Open Letter

Audit:
National Health and Medical Research Council
Public Statement (2010)
and
Rapid Review (2010)

Brett Horner BA CMA

July 31, 2012

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July 31, 2012

Re: Open Letter Audit: National Health and Medical Research Council Public Statement (2010) and Rapid Review (2010)

Dear Sirs,

I have audited the NHMRC Public Statement (2010) and Rapid Review (2010) and communicated my findings in letters[1],[2] addressed to Professor John McCallum, Dr. Bruce Armstrong, Professor Warwick Anderson and the Wind Turbine Project Team at wind.turbines@nhmrc.gov.au.

Subsequent to these communications individuals in Australia and elsewhere internationally, have expressed an interest in these audit findings. In response to these requests I have summarized some of the audit findings in this open letter.

The letter may be freely distributed to encourage scientific discourse and advance knowledge on the adverse health effects associated with human exposure to wind turbines.

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Audit: National Health and Medical Research Council Rapid Review (2010) and Public Statement 2010

Contents

1 Disclaimer

The contents of this open letter should not be used to infer any bias for or against wind energy. This letter is the authorship of Brett Horner and is not to be associated with and/or used to characterize any individual and/or organization.

Brett Horner has received no financial support for the research, authorship, and/or publication of this letter.

2 Background

For almost four years I have audited references related to the health effects of wind turbines and have coauthored a number of related papers. These audits have found some references contain errors of omission and/or commission. Horner et al. (2011) discusses a number of commonly cited literature reviews and considers their completeness, accuracy and objectivity.[3]

I am currently auditing other references on the health effects of wind turbines and have documented errors of omission and/or commission. For example audits reveal some recent literature reviews selectively cite and/or inappropriately cite and/or misquote references to support their statements. Experience confirms the necessity to audit each primary reference to ensure appropriate citations by authors.

In July 2010 the National Health and Medical Research Council (NHMRC) released a public statement "Wind Turbines and Health" (Public Statement, 2010) and a literature review entitled "Wind Turbines and Health, A Rapid Review of the Evidence July 2010" (Rapid Review, 2010).

The contents of the NHMRC Public Statement (2010) and Rapid Review (2010) do not merely impact Australians. These NHMRC public health documents have had; and will likely have; implications for communities internationally.

At least two published case studies[4,5] have documented reports of adverse effects from individuals exposed to Canadian wind turbine facilities. In some cases the symptoms were severe enough that the affected Canadians have effectively abandoned their homes and/or negotiated financial agreements with the wind energy developer.[6]

The expectation that wind turbines can result in adverse effects is supported by other references including an Ontario Ministry of Environment commissioned report which states:

> "The audible sound from wind turbines, at the levels experienced at typical receptor distances in Ontario, is nonetheless expected to result in a non-trivial percentage of persons being highly annoyed. As with sounds from many sources, research has shown that annoyance associated with sound from wind turbines can be expected to contribute to stress related health impacts in some persons." [7]

An Ontario Ministry of Environment document obtained in a freedom of information request states:

> "It appears compliance with the minimum setbacks and the noise study approach currently being used to approve the siting of WTGs will result or likely result in adverse effects …"[8]

In Canada consultants for members of the wind energy industry have cited the NHMRC Rapid Review (2010) as a governmental document which supports claims that the sound from wind turbines does not pose a risk of any adverse health effect in humans or that noise from wind turbines is not causally related to adverse effects.

3 Supporting References

This open letter provides references to support statements contained within.

References provided include, but are not limited to:

- Peer reviewed references publicly available before and after the release of the Public Statement (2010) and the Rapid Review (2010)
- Non peer reviewed references publicly available before and after the release of the Public Statement (2010) and the Rapid Review (2010)
- References cited by the Public Statement (2010)
- References cited by the Rapid Review (2010)
- References authored by Rapid Review (2010) peer reviewer Dr. Geoff Leventhall
- References authored by consultants for members of the wind energy industry
- References authored by members or previous members of the wind energy industry
- References obtained from governmental freedom of information requests

4 Literature Reviews and the Case for Audit

"Literature reviews can be useful tools for summarizing existing literature related to a particular topic. In order to be considered reliable a literature review must be complete, accurate, and objective." [9]

"Authors have an inherent responsibility to ensure that they accurately reflect the contents of references cited. Literature reviews which inappropriately cite or misquote references should be viewed with caution." [10]

Some literature reviews provide a balanced assessment and attempt to draw reasonable scientific conclusions based on the totality of evidence. Other literature reviews lack completeness, accuracy, and objectivity and contribute little to inform the public about the potential health risks associated with living in the environs of wind turbines. Literature reviews which contain errors of omission and/or errors of commission cannot be relied on to make informed decisions and should be amended or regarded with caution. [11]

Readers may sometimes assume statements contained in literature reviews accurately reflect the content of the primary reference being cited. Objective examination of evidence (audit), is recommended to evaluate the appropriateness of a literature review's citations.

4.1 Audit Illustration

The following example is provided to illustrate the importance of auditing literature reviews.

The peer reviewed literature review Knopper and Ollson (2011) contains the following statement:

> "A number of governmental health agencies agree that while noise from wind turbines is not loud enough to cause hearing impairment and are not causally related to adverse effects, wind turbines can be a source of annoyance for some people [1,30-34]." [12]

Knopper and Ollson (2011) cite six references to support this statement.

Readers might assume that the six references are appropriately cited. But do the references support the Knopper and Ollson (2011) statement?

4.2 The Audit Test

To verify if the cited references support the above Knopper and Ollson (2011) statement one needs to evaluate the individual references and assess if they meet the following four audit criteria:

1. Is the cited reference an official production of a governmental health agency?
2. Does the cited reference agree that noise from wind turbines is not loud enough to cause hearing impairment?
3. Does the cited reference agree noise from wind turbines is not causally related to adverse effects?
4. Does the cited reference agree wind turbines can be a source of annoyance?

