled “Wind Turbine Sound and Health Effects” critiqued Dr Pierpont’s published case studies and did not deny that the symptoms reported may be caused by wind turbine noise.</p> <p>The wind industry sponsored report disputes the mechanism of action offered by Dr. Pierpont and concludes ““wind turbine syndrome” symptoms are not new and have been published previously in the context of “annoyance” to environmental sounds .... The following symptoms are based on the experience of noise sufferers extending over a number of years: distraction, dizziness, eye strain, fatigue, feeling vibration, headache, insomnia, muscle spasm, nausea, nose bleeds, palpitations, pressure in the ears or head, skin burns, stress, and tension....”<sup>137</sup></p>

<b>Table 4</b>	
<b>Reference</b>	<b>Analysis of CMOH Review Section on Sound and Noise</b>  <b>CMOH Review contents in <i>italics</i></b> <b>SWV Analysis in non italics</b>
<b>10</b>	<p><b>CMOH Review statement (2.2. Sound and Noise – page 5):</b></p> <p><i>“The dominant sound source from modern wind turbines is aerodynamic, produced by the rotation of the turbine blades through air. The aerodynamic noise is present at all frequencies, from infrasound to low frequency to the normal audible range, producing the characteristic “swishing” sound.”</i></p> <p><b>SWV analysis</b></p> <p>This CMOH Review statement does not provide the reader context regarding the unique characteristics of wind turbine noise.</p> <p>An informative description of wind turbine noise offers the reader context.</p> <p>For example:</p> <p>“Sound generated by wind turbines has particular characteristics and it creates a different type of nuisance compared to usual urban, industrial, or commercial noise.” <sup>138</sup></p> <p>“...wind turbine noise is easily perceived and compared to sounds from other community sources relatively annoying.” <sup>139</sup></p> <p>See discussion in SWV Analysis Table 1 References 2 and 3 regarding the effects of wind turbine amplitude modulation and low frequency noise.</p>
<b>11</b>	<p><b>CMOH Review statement (2.2. Sound and Noise – page 5):</b></p> <p><i>“Environmental sound pressure levels are most commonly measured using an A-weighted scale. This scale gives less weight to very low and very high frequency components that is similar to the way the human ear perceives sound.”</i></p>

Reference	<p style="text-align: center;"><b>Table 4</b></p> <p style="text-align: center;"><b>Analysis of CMOH Review Section on Sound and Noise</b></p> <p><b>CMOH Review contents in <i>italics</i></b>  <b>SWV Analysis in non italics</b></p>
12	<p><b><i>CMOH Review statement (2.2. Sound and Noise – page 5):</i></b></p> <p><i>“Current requirements for wind turbine setbacks in Ontario are intended to limit noise at the nearest residence to 40 dB ... This is a sound level comparable to indoor background sound. This noise limit is consistent with the night-time noise guideline of 40 dB that the World Health Organization</i></p>

Reference	<p style="text-align: center;"><b>Table 4</b></p> <p style="text-align: center;"><b>Analysis of CMOH Review Section on Sound and Noise</b></p> <p><b>CMOH Review contents in <i>italics</i></b>  <b>SWV Analysis in non italics</b></p>
13	<p><b><i>CMOH Review statement (2.2. Sound and Noise – page 5):</i></b></p> <p><i>“Studies in Sweden and the Netherlands (Pedersen et al. 2009, Pedersen and Waye 2008, Pedersen and Waye 2007, Pedersen and Waye 2004) have found direct relationships between modelled sound pressure level and self-reported perception of sound and annoyance...”</i></p>

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14	<p><b><i>CMOH Review statement (2.2. Sound and Noise – page 5):</i></b></p> <p><i>“Available scientific data indicate that sound levels associated with wind turbines at common residential setbacks are not sufficient to damage</i></p>

