



The Waubra Foundation.  
 PO Box 7112  
 Banyule Vic 3084  
 Australia

Reg. No. A0054185H  
 ABN: 42 152 077 891

CEO Mobile: 61 + 0474 050 463  
 E: [info@waubrafoundation.org.au](mailto:info@waubrafoundation.org.au)  
[www.waubrafoundation.org.au](http://www.waubrafoundation.org.au)

**Patron**  
 Alby Schultz

**Board**  
 Charlie Arnott, BRuSci (Hons)  
 Dr Michael Crawford, B Sc, B A  
 (Admin), M Admin Studies, PhD  
 Tony Hodgson, AM FCA, FAICD  
 Sarah Laurie, BMBS (Flinders) (CEO)  
 Peter R. Mitchell AM, BChE (Chair)  
 Alexandra Nicol, B Ag (Hons)  
 Kathy Russell, BCom, CA  
 The Hon. Clive Tadjell, AO  
 The Hon. Dr. Michael Wooldridge,  
 B.Sc. MBBS, MBA

5<sup>th</sup> September, 2014

NSW Planning Assessment Commission  
 re Gullen Range Wind Development  
 Chair: Mr Garry Payne

Dear Mr Payne,

Please find attached the Waubra Foundation submission to the NSW Planning Assessment Commission concerning Gullen Range Wind Development.

Michael Crawford, Waubra Foundation Director, will present the key points of this submission during his presentation.

Yours sincerely

A handwritten signature in black ink, appearing to read 'S. Laurie', is positioned below the 'Yours sincerely' text.

Sarah Laurie  
 Waubra Foundation CEO  
 Bachelor Medicine, Bachelor Surgery, Flinders University, 1995.

# Contents

<b>Overview</b>	3
<b>Health and Well-being Effects From Excessive Environmental Noise</b>	5
Knowledge of the NSW Department of Planning and PAC Members	5
New Acoustic Survey Evidence from Waterloo in South Australia, and Relevance for NSW	5
What are the Adverse Health Effects?	6
Wind Turbine Syndrome	6
Vibroacoustic Disease	8
Knowledge of Direct Causation of “Annoyance” symptoms from ILFN since 1980’s	8
Are the symptoms of Wind Turbine Syndrome the same as “annoyance”?	9
What circumstances and at what distances are people affected by wind turbine ILFN?	10
Over what period of time is harm caused by ILFN?	10
What happens with cumulative exposure to ILFN	11
Judicial recognition of harm from wind turbines	11
<b>Fundamental Defects in Guidelines and Noise Modelling</b>	13
Noise monitoring in vicinity of Waterloo Wind Farm	14
Waterloo Noise Modeling, NHMRC and conflicts of interest	16
<b>The Precautionary Principle and its application</b>	18
<b>Application and Implications for Gullen Range Evaluation</b>	20
PAC Review: Making Decisions Based on Unreliable Information	20
Planning Department’s Persistent Maladministration on Noise Impact	20
Implications	21
Recommendations	21
PAC Responsibility to prevent Sleep Deprivation Torture of Residents	22
<b>Attachments</b>	24
<b>Appendix A: Permanent Noise Monitoring Mechanism</b>	26
<b>Annex A to Appendix A: Noise Compliance Plan</b>	28
<b>Annex B to Appendix A: Illustrative Noise Monitoring System Specifications</b>	29
<b>Appendix B: Recommended Inter Turbine Separation Distances</b>	31

## Overview

There is longstanding and growing clinical and acoustic evidence that industrial wind farm acoustic emissions directly cause serious harm to the health and well-being of some of their neighbours.

The NSW Department of Planning and Environment (DP&E) acknowledges this threat caused by wind farms and, for that reason, has instituted noise guidelines and imposes operational noise conditions on wind farms. Unfortunately, these guidelines are seriously deficient in protecting against this source of harm.

Developers employ noise modeling to demonstrate that their proposed wind farms will meet these guidelines and thus get approval. However, this modeling is not only fundamentally unreliable but somehow always seems to underestimate the noise actually caused (ie the unreliability has a particular and consistent bias beneficial to developers), as is confirmed by independent post construction acoustic measurement and resident experience. Consequently the modeling in this instance, as in others, cannot be considered to provide any guarantee against subsequent harm to residents.

The proponent in this case has, in multiple ways, demonstrated a lack of consideration for the local community, councils, the department and rulings of the Land & Environment Court. The department, in this case and others, has a long and inglorious track-record of maladministration and failure to act expeditiously, or even at all, to protect residents from developers' noise and other harm.

So the PAC and the community cannot rely on the good faith of either the developer or the department to protect residents. Thus the PAC needs to require the institution of mechanisms that will ensure protection of residents from the harm to health and well-being commonly associated with wind farms, using the mechanisms we recommend. Without them, harm is guaranteed.

The only protection for local residents will be permanent noise monitoring, particularly inside dwellings, conducted by genuinely independent parties, with strict, no-discretion sanctions for each breach of operating conditions. Rather like automatic speeding fines. Details of the recommendation and how it would operate are provided later in this submission.

The obligation for the PAC to do this is strengthened by the precautionary principle to which the department claims to subscribe in its wind farm guidelines, and which the NHMRC has recommended since July 2010.<sup>1</sup>

The obligation of PAC members is further strengthened by the fact that Australia is a signatory to the UN Convention Against Torture.<sup>2</sup> Sleep deprivation is a common consequence of wind farm noise, which the NHMRC recently recognised is present in the existing limited research literature, along with “annoyance” symptoms and poorer quality of life.<sup>3</sup>

Sleep deprivation is explicitly acknowledged as a form of torture by both the UN Committee against Torture,<sup>4</sup> and the Physicians for Human Rights.<sup>5</sup>

---

<sup>1</sup> [https://www.nhmrc.gov.au/files/nhmrc/publications/attachments/new0048\\_public\\_statement\\_wind%20turbines\\_and\\_health.pdf](https://www.nhmrc.gov.au/files/nhmrc/publications/attachments/new0048_public_statement_wind%20turbines_and_health.pdf)

<sup>2</sup> <https://www.humanrights.gov.au/convention-against-torture-and-other-cruel-inhuman-or-degrading-treatment-or-punishment-human-rights>

<sup>3</sup> <http://waubrafoundation.org.au/wp-content/uploads/2014/04/Systematic-review-of-the-human-health-effects-of-wind-farms-December-20131.pdf>

<sup>4</sup> <http://waubrafoundation.org.au/resources/un-convention-against-torture/>

Should the PAC not build in strong mechanisms to protect residents from sleep deprivation and other adverse health effects, the members deciding on this application will be explicitly authorising torture despite clear warning that is the consequence of such actions.

This submission also endorses proposals to roll back the mis-sited wind turbines and for a judicial enquiry into the departmental maladministration that has allowed this situation to occur and the Department of Planning's systematic delinquency in favouring wind farm developers' interests at the expense of residents.

---

<sup>5</sup> "*Leave No Marks*" by Physicians for Human Rights, pp 22 -26 <http://physiciansforhumanrights.org/library/reports/leave-no-marks-report-2007.html>

## Health and Well-being Effects from Excessive Environmental Noise

There is longstanding and growing clinical and acoustic evidence excessive environmental noise, which include industrial wind turbine acoustic emissions, directly cause serious harm to the health and well-being of some of their neighbours.

This harm is most often caused by the effects of chronic sleep deprivation and chronic physiological and psychological stress on both physical and mental health. These consequences are well known to clinical medicine.

Excessive environmental noise (especially at night) has long been known to cause sleep and stress related health problems – as the various World Health Organisation reports and Australian En Health Committee report on environmental noise in 2004 have pointed out.<sup>6</sup>

### Knowledge Of The NSW Department Of Planning<sup>7</sup> and PAC Members

The NSW Department of Planning and PAC members are not unfamiliar with the consequences to vulnerable rural residents resulting from excessive environmental noise from other industrial developments, in quiet background noise rural environments.

Specific examples include the impacts of the gas fired power station at Uranquinty, which MP Hon Katrina Hodgkinson, the member for Burrinjuck detailed at the PAC meeting concerning the Dalton gas fired power plant.<sup>8</sup> The MP for Burrinjuck pointed out that ten families had to be bought out at Uranquinty (and were silenced with non disclosure clauses) because of excessive noise impacts from low frequency noise, which ruined the health and sleep of the adversely impacted neighbours.

There is also the result of the Bulga coal mine extension appeal which went against the NSW Minister for Planning.<sup>9</sup> In that case the NSW Planning Department had approved the extension, but the court was concerned about the adverse health impacts from excessive noise. The Cullen Bullen decision also mentioned the problems of excessive environmental noise, and made the point that the NSW Industrial Noise Policy guidelines may need revision, because of the number of noise complaints being received.<sup>10</sup>

### New Acoustic Survey Evidence from Waterloo in South Australia, and Relevance for NSW

With respect to wind turbine noise specifically, Professor Colin Hansen's team's report of their acoustic survey at Waterloo in South Australia released in late August 2014, has demonstrated that the existing South Australian wind turbine noise pollution guidelines are dangerously inadequate and not only permit excessive noise which will disturb sleep at "compliant" wind power developments, they also do not measure the penetrating, disturbing, lower frequencies below 200 Hz (specifically

---

<sup>6</sup> The various WHO reports (Community Noise 1999, Night Noise Europe 2009, and Environmental Noise 2011, and the Australian En Health Report from 2004 <http://waubrafoundation.org.au/information/acousticians-noise-regulators/literature-reviews/>

<sup>7</sup> The relevant department is now the NSW Department of Planning & Environment, though at times the planning function has been part of differently named departments. For simplicity, reference here to the "Department of Planning" means that planning function, whatever broad department structure it was part of at various times.