4.2.1 Knopper and Ollson (2011) Reference 1

The first of the six references cited in Knopper and Ollson (2011) is *Fourth Ministerial Conference on Environment and Health. Energy, Sustainable Development and Health*.

Knopper and Ollson (2011) attribute the authors of WHO (2004) to be the World Health Organization (WHO). This attribution suggests that WHO (2004) is an official production authored and/or endorsed by the WHO.

The WHO (2004) version cited in Knopper and Ollson (2011) is an "UNEDITED DRAFT" [13] which states "The document still needs further in depth development and expert review." and describes a "… plan to hold a meeting to review this document and to develop further recommendations." [14]

WHO (2004) also contains a disclaimer "The views expressed in this document are the views of the authors". WHO (2004) lists numerous authors from different organizations. The draft reference cited, WHO (2004), may not be an official production of the WHO. [15],[16]

Does WHO (2004) fulfill any of the next three criteria? The answer appears to be no.

WHO (2004) does not provide conclusions regarding hearing impairment, causal relationship to reported adverse effects, or annoyance caused by wind turbine noise. WHO (2004) focuses on evaluating health impacts such as air pollution affects, bronchitis, and occupational accidents. WHO (2004) acknowledges the methodology used in the report did not evaluate wind turbine noise effects stating: "Within the ExternE comparison, health effects from wind energy are negligible, however issues such as sleep disturbance, school absenteeism, eventually resulting from noise in vicinity, could not be evaluated." [17]

WHO (2004) does comment on wind turbine noise stating:

> "Wind energy can, however, have some potential burdens on amenity through visual intrusion or/and noise." [18]
>
> "Most wind farms are considered to have very low impacts, and these are caused mostly at the local scale – noise pollution may be a problem if turbines are situated close to centres of population." [19]

Knopper and Ollson (2011) omit citing any of these WHO (2004) statements related to wind turbine noise.

To summarize WHO (2004) may not be an official production of the WHO. That being said the cited reference, WHO (2004), is a draft document which the authors note still needs further in depth development and expert review. Furthermore, WHO (2004) does not appear to evaluate the health impacts of wind turbine noise. WHO (2004) does acknowledge noise pollution may be a problem if turbines are situated close to centres of population.

4.2.2 Knopper and Ollson (2011) Reference 30

The second reference cited is *Coping strategies for low frequency noise. J Low Freq Noise V A 2008, 27:35-52.* (Leventhall et al., 2008) [20]. How many of the four audit criteria do Leventhall et al., (2008) meet? The short answer appears to be none.

Leventhall et al., (2008) does not appear to be an official production of a governmental health agency nor does it appear to consider wind turbines or the health impacts of wind turbines. Wind turbines do not appear to be mentioned in Leventhall et al., (2008).

4.2.3 Knopper and Ollson (2011) Reference 31

The next four references cited in Knopper and Ollson (2011) are literature reviews produced by various governmental health agencies. These literature reviews have varying degrees of completeness, accuracy, and objectivity (See discussion Horner et al., 2011[21]).

Knopper and Ollson (2011) cite *Chatham-Kent Public Health Unit: The Health Impact of Wind Turbines: A Review of the Current White, Grey and Published Literature 2008*. Chatham-Kent Public Health Unit (2008) is a public health agency literature review that states the "… health impact of the noise created by wind turbines has been studied and debated for decades with no definitive evidence supporting harm to the human ear." This appears to suggest noise from wind turbines is not loud enough to cause hearing impairment. Chatham-Kent Public Health Unit (2008) comments that noise and sound can be annoying but does not appear to specifically state that wind turbines can be a source of annoyance.

Chatham-Kent Public Health Unit (2008) states in the conclusion:

> "This paper concludes and concurs with the original quote from Chatham-Kent's Acting Medical Officer of Health, Dr. David Colby,
>
> "In summary, as long as the Ministry of Environment Guidelines for location criteria of wind farms are followed, it is my opinion that there will be negligible adverse health impacts on Chatham-Kent citizens. Although opposition to wind farms on aesthetic grounds is a legitimate point of view, opposition to wind farms on the basis of potential adverse health consequences is not justified by the evidence." [22]

Chatham-Kent Public Health Unit (2008) does not state noise from wind turbines is not causally related to adverse effects.

Although Chatham-Kent's Acting Medical Officer is not the author of Chatham-Kent Public Health Unit (2008), he has stated that he endorsed it and takes full responsibility for the contents.[23]

Chatham-Kent's Acting Medical Officer has authored[24], [25] or participated in [26] references which identify noise induced annoyance and/or stress as the plausible cause of reported wind turbine adverse health effects. One such reference is The American Wind Energy Association and The Canadian Wind Energy Association convened literature review, Colby et al. (2009). [27] (See discussion regarding Colby et al., 2009 later in this letter)

Knopper and Ollson (2011) omit any mention of The American Wind Energy Association and The Canadian Wind Energy Association convened literature review, Colby et al. (2009).

4.2.4 Knopper and Ollson (2011) Reference 32

The next reference cited is *Minnesota Department of Health Environmental Health Division: Public Health Impacts of Wind Turbines 2009*. Minnesota Department of Health (2009) does not appear to specifically comment on wind turbine noise and hearing impairment but does comment on wind turbine noise annoyance stating: "… lower noise levels (dB(A)) from wind turbines engenders annoyance similar to much higher levels of noise exposure from aircraft, road traffic and railroads."[28]

Minnesota Department of Health (2009) does not state noise from wind turbines is not causally related to adverse effects.

The conclusion of Minnesota Department of Health (2009) states:

> "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." [29]

Knopper and Ollson (2011) omit disclosing these Minnesota Department of Health (2009) statements related to wind turbine noise.