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<b>Reference</b>	<p><b>Table 4</b></p> <p><b>Analysis of CMOH Review Section on Sound and Noise</b></p> <p><b>CMOH Review contents in <i>italics</i></b>  <b>SWV Analysis in non italics</b></p>
	<p><i>hearing or to cause other direct adverse health effects, but some people may still find the sound annoying.”</i></p> <p><b>SWV analysis</b></p> <p>This statement contradicts the findings of peer reviewed research and articles.  There is no reference provided to support this statement.</p> <p>This CMOH statement contradicts references contained in the review.</p> <p>See discussion in SWV Analysis Table 1 Reference 2.</p>

<b>Table 5</b>	
<b>Reference</b>	<b>Analysis of CMOH Review Section on Low Frequency Sound, Infrasound and Vibration</b>  <b>CMOH Review contents in <i>italics</i></b> <b>SWV Analysis in non italics</b>
<b>15</b>	<p><b><i>CMOH Review statement (2.2.1 Low Frequency Sound, Infrasound and Vibration -page 6):</i></b></p> <p><i>“There is no scientific evidence, however, to indicate that low frequency sound generated from wind turbines causes adverse health effects.”</i></p> <p><b>SWV analysis</b></p> <p>The above statement contradicts relevant references including those contained in the CMOH Review.</p> <p>This CMOH statement contradicts its own contents as the Review acknowledges that wind turbine low frequency noise may cause annoyance.</p> <p>See discussion in SWV Analysis Table 1 Reference 3.</p>
<b>16</b>	<p><b><i>CMOH Review statement (2.2.1 Low Frequency Sound, Infrasound and Vibration -page 6):</i></b></p> <p><i>“Concerns have been raised about human exposure to “low frequency sound” and “infrasound” (see section 2.2 for definitions) from wind turbines. There is no scientific evidence, however, to indicate that low frequency sound generated from wind turbines causes adverse health effects.</i></p> <p><i>Low frequency sound and infrasound are everywhere in the environment. They are emitted from natural sources (e.g., wind, rivers) and from artificial sources including road traffic, aircraft, and ventilation systems. The most common source of infrasound is vehicles. Under many conditions, low frequency sound below 40Hz from wind turbines cannot be distinguished from environmental background noise from the wind itself (Leventhall 2006, Colby et al 2009).</i></p>

<b>Reference</b>	<p><b>Table 5</b></p> <p><b>Analysis of CMOH Review Section on Low Frequency Sound, Infrasound and Vibration</b></p> <p><b>CMOH Review contents in <i>italics</i></b>  <b>SWV Analysis in non italics</b></p>
	<p><i>Low frequency sound from environmental sources can produce annoyance in sensitive people, and infrasound at high sound pressure levels, above the threshold for human hearing, can cause severe ear pain. There is no evidence of adverse health effects from infrasound below the sound pressure level of 90dB (Leventhall 2003 and 2006).</i></p> <p><i>Studies conducted to assess wind turbine noise indicate that infrasound and low frequency sounds from modern wind turbines are well below the level where known health effects occur, typically at 50 to 70dB.</i></p> <p><i>A small increase in sound level at low frequency can result in a large increase in perceived loudness. This may be difficult to ignore, even at relatively low sound pressures, increasing the potential for annoyance. (Jakobsen 2005, Leventhall 2006).”</i></p> <p><b>SWV analysis</b></p> <p>There are peer-reviewed studies showing that infra and low frequency sound can cause adverse health effects, especially when dynamically modulated. The extent to which infra and low frequency noise from wind turbines inside or outside homes causes adverse effects upon the human body remains an open question <sup>156, 157, 158, 159</sup> - there is no settled medical science on this issue as of yet.</p> <p>See discussion in SWV Analysis Table 1 Reference 3 regarding wind turbine low frequency noise.</p>



