

# Overwhelming Grounds for Rejecting Requested Modification 2 for Proposed Capital II Wind Farm

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**Dr Michael Crawford**

**October 21, 2014**

The request to modify the Capital II wind farm by increasing rotor blade length should be rejected on at least three grounds: noise impact; visual impact; and impact on avifauna. The proposal is misleading and/or totally inadequate in its advice about the effect of the proposal on each of those aspects.

The request to modify the Capital II wind farm by increasing rotor blade length should be rejected on at least three grounds:

- Noise Impact
- Visual impact
- Vacuous advice about the impact on avifauna

In addition, it appears some of the statements in the request for modification are either false or misleading. The department needs to examine them closely on that point and, consistent with the Planning Minister's recent public statements, hold to account anyone who, as part of the proposal, has made statements that the person knows (or ought reasonably to know) are false or misleading in a material way.

## Noise

In its application to extend blade length, Infigen includes the claim

"Approval of this modification will have no impact on the Proponents ability to comply with the noise related conditions of consent."<sup>1</sup>

This assertion is based on one statement inconsistent with the facts and on one very important omission. It is contradicted by research evidence that clearly demonstrates a positive correlation between rotor diameter and noise levels, and it ignores the impact of the proposal on the ratio of interturbine separation distance to rotor diameter and the consequences for sound generation from a wind farm.

Infigen's submission includes the statement that Sonus

"provided analysis which includes examples that clearly show there is no direct correlation between increased blade length and increased noise levels."<sup>2</sup>

This is rather like the statement made by Mr Griffin in a letter to Mr Neville Osborne in relation to Infigen's earlier request to increase the approved capacity of wind turbines from 3MW to 3.5MW:

"there is no relationship between WTG generating capacity and noise"<sup>3</sup>

Mr Griffin then went on to provide 3 examples which he purported demonstrated the non existence of such a relationship. The department approved the requested modification and quoted Mr Griffin's fallacious examples to demonstrate there would be no adverse noise impact<sup>4</sup>.

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<sup>1</sup> Letter to Ms Anna Timbrell, Department of Planning and Environment re Application MP 10\_0135 Capital II Wind Farm – Modification 2 (Blade Length), dated 23<sup>rd</sup> September 2014 and signed David Griffin, GM Development.

<sup>2</sup> Op cit, p. 2.

<sup>3</sup> Letter to Mr Neville Osborne, NSW Department of Planning, dated 24<sup>th</sup> June 2013, and signed David Griffin, GM Development.

<sup>4</sup> Departmental approval for *Capital II Wind Farm – Modification 1*, signed 4/7/13 by Karen Jones, A/Director, Infrastructure Projects, Department of Planning & Infrastructure.

**WTG Nominal Power and Noise Relationships**

In fact there was already plenty of objective evidence of a positive relationship between wind turbine generator (WTG) capacity and noise levels, and also WTG rotor diameter and noise levels. That evidence shows the more powerful the WTG, the more noise it tends to emit; and the larger the WTG rotor diameter, the more noise it tends to emit. In addition, the more powerful the WTG, the greater the proportion of its noise is in the infrasound and low frequency sound ranges.

In 2011, Moller and Pedersen published a paper based on measurement of multiple turbines which showed

“both  $L_{WA}$  and  $L_{WALF}$  increase with increasing turbine size”<sup>5, 6</sup>

and that

“the apparent sound power increases more than proportionally to the nominal electric power. Thus, to the extent that turbines follow the trend of the regression line, a turbine of double size emits more than double the sound power.”<sup>7</sup>

They showed that with the following regression chart, which plots sound power level against nominal electric power, showing the two to generally increase together.

