IN THE MATTER of the Resource Management Act 1991

AND

IN THE MATTER of a Board of Inquiry appointed under s146 of the Resource Management Act 1991 to consider an application by Mighty River Power Limited for resource consents to construct, operate, and maintain a wind farm at Turitea

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REBUTTAL EVIDENCE OF NEVIL IAN HEGLEY

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1. INTRODUCTION

1.1 My name is Nevil Ian Hegley. My qualifications and relevant experience are set out in my evidence in chief. I confirm that I have prepared this rebuttal evidence in accordance with the Environment Court Code of Conduct for Expert Witnesses (July 2006).

1.2 I am providing this rebuttal evidence to comment on and respond to some of the primary evidence presented in respect of these applications that relate to noise matters. In particular, I will comment on the evidence of Robert Thorne presented on behalf of Huatau Marae, Tararua – Aokautere Guardians Incorporated and Friends of Turitea Reserve Incorporated, the evidence of Douglas Roger Scott Pringle, the evidence of Nigel Robert Lloyd on behalf of the Palmerston North City Council and of Jeffery Alan Baker on behalf of the Palmerston North City Council.

2. EVIDENCE OF ROBERT THORNE (ON BEHALF OF TAG AND FOTR)

2.1 Dr Thorne has written extensive evidence (128 pages) much of which conflicts with my findings, and I cannot support. Rather than make comments on every point raised, I have confined my rebuttal evidence to the more significant matters. However, I would like to emphasise that simply because I have not commented on a number of issues does not mean that I support his comments.

2.2 Dr Thorne has stated (paragraphs 2.5 and 2.6) that individual turbines have different acoustical characteristics and audibility at different wind speeds. He gives a Vestas V90 3.0 MW Mode 2 turbine running at 8 m/s as an example of a turbine with a tonal character as stated in the relevant Windtest Acoustical Emissions Report.

2.3 The Windtest report states (at section 3.4) that when tested at the appropriate distance (approximately 130m) in accordance with the requirements of IEC 61400-11 ed2, there is an audible tone at 890Hz. However, it goes on to recognise that this tone is reduced for greater distances, and therefore concludes that "*in this case, there is no need for any tonality penalty to be applied at surrounding points of noise impact*". This has been confirmed during field testing I have undertaken of Vestas 3MW V90 turbines, and was clearly stated in my evidence in chief (paragraph 8.17).

2.4 As a result, I consider that the evidence given by Dr Thorne with respect to tonal effects is of no relevance to the proposed wind farm.

2.5 At paragraphs 4.2 to 4.4 of his evidence, Dr Thorne attempts to establish that the wind farm will have a significant effect on the people of the Manawatu, in part because of his calculations as to the numbers of residents within the 45dBA noise contour he has plotted. The most obvious point in this regard is that it is completely inappropriate to determine there is a significant "effect" on a purely numerical basis. That aside, I also note that Dr Thorne's calculations do not appear to take into account the sites that have provided written approval to the proposed wind farm. He also provides no basis for his assumption that each dwelling will have an average of 3 residents.

2.6 Further, I consider the noise contours shown in Figures 3 – 8 of Dr Thorne's evidence are remarkably symmetrical for such steep topography. In my opinion, these contours are likely to have been developed with a computer program that does not consider all of the variables. The variables that should be considered include topography, ground effects, atmospheric absorption and meteorological effects. When modelled to include all aspects of the sound transmission path, I would expect significantly different results would be obtained.

2.7 At paragraph 5.15, Dr Thorne alleges that deficiencies have been found in the existing version of *NZS6808: 1998 Acoustics – The Assessment and measurement of sound from wind turbine generators* (NZS6808), illustrating the significant issues people have with developers and how their consultants have applied the existing Standard. In paragraph 5.16, Dr Thorne goes on to say that in his opinion the impetus for change to NZS6808 occurred after the acoustic experts provided their statement of agreed matters to the Environment Court in the Project West Wind case.