<b>Table 6</b>	
<b>Reference</b>	<b>Analysis of CMOH Review Section on Vibro-Acoustic Disease</b>  <b>CMOH Review contents in <i>italics</i></b> <b>SWV Analysis in non italics</b>
<b>17</b>	<p><b><i>CMOH Review statement (page 7):</i></b></p> <p><i>“A Portuguese research group (Alves-Pereira and Castelo Branco 2007) has proposed that excessive long term exposure to vibration from high levels of low frequency sound and infrasound can cause whole body system pathology (vibro-acoustic disease). This finding has not been recognized by the international medical and scientific community.”</i></p> <p><b>SWV analysis</b></p> <p>The CMOH Review provides no basis for their assertion “This finding has not been recognized by the international medical and scientific community.”</p> <p>Castelo Branco and Alves Pereira have published numerous peer reviewed articles in international journals. A search on Pubmed using “vibroacoustic disease” as the search criteria resulted in 36 individual articles on vibro-acoustic disease. <sup>160</sup></p> <p>The peer reviewed “Night Noise Guidelines for Europe 2009” World Health Organization cites Castello Branco and Alves-Pereira’s research on “vibro-acoustic disease”. <sup>161</sup></p>

Reference	<p style="text-align: center;"><b>Table 7</b></p> <p style="text-align: center;"><b>Analysis of CMOH Review Section on Shadow Flicker</b></p> <p>CMOH Review contents in <i>italics</i>  SWV Analysis in non italics</p>
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<b>Reference</b>	<b>Table 7</b>  <b>Analysis of CMOH Review Section on Shadow Flicker</b>  <b>CMOH Review contents in <i>italics</i></b> <b>SWV Analysis in non italics</b>
	<p>proper planning is adhered to. <sup>165</sup> Planning should ensure the flash frequency does not exceed three per second, and the shadows cast by one turbine on another should not have a cumulative flash rate exceeding three per second. <sup>166</sup></p> <p>Other acknowledged wind turbine visually induced adverse health effects include annoyance and or stress. <sup>167, 168, 169, 170, 171, 172, 173</sup></p> <p>“...shadow flicker can be an issue both indoors and outdoors when the sun is low in the sky. Therefore, shadow flicker may be an issue in locations other than the home.” <sup>174</sup></p> <p>To mitigate risk to human health wind turbines should be sited to ensure people will not be adversely affected. For example in the northern hemisphere people located East-NE or WNW from the turbine must be protected from shadow flicker. <sup>175</sup></p> <p>Recommended shadow flicker setbacks for current wind turbine designs are 10 rotational diameters which would typically translate to approximately 800m – 900 m. <sup>176</sup></p> <p>Greater setback distances may be required when wind turbines are sited on elevated ridges as the shadows can be cast over distances of several kilometres.</p> <p>Wind turbine noise including low frequency noise may also contribute to the overall annoyance. <sup>177</sup></p> <p>“Wind turbine noise is easily perceived and annoying even at low A-weighted SPLs....Wind turbines are furthermore prominent objects whose rotational movement attracts the eye. Multimodal sensory effects or negative aesthetic response could enhance the risk of annoyance. Adverse reactions could possibly lead to stress-related symptoms due to prolonged physiological arousal and hindrance to psychophysiological restoration.” <sup>178</sup></p>

<b>Reference</b>	<p><b>Table 7</b></p> <p><b>Analysis of CMOH Review Section on Shadow Flicker</b></p> <p><b>CMOH Review contents in <i>italics</i></b>  <b>SWV Analysis in non italics</b></p>
	<p>Further investigation into the effects of wind turbine stressors including shadow flicker is required to assist in the development of authoritative guidelines designed to mitigate potential adverse health effects.<sup>179, 180, 181, 182</sup></p> <p>The CMOH Review makes no mention of these references or the findings documented within.</p> <p>Currently there are no Ontario regulations to protect families from the adverse effects of shadow flicker inside or outside their homes.</p> <p>See discussion on research gaps in SWV Analysis Table 2.</p>