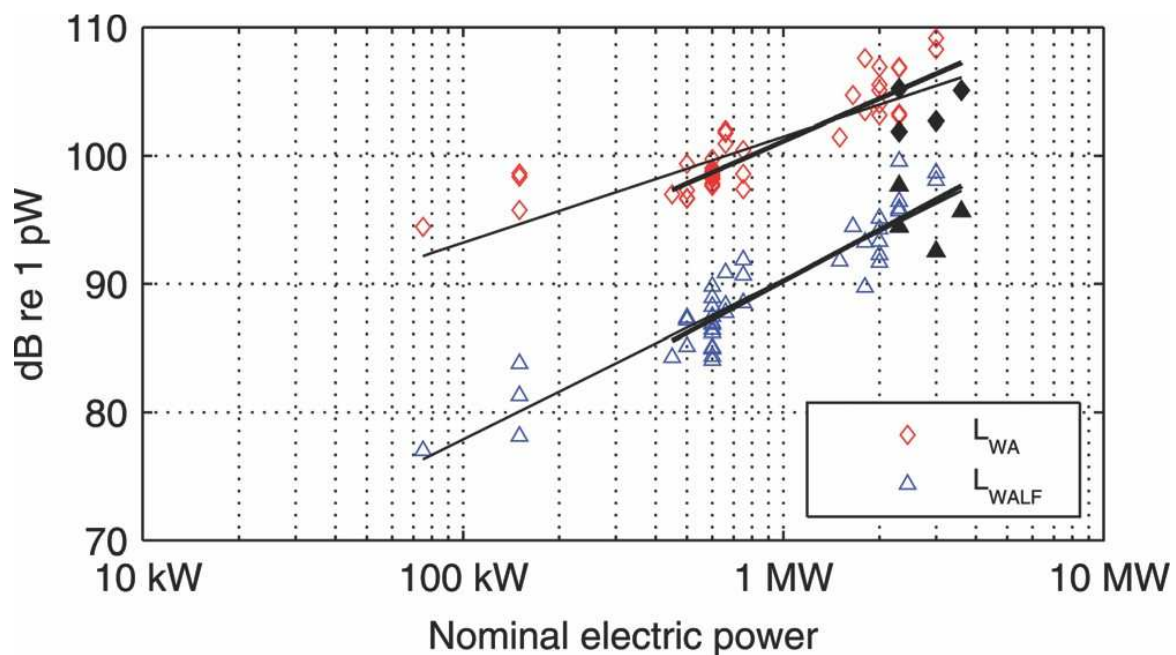


FIG. 1. (Color online) Apparent sound power levels ( $L_{WA}$  and  $L_{WALF}$ ) in the reference direction as a function of turbine size. Wind speed is 8 m/s. Regression lines: all turbines included (thin lines), four turbines below 450 kW excluded (bold lines). Black-filled marks are for turbines 1–4.

In addition, they were able to conclude from the data that:

<sup>5</sup> Henrik Moller and Christian Sejer Pedersen, “Low-frequency noise from large wind turbines”, *J. Acoust. Soc. Am.* 129 (6), June 2011, p. 3732.

<sup>6</sup> The sound measures  $L_{WA}$  and  $L_{WALF}$  were defined by Moller and Pedersen (p. 3730) as “Apparent sound power level was determined for one-third-octave bands and as total A-weighted level,  $L_{WA}$ . In addition, a special low-frequency measure,  $L_{WALF}$ , the apparent A-weighted sound power level for the one-third-octave bands 10–160 Hz was derived.”

<sup>7</sup> Op cit, p. 3737.

“It is also noted that  $L_{WALF}$  increases more steeply than  $L_{WA}$ , meaning that the relative amount of low frequency noise increases with increasing turbine size.”<sup>8</sup>

and it is well established that low frequency noise propagates further than higher frequencies thereby affecting a larger group of residents. So aside from the simple db increase in noise emission likely to occur due to increasing the nominal generation power requested in modification 1, that change is likely to cause wider propagation and impact due to the greater low frequency proportion in the emitted spectrum. Infigen failed to mention this in their application.