<sup>8</sup> <http://waubrafoundation.org.au/resources/ten-families-forced-from-homes-nr-uranquinty-gas-fired-power-station-due-noise/>

<sup>9</sup> <http://waubrafoundation.org.au/resources/bulga-milbrodale-v-min-for-planning-warkworth-mining-court-judgement/>

<sup>10</sup> <http://waubrafoundation.org.au/resources/cullen-bullen-mine-refused-due-noise/>

infrasound and low frequency noise or IFLN). These frequencies were measured inside the homes of adversely impacted residents at Waterloo out beyond 8km. <sup>11</sup>

NSW Wind Turbine Noise guidelines are based on these dangerously inadequate South Australian EPA Wind turbine Noise guidelines. These guidelines note that sleep deprivation is an adverse health effect, **but only for wind turbine hosts**. <sup>12</sup>

### What Are The Adverse Health Effects?

Sleep deprivation is the commonest reported symptom from people living within the acoustic impact zone of wind turbines, around the world. In Australia the acoustic impact zone is now acknowledged as 10km by acoustic consultants doing environmental assessments for new wind projects for the purposes of assessing cumulative impacts of wind turbine noise. <sup>13</sup>

Most medical practitioners would be aware that excessive night time noise could disturb sleep, and some may be aware of the evidence that excessive noise can cause a physiological stress effect – both reported by a number of comprehensive WHO Literature Reviews since 1980. <sup>14</sup>

However almost no medical practitioners would be aware of the important field research by rural General Practitioner Dr David Iser at Toora, Victoria, in 2004. <sup>15</sup> Dr Iser conducted the first population health survey in the world in residents living within 2km of the Toora wind turbines, and concluded that some people were severely impacted, some were moderately impacted, and others unaffected. Sleep deprivation and stress symptoms were specifically noted. Dr Iser notified the relevant state government Ministers and local council authorities in Victoria at the time, but was ignored. It is unfortunate, but perhaps not surprising, that the latest NHMRC literature review misclassified this important research, and then excluded it from consideration by the authors of the Systematic Literature Review from Adelaide University. <sup>16</sup>

Also not so well known to many in the medical profession is the evidence supporting the existence of the following two conditions: “wind turbine syndrome” and “vibroacoustic disease”. Both conditions are known to be directly caused by infrasound and low frequency noise from a variety of noise and vibration sources, not just wind turbines.

### Wind Turbine Syndrome

The acute effects and acutely disabling symptoms of vestibular disorder, including nausea and vertigo, triggered by a variety of stimuli in susceptible people such as motion, (motion sickness), as well as

---

<sup>11</sup> “Noise Monitoring in the Vicinity of Waterloo Wind Farm”, 2014 by Emeritus Professor Colin Hansen, Mr Branko Zajamsek, Dr Kristy Hansen

<http://waubrafoundation.org.au/resources/hansen-zajamsek-hansen-noise-monitoring-waterloo-wind-farm/>

<sup>12</sup> SA EPA Wind Farm Noise Guidelines can be downloaded here: [http://www.epa.sa.gov.au/environmental\\_info/noise/wind\\_farms](http://www.epa.sa.gov.au/environmental_info/noise/wind_farms)

<sup>13</sup> Marshall Day’s Acoustic Environmental Assessment for the Mt Emerald Wind Development see section 5.6 [http://mtemeraldwindfarm.com.au/updates/mewf\\_eis\\_docs/R72894%20EIS%20MEWF%20Volume%203%20-%20Appendix%207%20-%20Mt%20Emerald%20Wind%20Farm%20-%20Noise%20Impact%20Assessment.pdf](http://mtemeraldwindfarm.com.au/updates/mewf_eis_docs/R72894%20EIS%20MEWF%20Volume%203%20-%20Appendix%207%20-%20Mt%20Emerald%20Wind%20Farm%20-%20Noise%20Impact%20Assessment.pdf)

<sup>14</sup> <http://waubrafoundation.org.au/information/acousticians-noise-regulators/literature-reviews/>

<sup>15</sup> <http://waubrafoundation.org.au/resources/dr-david-iser-2004-conducts-first-survey-patients-living-near-wind-project/>

<sup>16</sup> The Waubra Foundation critique of the systematic literature review lists the concerns about omissions of literature from this review, and conflict of interest issues for some members of the NHMRC Literature Review Panel <http://waubrafoundation.org.au/resources/waubra-foundation-open-letter-nhmrc-re-systematic-literature-review/> . Other critiques of the NHMRC Literature Review and Draft Information Statement are available from here: <http://waubrafoundation.org.au/resources/responses-nhmrc-draft-information-paper-systematic-literature-review/>

infections in the inner ear (viral labyrinthitis), are reasonably well known and accepted in clinical medicine.

Less well known to most health practitioners is that these symptoms can also be triggered by exposure to infrasound and low frequency noise, regardless of the source of that environmental noise (ie wind turbines, gas fired power stations, coal mining noise, field compressors used for extraction and transportation of natural gas). Acousticians call these symptoms “annoyance”. Professor Salt’s neurophysiological research provides an animal model to explain the multiple physiological mechanisms including the activation of the “fight flight response”.<sup>17</sup> It is this response which is thought to be disturbing sleep and causing intense panic attacks in individuals not otherwise susceptible to such panic attacks, **which only occur when they are exposed to ILFN noise sources.**

These symptoms have been given the name of “Wind Turbine Syndrome” by American Paediatrician and Scientist Dr Nina Pierpont,<sup>18</sup> and are increasingly recognised by clinicians at the front line in rural areas who are treating these patients, such as Dr Sandy Reider from Vermont, USA.<sup>19</sup> The characteristic symptoms and health problems are also being publicly acknowledged by senior public health doctors such as Dr Colette Bonner,<sup>20</sup> the Irish Deputy chief Medical Officer, and Professor Steven Rauch, an otologist at the Massachusetts Eye and Ear Infirmary and a professor at Harvard Medical School, who was quoted in a recent article:<sup>21</sup>

*Dr. Steven Rauch, an otologist at the Massachusetts Eye and Ear Infirmary and a professor at Harvard Medical School, believes WTS is real. Patients who have come to him to discuss WTS suffer from a “very consistent” collection of symptoms, he says. Rauch compares WTS to migraines, adding that people who suffer from migraines are among the most susceptible to turbines. There’s no existing test for either condition but “Nobody questions whether or not migraine is real.”*

*“The patients deserve the benefit of the doubt,” Rauch says. “It’s clear from the documents that come out of the industry that they’re trying very hard to suppress the notion of WTS and they’ve done it in a way that [involves] a lot of blaming the victim.”*

The acute symptoms of wind turbine syndrome cease when exposure to the ILFN stimulus ceases. Some people report that they have persistent hearing problems, memory dysfunction, and post traumatic stress disorder symptoms after cessation of exposure, although these conditions are noted by them as less severe compared to when they are exposed to ILFN. Some of these people had none of these health problems prior to exposure to ILFN, others had pre existing conditions which were exacerbated by exposure to ILFN. If people are sensitive to one source of ILFN, they also consistently report sensitivity to other sources of ILFN. Prolonged cessation of exposure can bring considerable relief to those affected, as UK Acoustician and expert in low frequency noise, Dr Geoffrey Leventhall explained in a detailed literature review in 2003.<sup>22</sup>

<sup>17</sup> The latest summary of Professor Salt’s team’s work in this area was published in Acoustics today, Winter 2014 edition <http://waubrafoundation.org.au/resources/salt-n-lichtenhan-j-t-how-does-wind-turbine-noise-affect-people/>

<sup>18</sup> Dr Pierpont’s study is accessible via her submission to the 2011 Senate Inquiry <http://waubrafoundation.org.au/resources/dr-nina-pierpont-submission-australian-senate-inquiry/> and the executive summary can be accessed here: <http://waubrafoundation.org.au/resources/wind-turbine-syndrome-executive-summary/>

<sup>19</sup> <http://waubrafoundation.org.au/resources/reider-dr-sandy-md-rural-primary-care-physician-questions-ama-statement/>

<sup>20</sup> Dr Colette Bonner’s remarks are quoted here: <http://waubrafoundation.org.au/2014/i-need-protect-my-child-from-wind-farms/>

<sup>21</sup> <http://waubrafoundation.org.au/resources/halperin-big-wind-needs-address-wind-turbine-syndrome-new-republic/>

<sup>22</sup> <http://waubrafoundation.org.au/resources/review-published-research-low-frequency-noise-leventhall/> see conclusion



## Vibroacoustic Disease

Chronic effects of exposure to infrasound and low frequency noise have been documented over the last thirty years to result in tissue pathology in a variety of organs, known as vibroacoustic disease (VAD). Conditions such as late onset epilepsy, and cardiac valvular and pericardial thickening have been identified, as well as thickening of collagen, for example in blood vessel walls. <sup>23</sup>

VAD has been diagnosed in various occupational groups exposed to ILFN including aviation workers,<sup>24</sup> engineers working and sleeping on ferries with large diesel engines,<sup>25</sup> and residents living near sources of ILFN which also operate at night including a grain terminal <sup>26</sup> and industrial wind turbines. <sup>27</sup> The tissue pathology is serious and irreversible, even when exposure ceases. Worryingly, it is also being identified in children exposed to ILFN in utero and early childhood. Most of the work in this area has been done in Portugal, where both animal and human studies have been conducted, and where the courts have recognised this illness. <sup>28 29</sup>

## Knowledge Of Direct Causation Of “Annoyance” Symptoms From ILFN Since 1980’s

Direct causation of “annoyance” symptoms from infrasound and low frequency noise generated by impulsive wind turbine acoustic emissions was established by Dr Neil Kelley and his colleagues from NASA and a range of other scientific institutions and wind turbine manufacturers such as General Electric, during the 1980’s. <sup>30 31</sup>

As a result of this important research, presented at the American Wind Energy Conference in 1987,<sup>32</sup> there was a dramatic change in the design of wind turbines, to avoid the generation of excessive levels of infrasound and low frequency noise, known to be harmful to health and sleep by generating symptoms labelled as “annoyance”.