Reference	<p><b>Table 8</b></p> <p><b>Analysis of CMOH Review Section on Ice Throw and Structural Hazards</b></p> <p><b>CMOH Review contents in <i>italics</i></b>  <b>SWV Analysis in non italics</b></p>
<b>19</b>	<p><b><i>CMOH Review statement (2.3 Other Potential Health Hazards of Wind Turbines - page 7):</i></b></p> <p><i>“Ice Throw and Ice Shed</i></p> <p><i>Depending on weather conditions, ice may form on wind turbines and may be thrown or break loose and fall to the ground. Ice throw launched far from the turbine may pose a significant hazard. Ice that sheds from stationary components presents a potential risk to service personnel near the wind farm.</i></p> <p><i>Sizable ice fragments have been reported to be found within 100 metres of the wind turbine. Turbines can be stopped during icy conditions to minimize the risk.”</i></p> <p><b>SWV analysis</b></p> <p>The CMOH Review’s discussion on ice throw is incomplete as it does not disclose that Ontario setbacks are not adequate to protect people or passing vehicles from the physical danger of ice throw.</p> <p>CMOH Review acknowledges that sizable ice fragments have been reported to be found within 100 metres of the wind turbines.</p> <p>“Ice throw...presents a potentially severe public hazard since the ice may be launched far from the turbine.” and consequently is a “Physical danger to people or passing vehicles.” <sup>183</sup></p> <p>Recommended setbacks for ice throw are 200 m to 350 m. <sup>184</sup></p> <p>The CMOH Review does not mention that Ontario setbacks permit wind turbines to be situated within approximately 50 m (blade length plus 10 m)</p>

<b>Reference</b>	<b>Table 8</b>  <b>Analysis of CMOH Review Section on Ice Throw and Structural Hazards</b>  <b>CMOH Review contents in <i>italics</i></b> <b>SWV Analysis in non italics</b>
	<p>of a public roads, <sup>185</sup> railways <sup>186</sup> and or non-participating property <sup>187</sup> lines.</p> <p>The CMOH Review does not mention that more research is required into the risk of ice throw in regions where glaze ice is common as most research has focused on rime ice. <sup>188</sup></p> <p>See discussion on research gaps in SWV Analysis Table 2.</p>
<b>20</b>	<p><b><i>CMOH Review statement (2.3 Other Potential Health Hazards of Wind Turbines - page 7):</i></b></p> <p><i>“Structural hazards</i></p> <p><i>The maximum reported throw distance in documented turbine blade failure is 150 metres for an entire blade, and 500 metres for a blade fragment. Risks of turbine blade failure reported in a Dutch handbook range from one in 2,400 to one in 20,000 turbines per year (Braam et al 2005). Injuries and fatalities associated with wind turbines have been reported, mostly during construction and maintenance related activities.”</i></p> <p><b>SWV analysis</b></p> <p>The CMOH Review’s discussion on structural hazards is incomplete as it does not disclose that Ontario setbacks are not adequate to protect people or passing vehicles from the physical danger of structural failure.</p> <p>CMOH Review does not mention:</p> <p>Wind turbine “structural failure is potentially fatal” and is a “physical danger to people or passing vehicles” <sup>189</sup></p> <p>“Although most turbines are designed to withstand temperatures as low as</p>

<b>Reference</b>	<b>Table 8</b>  <b>Analysis of CMOH Review Section on Ice Throw and Structural Hazards</b>  <b>CMOH Review contents in <i>italics</i></b> <b>SWV Analysis in non italics</b>
	<p>–20 to –40°C, structural materials can be compromised by extreme cold. Cold stress can cause steel and/or composite components to crack or deform, interfere with electrical equipment, or damage moving parts in the gearbox increasing the risk of turbine failure.”<sup>190</sup></p> <p>Recommended setbacks for structural failure are 150 m to 500 m.<sup>191</sup></p> <p>CMOH Review does not mention that Ontario setbacks permit wind turbines to be situated within approximately 50 m (blade length plus 10 m) of a public roads,<sup>192</sup> railways<sup>193</sup> and or non-participating property<sup>194</sup> lines.</p> <p>See discussion on research gaps in SWV Analysis Table 2.</p>