2.8 I presented evidence to the Environment Court at the Project West Wind hearing. The title of section 5 of my evidence was "*Updating NZS6808*''. In this section of my evidence I outlined to the Court the position regarding the updating of NZS6808 at that time. This included the composition of the Committee convened to consider if it would be appropriate to review the Standard, and the resolution of that Committee as published by the Standards Update publication December 2004. The resolution of the scoping group for NZS6808 was:

"A scoping group met on 17 November 2004 to discuss possible changes to NZS 6808: 1998 - Acoustics - The Assessment and Measurement of Sound from Wind Turbine Generators. Based on limited experience with implementation of NZS 6808:1998 to date, the group resolved that:

- *NZS6808:1998 is an adequate Standard at present;*
- *It would be desirable to monitor the ongoing use and implementation of NZS 6808:1998;*
- *In about 2 years, a group should be convened to take into account the issues raised on 17 November (reference minutes from 17 November) and any issues arising in the ongoing use, research findings and implementation of NZS 6808: 1998; and*
- *The findings of the scoping group to be publicly notified through Standards New Zealand."*

2.9 I was a member of the above Committee and a member of the Standards sub-committee reviewing NZS6808. I am not aware that any of the issues raised by Dr Thorne were noted as being of particular significance, or given any specific focus, during that review process. In fact, the Committee has to date reinforced the use of L_{95} as the appropriate design limit (although L_{95} will be replaced with L_{90}), and the only substantive change it has recommended has been to clarify the original approach of NZS6808.

2.10 I was also a member of the caucusing team for Project West Wind. In this regard, I note that the conditions resulting from those without prejudice discussions did not necessarily reflect the opinion of all experts involved in them. It is not necessary for me to comment on Dr Thorne's statements regarding that caucusing exercise any further, save to note that some of those do not accord with my recollection of the discussions.

2.11 At paragraph 5.31, Dr Thorne states the conditions for the Motorimu Wind Farm require that wind farm noise should not exceed 35dBA L_{95} when the background sound conditions are low. The relevant decision is W010/2009, which is the "Decision Approving Conditions". In accordance with Condition 9 in Appendix 2, the Court has imposed the standard requirement that the wind farm noise should not exceed the background sound level (L_{95}) by more than 5dBA, or a level of 40dBA L_{95}, whichever is the greater.

2.12 I accept Condition 10 also requires that where the night time regression analysis shows the background sound is at or below 25dBA and the mean wind speed is less than 1.5m/s under specific conditions, then the wind farm noise should not exceed 35dBA. However, this is different to what Dr Thorne appears to be suggesting. He appears to be suggesting if the background sound is low under any conditions (no level is given) the design level also drops. It would seem his confusion may have been due to him referring to the Environment Court decision W67/2008 (rather than decision W10/2009) as footnoted on his page 28.

2.13 Dr Thorne goes on to suggest (at paragraph 5.32) that the draft revision of NZS6808 acknowledges that a higher level of acoustic protection is required in low background environments. This is an over simplification of what is being recommended, and I consider Dr Thorne's statements to be misleading for a subject that is more complex than this suggests. To warrant a design level of 35dBA there are a number of important criteria that need to be satisfied as would be expected for any noise control. The criteria may be summarised as:

- for evening and night time periods;
- when the wind speed at hub height is less than 6 m/s and when the average background noise level (obtained via regression curve) is 25dBA L_{90} or less and the wind turbine noise level more than 8 decibels above the background noise level; or
- if the relevant District Plan specifically recommends the application of lower noise limits, thus indicating that an area deserves special protection

2.14 It has been suggested that the use of L_{90} (the draft revision of NZS6808 is proposing to replace L_{95} with L_{90}) to assess wind farm noise is incorrect (paragraph 5.38). This issue was discussed at length by the Committee revising NZS6808. After addressing all of the methods available and experience gained both in New Zealand and overseas (an internationally recognised expert assisted us in these discussions), the Committee has agreed the use of L_{90} is the only practical and robust method to measure wind farm noise due to the special environment that wind farms are located in. The special environment is a wind y one.

2.15 Dr Thorne has stated (paragraph 5.40) that there is a high probability that the Turitea wind farm will exhibit a "special audible characteristic" under certain weather conditions. He does not state what these conditions are, which makes specific comment difficult.

However, I have undertaken detailed noise measurements of the Vestas V90 3MW turbines (one of the possible turbines to be used) and can advise there are no special audible characteristics to these turbines. Nor to my knowledge has a comment ever been received from the public that there is any such issue with these turbines.

2.16 Dr Thorne alleges that I have not considered the best practical option to manage turbine noise for the proposed wind farm (paragraphs 6.3 and 6.11). I disagree. The proposed wind farm will utilise modern three bladed wind turbines to minimise noise. These turbines have a pitch control, are able to be de-rated if required, and (as already noted above) do not exhibit any known special audible characteristics. I believe all of these factors contribute to satisfying the requirements of section 16 of the Resource Management Act 1991 (RMA) to adopt the best practical option to minimise noise. Further, the wind farm design has been undertaken with the noise requirements in mind to ensure the noise is controlled to within a reasonable level in terms of the requirements of the Palmerston North and Tararua District Plans.