---

<sup>23</sup> Some of the work of the Portuguese researchers is on our website, and the following article is a review article which gives an overview of their work and findings <http://waubrafoundation.org.au/resources/vibroacoustic-disease-biological-effects-infrasound-alves-periera-castelo-branco/>

<sup>24</sup> Research into Taiwanese aviation workers <http://waubrafoundation.org.au/resources/effect-low-frequency-noise-echocardiographic-parameter-ea-ratio-chao-et-al-2/>

<sup>25</sup> See for example the paper delivered by motorman Jonathon Arnot to the British Institute of Acoustics in 2004, <http://waubrafoundation.org.au/resources/arnot-jw-vibroacoustic-disease-i-personal-experience-motorman/> and further information in this media article <http://waubrafoundation.org.au/2004/enormous-ignorance-about-vibroacoustic-disease-within-medical-profession/>

<sup>26</sup> <http://waubrafoundation.org.au/resources/alves-periera-castelo-branco-low-frequency-noise-case-studies-residential-exposure/>

<sup>27</sup> <http://waubrafoundation.org.au/resources/follow-up-study-family-exposed-low-frequency-noise/>

<sup>28</sup> Some of the relevant research is cited in this letter, responding to criticism of their work <http://waubrafoundation.org.au/resources/alves-periera-m-castelo-branco-n-ltr-australian-new-zealand-journal-public-health/>

<sup>29</sup> <http://waubrafoundation.org.au/resources/low-frequency-noise-presentation/>

<sup>30</sup> Key elements of that research and links to it can be found here: <http://waubrafoundation.org.au/2013/explicit-warning-notice/>

<sup>31</sup> The list of participating research organisations including wind turbine manufacturers and multiple universities and two branches of NASA can be found in the beginning of the 1985 Acoustic survey report by Kelley et al <http://waubrafoundation.org.au/resources/kelley-et-al-1985-acoustic-noise-associated-with-mod-1-wind-turbine/>

<sup>32</sup> <http://waubrafoundation.org.au/resources/1987-problem-with-low-frequency-noise-from-wind-turbines-scientific-identified/>



However in 1989 the new upwind bladed wind turbines were also shown by NASA researchers Shepherd and Hubbard to generate unexpectedly high levels of ILFN where there was turbulent air flowing into upwind bladed turbines.<sup>33 34</sup>

**This increased turbulent air will inevitably occur if the inter turbine spacing distances are too close together, such as exists at Gullen Range Wind Development, at both the existing turbine locations, and the locations originally approved by the Land and Environment Court.**<sup>35</sup>

**This means that adverse effects on the health and sleep of the neighbours to this development are inevitable, even if the turbines are moved back to the original court approved locations.**

The additional “annoyance” effect is further compounded by the increasing power generating capacity of the turbines with taller towers and longer blades. Increased power generation capacity also results in increased proportion of LFN, resulting in more “annoyance” symptoms for the neighbours, as Danish Acoustics Professor Henrik Moller made clear in a peer reviewed published paper, using wind industry data, in 2011.<sup>36</sup>

### **Are the symptoms of Wind Turbine Syndrome the same as “Annoyance”?**

As British Acoustician Dr Geoffrey Leventhall explained to the NHMRC workshop in June 2011, when talking about Dr Nina Pierpont’s study, and listing the symptoms Dr Pierpont had described,<sup>37</sup>

*“What struck me was that the results were already well known ... there was nothing new except that Pierpont showed there was a predisposition due to existing health problems” (at 0.47.19 and slide 42 – 43)*

Leventhall then went on to list the specific symptoms from Dr Pierpont’s study (at 0.49.30, slide 43) and then stated:

*“Now when I saw those I just thought I’ve been familiar with these for years” (at 0.49.45 – 50 slide 43)*

and then

*“These are exactly the same as the stress effects due to noise annoyance (slide 44, concluding at 0.49.58)*

In other words, the acousticians, particularly those like Dr Leventhall who have specific expertise in the adverse health effects of low frequency noise, **have known for years that these symptoms are directly caused by sound energy frequencies in the lower part of the sound spectrum.** It is therefore puzzling that Dr Leventhall is now claiming these symptoms are caused by a “nocebo

---

<sup>33</sup> <http://waubrafoundation.org.au/resources/shepherd-k-hubbard-h-noise-radiation-characteristics-westinghouse-wwg-0600-wind-turbine-generator/>

<sup>34</sup> See also Dr Malcolm Swinbanks’ discussion of the importance of the NASA research: <http://waubrafoundation.org.au/resources/swinbanks-m-nasa-langley-wind-turbine-noise-research/>

<sup>35</sup> See Appendix B for more detail

<sup>36</sup> <http://waubrafoundation.org.au/resources/moller-pedersen-low-frequency-noise-from-large-wind-turbines/>

<sup>37</sup> the link to the NHMRC page with the video and powerpoint presentation is here: <https://www.nhmrc.gov.au/media/events/2011/wind-farms-and-human-health-scientific-forum-7-june-2011> An alternative site to access this material is here: <https://www.wind-watch.org/documents/wind-farms-and-human-health-scientific-forum/>

effect” or scaremongering, in court cases in which he gives expert evidence for the wind industry.<sup>38</sup> He appears to have forgotten what he once said he knew.

### **What circumstances and at what distances are people affected by wind turbine ILFN?**

As Dr Leventhall has acknowledged, one of Dr Pierpont’s significant contributions was to identify the particular pre-existing health conditions which meant that these people had increased susceptibility to developing the symptoms of “annoyance” or “wind turbine syndrome”.

These pre-existing conditions identified by Dr Pierpont include migraines (subsequently confirmed by otoneurologists Dr Steven Rauch,<sup>39</sup> and Drs Hakan and Inga Enbom<sup>40</sup> from Sweden), motion sickness (confirmed by Dr Paul Schomer,<sup>41</sup> senior US Acoustician familiar with old research into motion sickness) and inner ear damage (coexistence with VAD also noted by VAD researchers Dr Nuno Castelo Branco, and Professor Mariana Alves Pereira),<sup>42</sup>

Distances reported in Australia are out to at least 10km from existing wind developments 2-3MW in size, but there are concerns that with chronic exposure in very quiet rural environments, that the distances could be even larger, especially where there are multiple wind turbines, 3 MW and larger.<sup>43</sup>

### **Over what period of time is harm caused by wind turbine ILFN?**

For those who have one or more of the risk factors listed above, the effects can be immediate, and extremely disabling. People badly affected have resorted to leaving their homes, sometimes even to be homeless or reliant on the charity of others, because they are so unwell when at home if the turbines are operating.<sup>44</sup>

For most others the effects are more subtle and the changes are noted with chronic exposure over months, and sometimes years. People are differently affected, even with the same exposure doses. Husbands and wives sleeping in the same bedroom can experience different effects.

This of course is not inherently different to most diseases, toxins, carcinogens, etc that affect the human body, or indeed other organisms. The existence of variable impact does not, in itself, disprove causal effects.

Because ILFN is a relatively modern damaging agent, long term effects are not yet well understood. We now know that in the cases of smoking and asbestos exposure, whose adverse effects were initially derided but ultimately caused enormous social costs, it commonly takes decades for the effect on individuals to be manifest.

