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Federal AAT Findings and Regulatory Implications for Wind Farms

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Early in December 2017, the Federal Administrative Appeals Tribunal made multiple findings in a case[1], where the findings have major implications for the assessment of wind farm impact on communities. The relevant findings were predominantly in relation to health impacts, wind farm noise and its assessment. However, there are also references to the visual impact of wind farms and its potential for health impacts.

The case was heard by a Tribunal with a senior Federal Court Justice, White J, presiding as President of the Tribunal. I have attached a copy of the decision, in case you have yet to receive one.

I trust that in providing its assessment of the proposed Jupiter wind farm to the PAC, the Department will be drawing the PAC's attention to the findings of the Tribunal and the implications those findings have for assessment of the Jupiter wind farm proposal and others.

The findings also have implications for the Department's wind farm noise guidelines and possibly for its visual impact guidelines and its statements on health impacts of wind farms.

Noise

The Tribunal[2] found that:

- It is established that some wind farms create noise *annoyance* for members of the community and that there is a well established pathway from *annoyance* to adverse health effects.
- A significant proportion of wind farm noise is in the low frequency range.
- Humans are more sensitive to low frequency sound, and it can therefore cause greater annoyance than higher frequency sound.
- Even if it is not audible, low frequency noise and infrasound may have other effects on the human body, which are not mediated by hearing but also not fully understood.
- Noise measurement using dB(A) is an inadequate measure of relevant wind farm noise and wind farm noise measurement should not average noise over time and frequencies.
- Wind farm low frequency noise can be greater indoors than outdoors at a dwelling.
- There is as yet no "dose-response" curve which applies to wind farm noise which can be used by policy makers to set appropriate limits on wind farm sound emissions. Consequently, limits have been set by reference to the levels which have been found to be applicable in the context of different kinds of noise, such as road traffic noise despite it being known that "dose-response" characteristics vary by noise source and that wind farm noise has significant differences from other noise sources.

[1] *Waubra Foundation v Commissioner of Australian Charities and Not-for-profits Commission* [2017] AAT.
[2] *Ibid*.

These findings fundamentally invalidate the NSW wind farm noise guidelines and the standards and processes which the Department of Planning & Environment (DPE) has used to assess wind farm noise and approve wind farms, as well as the processes the NSW EPA uses to assess wind farm noise compliance.

The findings identify a specific pathway to adverse health effects, via noise annoyance and that annoyance occurs in relation to many wind farms both in Australia and overseas.

It does not follow that *annoyance* will occur in relation to every wind farm. However, the onus is on regulatory agencies to ensure that, for each wind farm, material harm from noise (and other factors) will not occur. The NSW wind farm noise guidelines inherently accept that responsibility. The Tribunal's findings indicate the NSW guidelines are defective and not fit for purpose.

The NSW wind farm noise guidelines have multiple important elements which the Tribunal findings invalidate:

- Sound measurement and standards are stated in terms of dB(A);
- Sound measurement is an average value over some period (10 minutes);
- Sound measurement is done external to dwellings;
- For wind farm assessment, sound values are calculated;
- For most properties, wind farm compliance noise results are calculated rather than actually measured;
- "Acceptable" levels have been set based not on dose-response data for wind farms but on dose-response data for quite different noise sources (e.g. traffic noise).

From the Tribunal's findings, each and every one of those is a source of invalidity. Collectively they render the NSW wind farm noise guidelines wholly invalid.

Wind Farm Noise and Adverse Health Effects

The Tribunal was repeatedly explicit that it recognised humans are frequently subject to an identifiable experience ("*annoyance*") attributable to wind farm noise **and** that *annoyance* is an established pathway to significant adverse health outcomes. The Tribunal stated:

> "As our earlier findings have indicated, some wind farms generate sound which is capable of causing, and does cause, annoyance. We are further satisfied that annoyance of the kind which is generated (often associated with psychological distress and sleep disturbance), is a recognised pathway to a range of adverse health outcomes, including hypertension and cardiovascular disease."[3]
>
> "We accept that the evidence points to an association and a plausible pathway between WTN [wind turbine noise] and adverse health effects (of a physical nature), mediated by annoyance, sleep disturbance and/or psychological distress."[4]

and the experience of annoyance from WTN is widespread:

> "There are numerous examples of WTN giving rise to complaints of annoyance from nearby residents, both in Australia and overseas."[5]

[3] *Ibid*, [476]
[4] *Ibid*, [500]

Thus the Tribunal leaves no doubt that there are reasonable grounds for apprehension about an adverse effect of wind farm noise on health from each wind farm. The question in each instance is the extent of noise actually experienced by each resident and the adequacy of wind farm noise forecasting, measurement and control by regulatory authorities.