4.2.5 Knopper and Ollson (2011) Reference 33

The fifth reference cited is *Chief Medical Officer of Health (CMOH) Ontario: The Potential Health Impact of Wind Turbines 2010*. CMOH (2010) does acknowledge wind turbine noise is not loud enough to cause hearing impairment and wind turbine noise may be annoying stating:

> "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 "swishing" or fluctuating nature of wind turbine sound rather than to the intensity of sound."[30]

CMOH (2010) focuses on direct causal links. In 2011 lead author of CMOH (2010) acknowledged under oath the literature review looked only at direct links to human health. [31] CMOH (2010) states:

> "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."[32]

CMOH (2010) does not state noise from wind turbines is not causally related to adverse effects.

Furthermore, a separate CMOH reference dated May 19 2010 states:

> "Although some people living near wind turbines report symptoms such as dizziness, headaches, and sleep disturbance, available scientific evidence does not demonstrate a direct causal link to wind turbine noise. It is possible that these symptoms are a result of annoyance with the noise."[33]

CMOH (2010) acknowledges the Ontario "… Ministry of the Environment has recently hired independent consultants to … review low frequency sound impacts from wind turbines, and to develop recommendations regarding low frequency sound." [34]

The drafts[35],[36]and final[37] versions of the consultant literature review referred to in CMOH (2010) state:

> "The audible sound from wind turbines, at the levels experienced at typical receptor distances in Ontario, is nonetheless expected to result in a non-trivial percentage of persons being highly annoyed. As with sounds from many sources, research has shown that annoyance associated with sound from wind turbines can be expected to contribute to stress related health impacts in some persons."
> ...
>
> "Stress symptoms associated with noise annoyance, and in particular low frequency annoyance include sleep interference, headaches, poor concentration, mood swings"
> …
>
> "Since it is evident that complaints related to low frequency noise from wind turbines often arise from the characteristics of the sound impact indoors, and since the indoor low frequency sound levels and frequency spectra can differ markedly from those outdoors, it is recommended that the MOE consider adopting or developing a protocol to provide guidance for addressing such complaints."

4.2.6 Knopper and Ollson (2011) Reference 34

The sixth and final reference cited is *"Australian Government, National Health and Medical Research Council: Wind Turbines and Health: A Rapid Review of the Evidence 2010."* Rapid Review (2010) does appear to acknowledge wind turbine noise is not loud enough to cause hearing impairment and wind turbine noise may be annoying. Rapid Review (2010) appears to focus on direct effects and states in the conclusion:

> "There are no direct pathological effects from wind farms and that any potential impact on humans can be minimised by following existing planning guidelines." [38]

Rapid Review (2010) does not specify what the potential impacts on humans are nor does it provide specifics of the planning guidelines which will minimize the impacts.

Rapid Review (2010) does not conclude that noise from wind turbines is not causally related to adverse effects.

A 2011 Australian Senate committee inquiry reports:

> "Many … witnesses who asserted that there are not any adverse health effects from wind farms relied on a survey of the literature published by the National Health and Medical Research Council (NHMRC)" [39]

The Australian Senate committee inquiry also reports:

> "Professor Anderson, the Chief Executive Officer of NHMRC, informed the Committee that:
>
> > I do want to make a point to anybody who is relying on this.
> >
> > We regard this as a work in progress. We certainly do not believe that this question has been settled. That is why we are keeping it under constant review. That is why we said in our review that we believe authorities must take a precautionary approach to this. That is what we do say in medicine anyhow, but this is very important here because of the very early stage of the scientific literature. In any area we make statements on, we are robust, we are used to being criticised from all sorts of directions and we cannot be responsible for the use that others make of the literature ..." [40]

In 2012 when asked if the NHMRC is prepared to say that there are no health problems from the wind turbines Professor Anderson stated "…we have never been prepared to say that because it is very hard to rule things out …". [41]

The NHMRC is currently working on producing an updated literature review with an expected release date in 2012.[42]

4.3 Audit Conclusion: Knopper and Ollson (2011) Statement

The above discussion suggests while some of the six references cited met some of the audit criteria, none met all four. (See Appendix Table 1).

One reference does not appear to meet any of the four audit criteria.

The audit comments presented suggest none of the six references cited support the complete Knopper and Ollson (2011) sentence:

> "A number of governmental health agencies agree that while noise from wind turbines is not loud enough to cause hearing impairment and are not causally related to adverse effects, wind turbines can be a source of annoyance for some people [1,30-34]."

For example, none of the six references appear to have concluded that wind turbines "… are not causally related to adverse effects… "

The above discussion illustrates the importance of auditing the completeness, accuracy and objectivity of literature reviews.

5 Audit Comments NHMRC Public Statement (2010)

In July 2010 the NHMRC released a public statement "Wind Turbines and Health" of July 2010 (Public Statement, 2010).

The following comments are based on an audit of relevant references:

- The Public Statement (2010) cites 13 references including 2 facts sheets by the Australian Wind Energy Association (AusWEA).[43],[44]
- The Public Statement (2010) omits a number of relevant references, including peer reviewed articles, which were available before the release of Public Statement (2010).
- The Public Statement (2010) states: "Those who oppose the development of wind farms contend that wind turbines can adversely impact the health of individuals living in close proximity."[45] The Public Statement (2010) does not provide a reference to support this statement.
- The Public Statement (2010) omits disclosing that commentators, including consultants for members of the wind energy, acknowledge that wind turbines can harm humans if they are placed too close to people. (See references provided below)
- The Public Statement (2010) appears to have a narrow focus stating:

  > "Concerns regarding the adverse health impacts of wind turbines focus on infrasound noise, electromagnetic interference, shadow flicker and blade glint produced by wind turbines." [46]

  The Public Statement (2010) also states:

  > "Concerns regarding the adverse health impacts of wind turbines focus on infrasound, electromagnetic radiation, shadow flicker and blade glint produced by wind turbines, as discussed above. While there is currently no evidence linking these phenomena with adverse health effects, the evidence is limited." [47]
- The Public Statement (2010) omits discussion of the well-known stress effects of audible noise. (See references provided below)
- The Public Statement (2010) states: "While a range of effects such as annoyance, anxiety, hearing loss, and interference with sleep, speech and learning have been reported anecdotally, there is no published scientific evidence to support adverse effects of wind turbines on health." [48]
- Studies published before the Public Statement (2010)[49],[50],[51] consistently demonstrate wind turbines produce sound which is perceived by humans to be more annoying than transportation noise or industrial noise at comparable sound pressure levels. This is omitted from the Public Statement (2010).
- Annoyance to wind turbine noise starts at wind turbine dBA sound pressure levels in the low 30's and rises sharply at 35 dBA.[52],[53] This is omitted from the Public Statement (2010).
- Dr. Nina Pierpont documented health effects in a case series which included Canadian participants. Dr. Pierpont defined the cluster of symptoms associated with wind turbines, (Wind Turbine Syndrome) to include: sleep disturbance, headache, tinnitus, ear pressure, dizziness, vertigo, nausea, visual blurring, tachycardia, irritability, problems with concentration and memory, and panic episodes associated with sensations of internal pulsation or quivering when awake or asleep.[54] This is omitted from the Public Statement (2010).
- Additional case studies, publicly available prior to the release of the Public Statement (2010), document similar reported symptoms and/or annoyance and/or reduced quality of life.[55],[56],[57] (See Minnesota Department of Health (2009) for discussion of case studies[58]). This is omitted from the Public Statement (2010). Case study results from Krogh et al. (2010) [59] were published in a 2011 peer reviewed article.[60] Krogh et al. (2011) is cited in the British Medical Journal.[61]

- In 2009, The American Wind Energy Association and The Canadian Wind Energy Association "…established a scientific advisory panel …"[62] and funded a literature review, Colby et al. (2009). In 2011, three of the Colby et al. (2009) coauthors under oath reaffirmed contents of Colby et al. (2009).
- The Public Statement (2010) cites Colby et al. (2009) once to support the statement: "A recent expert panel review in North America found no evidence that audible or subaudible sounds emitted by wind turbines have any direct adverse physiological effect." [63]
- Colby et al. (2009) did not find evidence that the sounds emitted by wind turbines have direct adverse health consequences. However, the authors of Colby et al. (2009) acknowledge the symptoms documented by Dr. Pierpont (which includes Canadian subjects) and state the symptoms "… are not new and have been published previously in the context of "annoyance"…" and are the "… well-known stress effects of exposure to noise …"[64]. This is omitted from the Public Statement (2010).
- Colby et al. (2009) identify a causal link through noise annoyance. These effects occur via the indirect pathway.
- Referring to wind turbines, an Ontario Environmental Review Tribunal Decision found ""serious harm to human health" includes … indirect impacts (e.g., a person being exposed to noise and then exhibiting stress and developing other related symptoms). This approach is consistent with both the WHO definition of health and Canadian jurisprudence on the topic."[65]
- It is not obvious if the Public Statement (2010) was subject to a peer review.
- Dr. Geoff Leventhall is reported to be one of two peer reviewers the Rapid Review (2010). [66]
- References authored or co-authored by Dr. Geoff Leventhall are cited, albeit selectively, the Public Statement (2010) and in the Rapid Review (2010).
- Dr. Leventhall states: "Pierpont defined the symptoms of the Wind Turbine Syndrome as:"….sleep disturbance, headache, tinnitus, ear pressure, dizziness, vertigo, nausea, visual blurring, tachycardia, irritability, problems with concentration and memory, and panic episodes associated with sensations of internal pulsation or quivering when awake or asleep … I am happy to accept these symptoms, as they have been known to me for many years as the symptoms of extreme psychological stress from environmental noise, particularly low frequency noise … what Pierpont describes is effects of annoyance by noise – a stress effect … simply the well known effects of persistent, unwanted noise …"[67] The acknowledgement the symptoms associated with wind turbine exposure is simply the well known effects of persistent, unwanted noise is not disclosed in the Public Statement (2010).
- In two separate 2010 references, Colby et al. (2009) coauthors, Dr. Leventhall and Dr. Colby state: "It appears that there is no specific Wind Turbine Syndrome, but there are stress effects from low levels of noise, either high frequency or low frequency noise, which affect a small number of people. It is the audible swoosh-swoosh which, when it occurs, is the cause …"[68,69] The above acknowledgement that the symptoms associated with wind turbine exposure are stress effects from low levels of noise is not disclosed in the Public Statement (2010).
- On June 7, 2011 Dr. Leventhall presented to the National Health and Medical Research Council at a "Scientific Forum" on "Wind Farms and Humans Health".[70] Dr. Leventhall states: "Pierpont's weakness in acoustics does not mean that there is no effect on health from audible wind turbine noise. What we have to aim for is a proper understanding of why low levels of wind turbine noise sometimes lead to a response which is greater than expected … Effects of wind turbine noise on health are mediated through annoyance from audible noise, particularly if aerodynamic fluctuations occur (swish) … The Wind Turbine Syndrome is the result of stress from annoyance by audible noise from wind turbines…"[71] The acknowledgement that Wind Turbine Syndrome is the result of stress from annoyance by audible noise from wind turbines is not disclosed in the Public Statement (2010).

