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The Acoustic Group
CONSULTING ACOUSTICAL & VIBRATION ENGINEERING



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Health Effects from Wind Turbine Low Frequency Noise & Infrasound Sound and Vibration, January 2017.

I am the author of the Cape Bridgewater study identified a number of times in the above article. The study is not listed as a reference to the document. The report and appendices are available at <http://waubrafoundation.org.au/resources/cooper-s-acoustic-group-results-cape-bridgewater-acoustic-investigation/>

The article makes a number of claims that are disputed and/or require clarification.

With respect to ‘Facts’ under Dr Schomer that are attributed to Dr Walker I specifically undertook measurements between the tower and the swept path of the blades at the base of Turbine 14 at Cape Bridgewater and did not find any blade pass frequency pulses at that location. On the contrary, measurements around that turbine found the two audible regions where the pulsation was evident are typically shown on camera measurements looking front onto the turbines for a hotspot at about two o'clock and then a secondary hotspot but of lower magnitude (and different frequency response) at about eight o'clock. At locations in line with those hot spots the blade pass frequency pulses were most pronounced.

At Cape Bridgewater I personally observed residents who could identify the operation of the turbines without seeing, or (to me) audibly detecting those turbines. These observations were attributed to the residents “sensing” the turbines.

The Cape Bridgewater study had the unique situation of being provided all the turbine data, and included specific full shutdowns tests of the entire wind farm on a number of occasions. For the full shutdowns it is correct that the subjects could have known when the turbines were not operating by looking at the turbines but they all noted a release of a pressure build-up that only became apparent when they entire wind farm was shutdown.

Under normal operations where the residents provided comments to me, as to detecting the operation of the turbines it was without seeing the turbines. For one resident in particular I could monitor the acoustic signature on my instruments and identify the times turbines were operating (and times where they were not operating) and the resident (from inside the dwelling) was correct every time.

As a result of Cape Bridgewater study I was invited to be part of the ASA wind turbine working group and have presented a number of papers over the last four meetings of that group on my research from the Cape Bridgewater study and further research in terms of some of the matters raised in the article.

In a presentation at Salt Lake City “Reproducing wind farm infrasound for subjective testing – Just how accurate is the reproduced signal?” (recently approved for publication in POMA) I raised the use of synthesised signals as presented by Walker. I have compared the synthesised signal versus the original way file signals to find that the use of the synthesised signal did not reproduce the original signal.

I have experienced the electroacoustic system identified in Figure 10 of the article and did not find that it accorded with my experience inside homes in proximity to various wind farms.

A concern in using synthesised infrasound signals is use of a synthesised signal versus the actual signal, as raised in part D1 of Annex D of ANSI/ASA S 12.9 – 2016/Part 7. One cannot recreate from LAeq FFTs 'tones' from a 10 minute way file, the original time signal without all the phase information of the "tones".

It would appear that in investigating the impact of turbine noise one should utilise actual wind turbine signals for determining impacts on people. This procedure in itself presents difficulties in reproducing the signal in a test laboratory whereas acoustic investigations in the field are the appropriate method, as proposed in the article.

Under "Opinions and Recommendations of Geoff Leventhall" the article refers to Nocebo effect and Tonin Brett assessing wind turbine infrasound. If actual wind turbine infrasound is NOT used, and either single tones (Crichton) or synthesised infrasound (Tonin) is used for testing purposes, it is incorrect to claim that such sources are wind turbine infrasound. Therefore, the conclusions being attributed to wind turbine infrasound are incorrect when the source is synthesised infrasound and restricted to just the infrasound region, or just one infrasound tone.

Leventhall also refers to "infrasound exposure levels" of other man-made sources in urban and industrial areas and also levels that occur naturally in coastal and other regions are similar to infrasound levels from wind farms. Such an opinion relies upon an unqualified position of the analysis used. Use of dBA, dBC, dBG or 1/3 octaves as the basis of such comparisons will reach that conclusion. However, when the analysis is conducted in narrow bands and restricted to the infrasound region the claim is incorrect. In Chapter 9 of the Cape Bridgewater Study I specifically addressed that very incorrect claim.