<b>Table 9</b>	
<b>Reference</b>	<b>Analysis of CMOH Review Section on Setbacks</b>
	<p><b>CMOH Review contents in <i>italics</i></b>  <b>SWV Analysis in non italics</b></p>
<b>21</b>	<p><b><i>CMOH Review statement (3.1 Setbacks – page 8):</i></b></p> <p><i>“Provincial setbacks were established to protect Ontarians from potential health and safety hazards of wind turbines including noise and structural hazards.”</i></p> <p><b>SWV analysis</b></p> <p>This SWV analysis presents references, including those cited by the CMOH Review, which demonstrate Ontario setbacks are not established to protect Ontarians from noise and structural hazards.</p> <p>Ontario setbacks and noise guidelines for wind turbines do not adhere to the authoritative limits and guidance of World Health Organization.</p> <p>Ontario noise guidelines for wind turbines systematically circumvent established Ontario noise standards for environmental noise pollution.</p> <p>See discussion in SWV Analysis Table 1 References 2 and 3.</p> <p>Ontario setbacks permit wind turbines to be situated within approximately 50 m (blade length plus 10 m) of a public roads,<sup>195</sup> railways<sup>196</sup> and or non-participating property<sup>197</sup> lines.</p> <p>Ontario setbacks for wind turbines do not adhere to protective setbacks for ice throw and structural hazards<sup>198</sup> but rather have adopted setbacks developed by the Canadian Wind Energy Association.<sup>199</sup></p> <p>See discussion SWV Analysis Table 8 References 19 and 20 and research gaps in SWV Analysis Table 2.</p>



Reference	<p style="text-align: center;"><b>Table 9</b></p> <p style="text-align: center;"><b>Analysis of CMOH Review Section on Setbacks</b></p> <p>CMOH Review contents in <i>italics</i> SWV Analysis in non italics</p>
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<b>Table 9</b>	
<b>Reference</b>	<b>Analysis of CMOH Review Section on Setbacks</b>
	<p><b>CMOH Review contents in <i>italics</i></b>  <b>SWV Analysis in non italics</b></p>
	<p>It is acknowledged that wind turbine noise limits of 40 dBA may cause annoyance and sleep disturbance.<sup>204</sup> and evidence demonstrates “Annoyance and sleep disruption are common when sound levels are 30 to 45 dBA.”<sup>205</sup></p>
<b>23</b>	<p><b><i>CMOH Review statement (3.1 Setbacks – page 8):</i></b></p> <p><i>“Ontario used the most conservative sound modelling available nationally and internationally, which is supported by experiences in the province and in other jurisdictions (MOE 2009).”</i></p> <p><b>SWV analysis</b></p> <p>This CMOH statement is not worthy of an independent literature review. This statement is not supported by any peer reviewed or authoritative reference but rather a self promoting fact sheet produced by the Ministry of Environment, the Ministry responsible for the development of the noise guidelines.<sup>206</sup></p> <p>With this CMOH statement the reader is given the impression that Ontario’s is an international leader in wind turbine noise regulations and guidelines. The reality is wind turbine developers can subject Ontario families to noise levels up to 53 dBA while families in British Columbia or South Australia would be limited to 40dBA and 35 dBA respectively.<sup>207</sup></p> <p>Wind turbines have been identified by MOE as a unique case that allows wind turbine noise emissions to increase with wind speed. This special consideration is permitted on the false premise that increased background wind noise will cause masking of the sound levels from the turbines.</p> <p>Health Canada advises wind energy proponents to “...omit statements about noise masking as they can be misleading...”<sup>208</sup></p> <p>Peer reviewed studies have confirmed “...that wind turbine noise is easily</p>

Reference	<p style="text-align: center;"><b>Table 9</b></p> <p style="text-align: center;"><b>Analysis of CMOH Review Section on Setbacks</b></p> <p><b>CMOH Review contents in <i>italics</i></b>  <b>SWV Analysis in non italics</b></p>