- Dr. Leventhall, [72],[73],[74] and other consultants [75],[76],[77] for members of the wind energy industry have suggested that cognitive behaviour therapy could be used to treat those suffering adverse effects of wind turbine noise annoyance. The Public Statement (2010) omits that Dr. Leventhall's suggestions that cognitive behaviour therapy could be used to treat affected individuals.
- The Public Statement (2010) states: "A study of three UK wind farms also supports this conclusion, finding that sound associated with modern wind turbines is not a source which will result in noise levels which may be injurious to the health of a wind farm neighbour." [78] The Public Statement (2010) cites Department of Trade and Industry UK (DTI) (2006) to support this statement.
- The Hayes McKenzie Partnership (HMP) conducted a study at UK wind farms for the government of the United Kingdom (UK). Based on a Freedom of Information documents in 2009 it was reported: "Civil servants have suppressed warnings that wind turbines can generate noise damaging people's health for several square miles around. The guidance from consultants indicated that the sound level permitted from spinning blades and gearboxes had been set so high — 43 decibels — that local people could be disturbed whenever the wind blew hard. The noise was also thought likely to disrupt sleep. The report said the best way to protect locals was to cut the maximum permitted noise to 38 decibels, or 33 decibels if the machines created discernible "beating" noises as they spun. It has now emerged that officials removed the warnings from the draft report in 2006 by Hayes McKenzie Partnership (HMP), the consultants. The final version made no mention of them."[79] Hayes McKenzie (2006) draft reports[80],[81] were obtained from a Freedom of Information request.
- The Public Statement (2010) states "… there is also the argument that if people are worried about their health they may become anxious, causing stress related illnesses which are genuine health effects arising from their worry, but not from the wind turbine itself."[82] The Public Statement (2010) does not provide a reference to support this statement.
- Research published subsequent to the Public Statement (2010) report that attitudes towards wind turbines were initially positive where there were reports of adverse effects documented. Communities welcomed wind energy projects for their perceived economic[83] and/or environmental[84] benefits. "The reported adverse impacts were unexpected[85]."
- The Public Statement (2010) states: "The situation is further complicated by findings that people who benefit economically from wind turbines were less likely to report annoyance, despite exposure to similar sound levels as people who were not economically benefiting." [86] The Public Statement (2010) cites Pederson E and Persson Waye K (2007). Perception and annoyance due to wind turbine noise – a dose-response relationship. Journal of the Acoustical Society of America, 116(6): 3460-3470 to support this statement.
- The article "Perception and annoyance due to wind turbine noise – a dose-response relationship. Journal of the Acoustical Society of America, 116(6): 3460-3470" is a 2004 citation not a 2007 citation as indicated in the Public Statement (2010)
- Pederson E and Persson Waye K (2004). Perception and annoyance due to wind turbine noise – a dose-response relationship. Journal of the Acoustical Society of America, 116(6): 3460-3470, does not appear to comment on annoyance levels of people who benefit economically from wind turbines.
- Pederson et al. (2009) reports those: "…who benefit economically from wind turbines have a significantly decreased risk of annoyance, despite exposure to similar sound levels."[87]

The study reported on in Pederson et al. (2009) is "Project WINDFARM Perception: Visual and Acoustic Impact of Wind Turbine Farms on Residents". van den Berg et al. (2008) reports:

"Respondents that benefit will more usually have control: most or all of them have taken part in the decision to put up the turbines and they can stop them if they want. One respondent remarked that if a turbine close by caused too much noise for him or his neighbour, he stopped the turbine."[88]

This is omitted from the Public Statement (2010).

- Excerpts from sample Canadian hosting agreements indicate individuals who benefit financially from wind energy projects typically agree to noise and/or other adverse effects:

  "… in consideration of the Rent paid by the Lessee to the Lessor. … the parties hereto covenant and agree … Lessor grants and transfers to Lessee a non-exclusive License for audio, visual, view, light, flicker, noise, shadow, vibration, air turbulence, wake, electromagnetic, electrical and radio interference, and any other effects attributable to the Wind Power Facilities or activity located on the Leased Lands or on adjacent properties ("Effect License")." [89]

  "The Rent, in respect of the Specified Locations…represent compensation in full for…nuisance, noise, signal interference,…, casting of shadows and other inconveniences or damage…incurred by Lessor from the acts or omissions of Lessee."[90]

- The Public Statement (2010) states: "A recent study found that noise annoyance was strongly associated with a negative attitude to the visual impact of wind turbines on the landscape."[91] The Public Statement (2010) cites Pederson E and Persson Waye K (2007). Perception and annoyance due to wind turbine noise – a dose-response relationship. Journal of the Acoustical Society of America, 116(6): 3460-3470. As noted above "Perception and annoyance due to wind turbine noise – a dose-response relationship" is a 2004 citation not a 2007 citation.
- In 2010 there are more recent studies than the 2004 "Perception and annoyance due to wind turbine noise – a dose-response relationship". van den Berg et al. (2008) reports:

  "A free sight from the dwelling to one or more of the wind turbines also gives free way for the sound. In these cases the immission levels at the dwelling of the respondent were in accordance with the calculated levels, and not less due to hindrance of the sound propagation. When the sight of the wind farm is blocked, than the sound may be (partly) blocked too, leading to lower sound levels. This may explain the lower levels of annoyance. However, the enhanced probability for annoyance if the wind turbines were visible could also be due to a multimodal effect; the rotating blades of a wind turbine attracting the sight could increase the awareness of the sound and hence also the possibility of noise annoyance."[92] …

  "It is difficult to separate the visual from the acoustic impact, because they are so closely related: when turbines are closer and bigger they are usually better audible. However, when wind turbines are less visible they are less easily noticed by their sound and cause less annoyance." [93]

  This is omitted from the Public Statement (2010).
- The Public Statement (2010) cites Minnesota Department of Health (2009) twice.
- Minnesota Department of Health (2009) is cited to support the Public Statement (2010) statement "The perception of the noise is influenced by the attitude of the hearer towards the sound source." [94] The rationale used to cite Minnesota (2009) is not readily apparent. (Based on keyword searches of "perception" and "attitude")
- Keyword searches of "perception" and "attitude" reveal Minnesota Department of Health (2009) states: "Any noise criteria beyond current state standards used for placement of wind turbines should reflect priorities and attitudes of the community."[95] This is omitted from the Public Statement (2010).