A person exposed to the ongoing thumping of the bass from a nightclub will experience a different response to a person exposed to free flowing traffic that has the same dBA or octave band levels. The spectra and the repetitive nature of the bass beat do not show up in Leq results.

In relation to the use of synthesised infrasound as proposed by Walker, we have specifically listened to the original signal and the synthesised signal (in both the real frequency scale and also scaling the time signal to 50 and 100 times in speed). The signals when sped up sounded different.

In my series of papers to the last 4 ASA meetings, I have questioned whether there is actually an infrasound signal in the normal concept of tones. I have shown that there is an amplitude modulation at the blade pass frequency that occurs across the entire spectrum. As presented in the ASA meeting in December 2016 even with filtering of the wind turbine signals so that there was no audible component produced by the amplifier/speakers below 50 Hz, the FFT analysis of the signal generated in the laboratory still produced peaks in the infrasound region (whether free running or triggered analysis).

As a result of the amplitude modulation across the entire spectrum I have been able to identify the presence of modulated tones in the region of 30 to 50 Hz and the presence of the mid band swish (500 Hz to 1600 hertz) occurring in the signature at or above the threshold levels of hearing.

We have compared the on-off testing results from Cape Bridgewater using band limited signals and for the measurements inside dwellings can detect a broad band low frequency rumble in the signature (when the turbines are operating).

The fundamental question we were presented was that if infrasound recorded in proximity to wind turbines are below the threshold of hearing then what is the mechanism that gives rise to sensation and/or disturbance to residents?

I have raised the possibility of the differential pressure differences to either ears (or the dynamically pulsed amplitude modulation to the body) that are occurring at an infrasound rate being an area to investigate.

As identified in the Cape Bridgewater report I was unable to extract the dB(A) contribution of wind turbine operations during normal operations and specifically between the on off tests.



To date I have been unable to find anybody that can determine the actual dB(A) contribution of a wind turbine at residential receivers and note that in the main the wind turbine noise levels have been nominated as limits that are a calculated contribution (not measured) without taking account any subjective or special characteristics to the audible signal.

Whilst I am unable to agree with the use of dB(A) for wind turbines with respect to impacts observed at residential properties the important matter in terms of the penultimate sentence in the article is to determine an acceptable noise level for wind turbines.

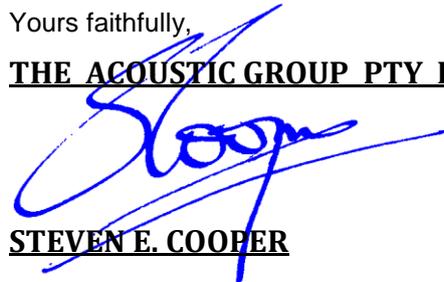
As presented in the ASA meeting in Hawaii, the most common complaint that I receive from residents in proximity to wind farm developments is that of sleep disturbance. With the benefit of narrowband analysis to identify the operation of the wind turbines in the infrasound region, then an appropriate mechanism to move forward in addressing the issue of sleep disturbance and or health impacts as result of wind turbines is to ascertain noise levels that will create an adverse impact and noise levels that will not create an adverse impact. Whether the parameter is dBA or dBC, dBG or dB (WTS) is irrelevant.

In light of the above I suggest additional lines of investigation should be added to the article to answer the following:

- In acoustics we have dose-response curves for various noise sources upon which criteria have been developed related to a level at which 10% of the population are highly affected/annoyed.
- The use of sleep or dose-response studies related to road/rail and air traffic cannot be used for wind turbines.
- Studies of wind farm noise are required to identify the dose response curve (in any relevant acoustic index).
- Studies of wind farm noise are required to identify the noise level (in any relevant acoustic index) that gives rise to sleep disturbance and the noise level that will not give rise to sleep disturbance.

Yours faithfully,

THE ACOUSTIC GROUP PTY LTD



STEVEN E. COOPER