However there is ample evidence in the research literature relating to the effects of chronic sleep deprivation and chronic stress, that widespread and serious illnesses will result for those affected in

---

<sup>38</sup> Transcript from oral evidence given by Dr Leventhall in the Bull Creek case before the Alberta Utilities Commission

<sup>39</sup> <http://waubrafoundation.org.au/resources/halperin-big-wind-needs-address-wind-turbine-syndrome-new-republic/>

<sup>40</sup> <http://waubrafoundation.org.au/resources/enbom-h-infrasound-from-wind-turbines-can-trigger-migraine-and-related-symptoms/>

<sup>41</sup> <http://waubrafoundation.org.au/resources/schomer-et-al-wind-turbine-noise-conference-denver-august-2013/>

<sup>42</sup> Personal communication, Professor Mariana Alves Pereira with CEO, Sarah Laurie

<sup>43</sup> The Letter to Slovenia August 2014 contains an appendix which lists the acoustic and population survey evidence of impacts out to 10km (as well as other useful information) <http://waubrafoundation.org.au/resources/letter-slovenia-re-known-adverse-health-impacts-wind-turbine-noise/>

<sup>44</sup> See first hand interviews with Trish Godfrey, before she left her home (bought out and silenced with non disclosure clause) <http://waubrafoundation.org.au/resources/channel-9-current-affair/> and Samantha Stepnell, <http://waubrafoundation.org.au/resources/abc-tv-hungry-beast/>

this way, including cardiovascular disease, decreased immunity leading to chronic infections and cancer, and mental health disorders including anxiety and depression.<sup>45</sup>

### **What happens with cumulative exposure to wind turbine ILFN?**

Prolonged exposure resulting in chronic sleep deprivation and chronic stress can, and have caused significant adverse health impacts on susceptible individuals over the longer term if people are unable to get away and reduce their exposure dose. The rapid aging effect has been noted in animal studies – the human “guinea pigs” are no different.<sup>46</sup> Many people describe being unaware of the impacts, until they get away from their home, and notice that their health and sleep problems improve, or resolve completely, only to recur when they go home again. Many people do this repeatedly as they do not wish to leave their homes, and do not want to believe that the turbines are causing their symptoms.

### **Judicial recognition of harm from wind turbines**

Courts in a number of jurisdictions including Australia are increasingly acknowledging that the adverse health impacts reported by residents living near wind turbines are “real and not imagined”.

In Ontario in July 2011, the Environment Review Tribunal found that:<sup>47</sup>

*“This case has successfully shown that the debate should not be simplified to one about whether wind turbines can cause harm to humans. The evidence presented to the Tribunal demonstrates that they can, if facilities are placed too close to residents”*

In Victoria, the VCAT Tribunal members stated the following in March 2013:<sup>48</sup>

*“The Tribunal finds itself in a position where there is some direct evidence and much anecdotal evidence that people living in proximity to wind farms experience deleterious health effects, and those effects are of the same type, being sleep disturbance, increased anxiety, headaches, and pressure at the base of the neck.*

In April 2013, the Tribunal members said the following:<sup>49</sup>

*” 116 There is evidence before the Tribunal that a number of people living close to wind farms suffer deleterious health effects. The evidence is both direct and anecdotal. There is a uniformity of description of these effects across a number of wind farms, both in south east Australia and North America. Residents complain of suffering sleep disturbance, feelings of anxiety upon awakening, headaches, pressure at the base of the neck and in the head and ears, nausea and loss of balance.*

*117 In some cases the impacts have been of such gravity that residents have been forced to abandon their homes.*

---

<sup>45</sup> See particularly the WHO Night Noise Guidelines for Europe section on chronic sleep deprivation <http://waubrafoundation.org.au/resources/who-night-noise-guidelines-for-europe/>

<sup>46</sup> See for example Dr Bruce McEwen’s seminal work on chronic stress in the New England Journal of Medicine in 1998, “Protective and Damaging Effects of Stress Mediators” New England Journal of Medicine 1998, 338 171–179 and <http://waubrafoundation.org.au/2014/too-little-sleep-causes-lasting-brain-damage/>

<sup>47</sup> <http://waubrafoundation.org.au/resources/judgement-erikson-v-min-environment-suncor-kent-breeze-case/>

<sup>48</sup> <http://waubrafoundation.org.au/resources/cherry-tree-wind-farm-vcac-heating/>

<sup>49</sup> <http://waubrafoundation.org.au/resources/vcat-cherry-tree-wind-farm-hearing-orders/>

*118 On the basis of this evidence it is clear that some residents who live in close proximity to a wind farm experience the symptoms described, and that the experience is not simply imagined.”*

In November 2013, the VCAT Tribunal members approved the Cherry Tree project but reiterated their acknowledgement of adverse health effects, including sleep disturbance. At paragraph 46 they stated:<sup>50</sup>

*“The Tribunal has no doubt that some people who live close to a wind turbine experience adverse health effects, including sleep disturbance”*

In Falmouth USA, also in November 2013, a superior court issued an immediate injunction to stop the operation of two wind turbines to prevent “irreparable harm to physical and psychological health”. The turbines were ordered to cease operating between 7pm and 7am, and on Sundays and specified public holidays. <sup>51</sup>

In Portugal, a superior court ordered four turbines to cease operating day and night and that the turbines should be removed because of adverse health effects which were reported both day and night. Sleep deprivation was explicitly mentioned. The English translation of the relevant section of the original judgment is below: <sup>52</sup>

*“The right to rest, tranquility and sleep are aspects of the right to humane treatment (Article 25, para. 1 of the Constitution of the Republic of Portugal), which is part of established fundamental rights, the collection of rights, freedoms, and guarantees. These personality rights are well protected against any unlawful interference, not necessarily in blame for an offense in intent to harm the victim, but in the offense itself.*

Most recently in Denmark, the Danish High Court granted compensation to a property affected by wind turbine noise after the turbines were constructed. <sup>53</sup>

---

<sup>50</sup> <http://waubrafoundation.org.au/resources/cherry-tree-vcata-final-orders-november-2013/>

<sup>51</sup> <http://waubrafoundation.org.au/resources/falmouth-mass-judge-muse-decision-shut-down-wind-turbines-causing-irreparable-harm/>

<sup>52</sup> <http://waubrafoundation.org.au/2014/portugese-supreme-court-orders-four-wind-turbines-removed/>

<sup>53</sup> <http://waubrafoundation.org.au/2014/danish-high-court-rules-compensation-for-wind-turbine-noise/>

## Fundamental Defects in Guidelines and Noise Modelling

The draft guidelines applied by the NSW Department of Planning are like those of most such bodies, which believe their job is to get wind farms built, not protect local residents. They make no serious attempt to deal directly with prevention of harm to residents, despite being made directly and repeatedly aware of the serious adverse impacts on sleep and health.

The closest they come to dealing with adverse effects on wellbeing is through imposing some totally inadequate noise guidelines. In what way are the guidelines inadequate?

- First they focus on db(A) measures, ie almost entirely on audible sound and that only in terms of aggregate sound. Yet much of the documented harm to individuals is from infrasound and low frequency sound that is essentially excluded by db(A) measures. So they ignore a large part of the relevant sound spectrum.
- Second, they are based on sound projection *outside* homes, not inside. Yet, as the department has acknowledged, it is the latter that matters most, particularly in terms of impact on sleep. There may be an assumption that sound will be less inside homes, yet how much less depends on the characteristics of each dwelling, which is not modelled. In fact, some frequencies are stronger inside than outside, because of resonance effects, peculiar to each dwelling, which cause amplification of some frequencies internally. Good sound insulation inside homes can make the problems worse, because the proportion of ILFN is increased inside an internally quiet home.
- The required measures and predictions concentrate on aggregate sound levels when there are often some frequencies accentuated within the overall sound emissions from wind turbines and individual frequencies can be particularly disturbing and some can be particularly harmful physiologically.
- Finally, the guidelines do not take into account the extremely quiet background noise environment in rural areas, so the maximum levels of allowable audible noise will be guaranteed to cause disturbance because the difference is so great between the background noise and additional noise from sources of environmental noise. This problem is accentuated further at night as levels of background noise fall, and wind turbine low frequency noise increases. The PAC specifically noted this problem of inappropriately elevated background noise levels in the Cullen Bullen decision with respect to coal mining noise. In addition, Professor Salt's work demonstrates that the physiological impact of infrasound on the inner ear can be accentuated where there is very quiet background audible noise.

Applying the guidelines depends on noise modelling, which is inherently deficient, as we can see from examination of the techniques used and from comparisons between forecasts and outcomes.

Noise is an inherent by-product of wind turbine electricity generation. Most of the noise that matters is not from the turbine inside the nacelle on top of the tower, which might be shielded in some way. The bulk of the noise, and particularly ILFN, is caused by the interaction of the blades moving through the air, physically impacting on the air as well as causing pulses as they pass the tower. There is no way to shield this sound generation, whose volume and characteristics at emission depend on things like wind speed, wind shear, and blade characteristics including the angle of attack, as well as the wind perturbations caused by other turbines in the field.

While it is possible to change noise levels during operation by altering the blade orientation and speed of rotation, for example to pass monitoring tests, you can't simultaneously maximise electricity generation and minimise noise from a turbine.

Typically noise modelling software such as Cadna A, used by MW in this case, is based on ISO 9613-2 which is designed fundamentally for noise emitters close to ground level, not 100 metres or more above ground level.

A set of very significant factors come into play when applying such tools:

- Typically they have parameters you can vary when running the “model” (so which set of parameters is the “right” one?). Changing those parameters leads to substantially different predictions. For instance predictions using Cadna A can differ by 10db(A) depending on which parameter assumptions available within Cadna A are used<sup>54</sup>. That could easily move predictions from being well within guidelines to well outside them. Indeed another comparison of a number of models for estimating the propagation of wind turbine noise found a differences ranging from 20dB at 500m to 30db at 5000m<sup>55</sup>
- The input data on noise output from each turbine, parameterised terrain details, assumptions about wind and other atmospheric characteristics, assumptions about where sound is produced by an individual wind turbine (they are not point sources), assumptions about interaction between turbines in the process of generating sound.