2.17 It has been stated I have not addressed issues of sound modulation or presented any self researched evidence to refute the problem of such noise at residents' dwellings (paragraph 6.13). I am not aware of any such issues with the turbines being considered for this wind farm and as such there is nothing to present. However, I have undertaken six months of field monitoring at 10 minute intervals of the only operational wind farm using Vestas V90 turbines and can advise there were no such problems found or reported by residents. Further, I have undertaken detailed noise measurements of the same turbines that support the above conclusions. I believe that Dr Thorne may be confusing the noise issues he has raised with a different style turbine than that proposed for this site.

2.18 At paragraph 6.15, Dr Thorne alleges my analysis shows that there is significant reason to conclude that the wind farm as proposed will not comply with the criteria of the existing NZS6808, and will create significant adverse noise effects. This is simply not the case. My analysis shows the proposed wind farm is able to be operated to comply with the requirements of both the current and proposed versions of NZS6808 at all times. If this were not the case I would not be supporting the application.

2.19 I am surprised that Dr Thorne has expressed the opinion that one of the West Wind conditions can only be monitored "with extreme difficulty" (paragraph 6.19). As set out above, Dr Thorne was party to the West Wind conditions.

2.20 Dr Thorne has been very critical of the background noise monitoring undertaken to date (paragraphs 6.23 and 6.24). I refute all of these statements. In fact, some of the issues raised here were specifically addressed in the original noise assessment. Issues considered in the analysis of field measurements included the variation in the wind speed, wind direction and the day/night variations. Additional monitoring was undertaken at some sites to confirm otherwise incongruous results obtained through the initial testing. There has also been further monitoring undertaken of the existing noise environment since my original assessment. None of this monitoring has altered my original assessment and conclusions. It is also important to appreciate that there is still a lot of noise monitoring to be undertaken to fulfil the requirements of NZS6808 should the project be approved.

2.21 The accuracy of noise predictions is questioned and it is suggested a range of levels should be given (paragraphs A.3.11 – A.3.13). My modelling and assessment has been undertaken assuming downwind conditions with all variables included. While predictions are just that, field monitoring to date has shown the prediction of wind farm noise is generally conservative. Regardless, a monitoring condition is proposed and should the wind farm be approved, it will have to comply with the relevant noise levels also imposed by way of conditions. If it does not, then operation of the wind farm would need to be modified (for example by de-rating turbines during appropriate conditions) to ensure compliance.

2.22 Further, I note the only concerns (justified or otherwise) I am aware of regarding wind farm noise relate to their operation during calmer conditions. I am not aware that any complaints have been made about turbine noise during high winds, which appears to be the conditions of most concern to Dr Thorne with respect to the accuracy of noise predictions.

2.23 Dr Thorne has concluded the proposed Turitea Wind Farm will have a significant cumulative noise effect on the community (paragraph B.2.4). I do not agree. Based on the background noise monitoring and modelling I have undertaken for the Turitea site, and compliance monitoring of other wind farms I have been involved in, I consider that my noise predictions are if anything, overly conservative. I also question the accuracy of Dr Thorne's noise contours, give that as set out above, these do not appear to include all of the variables that are applicable for noise modelling (pages 15 – 20, Figures 3 – 8 and page 49, Figures B.2.1 and B.2.2).

2.24 In Section Topic C: Draft NZS6808 (pages 52 – 54) of Dr Thorne's evidence, he quotes from the draft Standard. As this is a draft Standard and could change I do not believe it provides information that could be used with confidence so do not comment on this further.

2.25 In my opinion, Section Topic D: Synopsis of Assessing Intrusive Noise and Low Amplitude Sound (pages 55 – 76) of Dr Thorne's evidence does not provide any helpful new methodology for assessing, or design aspects for addressing, the potential acoustic effects of the proposed wind farm that have not already been considered where relevant.

2.26 The same applies to sections Topic E: Wind Farms – the Potential for Annoyance (pages 77 – 83), Topic F: Health, wellbeing, annoyance and amenity (pages 84 – 89) and Topic G: Noise from Wind Turbines (pages 90 – 94).

2.27 Section Topic H: The Manawatu Studies (pages 95 – 103) is outside my area of expertise, so I do not comment on it further. Section Topic I: Low Frequency Noise or is that Vibration? (pages 104 – 109) appears to relate to the older types of turbine installed in the area and has no apparent relevance to the more modern turbine proposed at Turitea. I have undertaken a study of the Vestas V90 3MW turbines and have not identified any unusual vibrations at the base of the turbine tower nor on the concrete block that the tower was attached to.

2.28 Sections Topic J: The Character of the Local Environment (pages 110 – 114) and section Topic K: Noise Mitigation – the valuation of noise (pages 115 – 117) are not considered applicable to this application as they again address different types of turbine to that proposed.