So far as the power-noise relationship is concerned, Delta, a manufacturer of wind turbines, even admits on their website:

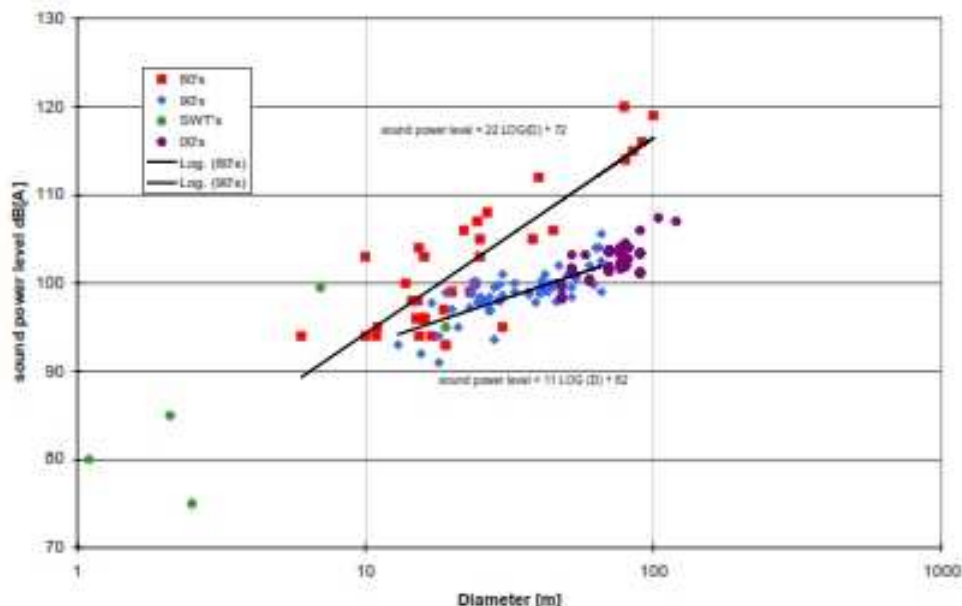
“The emitted sound power from the wind turbines increases with the nominal power of the turbines”<sup>9</sup>

### ***WTG Rotor Diameter and Noise Relationships***

Contrary to the most recent claims by Mr Griffin, the positive correlation between rotor diameter and noise levels is well established and has been for some years.

In a paper first published in 2002 and updated in 2006, Rogers, et al reported

“The data illustrate that sound emissions from wind turbines generally increases with turbine size”<sup>10</sup>



Source: Anthony L. Rogers, James F. Manwell and Sally Wright, “Wind Turbine Acoustic Noise”, Renewable Energy Research Laboratory, Department of Mechanical and Industrial Engineering, University of Massachusetts at Amherst, June 2002 amended January 2006, p 21.

<sup>8</sup> Op cit, p. 3732.

<sup>9</sup>

[http://www.madebydelta.com/delta/Business\\_units/TC/Services+by+technology/Acoustics/Low+frequency+noise/Low+frequency+noise+from+large+wind+turbines.page](http://www.madebydelta.com/delta/Business_units/TC/Services+by+technology/Acoustics/Low+frequency+noise/Low+frequency+noise+from+large+wind+turbines.page)