For all of the latter, modelling depends on simplifying abstractions. And simplifying abstractions, even if done with honest intentions, produce results different from reality.

The variations allowed in the modelling software together with the ability to adjust all the other input parameters in favourable ways allows enormous latitude to get the “right” results.

This combination of possibilities is why every sound model, and its forecasts, served up to a justify a wind farm is something of a fiction. It is a complex mathematical fiction with a lot of computer computation behind it. But GIGO always prevails.

That is an explanation why you would expect wind farm sound models to be unreliable. The ultimate test is what happens in reality. What do we find when *independent*<sup>56</sup> tests are done on operating wind farms?

Invariably we find that sound pollution occurs in excess of what the “modeling” claimed would be the case. In general, where “modeling” claimed each wind farm would comply with guidelines, independent monitoring shows they don’t. And this is despite the fact the guidelines are normally set far too leniently.

### **Noise Monitoring in Vicinity of the Waterloo Wind Farm**

A group from the University of Adelaide School of Mechanical Engineering conducted extensive monitoring of nighttime (midnight – 5am) noise in and around a number of dwellings in the vicinity of the Waterloo wind farm. The observations were conducted over about 2 months with 8 dwelling in various directions around the wind farm. Noise at each dwelling was monitored for about one week.

As well as providing a lot of finely detailed observations and conclusions, the authors reported:

---

<sup>54</sup> “Propagation Modelling Parameters for Wind Power Projects”, Kenneth Kaliski and Eddie Duncan, *Sound & Vibration*, December 2008, pp 12-15 (see Figure 5).

<sup>55</sup> Tickell, C.E., Ellis, J.T. and Bastasch, M., “Wind Turbine Generator Noise Prediction – Comparison of Computer Models”, *Proceedings of Acoustics*, 3-5 November 2004, pp 45-50.

<sup>56</sup> Note, studies done by or for government agencies involved in wind farm approval are not independent. Those agencies are complicit in the creation of health problems from wind farm noise and will normally attempt to conceal their culpability.

- “The most significant differences between shutdown [*of the wind farm*] and operational conditions can be observed when the residence is downwind from the nearest turbine and the hub height wind speed is greater than 8m/s.”
- “There is a good correlation between low frequency noise events [*that they measured*] and complaints registered in noise diaries [*by residents*]”.
- “The indoor limit for wind turbine hosts of 30dB(A) recommended by the SA EPA (2009) was exceeded on many occasions between 12 am and 5 am.”

Measured Noise Guideline Breaches: Waterloo Wind Farm, Apr-June 2013								
Observation Site	Closest Turbine kms	Obs Period Days	Down -wind %*	Avg HH Wind Sp m/s*	Observed breaches of Guidelines			
					SA EPA (2009)		Danish	UK
					Outdoor 40dB(A)	Indoor Host Limit	Indoor Low Freq	DEFRA Criteria
Township Site 1	3.5		50%	11	Y		Y	Y
Township Site 2	3.4	8	65%	9				
North Site	1.3	7	5%	11	Y			
West Site	2.5	11	65%	9	Y	Y	Y	Y
South East Site	2.4	7	75%	6				
East Site 1	7.6	8	75%	10	Y			
East Site 2	8.7	7	45%	9	NM	Y	Y	Y
South West Site	2.7	6	20%	9	Y	Y	Y	Y
Information extracted from detailed measurement reported in paper "Noise Monitoring in the Vicinity of the Waterloo Wind Farm", May 26, 2014 by Kristy Hansen, Branko Zajamsek and Colin Hansen. All observations were between midnight and 5am (p 3).								
<b>Downwind %:</b> % of observations downwind of turbines								
<b>Avg HH Wind Sp:</b> Average wind speed at hub height of turbines during time of observations								
* Estimates extracted from graphs in paper, accuracy likely $\pm 10\%$								
NM = Not measured (equipment problem)								

Some key results for each residence are summarised in the table above, which shows:

- **About half the residences had multiple breaches of various guidelines during the period for which they were monitored.** Not every observation was in breach but the number was substantial, which is important given it was night.
- The pattern of breaches by residence tends to reflect the study’s general observation about the importance of hub height wind speed and whether the residence is down wind. For residences showing few or no breaches in the table, either they were generally not down wind during monitoring or hub height wind speeds were relatively low
- **Breaches were observed at a residence almost 9kms from the nearest turbine,** while some closer ones did not register breaches at the time they were monitored. Thus **the absence of breaches at a residence near to a wind farm is no guarantee they won’t be occurring at one further away.**

It seems rather unlikely the noise modeling used to justify the Waterloo wind farm forecast these sorts of results.



## Waterloo Noise Modelling, NHMRC and Conflicts of Interest

In fact the preconstruction noise modeling at Waterloo Wind Development is publicly available, and was performed by SKM, and signed off by Dr Norm Broner.<sup>57</sup> Dr Broner is the sole acoustic expert on the NHMRC's Expert Panel overseeing the recent Systematic Literature Review, and the accompanying draft public statement which is currently being finalised. Dr Broner's acoustic consulting work at this wind development, and at other wind developments, was not publicly disclosed on the NHMRC website despite the NHMRC being made explicitly aware of the potential conflicts of interest when the composition of the panel was announced.<sup>58</sup>

This serious conflict of interest has not been properly "managed" by the NHMRC, despite the claims of senior NHMRC staff to the contrary, and has been mentioned in Federal Parliament by both Senator Chris Back, Liberal WA<sup>59</sup> and Senator John Madigan, Independent, Victoria.<sup>60</sup>

Professor Colin Hansen's peer review of the NHMRC documents illustrates the consequences of failing to ensure such conflicts of interest do not occur.<sup>61</sup> The result is fatally flawed and misleading documents, with obvious bias towards the continuation of the harm the wind industry are knowingly inflicting on a growing number of rural residents. Multiple critiques of those NHMRC documents are listed as attachments.<sup>62</sup>

Relying blindly on the findings of the 2014 NHMRC Systematic Literature Review would therefore be unwise, given the known serious conflicts of interest held by the sole acoustician on that committee. Professor Colin Hansen's team report has shown just how wrong Dr Broner's pre construction noise modeling at Waterloo Wind development was.<sup>63</sup> The experiences of the residents are captured in population impact surveys by Mr Wang<sup>64</sup> and Mrs Mary Morris, whose 2012 population noise impact survey was the only Australian research data included in the NHMRC's 2014 systematic literature review.<sup>65</sup>

Mrs Morris also wrote up the experiences of the residents at Waterloo when the turbines were off for a week in the format of a cross over study – the difference in sleep alone was significant and noted by those usually adversely impacted from wind turbine acoustic emissions.<sup>66</sup>

It is clear from the work by Wang and Morris over the last three years that noise related sleep disturbance and consequent sleep deprivation is widespread in the Waterloo Wind Development acoustic impact zone, and extends out to nearly 10km. Professor Hansen's team's report of their acoustic survey provides the independent acoustic evidence to support the validity of the data in the Waterloo community noise impact surveys.

---

<sup>57</sup> The preconstruction noise modelling signed by Dr Broner is available here, together with a comparison with post construction noise measurements performed by Marshall Day Acoustics <http://waubrafoundation.org.au/resources/morris-m-charts-comparing-pre-construction-modeling-vs-post-construction-noise-at-waterloo-wind-development/>

<sup>58</sup> <https://www.nhmrc.gov.au/your-health/wind-farms-and-human-health/wind-farms-and-human-health-reference-group>

<sup>59</sup> <http://waubrafoundation.org.au/resources/senator-chris-back-questions-evidence-from-vested-interests-at-planning-review-hearings/>

<sup>60</sup> <http://waubrafoundation.org.au/resources/nhmrc-ceo-prof-anderson-questioned-about-draft-review-by-senate/>

<sup>61</sup> <http://waubrafoundation.org.au/resources/hansen-c-expert-review-nhmrc-draft-information-paper/>

<sup>62</sup> also accessible here: <http://waubrafoundation.org.au/resources/responses-nhmrc-draft-information-paper-systematic-literature-review/>

<sup>63</sup> <http://waubrafoundation.org.au/resources/hansen-zajamsek-hansen-noise-monitoring-waterloo-wind-farm/>

<sup>64</sup> <http://waubrafoundation.org.au/resources/evaluation-wind-farm-noise-policies-south-australia/>

<sup>65</sup> <http://waubrafoundation.org.au/resources/waterloo-wind-farm-survey-2012/>

<sup>66</sup> <http://waubrafoundation.org.au/resources/morris-m-waterloo-case-series-preliminary-report/>

The Hansen report is in marked contrast to the discredited SA EPA Waterloo Acoustic survey, conducted at the same time <sup>67</sup> as Professor Hansen's team's acoustic survey, and about which the Waubra Foundation expressed strong public concerns to the South Australian Premier, and the Clean Energy Regulator. <sup>68</sup>

---

<sup>67</sup> <http://waubrafoundation.org.au/resources/waterloo-wind-farm-environmental-noise-study-sa-epa/>

<sup>68</sup> <http://waubrafoundation.org.au/resources/open-letter-premier-south-australia-clean-energy-regulator-concerning-sa-epa-acoustic-survey-2/>

## The Precautionary Principle and Its Application

The NSW Draft Wind Farm Guidelines, which the department appears to honour more in the breach than in their application, says “The guidelines adopt a precautionary approach for the consideration of health issues.”.<sup>69</sup> Nonetheless, the principle is endorsed by the department, and presumably the government.