2.29 Section Topic L: Indicative Noise Management Conditions (pages 118 – 127) set out Dr Thorne's view of the conditions he considers should be imposed should the Board decide to grant these applications. I am of the opinion that these conditions are unnecessarily verbose and in conflict with all of the relevant Standards.

2.30 An example of my concerns is the definition of the notional boundary (page 118 condition 2). The notional boundary is defined in *NZS 6802:2008 Acoustics – Measurement of Environmental Sound* (NZS6802), so to redefine it results in unnecessary uncertainties.

2.31 For some reason Dr Thorne has chosen to redefine the requirements of *NZS 6803:1999 Acoustics – Construction Noise* (NZS6803) by setting levels that are more appropriate for an ongoing noise rule in a District Plan (page 119 condition 3). Further, by redefining the conditions the rule becomes unworkable, such as there is no longer any guidance on what constitutes a tone. There is no reason why there should be any deviation from adopting the requirements of NZS6803.

2.32 There is no logic why there is a limitation on the hours of the manufacturing of concrete as recommended (page 119 condition 4). If a level of 40dBA is achieved at night time (as proposed by Dr Thorne), this would not cause a nuisance and would be within the baseline noise for the area. I therefore do not support such a condition.

2.33 The same basic arguments apply to the majority of the proposed conditions, some of which I consider to be totally unreasonable (such as that requiring inaudibility - see page 120, condition 7). Apart from anything else, inaudibility is dependent on the hearing ability of the receiver and the background sound at the time. This does not provide the certainty that is necessary for design and compliance monitoring.

2.34 Rather than go through each of the proposed conditions (most of which are considered unrealistic and unnecessary) I will address the recommended conditions when commenting on Mr Lloyd's evidence.

3. EVIDENCE OF ROBERT THORNE (ON BEHALF OF HUATAU MARAE)

3.1 Dr Thorne has stated that the monitoring position I selected at the Marae is affected by reflections off the building so there should be a +3dBA adjustment to the measured levels (paragraph 3.2). I note that the selected position was adopted for practical reasons at this site. However, the suggestion it is necessary to add 3dBA because of the selected monitoring position is flawed for two reasons. The first is that the monitoring is to determine the existing noise level. Once the wind farm is operational, further monitoring will be undertaken at the same location to determine compliance with the conditions. As compliance is a simple matter of establishing the difference between the noise levels before the wind farm was constructed and after it is operating to some extent it is irrelevant where the levels are measured provided the same location is adopted for both tests.

3.2 The second reason is that the +3dBA Dr Thorne addresses is not appropriate or necessary with respect to L_{95} measurements, so such an adjustment is unwarranted in this case. This is demonstrated by my involvement in the assessment of the Mahinerangi Wind Farm, where one resident was not happy with the monitoring being undertaken at a location clear of the house when she lived within the house. For that reason, monitoring was undertaken at 1m from the facade of the house and at the same time at a position well clear of the house within the notional boundary. Ten days of noise monitoring at each position was undertaken with the results plotted together as shown on Figure 1. As shown on this figure there were small variations in the measured levels, with one site being slightly higher on some occasions and the other site being slightly higher on others. When the best fit regression line two was fitted to both of the monitoring positions the resulting equation was exactly the same.