Wind Farm Noise: Character and Measurement

Based on the testimony of multiple expert witnesses, and published studies, the Tribunal made a number of important findings about the character and measurement of WTN. These findings have significant implications for wind farm noise standards and the appropriate measurement of wind farm noise. In particular, the Tribunal found[6]

- "A significant proportion of the sound emitted by wind turbines is in the lower frequency range, i.e. below 20 Hz;
- The dB(A) weighting system is not designed to measure that sound, and is not an appropriate way of measuring it;
- The most accurate way of determining the level and type of sound present at a particular location is to measure the sound at that location;
- The best way of accurately measuring WTN at a particular location is through 'raw' unweighted measurements which are not averaged across time and are then subjected to detailed "narrow-band" analysis;
- When it is present, due to its particular characteristics, low frequency noise and infrasound can be greater indoors than outdoors at the same location, and can cause a building to vibrate, resulting in resonance;
- Humans are more sensitive to low frequency sound, and it can therefore cause greater annoyance than higher frequency sound;
- Even if it is not audible, low frequency noise and infrasound may have other effects on the human body, which are not mediated by hearing but also not fully understood. Those effects may include motion-sickness-like symptoms, vertigo, and tinnitus-like symptoms. However, the material before us does not include any study which has explored a possible connection between such symptoms and wind turbine emissions in a particular population."

The Tribunal further commented:

> "A major limitation is that the conclusions of the [Health Canada] study were based on calculated, rather than actual, noise measurements (although some of the calculated noise levels were based on measurements). However, as we understand the evidence, the sound generated by wind turbines is so variable that actual measurements are to be preferred. We accept that measurements based on estimates or averages may not accurately reflect the sound which was present when the particular level of annoyance was experienced or recorded."[7]
>
> "Another significant drawback of the Health Canada study, as we understand it, is that the WTN was measured in dB(A) and dB(C). All of the evidence before us is to the effect that WTN cannot be accurately captured in dB(A), or even dB(C) (although

[5] *Ibid*, [468]
[6] *Ibid*, [469]
[7] *Ibid*, [478]

dB(C) is preferable). The preponderance of the acoustic evidence is also to the effect that by far the best way of capturing the sound produced by wind farms is to take unweighted measurements, and then subject them to detailed analysis, including narrow band analysis, to determine the components of the sound which is present."[8]

So the Tribunal concluded that:

dB(A) is an inappropriate measure

- Sound measurement and standards stated in terms of dB(A) values are inappropriate for WTN because a significant part of WTN is low frequency, which dB(A) drastically underweights, and low frequency noise is particularly significant because[9]:

> "Humans are more sensitive to low frequency sound, and it can therefore cause greater annoyance than higher frequency sound"
>
> "Even if it is not audible, low frequency noise and infrasound may have other effects on the human body, which are not mediated by hearing"
>
> "When it is present, due to its particular characteristics, low frequency noise and infrasound can be greater indoors than outdoors at the same location, and can cause a building to vibrate, resulting in resonance"

and

> "The best way of accurately measuring WTN at a particular location is through 'raw' unweighted measurements which are not averaged across time and are then subjected to detailed "narrow-band" analysis"

Measurements should not be averaged over some period

- The Tribunal stated:

> "We accept that measurements based on estimates or averages may not accurately reflect the sound which was present when the particular level of annoyance was experienced or recorded."[10]

and

> "The best way of accurately measuring WTN at a particular location is through 'raw' unweighted measurements which are not averaged across time and are then subjected to detailed "narrow-band" analysis"[11]

For low frequencies, outdoor measurements may underestimate indoor noise

- The Tribunal noted:

> "When it is present, due to its particular characteristics, low frequency noise and infrasound can be greater indoors than outdoors at the same location, and can cause a building to vibrate, resulting in resonance"[12]

[8] *Ibid*, [479]
[9] *Ibid*, [469]
[10] *Ibid*, [478]
[11] *Ibid*, [469]
[12] *Ibid*, [469]

Inaccuracy in computed sound levels

- In developing wind farm proposals, noise levels at all residences are computed based on a range of assumptions and then, during compliance testing, noise levels at most residences are computed from measurement at a small number of locations. [Note. These are normally dB(A) values, in terms of 10 minute blocs, i.e. with the associated validity problems previously noted.] Pertinent to that, the Tribunal stated:

> "The most accurate way of determining the level and type of sound present at a particular location is to measure the sound at that location"[13]
>
> "A major limitation is that the conclusions of the [Health Canada] study were based on calculated, rather than actual, noise measurements (although some of the calculated noise levels were based on measurements). However, as we understand the evidence, the sound generated by wind turbines is so variable that actual measurements are to be preferred."[14]

In its summary of the scientific evidence, the Tribunal noted a number of factors that would underlie the inaccuracy of computed noise levels[15]:

> "WTN is complex, highly variable and has unique characteristics;"
>
> "The amount and type of sound emitted by a wind farm at a given time and in a given location is influenced by many variables including topography, temperature, wind speed, the type of wind turbines, the extent to which they are maintained, the number of turbines, and their mode of operation;"

It is patently obvious that no computer model can accurately account for all of those variables and their combinations as will occur over days, weeks and years, and thus the exposure which individuals will experience, since none can forecast local weather on a day by day, hour by hour, basis for years.

Unsubstantiated limits set for wind farm noise

- The Tribunal stated[16]:

> Given the absence of detailed studies, we accept the evidence of many of the experts that there is as yet no "dose-response" curve which applies to wind turbine sound which can be used by policy makers to set appropriate limits on wind farm sound emissions. Consequently, limits are set by reference to the levels which have been found to be applicable in the context of different kinds of noise, such as road traffic noise. In many cases, the limits are set by reference to dB(A). We note again the consensus that wind farm sound emissions cannot be accurately captured in dB(A).

In relation to that point, the Tribunal quoted the evidence of one of the experts, Mr Cooper[17]:

> "So we can have a dose-response curve for aircraft that sets a noise level that will protect 90 per cent of the people 90 per cent of the time. We have a dose-response curve for road traffic, which is a different number to aircraft, still to protect 90 per cent of the people 90 per cent of the time. We have a similar curve for rail traffic, again a different number, and so you have different dose-

[13] *Ibid*, [469]
[14] *Ibid*, [478]
[15] *Ibid*, [468]
[16] *Ibid*, [480]
[17] *Ibid*, [451]

response curves. Work done by Moller in Germany in relation to two surveys that were done in Sweden showed that the dose-response curve for wind farms occurs at a much lower level. So if you use a dose-response curve for general community or road traffic noise, it's not the same as using it – you can't use that dose-response curve for wind farms until such time as you develop a proper dose-response curve."

Summary re Noise

In its findings, the Tribunal was explicit that wind farm noise can cause annoyance to humans and does so in many cases. It also found that there is an established pathway from annoyance to significant adverse health outcomes. Consequently the proper evaluation of prospective and actual wind farm noise by regulatory authorities is critical.

The Tribunal identified multiple aspects of wind farm noise and its determination which invalidate the whole structure and approach of the NSW Planning Department and the NSW EPA in assessing noise from proposed and operating wind farms.

Visual Impact, Annoyance and Adverse Health Impact

The AAT decision includes a number of references to annoyance being caused or exacerbated by the visual impact of wind farms (including general visual appearance, shadow flicker and blinking lights). In that regard the Tribunal's report cited a literature review by Danish researchers[18], the Health Canada study[19], and the evidence of expert witnesses Professor Wittert[20] and Dr McBride[21].

On this matter, Professor Wittert, giving evidence on behalf of the Australian Charities and Not-for-profits Commission, stated[22]:

- "The respondents' attitude to the visual impact of wind turbines on the landscape scenery has been found to influence noise annoyance in a number of studies."
- "In peer reviewed studies, wind turbine annoyance has been statistically associated with wind turbine noise, but found to be more strongly related to visual impact, attitude to wind turbines and sensitivity to noise."
- "That aside, annoyance appears to be more strongly related to visual cues and attitude than to noise itself."

With the benefit of all the evidence, the Tribunal concluded[23]:

> "We have not overlooked the evidence to the effect that, while annoyance is produced by wind farms, it may have no association with wind turbine sound emissions and instead be related to other things, such as loss of amenity, the appearance of the turbines and consequent change to the landscape, blinking lights, or other factors. Whether that is so is yet to be established, one way or the other."