Likewise the NHMRC has recommended the adoption of a precautionary approach in various documents and oral testimony on this issue.

The 2010 Public Statement by the NHMRC stated that:

*“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.*

*Therefore it is recommended that relevant authorities take a precautionary approach and continue to monitor research outcomes.”*

In March 2011, the CEO of the NHMRC Professor Warwick Anderson reiterated the NHMRC’s advice that a precautionary approach should be adopted. He stated in his oral evidence to the Senate Inquiry into the Social and Economic Effect of Rural Wind Farms:<sup>70</sup>

*“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.”*

A UNESCO Conference on the Precautionary principle has stated it thus:<sup>71</sup>

When human activities may lead to morally unacceptable harm that is scientifically plausible but uncertain, actions shall be taken to avoid or diminish that harm.

Morally unacceptable harm refers to harm to humans or the environment that is

- threatening to human life or health, or
- serious and effectively irreversible, or
- inequitable to present or future generations, or
- imposed without adequate consideration of the human rights of those affected.

Unless the PAC is *certain* there can be no harm to residents from the Gullen Range wind farm, then the department’s own commitment to a precautionary approach requires the PAC to institute conditions on the development that will ensure harm to residents is avoided.

<sup>69</sup> NSW Draft Planning Guidelines, Wind Farms, December 2011, p.7.

<sup>70</sup> <http://waubrafoundation.org.au/resources/social-and-economic-impact-rural-wind-farms-prof-warwick-anderson-nhmrc/>

<sup>71</sup> The Precautionary Principle, World Commission on the Ethics of Scientific Knowledge and Technology and United Nations Educational, Scientific and Cultural Organization, 2005, p. 14.

This submission has shown that harm to residents from wind farm noise is more than “scientifically plausible”. So unless the PAC rejects the department’s commitment to a precautionary approach, it must institute rigorous controls should it approve the operation of this wind farm.

## **Application and Implications for Gullen Range Evaluation**

### **PAC Review: Making Decisions Based on Unreliable Information**

The proponent has built a wind farm different to what was approved. This is not a variation. It is a different wind farm.

A wind farm is a collection of interacting sound emitters whose output is reflected, channelled and transformed by the terrain in a way that depends on the spatial placement of the wind turbines relative to one another and relative to the terrain. Thus the sound impact on individual dwellings kilometres away is dependent on that spatial positioning.

When you alter the location of individual turbines, relative to other turbines and relative to the terrain, you change the pattern of sound generation and sound propagation for kilometres. Thus the people affected are not simply those closest to a moved turbine. Anyone else in the broad acoustic impact zone may be adversely affected, as the Waterloo wind farm study has well illustrated.

Because the proponent has departed from the original proposal so profoundly, the department has no reliable knowledge of those sound pollution effects and their specific impact on individual residents. The PAC has no reliable knowledge of them. Therefore approving the proponent's application or the department's recommendations would be an inherently arbitrary action unrelated to merit.

### **Planning Department's Persistent Maladministration on Noise Impact**

The department's response to this fundamental problem is to claim it will be dealt with through an appropriate operational noise monitoring and control plan. Given the department's delinquency in monitoring and controlling construction of GRWF and the proponent's total and repeated disregard for local residents, their councils, the department and the Land & Environment court rulings, any suggestion the community can rely on an operational plan sanctioned and monitored by the DP&E would be absurd.

This is not an isolated instance of maladministration. The Planning function now in DP&E, in approving new developments, has consistently shown disregard for the welfare of residents exposed to noise and it has repeatedly failed to act to police noise conditions imposed on developments. For instance:

- The recent decision re Bulga coal mine extension against the Minister & Department of Planning, and the problematic recommendation of approval by the NSW Department of Planning of a gas fired power station despite it being within the acoustic impact zone of Wellington Township, the Wellington Correctional Centre as well as a home on the Heritage Register make it clear the department has a disposition to underestimate environmental noise from various industrial sources.<sup>72</sup>

This has become a matter of current concern to the NSW Government, including the Members of Parliament whose electorates host these proposed developments where known adverse health impacts of environmental noise are ignored by PAC members and bureaucrats within the Department of Planning with responsibility for noise pollution predictions.

- Then there is the failure of the NSW Department of Planning to act on noise complaints from existing wind developments in NSW, even after an audit demonstrated these problems at Cullerin, Capital and Woodlawn wind developments in 2012. The noise and sleep problems

<sup>72</sup> <http://waubrafoundation.org.au/resources/wellington-nsw-gas-fired-power-station-waubra-foundation-letter/>

reported to the NSW department of Planning audit remain for those residents, some two years later.

## Implications

The noise related recommendations from DP&E for this proposal, in particular 2.24A, are totally inadequate. As the Waterloo study has shown, noise condition breaches may occur at least 9kms from a turbine and quite possibly further. So offering the option to seek an independent noise review only to residents within 3kms is far too restrictive. In addition, as the Waterloo study also illustrates, because of changes in wind direction, speed and multiple other factors, a survey result over one period may be quite unrepresentative of the experience in later periods.

Given the track record of both the proponent and the department, the only protection for local residents will be permanent noise monitoring, particularly inside dwellings, conducted by genuinely independent parties, with strict, no-discretion sanctions for each breach of operating conditions, whose terms are set out in the recommendations. If placed in a reasonable number of residences around the wind farm and out to 10 kms, together with tough sanctions for any breach, that should provide protection for all residents.

Since the proponent claims there will be no adverse impact from their wind turbines, regardless of where they are sited, this requirement will impose no hardship on the proponent beyond the cost of providing the monitoring facility. Given the trauma and extra expense which the proponent has now imposed on local residents, as well as extra cost to the NSW taxpayer, to cope with its massive breach of development conditions, and its track record of disregard for everyone, it has brought that cost on itself.

## Recommendations

Since the proponent has built a different wind farm than the one approved, and everything indicates it has done this consciously not inadvertently, changing the noise emission and propagation in unknown ways, the PAC should:

1. Require removal of all wind turbines more than a minor distance (10 metres) from the approved location, including total remediation of all such locations.
2. Determine that by building a completely different wind farm than the one approved, the Part 3A transitional arrangement are not applicable to the wind farm now built and should the proponent wish to persist with the departures from the previously approved plan, a new application will be required for the whole project, to be evaluated under current wind farm guidelines.
3. Specify operating conditions for the wind farm (including all turbines and ancillary work) such that it:
  - a. is inaudible at all times within any noise sensitive place (residence, hostel, etc); and
  - b. does not create infrasound that exceeds a sound level of 50dB measured in the 8Hz one-third octave band within a noise sensitive place.<sup>73</sup>
4. Require the proponent to fund the permanent installation and operation, for at least 3 years, of full spectrum, sound monitoring inside and outside 12 dwellings around the wind farm, out to

---

<sup>73</sup> This level of 50 dB infrasound is consistent with the recommendations from the NASA / Kelley research in 1985 (see footnote ten of <http://waubrafoundation.org.au/2013/explicit-warning-notice/>, itself consistent with previous research by Hubbard relating to another noise source (military aircraft noise) <http://waubrafoundation.org.au/resources/hubbard-h-1982-noise-induced-house-vibrations-human-perception/> and consistent with Steven Cooper's field research in Australia at multiple wind developments (personal communication).

10 kms, with monitoring by independent acousticians,<sup>74</sup> with the process managed jointly by DP&E and a representative group of objecting residents. and with the whole wind farm to be shut for a week every time this measurement reveals a breach of the noise conditions determined by the PAC.

5. Recommend to the Minister that a judicial enquiry be held into:
  - a. the delinquency of the department in this case;
  - b. the extent to which delinquencies have occurred in relation to other wind farm proposals; and
  - c. the extent to which advice obtained by the department from other government agencies or advisors may have been compromised and corrupted to suit political agendas and the interests of developers.

These are strong recommendations. They are wholly warranted to protect local residents, especially given the combination of the multiple, intentional, breaches by the proponent combined with the persistent maladministration by the Department of Planning in relation not just to this development but to virtually all in which there are adverse noise impacts on neighbours.

The requirement to impose an automatic shutdown whenever a noise breach occurs is no different in principle to automatic fines for speeding imposed on motorists. If the PAC wants to be fully consistent with the government's approach to individual citizens, it could apply the equivalent of the points system, such that 3 or 4 breaches in a year would lead to a 12 month shutdown.

Detailed proposals for how the recommended noise management regime would be established, funded and operated are provided in Appendix A. This is not intended as a punitive arrangement. It is sincerely hoped that with the benefit of permanent, in-home, noise monitoring around the facility plus the motivation provided by quick penalties for breaches, the GRWF operator will quickly learn how to operate the facility without imposing adverse noise impacts on neighbours – which is no doubt the outcome desired by the NSW Government in all such cases.

The fact that providing the mechanism imposes some costs on the wind farm operator is entirely consistent with general government practice of requiring potential polluters to install equipment and operate in ways that eliminate their pollution, but at some cost to the potential polluter.