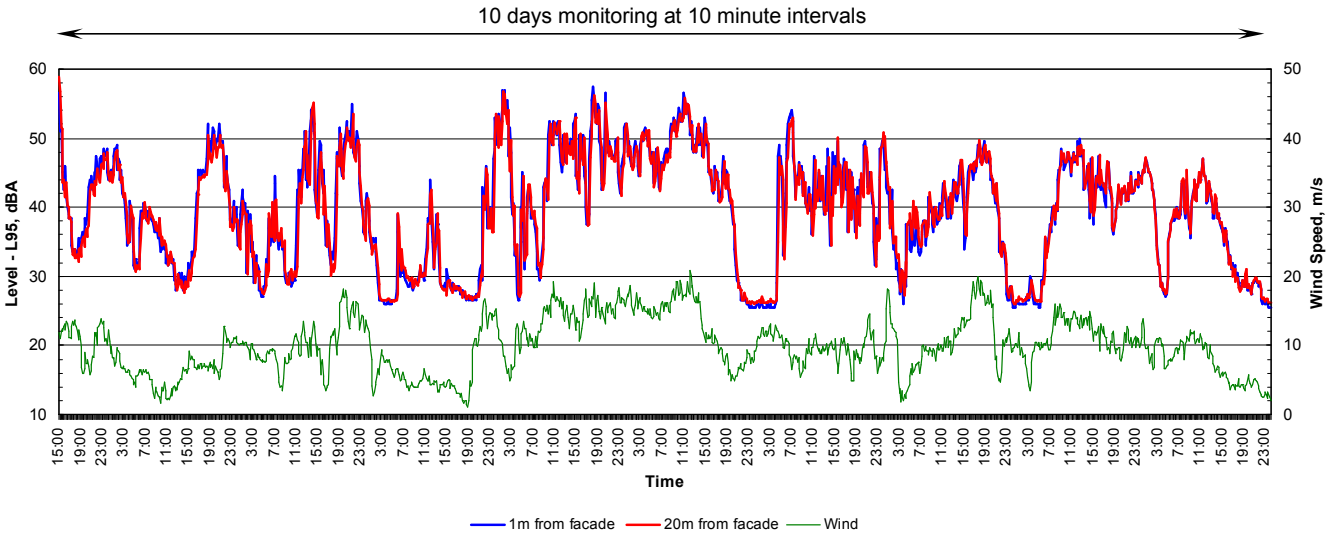

Figure 1. Noise at 1m and 20m from Façade

3.3 Dr Thorne has assumed this Marae is located in a "special-background environment", and therefore contends that the background noise should not be exceeded by more than 5dBA during the day and by 0dBA at night (paragraph 3.6). No reason has been given by Dr Thorne for this assumption other than his apparent perception of the area (paragraph 3.5), and I do not consider there are any factors indicating this to be the case.

3.4 It is stated the L_{eq} and L_{95} levels have been predicted (paragraph 3.11), although it is unclear exactly why the L_{95} has been adopted as this value is not required by NZS6808.

The L_{95} is used for determining the background sound and compliance monitoring, not predictions.

3.5 Dr Thorne has stated the proposed wind farm "*has significant adverse effect on the community as shown by the "35dBA" sound level contour"* (paragraph 3.12). This is contrary to the requirements of NZS6808 (which is also adopted by the Palmerston North City Council). I support the findings of NZS6808 and do not agree with Dr Thorne's comments.

3.6 It has been recommended that various noise mitigation measures be considered by the applicant to address this submitter's concerns (paragraph 4.1). However, it is unclear exactly what Dr Thorne is suggesting may be required in this regard. As an example, one of Dr Thorne's suggested measures refers to a "noise sensitive place", but provides no definition of this term. There is also reference to achieving a "satisfactory level" of noise (paragraph 4.1(b)), but again no indication is given as to what such a level would be.

4. EVIDENCE OF DOUGLAS ROGER SCOTT PRINGLE

4.1 In the second bullet point of paragraph 2.14 Mr Pringle states "Sound pressure levels are logarithmic and an increase of 9dbA represents an increase of 3 times the sound pressure level". This is incorrect and it appears he is getting confused between sound energy and sound level. An increase of 10dBA represents a doubling of the sound pressure level, not a threefold increase as suggested. This error leads to further errors in his analysis of the noise.

4.2 It has been stated (bullet point 4 paragraph 2.15) that "Noise transmission is greater at night. Due to more stable air". There is no difference in the transmission of sound with respect to the time of the day. One variation is due to meteorological conditions and there are other factors such as screening etc to be taken into account and given the same weather conditions the same noise level will be heard at night time as during the daytime.

4.3 Due to the errors brought about by his not understanding the noise issues as set out above, the comments made by Mr Pringle in his paragraph 2.16 are incorrect. Further, I totally refute the statement he makes in his bullet point 4 that "This is an acknowledgement the design is non compliant".

4.4 In paragraph 2.17 Mr Pringle seeks permission to undertake a demonstration of a 5dBA difference in levels. My only comment to this request is that in my opinion such a demonstration will not provide any valuable understanding of the issues. Should the Board wish to have an understanding of this type of effect, or any other type of wind farm noise effect, it is recommended this would be better achieved with a visit to an existing wind farm.

4.5 Mr Pringle has set out some assumptions related to his property and reached a conclusion that "the predicted sound pressure levels are in excess of those permitted by NZS 6808" (paragraphs 2.18 – 2.21). There has not been a background noise survey undertaken at Mr Pringle's property at this point and this will be necessary before any final conclusions can be reached on the design level. I am able to say that for a site on top of a hill (paragraph 2.2 of Mr Pringle's evidence) the exposure to wind is generally greater then a location not as exposed so the design level is generally higher than for more sheltered sites. I can advise that the noise level at Mr Pringle's property will be achieved.