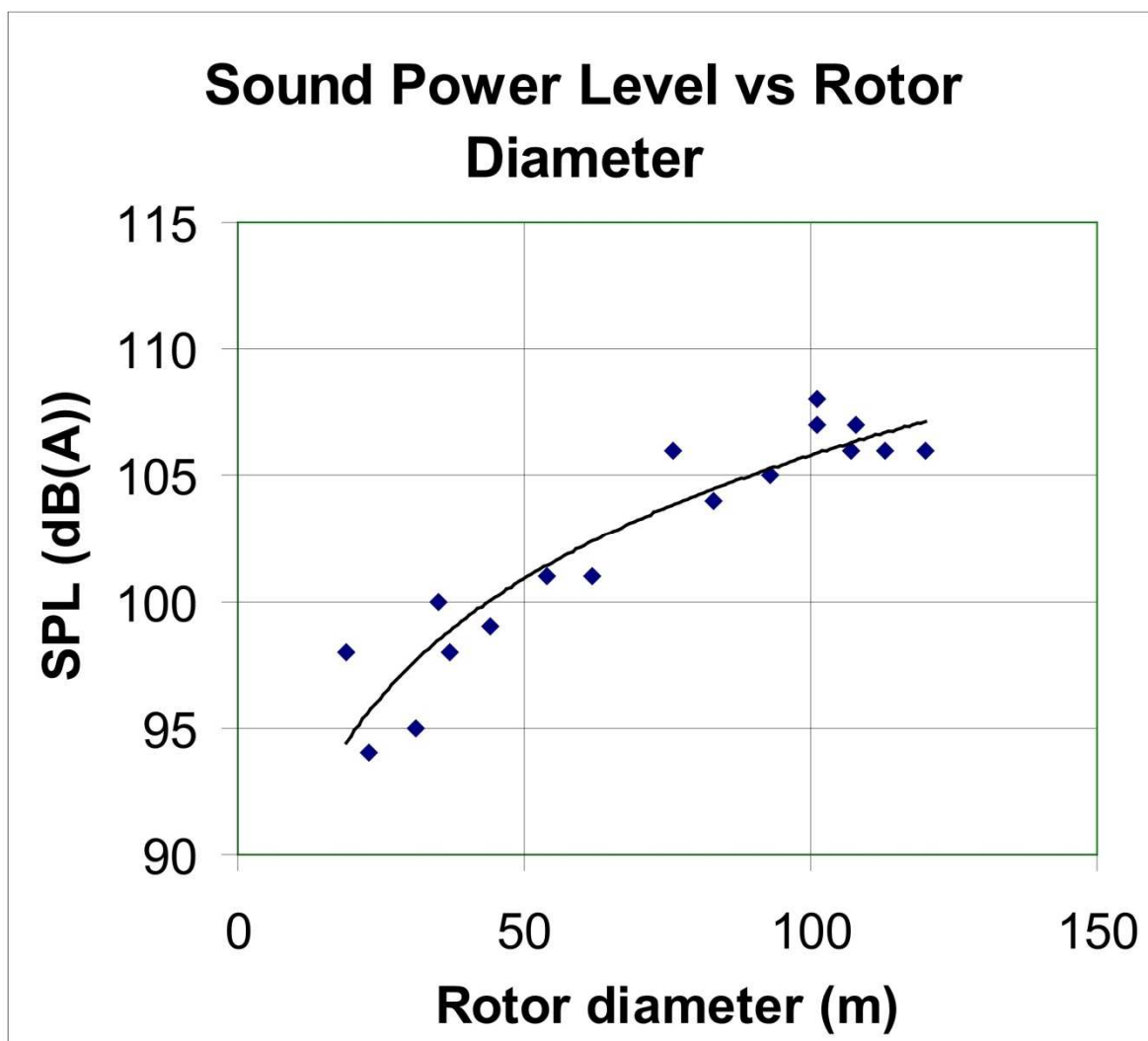
<sup>10</sup> Anthony L. Rogers, James F. Manwell and Sally Wright, “Wind Turbine Acoustic Noise”, Renewable Energy Research Laboratory, Department of Mechanical and Industrial Engineering, University of Massachusetts at Amherst, June 2002 amended January 2006, p. 20.

They demonstrated the relationship in the chart above. The chart shows the correlation between sound power level, in db(A), (vertical axis) and rotor diameter (horizontal axis). The graph includes two regression lines, one for turbines installed in the 1980s and a second for those installed in the 1990s. In both cases there is a positive (or in some terminology “direct”) correlation between WTG rotor diameter and sound levels.

It is the case that the technology introduced after the 1980s tends to generally emit less noise than earlier WTGs with the same rotor diameter. However, among the newer generation of turbines the same positive correlation exists between rotor diameter and noise levels as found in the earlier era.

The chart also includes points for turbines installed from 2000. They are coloured purple and a regression line has not been fitted for them. Examination of the chart reveals the same positive correlation between rotor diameter and sound levels for that group. Indeed the regression coefficient (ie amount of change in sound level per extra metre of diameter) appears stronger for that group than for the 1990s turbines.

In their presentation to the European Wind Energy Association’s Noise Workshop at Oxford in 2012, Stefan Oerlemans and Peter Fuglsang of Siemens AG presented the following chart:



Source: Stefan Oerlemans, Peter Fuglsang, “Low-noise wind turbine design”, Siemens Wind Power A/S, Siemens AG, at EWEA Noise Workshop, Oxford, 2012, p 11.

and referring to sound power levels they remarked:

“Level clearly increases with diameter and tip speed”<sup>11</sup>

Siemens is a very large German industrial company and a wind turbine manufacturer. So they can hardly be supposed to be spreading disinformation against the wind industry, however inconvenient their statements may be for Infigen.