### **PAC Responsibility to Prevent Sleep Deprivation Torture of Residents**

As noted earlier, sleep deprivation is endemic around wind farms – and will be around the Gullen Range wind farm unless powerful operating constraints are applied, of the sort included in our recommendations.

The UN Convention Against Torture and Cruel, Inhuman or Degrading Treatment **makes it clear there is no justification for torture, ever, and specifies criminal charges for those public officials who allow torture to occur, or to continue.** The UN Committee against Torture explicitly recognises sleep deprivation as torture: <sup>75</sup>

---

<sup>74</sup> “independent” means they have no or a minimal financial conflict of interest with wind developers. Acousticians who regularly work for the wind developers are not considered independent by the community.

<sup>75</sup> <http://waubrafoundation.org.au/resources/un-convention-against-torture/>



***“The Committee against Torture (CAT) has noted that sleep deprivation used for prolonged periods constitutes a breach of the CAT, and is primarily used to break down the will of the detainee. Sleep deprivation can cause impaired memory and cognitive functioning, decreased short term memory, speech impairment, hallucinations, psychosis, lowered immunity, headaches, high blood pressure, cardiovascular disease, stress, anxiety and depression.”***

Given Australia is a signatory to the UN Convention Against Torture, the PAC officials deciding on this application in relation to the Gullen Range wind farm and its operating conditions are legally bound to ensure those conditions do not result in torture for local residents, through sleep deprivation.

Yours sincerely

Michael Crawford,  
Director, Waubra Foundation

Sarah Laurie,  
CEO, Waubra Foundation

## Attachments

“*Noise Monitoring in the Vicinity of Waterloo Wind Farm*”, 2014 by Emeritus Professor Colin Hansen, Mr Branko Zajamsek, Dr Kristy Hansen

<http://waubrafoundation.org.au/resources/hansen-zajamsek-hansen-noise-monitoring-waterloo-wind-farm/>

“*Expert Review of the NHMRC Draft Information Paper “Evidence on Wind Farms and Human Health”*” by Emeritus Professor Colin Hansen, University of Adelaide, 10<sup>th</sup> April, 2014

<http://waubrafoundation.org.au/resources/hansen-c-expert-review-nhmrc-draft-information-paper/>

“*Gross Defects in NHMRC Review into Wind Farms and Human Health*” by Dr Michael Crawford, April 2014 <http://waubrafoundation.org.au/resources/crawford-m-gross-defects-nhmrc-review-into-wind-farms-human-health/>

*Critique of the NHMRC commissioned 2014 Systematic Literature Review*; as an Open Letter to NHMRC staff Professor Warwick Anderson, and Professor John McCallum, and NHMRC Expert Panel Chair Professor Bruce Armstrong, April 2014 <http://waubrafoundation.org.au/resources/waubrafoundation-open-letter-nhmrc-re-systematic-literature-review/>

Letter from Professor Emeritus Alun Evans to the Australian Medical Association

<http://waubrafoundation.org.au/resources/evans-prof-emeritus-alun-dismiss-any-adverse-effects-absurd-view-mounting-evidence/>

Letter to Slovenia, which summarises much of the current evidence

<http://waubrafoundation.org.au/resources/letter-slovenia-re-known-adverse-health-impacts-wind-turbine-noise/>

Wind Turbine Noise – A Simple Statement of Facts, August 2014

<http://waubrafoundation.org.au/resources/definitive-document-wind-turbine-noise-simple-statement-facts-august-2014/>

### Population Noise Impact Surveys from Australian Wind Developments

The two population noise impact surveys conducted in NSW were at Cullerin.

<http://waubrafoundation.org.au/resources/schneider-p-cullerin-range-wind-farm-survey-follow-up-july-august-2013/>

<http://waubrafoundation.org.au/resources/cullerin-range-wind-farm-survey-august-2012/>

Population noise impact surveys and case series crossover study at Waterloo, South Australia

<http://waubrafoundation.org.au/resources/morris-m-waterloo-case-series-preliminary-report/>

<http://waubrafoundation.org.au/resources/waterloo-wind-farm-survey-2012/>

<http://waubrafoundation.org.au/resources/evaluation-wind-farm-noise-policies-south-australia/>

Population Noise Impact Survey, and Case Series with limited controls in Victoria

<http://waubrafoundation.org.au/resources/macarthur-wind-energy-facility-preliminary-survey/>

<http://waubrafoundation.org.au/resources/thorne-r-victorian-wind-farm-review-updated-june-2014/>



## Appendix A: Permanent Noise Monitoring Mechanism

### Context and Control

The Gullen Range Wind Farm in the Southern Tableland of New South Wales is in the final stages of project completion. The wind farm has been the subject of concern by residents as there are approximately 27 homes within 2 kilometres of the turbines and turbine locations are vastly different from what was approved.

Within 2 months of approval by the PAC, a non-profit corporate entity (“NoiseCo”) will be established with 25% of its shares held by the Department of Planning and Environment (DP&E)<sup>76</sup> and the remainder held by persons and entities that have lodged objections to the Gullen Range Wind Farm or to modification of the original proposal.

The purpose of NoiseCo will be to monitor sound emissions in and near dwellings around the Gullen Range Wind Farm, to identify breaches of noise conditions, to notify all such breaches to DP&E and to other relevant agencies such as the Clean Energy Regulator and to provide them with all relevant evidence.

NoiseCo will appoint a board, elected by its members, to oversee its activities.

### Funding

Gullen Range Wind Farm will be required to pay to NoiseCo:

- The capital cost of establishing permanent, full spectrum sound monitoring for 12 dwellings, for one internal room and external to the dwelling in each case. DP&E will determine appropriate market costs for acquiring and installing relevant equipment.
- An annual operational payment equivalent to the company’s annual payment for hosting rights<sup>77</sup>. For any wind turbines installed on property owned or leased by the company, a notional payment equal to the average of per-turbine hosted payments will be imputed. This operational payment will be paid quarterly to NoiseCo.

The operational payment will run for three years. However, the term over which operational payments are to be made will be extended by one year for each calendar year in which the wind farm has had three recorded breaches of noise conditions.

All payments will be made within one month of falling due and DP&E will ensure the wind farm is shut down during any period in which payments are delinquent.

All operational, maintenance and data analysis costs for the sound maintenance equipment and its use will be borne by NoiseCo, which will have the right to raise funds additional to those provided by Gullen Range Wind Farm.

---

<sup>76</sup> If there are reasons why DP&E should not hold shares in this non-profit corporate entity, the department may propose a clearly impartial, appropriate non-profit entity to hold the 25% share.

<sup>77</sup> With clarity about the wind farm’s hosting payments, this amount might be set at a lower level reliably sufficient to perform the function.

DP&E will review NoiseCo's financial position after one year of operation. If it is clear there is a substantial excess of revenue over expenses required to perform its function, future payments by the Gullen Range Wind Farm will be appropriately reduced.

In the event NoiseCo is wound up, any residual assets will be assigned to activities consistent with protecting communities from adverse noise.

### **Operation and Data Access**

DP&E will have the right of full access to all monitored data and analysis arranged by NoiseCo, subject to appropriate privacy protection for residents of dwellings in which monitoring occurs.

Gullen Range Wind Farm will have the right of full access to all monitored data, subject to appropriate privacy protection for residents of dwellings in which monitoring occurs. Any additional costs of providing this data to Gullen Range Wind Farm, eg for media, communication links, pre-processing, will be billed at cost to Gullen Range Wind Farm by NoiseCo.

NoiseCo will have the right to relocate measuring equipment either at existing monitored dwellings or to new sites. All costs of so doing will be borne by NoiseCo. However, the company will be required to ensure there is reasonable coverage in all directions around the wind farm.

### **Noise Conditions**

The noise conditions the wind farm is required to meet are that it:

1. is inaudible at all times within any noise sensitive place (residence, hostel, etc); and
2. does not create infrasound that exceeds a sound level of 50dB measured in the 8Hz one-third octave band within a noise sensitive place.

A compliance plan to determine the monitoring protocols will be developed as described in Annex A: Wind Farm Noise Compliance Plan. Illustrative instrumentation to measure and record the required sound levels is described in Annex B: Noise Monitoring Systems Specifications. Note, Annex B is, at this time, merely indicative of the system that might be employed and may need adjustment in the context of the Noise Compliance Plan.

Audibility is a personal matter and it is known that wind farm and other industrial noise can sensitise some individuals and lower the threshold of audibility for them. Within the first 12 months of operation, NoiseCo will commission a project to determine objective means of establishing individual audibility thresholds where they fall below normal audibility limits.

It will be a breach of the wind farm's noise audibility condition whenever wind farm originated sound in a monitored dwelling exceeds:

- normal audibility levels; OR
- objectively established audibility levels for any person normally residing at that dwelling.

### **Breaches**

For the first three months of wind farm operation and monitoring by NoiseCo, all breaches will involve only a warning from DP&E to Gullen Range Wind Farm, so the company can adjust its practices to ensure no breaches.

Thereafter, every time a breach of the noise conditions is notified to DP&E by NoiseCo, with sufficient corroborating evidence, DP&E will require the wind farm to be shut down for one week.