Reference	<p style="text-align: center;"><b>Table 9</b></p> <p style="text-align: center;"><b>Analysis of CMOH Review Section on Setbacks</b></p> <p>CMOH Review contents in <i>italics</i> SWV Analysis in non italics</p>
	<p><b>24</b></p>
<p><b>25</b></p>	<p><b>CMOH Review statement (3.1 Setbacks – page 8):</b></p> <p><i>“Ontario setback distances for wind turbine noise control also take into account potential risk of injury from ice throw and structural failure of wind turbines. The risk of injury is minimized with setbacks of 200 to 500 metres.”</i></p>

Reference	<p style="text-align: center;"><b>Table 9</b></p> <p style="text-align: center;"><b>Analysis of CMOH Review Section on Setbacks</b></p> <p>CMOH Review contents in <i>italics</i> SWV Analysis in non italics</p>

<b>Table 10</b>	
<b>Reference</b>	<b>Analysis of CMOH Review Section on Community Consultation</b>  <b>CMOH Review contents in <i>italics</i></b> <b>SWV Analysis in non italics</b>
<b>26</b>	<p><b><i>CMOH Review statement (3.2 Community Consultation - page 9):</i></b></p> <p><i>“The applicant must also consult directly with local municipalities prior to applying for a Renewable Energy Approval on specific matters related to municipal lands, infrastructure, and services.”</i></p> <p><b>SWV analysis</b></p> <p>In a media report Mr. George Smitherman, then Minister of Energy and Infrastructure, is reported to have pronounced:</p> <p>“We passed a law, and the law does not create an opportunity for municipalities to resist these projects just because they may have a concern.” <sup>224</sup></p> <p>Mr. Smitherman’s reported pronouncement demonstrates the lack of sincerity incorporated into the community consultation.</p> <p>The SWV has no further comment.</p> <p>See discussion in SWV Analysis Table 1 Reference 4.</p>

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Note any errors or omissions are unintentional

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equivalent to the height of the turbine which is considered as the distance from the

ground to the top of the turbine hub without including the blades.” however “In the absence of an agreement with a neighbouring land owner specifically permitting a closer setback, the proponent may consider applying to reduce the property line setback to the length of the turbine blade plus 10 metres.”

<sup>198</sup> Rideout K, Copes R, Bos C. Wind turbines and health. Vancouver: National Collaborating Centre for Environmental Health; 2010 Jan [cited 2010 June 3]. Available from: [http://www.nceh.ca/files/Wind\\_Turbines\\_January\\_2010.pdf](http://www.nceh.ca/files/Wind_Turbines_January_2010.pdf).

<sup>199</sup> CanWEA. Canadian Wind Energy Association position on setbacks for large-scale wind turbines in rural areas (MOE Class 3) in Ontario. Ottawa, ON: Canadian Wind Energy Association; 2007 Available from: <http://www.canwea.ca/images/uploads/File/FINAL-CanWEAPositionOnSetbacks-2007-09-28.pdf>.

<sup>200</sup> Noise Guidelines for Wind Farms, Interpretation for Applying MOE NPC Publications to Wind Power Generation Facilities, Ministry of the Environment, October 2008

<sup>201</sup> Rideout et al, Wind Turbines and Health, National Collaborating Centre for Environmental Health, January 2010

<sup>202</sup> Noise Guidelines for Wind Farms, Interpretation for Applying MOE NPC Publications to Wind Power Generation Facilities, Ministry of the Environment, October 2008

<sup>203</sup> Rideout et al, Wind Turbines and Health, National Collaborating Centre for Environmental Health, January 2010

<sup>204</sup> Keith, S. E., D. S. Michaud, and S. H. P. Bly. 2008. A proposal for evaluating the potential health effects of wind turbine noise for projects under the Canadian Environmental Assessment Act. *Journal of Low Frequency Noise, Vibration and Active Control*, 27(4):253-265.