4.6 There appears to be a misunderstanding by Mr Pringle with respect to the noise levels from the wind farm complying with the requirements of NZS6808 (paragraph 3.3). I would like to make it quite clear that from my analysis of the proposed wind farm the noise levels will comply with the requirements of NZS6808. This is confirmed by the proposed conditions, which include a monitoring condition.

4.7 There are references in Mr Pringle's evidence to the WHO guidelines and he includes reference to some additional 2004 and 2005 WHO documents (paragraphs 3.2, 3.6, 3.7). The 1999 version of the WHO guidelines is not replaced by the later documents. However, the more important point that should be taken into account is that none of the WHO documents make any reference at all to wind farms so care must be taken when considering these documents.

4.8 Mr Pringle has stated (paragraph 4.5) "it is essential to consider what changes are being considered by the standards technical committee on the assessment and measurement of sound from wind turbine generators". This has been taken into account in the noise evaluation.

4.9 In paragraphs 4.7 to 4.10 Mr Pringle addresses the secondary standard of 35dBA as a design tool. I believe he has wrongly interpreted this requirement. However, it is

proposed to adopt the requirement of this secondary standard and to that extent the proposed conditions includes reference to the secondary standard, which should satisfy the concerns raised by Mr Pringle.

4.10 Mr Pringle discusses the difference of sound propagation of high and low frequencies (paragraphs 4.11 – 4.13). All predictions for the wind farm have been undertaken using the individual octave bands (from 63Hz to 4kHz) to take this (as well as other effects) into account. This should satisfy this concern.

4.11 It has been suggested there is no certainty to the noise predictions (paragraph 4.15). This is not agreed with. Regardless, the proposed conditions require compliance monitoring so again, this should resolve the concern raised.

4.12 Mr Pringle states "The evidence provided by Mighty River Power is well out of date and does not meet current state of knowledge" (paragraph 4.20). This is certainly not the case. I am not aware of any better technique that would improve the prediction accuracy, and this includes the reference made to the work by G.P.van den Berg referred to in paragraph 4.17 by Mr Pringle.

4.13 In his conclusions (paragraphs 6.1 – 6.6) Mr Pringle has stated a precautionary approach has not been taken with the predictions, NZS6808 is not adequate, the best practical option has not been adopted and there has been sleep deprivation reported from Te Apiti wind farm. These are all sweeping statements, none of which have been substantiated or are considered to have any factual credibility. I do not accept any of these conclusions and believe the opposite to be the case.

5. EVIDENCE OF NIGEL ROBERT LLOYD

5.1 It has been suggested that as the existing turbines at the Te Rere Hau wind farm exhibit a "tone" this should be included in the analysis of cumulative noise effects that may be received by the residents (paragraph 20). I understand the wind turbine manufacturer supplying the Te Rere Hau turbines is addressing this issue and has eliminated the tonal component of the turbines at 502Hz, 756Hz and 1220Hz (in accordance with the requirements of IEC 61400-11-2002 Wind Turbine Generator Systems – Part 11: Acoustic noise measurement techniques). There is another tone, which is at 996Hz, and this has been noticeably reduced to only 2 – 3dB above the tonal criterion. Given that it is

incumbent on the Te Rere Hau wind farm to correct the tonal effect, it is not appropriate for Mighty River Power to be required to model that tonal effect.

5.2 Mr Lloyd has suggested the 35dBA contour extends out to at least the Manawatu River by Linton Army Camp (paragraphs 28 and 29). He appears to have reached this conclusion because of the way he has interpreted the noise contours in my evidence in chief, without taking the ground contour into consideration as well. However, the ground contour rises to be more exposed to the wind farm noise to the west compared to the adjacent land. The noise level then immediately drops off again on the other side of this rise, so Mr Lloyd's suggestion that the noise is above 35dBA beyond the area within the noise contour is incorrect.

5.3 I therefore disagree with Mr Lloyd's conclusion (at paragraph 30) that I have greatly underestimated the number of dwellings likely to be impacted by the wind farm noise (paragraph 30).

5.4 Mr Lloyd considers that wind farm noise cannot be compared to other industrial types of noise as it has a special nature (paragraphs 31 and 32). In paragraph 32(a), Mr Lloyd states the Tararua Ranges and majority of the surrounding area are remote from significant roads or significant activity. What Mr Lloyd appears to have overlooked is that in general terms the noise environment as assessed and presented in my evidence in chief (Figures 4 – 19) shows how the background sound (L_{95}) is relatively high when there is a wind blowing, which is for significant periods. While not plotted, the L_{10} is at a higher noise level than the L_{95} levels shown so for significant periods the noise environment in the area is high.