### *Infigen’s Advice on Noise Relationships*

Thus there is clear evidence from both industry and from academic researchers that:

- Noise levels are positively correlated with rated power; and
- For WTGs of a similar era, noise levels are positively correlated with rotor diameter.

This strong evidence totally contradicts the advice provided by Mr Griffin to the Department of Planning in relation to the modification to increase the allowed power rating of turbines for the Capital II Wind Farm and the latest requested modification.

To support his claim in June 2013, Mr Griffin presented noise levels for 3 different turbines, which fortuitously supported his case despite being out of character with the research, cited above, on the well established relationship between WTG rated power and noise levels.

This is rather like claiming there is no correlation between the age and height of children because someone has found a tall younger child, a short older one, and someone in between. Given some variability in a subject area, you can always find exceptions which, if taken on their own, show a pattern inconsistent with the broader population. That is what Mr Griffin managed to do on behalf of Infigen.

This displays either a remarkable ignorance about their own industry or a clear intent to mislead the Planning Department. The Department might reasonably conclude that Infigen and Mr Griffin ought reasonably to know of these relationships, since they were published by multiple sources before Infigen submitted its first modification request, and Infigen claims to be a large player in the wind power industry in Australia.

Since the Department accepted the “evidence” presented by Mr Griffin and reproduced it in the Department’s approval of the modification, it must be assumed to have relied on that misleading information in reaching its decision.

Incidentally, it should be noted that in providing his selected cases, Mr Griffin did not provide any evidence that the process of measuring the three turbines (which were from different manufacturers) had been consistent, nor did he give any indication of the accuracy of the measurement. Anyone who understands anything about measurement of any matter knows measurement is unavoidably imprecise. Some forms of measurement are highly precise (ie the inaccuracy is known to be very small relative to the magnitude of the measurement). In other cases, the measurement is not very precise (the possible difference between the number “measured” and the actual value can be relatively large).

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<sup>11</sup> Stefan Oerlemans, Peter Fuglsang, “Low-noise wind turbine design”, Siemens Wind Power A/S, Siemens AG at *EWEA Noise Workshop, Oxford, 2012*, p 11.

In the data Mr Griffin presented to support Infigen's case, a 1% change due to either measurement error or to differences between the manufacturers in the way they measured for reporting would totally invalidate the claim made by Mr Griffin. Measurements quoted by Cummings from a study by Pedersen et al, suggest differences between *identical* turbine models substantially greater than 1%<sup>12</sup>. Without providing any indication of precision, Mr Griffin's figures are worthless. This is additional to the fact that the turbines selected are inconsistent with the published relationships between noise levels and turbine power.

### WTG Separation and Increased Noise

The SEDA *NSW Wind Energy Handbook 2002* makes the very clear statement:

"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."<sup>13</sup>

The reasons for this spacing are reported by Laratro, et al:

"close spacing creates the possibility that the wind turbines in a farm will adversely interact with each other, which can lead to unsteady blade loading, reducing power output and **increasing noise level** [my emphasis] and blade fatigue"<sup>14</sup>

From the turbine map published<sup>15</sup> with approval for Modification 1 of the Capital II Wind Farm, it appears that the majority of the new turbines will be only several hundred metres apart, in many cases perhaps as little as 200 metres apart. That small interturbine separation applies not just to the turbines added as part of Capital II but also to the distance between some of the new turbines and ones already in place.

Using the SEDA rule noted above, the minimum interturbine distance for WTGs with 114 metre rotor diameters would be 570 metres. SEDA actually says:

"On very directional sites the 'abreast spacing' can be decreased by around 15 per cent"<sup>16</sup>

Allowing for that factor would reduce the appropriate minimum spacing for the Capital II turbines to 485 metres, if they have a rotor diameter of 114 metres as currently approved. On that basis, the actual interturbine distance proposed for Capital II appears to be between 41% and 52% of the spacing recommended by SEDA.