<sup>205</sup> Rideout K, Copes R, Bos C. Wind turbines and health. Vancouver: National Collaborating Centre for Environmental Health; 2010 Jan [cited 2010 June 3]. Available from: [http://www.nceh.ca/files/Wind\\_Turbines\\_January\\_2010.pdf](http://www.nceh.ca/files/Wind_Turbines_January_2010.pdf).

<sup>206</sup> The CMOH Review cites (MOE 2009) to support the statement “Ontario used the most conservative sound modelling available nationally and internationally, which is supported by experiences in the province and in other jurisdictions (MOE 2009).” There are two references in the Appendix 1 of the CMOH Review which might be considered (MOE 2009)

Ontario. One reference is Ministry of the Environment. Development of noise setbacks for wind farms: requirements for compliance with MOE noise limits. Toronto, ON: Queen’s Printer for Ontario; 2009. Available from

<http://www.ene.gov.on.ca/en/business/green-energy/docs/WindNoiseSetbacks.pdf>. The other reference is Ontario. Ministry of the Environment. Frequently asked questions: renewable energy approval. Toronto: Queen’s Printer for Ontario; 2009.

Available from: <http://www.ene.gov.on.ca/en/business/green-energy/docs/FAQs%20-final.pdf>. Neither reference is peer reviewed nor do they disclose authorship. Both references appear to be produced and distributed by the Ministry of Environment, the Ministry responsible for the development of the noise guidelines for wind turbines.

<sup>207</sup> Keith, S. E., D. S. Michaud, and S. H. P. Bly. 2008. A proposal for evaluating the potential health effects of wind turbine noise for projects under the Canadian Environmental Assessment Act. *Journal of Low Frequency Noise, Vibration and Active Control*, 27(4):253-265.

<sup>208</sup> Safe Environs Program, Health Canada Environmental Assessment Nova Scotia, August 6, 2009

<sup>209</sup> Pedersen, E., R. Bakker, J. Bouma and F van den Berg 2009. Response To Noise From Modern Wind Farms in The Netherlands. *Journal of the Acoustical Society of America*

- <sup>210</sup> Pedersen, E. and K. Persson Waye. 2004. Perception and annoyance due to wind turbine noise: A dose–response relationship, *Journal of the Acoustical Society of America* 116: 3460–3470.
- <sup>211</sup> World Health Organization, *Night Noise Guidelines for Europe*, 2009  
[http://www.euro.who.int/InformationSources/Publications/Catalogue/20090904\\_12](http://www.euro.who.int/InformationSources/Publications/Catalogue/20090904_12)
- <sup>212</sup> HGC Engineering, *Wind Turbines and Sound: Review and Best Practice Guidelines*, 2007, Prepared for the Canadian Wind Energy Association
- <sup>213</sup> Safe Environs Program, Health Canada Environmental Assessment Nova Scotia, August 6, 2009
- <sup>214</sup> World Health Organization, *Guidelines for Community Noise*, 1999  
[http://www.euro.who.int/mediacentre/PR/2009/20091008\\_1](http://www.euro.who.int/mediacentre/PR/2009/20091008_1)
- <sup>215</sup> *Noise Guidelines for Wind Farms, Interpretation for Applying MOE NPC Publications to Wind Power Generation Facilities*, Ministry of the Environment, October 2008
- <sup>216</sup> Keith, S. E., D. S. Michaud, and S. H. P. Bly. 2008. A proposal for evaluating the potential health effects of wind turbine noise for projects under the Canadian Environmental Assessment Act. *Journal of Low Frequency Noise, Vibration and Active Control*, 27(4):253-265.
- <sup>217</sup> *Interpretation For Applying MOE NPC Technical Publications To Wind Turbine Generators*, 2004
- <sup>218</sup> Rideout K, Copes R, Bos C. *Wind turbines and health*. Vancouver: National Collaborating Centre for Environmental Health; 2010 Jan [cited 2010 June 3]. Available from: [http://www.nceeh.ca/files/Wind\\_Turbines\\_January\\_2010.pdf](http://www.nceeh.ca/files/Wind_Turbines_January_2010.pdf).
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