5.5 Further, for winds below 3.5m/s the turbines do not generate any power. The noise from the turbines is 12dBA below the design level at 4m/s, and still 3.5dBA below the design noise level even at 6m/s. That is, the turbines will generally only be creating noise when there is already significant background noise from the wind, and will not be operating (or generating only very limited noise) in calm conditions when the background environment is quiet. This is different to all other industries, which can generate (in the case of industry in the Palmerston North City District) a level of 50dBA L_{10} from 7:00am – 10:00pm and 40dBA L_{10} from 10:00pm – 7:00am every day of the week (Rule 9.12.1 of the Palmerston North District Plan), even when there is no wind and the background noise levels are very low.

5.6 Mr Lloyd has stated wind farm noise is different from all other noisy activities in that it is both generated, and spreads, over a wide area (paragraph 32(c)). For the receiver this is totally irrelevant. The critical issue is the noise levels that are received, not how big the area of influence is. I am not aware of any research that indicates the area influenced by noise has a bearing on the acceptability of the noise.

5.7 It has been suggested that when wind farm noise impacts on a property, the noise levels may not vary considerably between that part of the property that is closest to the wind farm, and that part which is furthest away. In other words, turbine noise is different to and has a different effect than other noise sources, because it is difficult to "escape" from (paragraph 32(d)).

5.8 I am not sure how Mr Lloyd has come to this conclusion, as my assessment demonstrates there is a significant difference between the noise levels that may be received at different areas of the same property (>4 - 5dBA), due to the screening effects of hilly topography.

5.9 The variation of wind direction will also alter the noise significantly at any given receiver position. There are also large industries (such as Methanex in Taranaki) where the noise is controlled to 45dBA at approximately 1km (the location of the closest house), giving a level of approximately 40dBA at 2km in calm conditions where there would otherwise be a low background sound. The flat topography around that plant means there would be far less variation in the noise received at neighbouring properties from this site, than is predicted to be generated from the Turitea wind farm. Further, the predicted noise levels from the Turitea site are comfortably within those that are considered acceptable for continued exposure; the levels are not at the limits of acceptability. I also note the District Plan (or any other document or research I am aware of) does not include the variation of noise over distance as a design criteria for determining acceptability. If it is the variation of levels over a given farm that is of concern, then it needs to be kept in mind the design level is a night time control, which is adopted during the daytime as well. Further, the farm is an industry itself and is likely to generate much higher noise levels itself at times than would ever result from the proposed wind farm.

5.10 It is also incorrect for Mr Lloyd to imply in his paragraph 33 that it is appropriate to have a separate standard for wind farm noise because it cannot be dealt with in the same way as other industrial noise. Clause 1.3 of NZS6808 states:

> *This Standard deals specifically with the measurement of sound from WTGs in the presence of wind, a situation which has high potential for fluctuations and errors due to both increased background sound levels and wind effects at the microphone …*

5.11 Clauses 2.1 and 2.2 go on to state:

> *It has been necessary to develop specific guidelines for the prediction, measurement and assessment of sound from WTGs because the requirements of other acoustic Standards are unsuitable for application to WTGS. These other Standards require the assessment of sound levels in the absence of wind, a situation that does not apply for operating WTGs …*
>
> *The normally applied method for the measurement of sound (set out in NZS 6801) is designed to be applied to measurements in windspeeds below 5m/s. This is not suitable because WTGs operate in windspeeds typically from 4m/s - 30m/s and emit higher sound levels as windspeed increases.*

5.12 This makes it clear that there is a separate Standard for wind farm noise because of difficulties in measurement of that noise, not because of its acceptability, which is closely linked to the research of intrusive noise in the same way as other industrial sounds.

5.13 At paragraph 34, Mr Lloyd expresses surprise that I have said my analysis would not alter if the draft revision of NZS6808 were to be used. I confirm this remains my professional opinion, and do not understand how Mr Lloyd is able to take a different view when he has never asked for the field data regarding the noise and wind conditions in order to make his own assessment in this regard.

5.14 Mr Lloyd has adopted the position that if a sound is more than 10dBA above the background sound it is likely to be unacceptable at times when the background sound levels themselves are low (paragraph 36). As referred to in paragraph 12.8 of my evidence in chief, the Executive Summary (page ix) of the World Health Organization (WHO) document "*Guidelines for Community Noise*" (referenced at paragraph 10.9 of my evidence in chief) states that "*for a good night's sleep, the equivalent sound level should not exceed 30dB(A) for continuous background noise*." This equates to an external level of 45dBA. There is no suggestion a lower background sound warrants a lower noise level, and I consider this should only be the case where the single event sound (L_{max}) is being considered. While NZS6802 previously included a "background sound plus 10dB criterion", this approach was removed from the 2008 version primarily because it was consistently misused.