The shutdown must start within one week of notification. Any failure to comply within a week will extend the shutdown to two weeks.

## **Annex A to Appendix A: Wind Farm Noise Compliance Plan**

Prior to the commencement of the wind farm the Authorised NoiseCo Officer, in association with the wind farm facility operator, shall prepare and implement a Noise Compliance Plan to determine compliance with the following two Conditions that the wind farm is required to meet:

1. that it is inaudible at all times within any noise sensitive place (residence, hostel, etc); and
2. does not create infrasound that exceeds a sound level of 50dB measured in the 8Hz one-third octave band within a noise sensitive place.

The Noise Compliance Plan shall not contain any item that may in any way modify or negate the intent of these Conditions. The Noise Compliance Plan shall include, but not be limited to, the following:

1. A methodology or methodologies to implement Condition 1 and Condition 2;
2. An assessment of the contribution to the overall sound levels from individual wind turbine generators;
3. A methodology or methodologies to implement the assessment of audible characteristics as they occur within real-time and affect residents and to provide feedback to the wind farm which may allow action to avoid a breach;

Note: “real-time” means the time period as the sound under investigation occurs.



## **Annex B to Appendix A: Illustrative Noise Monitoring System Specifications**

### **Technical Capability of a System**

Standard, Customised and Turn-Key systems are available from manufacturers such as Bruel & Kjaer, Larson Davis, Norsonic. Generalised specifications for a monitoring system follow.

1. A customised noise monitoring system is designed, for example, to record L<sub>max</sub>, L<sub>peak</sub>, L<sub>eq</sub>, SEL, and statistical (e.g. L<sub>99</sub> to L<sub>1</sub>) noise level indices in broad band and 1/1 and 1/3 octave band data (6.3 Hz to 20kHz) in defined time intervals [nominal programmable times: 10ms, 50ms, 100ms, 1s, 10s, 30s; 1, 5, 10, 15, 60 minutes; 24-hr], L<sub>dn</sub>, L<sub>den</sub>.
2. Standard noise level indices recorded include A-weighting, C-weighting and Z-weighting frequency profiles.
3. Identification of noise sources is provided through sound-file recording and live real-time audio streaming a remote data connection.
4. The system is designed to record audio (.wav lossless format) either continuously, during defined programmable periods (preferred) or using a noise level trigger.
5. System health is checked via remote calibration of the complete system on a daily basis. The calibration data allows for either automatic adjustment of the system (within stated tolerances) or a warning system for immediate maintenance.
6. A GPS module establishes the measurement location and security – for example, to detect if the station moves without authority.
7. Sound levels are displayed in real-time via smart-phone or remote computer with live recording to a map or display.
8. The complete system is designed to meet the requirements detailed in IEC 61672.1-Edition 2, 2013 and DIN 45657-2005.
9. A least one weather station is installed with wind speed and direction, temperature, humidity and rain sensors. The station sensors' height is 10 metres above ground level. A second weather station sited near the primary station may be installed with the sensors at 1.8 metres above ground level.

### **Microphones**

1. A durable and robust free-field microphone and pre-amplifier designed for a Class 1 sound level meter as detailed in IEC 61672.1-Edition 2, 2013.
2. The selected microphone, pre-amplifier and shroud design is designed to minimise ongoing repair and maintenance costs, as much as practicably possible.
3. Remote calibration microphone adapter for regular system checking and calibration with long-term wind and rain protection shroud.

### **Communications Hardware**

1. Reliable remote connectivity using LAN, WLAN, Internet or GPRS is designed to view and download data.
2. If wireless connection using a public data network is not available then data transfer is by default to the Telstra network. Data transfer is the most significant issue and therefore video

and audio processing is carried out within the system computer in order to reduce bandwidth and upload demands.

3. All remote connectivity hardware and connection protocols are designed to be compliant with best practice industry standards as specified by relevant Australia and or International regulatory bodies. This includes a specification showing compliance for providing a secure wireless data network where designed.

### **Power**

1. Each noise monitor is designed to be provided with a continuous, reliable and proven battery and/or solar power solution. The solution is designed to be capable of powering all components (Sound Level Meter, Modem etc) at all times. Battery life is designed for continuous operation with all components operating.

### **Data Management, Interface and Reporting**

1. The operation, control and management of the noise monitoring system are designed to be centralised from a remote office location.
2. The system is designed to have the capability to view (over a remote connection from multiple noise monitor locations) noise level indices in real-time. This is achieved by using dedicated system software or a web-based user interface (preferred). Real-time noise level indices include, but not be limited to for example: LAF (1s), LAeq (1s), LA10,(time); LA90,(time); LAeq,(time); LAmx, LCmax; and summary report (time) where (time) is the measurement time period and at the end of day (24hr).
3. The system is designed to incorporate a solution for long term data storage (minimum of 12 months). Long term data storage requirements will be discussed with relevant parties.
4. Report templates are designed for clear description and presentation of information to readily and effectively assess the noise emission data and to highlight breaches of the noise conditions. Daily, weekly, and monthly report templates are prepared for ease of incorporation into reports. Raw data is also stored for spreadsheet (e.g. Excel™ 2013 format).
5. The system is designed to be able to integrate weather data (wind speed, wind direction, temperature, humidity, precipitation) to noise data and display same in a report to readily and effectively assess the data. The system is designed to support the ability to tailor reports to meet more specific requirements.

### **Installation**

1. The noise monitoring station is to be designed to be installed semi-permanently or permanently on-site. The system design includes the method for providing a fixed, secure and permanent installation. The complete system is designed for locations with different capability in terms of existing services (eg power, communications), physical environment and existing structures.
2. The instrument case is to be designed to be permanently located in an outdoor environment, exposed to the prevailing weather conditions across the whole year; for example, temperatures of -10°C in winter and 50°C in summer. All equipment is to be designed to perform accurately in these conditions as well as any other climatic conditions (such as wind, rain and humidity) that are typically experienced in a locale.

## Appendix B: Recommended Inter Turbine Separation Distances

Johns Hopkins University researchers have shown that fifteen rotor diameter distances are optimal for efficient generation of power from wind turbines. Adelaide University researchers have shown that tip vortices being generated by the blades start to break down at 7 rotor diameters. These two pieces of fundamental research support the inter turbine separation distances being at least 7 rotor diameters, in order to prevent excessive additional generation of ILFN from wake turbulence effects.<sup>78</sup>

It has long been accepted practice that 5 – 8 rotor diameter inter turbine separation distances should be used to minimise turbulence, and this was documented in the NSW Wind Energy Handbook 2002, written in collaboration with the wind industry and environmental groups and published by the NSW Sustainable Energy Development Authority. That document stated:<sup>79</sup>

*“A wind-farm layout must take into account that turbines have substantial ‘wakes’, which interfere with each other depending on wind direction and spacing. The general rule of thumb for spacing (the ‘5r-8r rule’) is five times rotor diameter abreast and eight times rotor diameter downwind”*

However in more recent times the wind industry have ignored these guidelines, and opted for much closer inter turbine separation distances. The results are predictably increased ILFN generation, and therefore more “annoyance” symptoms for the neighbours, such as have been reported at Cullerin wind developments in NSW,<sup>80</sup> and at Macarthur<sup>81</sup> and Waterloo Wind Developments in South Australia.<sup>82</sup> All three wind developments have reduced inter turbine separation distances, and the various population noise impact surveys reveal the extent of the noise related sleep disturbance/deprivation problems in the surrounding community. The 2013 Cullerin survey results in particular are worth noting:<sup>83</sup>

*“68.5% of residents who lived between 0-10km returned the survey with 83% of respondents being impacted by noise and/or vibration. The 83% impacted all have lodged complaints with various authorities and health care providers.*

*91% of those that responded out to 8km are impacted by noise and/or vibration which is impacting on their sleep and health and those very same residents have all made complaints. In the 20 households there are 50 residents with a total of 49 being impacted by sleep deprivation and other health impacts.”*

The Gullen Range inter turbine separation distances do not meet even the minimum of 5 rotor diameters specified by the NSW SEDA guidelines. There is no scientific evidence demonstrating it is not necessary to ensure adequate inter turbine separation distances, and increasing independent research supporting even more conservative inter turbine separation distances, to minimise ILFN generation and the consequent known adverse health effects for the neighbours.

<sup>78</sup> <http://waubrafoundation.org.au/resources/definitive-document-wind-turbine-noise-simple-statement-facts-august-2014/>

<sup>79</sup> <http://waubrafoundation.org.au/resources/nsw-wind-energy-handbook-2002/>

<sup>80</sup> <http://waubrafoundation.org.au/resources/schneider-p-cullerin-range-wind-farm-survey-follow-up-july-august-2013/>

and

<http://waubrafoundation.org.au/resources/cullerin-range-wind-farm-survey-august-2012/>

<sup>81</sup> <http://waubrafoundation.org.au/resources/macarthur-wind-energy-facility-preliminary-survey/>

<sup>82</sup> <http://waubrafoundation.org.au/resources/waterloo-wind-farm-survey-2012/>

and

<http://waubrafoundation.org.au/resources/evaluation-wind-farm-noise-policies-south-australia/>

<sup>83</sup> <http://waubrafoundation.org.au/resources/schneider-p-cullerin-range-wind-farm-survey-follow-up-july-august-2013/>