[18] *Ibid*, [268]
[19] *Ibid*, [273]
[20] *Ibid*, [363]
[21] *Ibid*, [374]
[22] *Ibid*, [363]
[23] *Ibid*, [483]

Thus the Tribunal accepted the possibility that visual impact, in its various forms, may be a contributor to *annoyance* and thus, via the *annoyance* pathway, to adverse health impacts.

DPE, in its guidelines for the assessment of visual impact and in its visual impact assessments of wind farms, does not appear to have contemplated that this form of impact is also a potential mechanism leading to adverse health outcomes.

The evidence adduced and discussed by the Tribunal, and the comments by the Tribunal, indicate this is at least a reasonable possibility.

While there is a scientific interest in the mechanisms by which wind farms lead to *annoyance*, and there may be a regulatory one in terms of control, from the point of view of members of affected communities, the precise mechanism by which wind farms cause *annoyance* and potential harm to their health is moot. What matters to them is the outcome.

In his evidence to the Tribunal, Professor Wittert stated[24]:

> "Epidemiological studies have shown associations between living near wind turbines and annoyance"

For those impacted, that statement is really the bottom line, together with the consequences of the *annoyance* on their health.

It is also the responsibility of consent authorities to consider the overall magnitude of impact on people in determining wind farm applications, not precisely how much comes from noise, or visual impact or some other mechanism discretely.

That said, the Department and PAC are clearly aware that many people in affected communities find the sight of wind farms and the impact on their views and environment disturbing. That is the reason there is a DPE guideline for visual impact assessment.

Since the Tribunal accepted that *annoyance* provides a pathway to adverse health outcomes, it is certainly plausible that the visual impact of wind farms contributes to that *annoyance*, as indicated by the various sources mentioned by the Tribunal, and thereby to adverse health outcomes.

In formulating its wind farm noise guidelines, the Department has assumed that people will not be disturbed (and thus annoyed) with sound levels below a certain dB(A). Leaving aside all the additional aspects of wind farm noise identified by the Tribunal, it is plausible that if a source (wind farm or anything else) was producing noise at a level that, on its own, would engender a marginal level of annoyance, the level of annoyance actually experienced might be much larger if a person was also subject to other unwanted emissions (e.g. noxious odours, vibration, visual pollution) from the same source. That would provide one possible reason why wind farm noise levels which the Department believes ought to be acceptable are nonetheless associated with material levels of *annoyance* for members of an affected community.

Given the observations of the Tribunal, together with its findings in relation to *annoyance* and adverse health effects, consent authorities now need to consider whether there are reasonable grounds for considering that visual impact may either independently, or in conjunction with wind farm noise and other aspects of wind farms, compound the *annoyance* experienced by

[24] *Ibid*, [363]

residents and lead to the adverse health outcomes to which the Tribunal found *annoyance* to be a pathway.

If there is a compounding effect in the creation and level of *annoyance*, as is suggested by some of the evidence recorded by the Tribunal, then it is certainly wholly inappropriate to consider each factor that might engender *annoyance* for a resident, decide that the *annoyance* due to each factor on its own is below some assumed critical threshold and then proceed to ignore the effect from each factor both individually and collectively.

Conclusion

The Tribunal stated very explicitly:

> "some wind farms generate sound which is capable of causing, and does cause, annoyance. We are further satisfied that annoyance of the kind which is generated (often associated with psychological distress and sleep disturbance), is a recognised pathway to a range of adverse health outcomes, including hypertension and cardiovascular disease."[25]
>
> "We accept that the evidence points to an association and a plausible pathway between WTN and adverse health effects (of a physical nature), mediated by annoyance, sleep disturbance and/or psychological distress."[26]

It also identified multiple factors associated with wind farm noise and its measurement which invalidate DPE's wind farm guidelines in terms of both methodology and standards.

The Tribunal also discussed evidence and grounds for accepting that the visual impact of wind farms may contribute to *annoyance* experienced by residents and thus to adverse health outcomes.

The Tribunal's findings are a new, authoritative statement by a legal body, led by a senior Federal Court Justice, which has very carefully considered a wide range of evidence from multiple sources.

There is a reasonable presumption that the range of evidence considered, the rigour of process and the judicial expertise in weighing evidence exceeds that which DPE and the PAC have been able to bring to previous wind farm assessments, to the prospective Jupiter wind farm assessment, or the preparation of wind farm guidelines.

It is therefore incumbent on the Department and PAC to take full and careful account of the findings published by the Tribunal.

Yours sincerely

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[25] *Ibid*, [476]
[26] *Ibid*, [500]