- Minnesota Department of Health (2009) states: "… lower noise levels (dB(A)) from wind turbines engenders annoyance similar to much higher levels of noise exposure from aircraft, road traffic and railroads. Sound impulsiveness, low frequency noise and persistence of the noise, as well as demographic characteristics may explain some of the difference." [96] This is omitted from the Public Statement (2010).
- Minnesota Department of Health (2009) states: "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)."[97] This is omitted from the Public Statement (2010).
- The Public Statement (2010) contains the heading: "How much sound do wind turbines produce?"[98] However, the Public Statement (2010) omits disclosing how much sound wind turbines produce.
- The Rapid Review (2010) twice cites HGC Engineering (2007).
- HGC Engineering (2007) states: "Sound power levels of 105 dBA re 10-12 W are typical for modern turbines in the 1 to 2 MW range at moderate wind speeds." [99] This is omitted from the Public Statement (2010).
- The Public Statement (2010) contains "Table 1: Noise levels compared to a ten turbine wind farm" [100] which suggests the sound pressure level from 10 turbines would be 35 - 45 dBA at 350m. It is unclear if the sound pressure levels presented in "Table 1" represent minimum, maximum, or average sound pressure levels. The sizes, model design of the 10 turbines are not disclosed. This table may be misleading as a separation distance of 350 m from 10 modern turbines could result in sound pressure levels greater than 35 - 45 dBA.
- The Public Statement (2010) focuses on wind turbine sound pressure levels and does not focus on the other dimensions of sound.
- Leventhall (2006) states:

  > "Noise is multidimensional. A one dimensional view of noise is the A - weighting, which considers only levels and neglects frequencies. Another one-dimensional view is to consider only frequencies and neglect levels. Developing the dimensions further, two dimensions include both frequency and level (the spectrum), three dimensions adds in the time variations of the noise, whilst higher dimensions include subjective response."[101]

  This is omitted from the Public Statement (2010).
- WHO (1999) states:

  > "Noise measures based solely on LAeq values do not adequately characterize most noise environments and do not adequately assess the health impacts of noise on human well-being. It is also important to measure the maximum noise level and the number of noise events when deriving guideline values. If the noise includes a large proportion of low-frequency components, values even lower than the guideline values will be needed, because low-frequency components in noise may increase the adverse effects considerably. … It is not enough to characterize the noise environment in terms of noise measures or indices based only on energy summation (e.g. LAeq), because different critical health effects require different descriptions. Therefore, it is important to display the maximum values of the noise fluctuations, preferably combined with a measure of the number of noise events. A separate characterization of noise exposures during night-time would be required. For indoor environments, reverberation time is also an important factor. If the noise includes a large proportion of low frequency components, still lower guideline values should be applied."[102]

- Plausible causes of annoyance and/or other reported health effects are wind turbine sound characteristics which include amplitude modulation,[103],[104],[105],[106],[107] audible low frequency noise,[108],[109],[110] infrasound,[111] tonal noise, impulse noise[112] and night time noise[113]. This is omitted from the Public Statement (2010).
- Wind turbine compliance noise audits are typically based on an averaged "A"-weighted metric. An averaged "A"-weighted metric is acknowledged to be unsatisfactory[114] for complaints of cyclical amplitude modulation[115] and/or low frequency noise.[116] This is omitted from the Public Statement (2010).
- The Public Statement (2010) discusses shadow flicker stating :

  > "It has been suggested that phenomena such as shadow flicker and blade glint could have effects on health. Shadow flicker describes the flicking on and off of the wind turbine's shadow as the blades rotate. The primary concern with shadow flicker is the potential to cause epileptic seizures. The evidence on shadow flicker does not support a health concern." [117]
- Public Statement (2010) omits discussion of annoyance and nuisance impacts of wind turbine shadow flicker.
- The Rapid Review (2010) cites "National Research Council (NRC). (2007): Environmental Impacts of Wind-Energy Projects. Committee on Environmental Impacts of Wind Energy Projects, Board on Environmental Studies and Toxicology, Division on Earth and Life Studies"
- NRC (2007) states: "…to the extent that wind-energy projects create negative impacts on human health and well-being, the impacts are experienced mainly by people living near wind turbines who are affected by noise and shadow flicker."[118] This is omitted from the Public Statement (2010).
- As noted above the Public Statement (2010) cites Minnesota Department of Health (2009). Minnesota Department of Health (2009) states:

  > "Impacts noted by the NRC that may have the most effect on health include noise and low frequency vibration, and shadow flicker…
  >
  > Rhythmic light flicker from the blades of a wind turbine casting intermittent shadows has been reported to be annoying in many locations (NRC, 2007; Large Wind Turbine Citizens Committee, 2008). (Note: Flashing light at frequencies around 1 Hz is too slow to trigger an epileptic response.) …
  >
  > 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)…
  >
  > 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 …
  >
  > Potential impacts from shadow flicker and turbine visibility should be evaluated." [119]

  This is omitted from the Public Statement (2010).
- The Public Statement (2010) states: "… it is recommended that relevant authorities take a precautionary approach and continue to monitor research outcomes." [120]
  The Rapid Review (2010) appears to omit statements recommending that relevant authorities take a precautionary approach and continue to monitor research outcomes.
- The Public Statement (2010) states: "Complying with standards relating to wind turbine design, manufacture, and site evaluation will minimise any potential impacts of wind turbines on surrounding areas" [121] The Public Statement (2010) does not identify the specific potential

impacts of wind turbines on surrounding areas nor does it provide science based standards which will minimise the impact.

5.1 Audit Conclusion NHMRC Public Statement (2010)

It appears a rigorous and objective audit of the Public Statement (2010) and the supporting primary references did not occur. It appears the Public Statement 2010 review process failed to ensure a complete, accurate and objective end product.

Audit comments contained in this letter support the conclusion that the NHMRC should revise the Public Statement (2010).

6 Audit Comments NHMRC Rapid Review (2010)

In July 2010 NHMRC released a literature review entitled "Wind Turbines and Health, A Rapid Review of the Evidence July 2010" (Rapid Review, 2010). See Horner et al. (2011) for a discussion of the Rapid Review (2010).

To my knowledge the names of the individual authors responsible for the Rapid Review (2010) have not been publicly disclosed. However, it has been documented Professor Anderson identified "… Professor Simon Chapman and Professor Geoffrey Leventhal …" [122] as the two peer reviewers of the Rapid Review (2010). On the assumption that this information is correct I offer the following observations.