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<sup>12</sup> Drawing on a study by CS Pedersen et al, Cummings reports "these field measurements found that individual turbines did indeed have significantly varied sound output: the standard deviation of identical models was 1.6-3.5db, resulting in a 90% confidence interval of 2.6-5.75 around the mean.", Jim Cummings, "The Variability Factor in Wind Turbine Noise", *5<sup>th</sup> International Conference on Wind Turbine Noise*, Denver 28-30 August 2013, p. 4. Applied to the sound power levels (around 103db(A)) stated in Mr Griffin's letter, the figures reported by Cummings would amount to  $\pm 2.5\%$  to  $5.6\%$ . And this is without considering differences between manufacturers in precisely how they measure and the conditions used in establishing norms for their turbine models.

<sup>13</sup> *NSW Wind Energy Handbook 2002*, Sustainable Energy Development Authority of NSW (SEDA), p. 53.

<sup>14</sup> Alex Laratro, Maziar Arjomandi, Richard Kelso, Benjamin Cazzolato, "A discussion of wind turbine interaction and stall contributions to wind farm noise", *J. Wind Eng. Ind. Aerodyn.*, 127, 2014, pp. 1 – 10.

<sup>15</sup> Departmental approval for *Capital II Wind Farm – Modification 1*, signed 4/7/13 by Karen Jones, A/Director, Infrastructure Projects, Department of Planning & Infrastructure, Figure 1 – Project Location.

<sup>16</sup> *NSW Wind Energy Handbook 2002*, Sustainable Energy Development Authority of NSW (SEDA), p. 53.

If the rotor diameter is increased to 126 metres, then the minimum spacing would be 535 metres. In that case, if the turbines stay as shown in the Modification 1 submission, then the actual interturbine distance proposed for Capital II appears to be between 37% and 47% of the spacing recommended by SEDA.

In light of the SEDA recommendations it is astounding the original application was approved. Given that it was, unless Infigen is proposing to reduce the number of turbines, and the modification request has not mentioned it, then the interturbine spacing will become substantially worse compared to SEDA's recommendations, dropping from the range 41%-52% down to 37%-47%.

Based on SEDA's advice and research evidence, it appears highly likely that noise pollution from the project will be exacerbated by the requested modification. The developer has not submitted any analysis to counter that expectation. Consequently, to approve the modification without such evidence would be an act clearly partial to the developer and thus consistent with what the ICAC Act identifies as corrupt conduct <sup>17</sup>.

## Visual Impact

The best practice Zone of Visual Influence (ZVI) recommended by Scottish National Heritage is dependent on the tip height of wind turbines. The ZVI is the area within which there may be some visual impact from the wind turbines and for which the impact should be assessed. For WTGs over 150 metres to tip, the appropriate ZVI is 45 kms <sup>18</sup>. It should be noted that the best practice ZVI is based on tip height of turbines, not tower height.

Infigen has made the spurious assertion that because the towers may be 6 metres shorter, the visual impact will be reduced. While the tower may be 6% lower, the length of blades will increase by more than 10% each and there are 3 of them. In addition, longer blades are often broader as well, which Infigen has not mentioned. So the static physical mass may actually be greater.

More importantly, the visually critical thing about WTGs is that their blades move. That in particular draws the eye and causes more visual impact than static constructions of the same height. Under Infigen's requested modification, there would be blades sweeping across an area increased by more than 20%. The suggestion this would have a reduced visual impact is simply ludicrous.

The proposed modification should not be accepted without a well conducted visual impact assessment <sup>19</sup> that:

- uses a ZVI reasonably consistent with the best practice ZVI identified by Scottish National Heritage (which would certainly include Collector, Tarago and Bungendore);

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<sup>17</sup> *The Independent Commission Against Corruption Act 1988 No 35*, includes under corrupt conduct: any conduct of any person (whether or not a public official) that adversely affects, or that could adversely affect, either directly or indirectly, the honest or impartial exercise of official functions by any public official, any group or body of public officials or any public authority {8(1)(a)}; or any conduct of a public official that constitutes or involves the dishonest or partial exercise of any of his or her official functions {8(1)(b)}; and official misconduct (including breach of trust, fraud in office, nonfeasance, misfeasance, malfeasance, oppression, extortion or imposition) {8(2)(a)}.

<sup>18</sup> *Visual Representation of Wind Farms, Version 2*, Scottish Natural Heritage, July 2014, p. 13.

<sup>19</sup> Described in more detail in this author's critique of the LRWF proposal submitted 30<sup>th</sup> September 2014 to the Department of Planning and Environment.



- in order to overcome the biases found in all assessors <sup>20</sup>, uses an assessment panel of 3-5 assessors that fairly includes non-involved locals, transparently chosen, and with all assessments reported to the approving authority.

To simply accept the developer's assertion of reduced visual impact from this proposed modification without having the visual impact properly assessed would clearly be an act partial to the developer at the expense of other parties and thus consistent with what the ICAC Act identifies as corrupt conduct.

### **Avifauna Impact**

Infigen's modification request includes the statement:

"The impact on avifauna is negligible as the total turbine tip height remains within the approved planning envelope of 157 metres." <sup>21</sup>

totally ignoring the fact that the swept area will increase by 22% and that the bottom of the swept area will extend 12 metres closer to the ground and thus become an increased problem for birds that would otherwise be flying below the rotors.

In addition, there is no comment on the fact that since Capital II is largely a long line of WTGs abreast of one another, the increased rotor diameter would significantly reduce the unimpeded gap between WTGs. Along most of a distance of about 15 kms, approximately half or more of the air space would be occupied by rotating blades, and the proposal increases the area so occupied by more than 10% and correspondingly reduces the area safe for avifauna by a similar amount. This is surely relevant to any assessment of avifauna impact.

That statement in Mr Griffin's letter is so obviously a non sequiter one has to wonder what sort of people he believes work in the Department of Planning and Environment that would accept such a statement.

To support the asserted safety of birds and bats, Infigen also enclosed a letter from Dr Kevin Mills which makes the wonderfully vague statement

"there is not likely to be any appreciable difference in the potential strike hazard under the proposed modification". <sup>22</sup>

One doesn't have to be an environmental expert to recognise the multiple vague terms in that statement meant to encourage the department to approve the modification request. Dr Mills tells the department there is "not likely to be". He doesn't say there won't be. He claims there probably won't be an "appreciable" difference, without offering any quantification of that word "appreciable". And he refers to a "potential strike hazard" instead of to actual avifauna strikes.

Aside from his calculation of swept area, the only quantification offered in Dr Mills' letter is that:

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<sup>20</sup> Molnarova K., Sklenicka P., Stiborek J., Svobodova K., Salek M., and E. Brabec, "Visual Preferences for Wind Turbines: location, numbers and respondent characteristics", *Applied Energy* 92 (2012): 269-278.

<sup>21</sup> Letter to Ms Anna Timbrell, Department of Planning and Environment re Application MP 10\_0135 Capital II Wind Farm – Modification 2 (Blade Length), dated 23<sup>rd</sup> September 2014 and signed David Griffin, GM Development, p. 2.

<sup>22</sup> Letter to Anna Timbrell, Department of Planning and Environment re Capital Wind Farm 2: MP 10\_0135 Mod2, dated 17<sup>th</sup> June 2014 and signed by Dr Kevin Mills for Kevin Mills & Associates, p. 2.

“The surveys on Capital found that 97% of all bird observations were below 20 metres”<sup>23</sup>

At first glance this conveys the sense that at most 3% of birds (no mention of bats) are at risk. But casual observation of birds in the country certainly indicates that a single bird will fly at a range of heights. The fact that it may spend much of its time below 20 metres does not mean it will not also fly at heights of 30 or 40 metres or more, all of which would bring it into the rotor range of the turbines, not to mention the broader turbulence zone around them.

So Dr Mills’ single effort of quantification could be consistent with either very few birds flying in the danger zone or with most of them doing so for some part of the day or night. It is thus a useless statistic in terms of understanding the risk.

In addition, there is no reference to various species of birds and how the arrangement may differentially impact them. For instance, there is no specific discussion of raptors or other large birds. There is also no discussion of the different risks between night time and day time and what that may mean for various species.