I have audited a number of references attributed to Dr. Chapman and Dr. Leventhall. I note that Dr. Chapman is cited twice in the Rapid Review (2010). The two references cited in the Rapid Review (2010), (Chapman S. (2010)[123] and Chapman S. (2010): Personal Communication[124]), appear to be non peer reviewed opinion pieces authored by Dr. Chapman. It is of concern that these two references are cited in the Rapid Review (2010), particularly in light of Dr. Chapman's role as peer reviewer.

Dr. Leventhall is identified as the other Rapid Review (2010) peer reviewer. Prior to the release of the Rapid Review (2010) Dr. Leventhall authored or co-authored a number of references on the health effects of wind turbines. Two of Dr. Leventhall's references are repetitively cited, albeit selectively, in the Rapid Review (2010) (see audit comments below). For example Leventhall (2006) is specifically cited three times and Colby et al. (2009) is specifically cited twice.

The following comments are based on an audit of relevant references:

- The Rapid Review (2010) cites a number of non peer reviewed references including an internet blog posting and references produced for or by members of the wind energy industry.
- The Rapid Review (2010) omits a number of relevant references, including peer reviewed articles, which were available before the release of Rapid Review (2010).
- Dr. Nina Pierpont states that noise from wind turbines produces a cluster of symptoms. This is disclosed on page 5 of the Rapid Review (2010).
- Dr. Pierpont defines the cluster of symptoms to include: sleep disturbance, headache, tinnitus, ear pressure, dizziness, vertigo, nausea, visual blurring, tachycardia, irritability, problems with concentration and memory, and panic episodes associated with sensations of internal pulsation or quivering when awake or asleep.[125] This is omitted from the Rapid Review (2010).

- A 2009 reference authored by Dr. Leventhall lists the above symptoms and states: "I am happy to accept these symptoms, as they have been known to me for many years as the symptoms of extreme psychological stress from environmental noise, particularly low frequency noise … what Pierpont describes is effects of annoyance by noise – a stress effect … simply the well known effects of persistent, unwanted noise …" [126] These acknowledgements by Dr. Leventhall are omitted from the Rapid Review (2010).
- Dr. Leventhall is a coauthor of The American Wind Energy Association and The Canadian Wind Energy Association funded Colby et al. (2009). The authors of Colby et al. (2009) acknowledge the symptoms documented by Dr. Pierpont and state they "… are not new and have been published previously in the context of "annoyance"…" and are the "… well-known stress effects of exposure to noise …" [127] These acknowledgements by Dr. Leventhall, and the coauthors of Colby et al. (2009), are omitted from the Rapid Review (2010).
- In 2011 Dr. Leventhall was questioned about the Colby et al. (2009) conclusion "Sound from wind turbines does not pose a risk of hearing loss or any other adverse health effects in humans."[128] Dr. Leventhall acknowledged under oath that the words "direct physiopathological effects"[129] should be added. Consequently the Colby et al. (2009) conclusion: "Sound from wind turbines does not pose a risk of hearing loss or any other adverse health effects in humans" is scientifically incorrect.
- The Colby et al. (2009) conclusion "Sound from wind turbines does not pose a risk of hearing loss or any other adverse health effects in humans.", though scientifically incorrect, is cited verbatim and unchallenged on page 5 of the Rapid Review (2010).
- Dr. Leventhall has expressed the opinion that low level frequency noise or infrasound emitted by wind turbines is minimal and of no consequence. These acknowledgements by Dr. Leventhall are cited on pages 3 and 4 of the Rapid Review (2010).
- References available at the time the Rapid Review (2010) suggest wind turbine audible low frequency noise[130] or infrasound [131] could be a cause of adverse health effects. These acknowledgements by other authors are omitted from of the Rapid Review (2010).
- Dr. Leventhall has expressed the opinion that wind turbine amplitude modulation[132] is the cause of reported health effects. In a February 2010 reference Dr. Leventhall states "It appears that there is no specific Wind Turbine Syndrome, but there are stress effects from low levels of noise, either high frequency or low frequency noise, which affect a small number of people. It is the audible swoosh-swoosh which, when it occurs, is the cause …".[133] Dr. Leventhall's acknowledgements that wind turbine amplitude modulation is the cause of adverse health effects is omitted from the Rapid Review (2010).
- Dr. Leventhall suggests wind turbine noise sufferers may be treated using his experimental cognitive behaviour therapy. [134],[135],[136] However, in March 2011 Dr. Leventhall testified under oath that his cognitive behaviour therapy has "… never been applied to wind turbine noise." [137] Dr. Leventhall's suggestions that experimental cognitive behaviour therapy may be used to treat people experiencing adverse health effects from wind turbine noise is omitted from the Rapid Review (2010).

References by Dr. Leventhall are publicly available on the web and are frequently relied upon by members of the wind energy industry. In 2011 Dr. Leventhall reaffirmed, under oath, the contents of a number of the above references at an Ontario Environmental Review Tribunal.[138]

The omission of Dr. Leventhall's acknowledgements is of concern. These omissions are troubling in light of Dr. Leventhall's role as peer reviewer of the Rapid Review (2010).

On June 7, 2011 Dr. Chapman and Dr. Leventhall were granted another opportunity to present their opinions to the NHMRC at a "Scientific Forum" on "Wind Farms and Humans Health".[139] I have downloaded and audited Dr. Leventhall's slides [140] and Dr. Chapman's Microsoft Word Document [141] from the NHMRC website.

I note the contents of Dr. Chapman's Microsoft Word Document [142] appear to be, in material respects, similar to the un-reviewed material already cited in the Rapid Review (2010) (i.e. Chapman S. (2010): Personal Communication [143]).