Infigen should be required to provide

- accurate quantified data on current levels of actual avifauna strikes;
- an accurate calculation of what will be the new strike levels taking account not only of the changes on an individual turbine basis but in a row of turbines where the space between their blades would shrink while the zone of turbulence would expand;
- the specific impact on significant species;
- quantified estimates of survival rates of avifauna populations in the vicinity of the wind farm.

and let the approving authority decide whether those numbers are “appreciable” or not.

Without that information, the approving authority is not in a position to make any judgement about the actual impact the proposed modification would have on avifauna and therefore cannot approve the proposal if it actually considers environmental effects.

## Summary

### *Overwhelming Grounds for Rejection of Request*

Contrary to Infigen’s claim, increased rotor diameter is generally associated with increased noise levels, as reported by both scholarly research and statements from WTG manufacturers. Thus in the absence of rigorous analysis showing why that would not be the case in practice at Capital II, this proposal should be rejected on noise grounds.

Given that a lot of time and attention is devoted to noise modelling in the normal assessment of wind farm proposals by the NSW Government, to not require the same scrutiny in this case, given the research conclusions and manufacturers’ statements, would clearly display partial behaviour in favour of the developer.

The claim that there will be a reduced visual impact, when all the evidence indicates a worsened visual impact, is simply ridiculous and an insult to the approving authority and the affected communities. The developer should be required to provide a proper visual impact

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<sup>23</sup> Op cit, p. 2.

assessment of this large change to visual impact, and that visual impact assessment should be conducted using best practice ZVI for WTGs of the proposed height and an assessment panel that is not biased towards finding weak impacts. In the absence of such an assessment, the proposal should be rejected.

Likewise in considering environmental impact the approving authority needs well substantiated analysis, not throwaway comments. There are good reasons to suspect that the proposal will adversely affect avifauna. In the absence of analysis that proves avifauna populations in the region will not be adversely affected, the proposal should be rejected.

In the words of the Gullen Range Wind Farm PAC

The application is inconsistent with the intent and spirit of the *Draft NSW Planning Guidelines: Wind Farms*.<sup>24</sup>

and it should be rejected.

### ***Investigation of False or Misleading Claims***

As examined in this paper, the claim by Infigen's Mr Griffin:

"there is no direct correlation between increased blade length and increased noise levels."<sup>25</sup>

is completely inconsistent with research and manufacturers' statements. It thus appears to be an instance of making false or misleading claims to influence the decision of the approving authority. The department needs to investigate whether this actually contravenes any regulations or laws, including a possible breach of section 8(1)(a) of *The Independent Commission Against Corruption Act 1988*.

Likewise, the claim, in requesting modification 1, by Infigen's Mr Griffin:

"there is no relationship between WTG generating capacity and noise"<sup>26</sup>

is completely inconsistent with research and manufacturers' statements. It thus appears to be an instance of making false or misleading claims to influence the decision of the approving authority. The department needs to investigate whether this actually contravened any regulations or laws, including a possible breach of Section 8(1)(a) of *The Independent Commission Against Corruption Act 1988*.

Given that statement, and the accompanying misleading data, were used by the Department of Planning and Infrastructure as the basis for approving Modification 1, the Department needs to consider the revocation of that approval. The Department needs to also investigate how it came to accept such misleading information.

Finally, the Department needs to assess the implications of possibly false or misleading statements in multiple submissions from Infigen.

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<sup>24</sup> *NSW Planning Assessment Commission Determination Report Gullen Range Wind Farm Project (MP07\_0118)*, Upper Lachlan Shire LGA, 2 October 2014.

<sup>25</sup> Letter to Ms Anna Timbrell, Department of Planning and Environment re Application MP 10\_0135 Capital II Wind Farm – Modification 2 (Blade Length), dated 23<sup>rd</sup> September 2014 and signed David Griffin, GM Development, p. 2.

<sup>26</sup> Letter to Mr Neville Osborne, NSW Department of Planning, dated 24<sup>th</sup> June 2013, and signed David Griffin, GM Development.