Dr. Leventhall's June 7, 2011 slides state: "Pierpont's weakness in acoustics does not mean that there is no effect on health from audible wind turbine noise. What we have to aim for is a proper understanding of why low levels of wind turbine noise sometimes lead to a response which is greater than expected … Effects of wind turbine noise on health are mediated through annoyance from audible noise, particularly if aerodynamic fluctuations occur (swish) … The Wind Turbine Syndrome is the result of stress from annoyance by audible noise from wind turbines…"[144] These June 7, 2011 statements are consistent with Dr. Leventhall's references publicly available at the time of the Rapid Review (2010). These relevant acknowledgements are omitted from the Rapid Review (2010) even though Dr. Leventhall was a peer reviewer.

To summarize, both Dr. Chapman and Dr. Leventhall have publicized opinions on the health effects of wind turbines. Both Dr. Leventhall and Dr. Chapman were repeatedly (and selectively) cited in the Rapid Review (2010). Both Dr. Leventhall and Dr. Chapman were granted the responsibility to peer review the Rapid Review (2010). On June 7, 2011 they were both granted another opportunity (i.e. two of the limited presenters on June 7, 2011) to restate their opinions.

6.1 Audit Conclusion NHMRC Rapid Review (2010)

It appears the Rapid Review (2010) peer review process failed to ensure an objective end product.

It appears a rigorous and objective audit of the Rapid Review (2010) and the supporting primary references did not occur.

7 Recommendations NHMRC Updated Literature Review (2012)

"Government's job is to provide citizens with accurate and appropriate information so that they can protect themselves."[145]

There is global interest in the NHMRC updated literature review. The updated literature review will likely impact communities internationally.

The completeness, accuracy and objectivity of the updated literature review will undoubtedly be rigorously scrutinized and commented on by international experts and the general public.

In addition to under going a peer review the NHMRC updated literature review and the supporting primary references should be subject to a rigorous and objective audit.

8 Appendix Table 1: Summary of Knopper and Ollson (2011) Audit Result

Reference Cited in Knopper and Ollson (2011)	1. Is the cited reference an official production of a governmental health agency?	2. Does the cited reference agree that noise from wind turbines is not loud enough to cause hearing impairment?	3. Does the cited reference agree noise from wind turbines is not causally related to adverse effects?	4. Does the cited reference agree wind turbines can be a source of annoyance?
1. World Health Organization (WHO): Fourth Ministerial Conference on Environment and Health. Energy, Sustainable Development and Health; 2004.	**Uncertain** Reference is an unedited draft. Reference may not be an official WHO document. See discussion section 4.2.1	**No** Reference does not appear to comment on hearing impairment.	**No** Reference does not appear to evaluate noise health impacts.	**No** Reference does not appear to comment on wind turbine annoyance.
30. Leventhall G, Benton S, Robertson D: Coping strategies for low frequency noise. J Low Freq Noise V A 2008, 27:35-52.	**No** Reference does not appear to be an official production of a governmental health agency.	**No** Reference does not appear to mention wind turbines.	**No** Reference does not appear to mention wind turbines.	**No** Reference does not appear to mention wind turbines.
31. Chatham-Kent Public Health Unit: The Health Impact of Wind Turbines: A Review of the Current White, Grey and Published Literature 2008.	**Yes**	**Yes -** (Indirectly)	**No** "…as long as the Ministry of Environment Guidelines for location criteria of wind farms are followed, it is my opinion that there will be negligible adverse health impacts…" See discussion section 4.2.3	**Yes -** (Indirectly) Does not specifically state wind turbines can be a source of annoyance for some people

Reference Reference Cited in Knopper and Ollson (2011)	1. Is the cited reference an official production of a governmental health agency?	2. Does the cited reference agree that noise from wind turbines is not loud enough to cause hearing impairment?	3. Does the cited reference agree noise from wind turbines is not causally related to adverse effects?	4. Does the cited reference agree wind turbines can be a source of annoyance?
32. Minnesota Department of Health Environmental Health Division: Public Health Impacts of Wind Turbines 2009.	**Yes**	**No** Reference did not appear to specifically comment on hearing impairment.	**No** Reference states "Most available evidence suggests that reported health effects are related to audible low frequency noise."	**Yes**
33. Chief Medical Officer of Health (CMOH) Ontario: The Potential Health Impact of Wind Turbines 2010.	**Yes**	**Yes**	**No** Focused on direct causal links. A separate CMOH Q&A document states: "It is possible that these symptoms are a result of annoyance with the noise." See discussion section 4.2.5	**Yes**
34. Australian Government, National Health and Medical Research Council: Wind Turbines and Health: A Rapid Review of the Evidence 2010.	**Yes**	**Yes**	**No** Focused on direct pathological effects. Potential impact on humans can be minimised by following existing planning guidelines See discussion section 4.2.6	**Yes**

9 References

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[2] Letter to John McCallum, Dr. Bruce Armstrong, Professor Warwick Anderson and the Wind Turbine Project Team at wind.turbines@nhmrc.gov.au, July 26 2012, Re: Audit: National Health and Medical Research Council Public Statement 2010 and Updated Review

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[12] Knopper & Ollson, "Health Effects and Wind Turbines: A Review of the Literature" Environmental Health, 10:78, (2011)

[13] Note: In an email dated July 17, 2012 Dr. Knopper confirmed the version of Fourth Ministerial Conference on Environment and Health. Energy, Sustainable Development and Health cited in Knopper and Ollson (2011).

[14] World Health Organization (WHO): Fourth Ministerial Conference on Environment and Health. Energy, Sustainable Development and Health; 2004.

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[16] Note: attempts to confirm if document number EUR/04/5046267/BD/8, dated 3 June 2004, entitled: "Energy, sustainable development and health" is an official WHO document have been made. As of the date of this open letter the WHO have not confirmed that it is an official WHO document Email from WHO July 23 2012.

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[18] World Health Organization (WHO): Fourth Ministerial Conference on Environment and Health. Energy, Sustainable Development and Health; 2004.

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[20] Note Dr. Knopper confirmed this is the version of Leventhall et al. (2008) cited in Knopper and Ollson (2011) in an email dated July 17, 2012.

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