5.15 Mr Lloyd has stated that paragraph 4.4.4 of NZS6808 provides for the Territorial Authority to specify an alternative compliance level when taking into account individual circumstances (paragraph 37). I note the District Plan has specified wind farms should be assessed in accordance with the requirements of NZS6808 without any exceptions.

5.16 It has been suggested that the results of the wind/noise monitoring should have been separated into day/night periods for analysis (paragraph 42). The results Mr Lloyd refers to constitute the base evaluation. I have also undertaken the noise analysis based on actual wind directions, rather than the artificial design criteria used in the original analysis of the wind blowing toward the receiver position from every turbine (which as outlined in both my original report and evidence in chief, was done to ensure an appropriately conservative assessment). The refined analysis also included day/night separations, such as shown in Figure 2. From this work it has been established that the wind farm can be managed to operate in full compliance with the requirements of NZS6808 at all times.

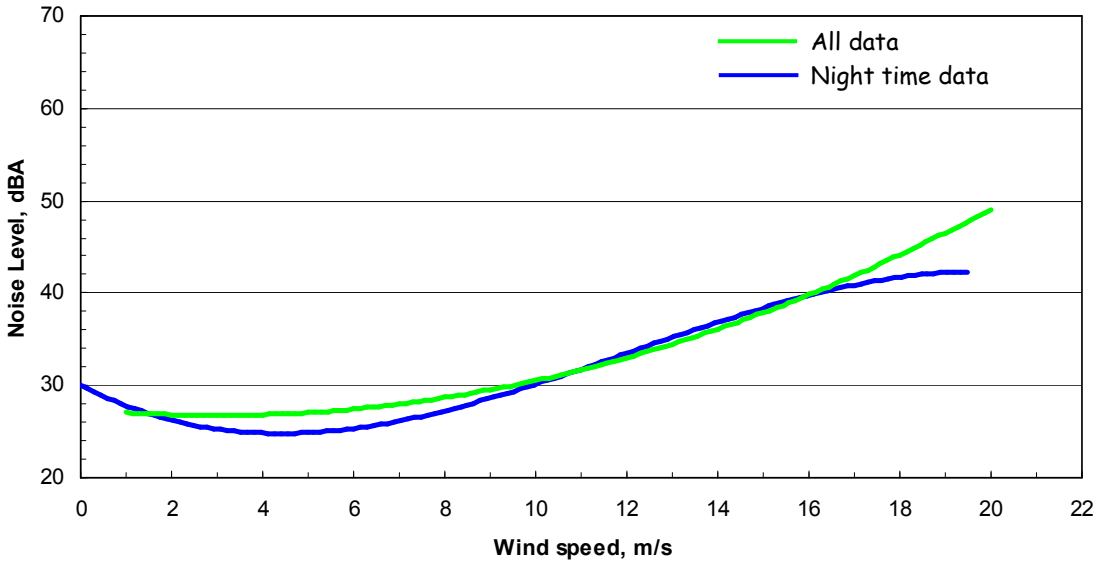

Figure 2. Day/Night effects on Design Level at Marae Site (Adams)

5.17 Mr Lloyd has commented on the differences between the noise predictions undertaken by myself and Mr Day of Marshall Day Acoustics (paragraphs 48 – 56). It is important to understand that noise predictions, regardless of the noise model used, are only

predictions and variations are to be expected. In order to minimise under prediction, which could result in difficulties during construction and operation of a project, I included factors of safety in my modelling which Mr Day did not. This includes modelling the wind blowing from the source (turbine) to the receiver position in every case. This is clearly not what will occur in practice. In simplistic terms there will be less than half of the dwellings downwind at any one time. As noted in Mr Lloyd's evidence (at paragraph 49), I also did not include ground absorption effects as the height of the turbines essentially negates such effects. As a further factor of conservatism, I reduced the effect of barriers after 1km from the source position, as barriers lose their effectiveness with distance.

5.18 There were two monitoring points that required correction due to the proximity of the turbine and its height above the receiver. Otherwise, the main differences between the two models used are not considered to be critical in terms of the accuracy of the predictions they generate. It should also be reiterated that given the conservatism involved in my assessment, actual noise levels are generally expected to be significantly less that those predicted.

5.19 Mr Lloyd also suggests that the Board requires greater certainty as to how the applicant will demonstrate compliance with the proposed conditions (paragraph 89 – 90). The final design criteria will be undertaken considering the wind direction as it actually occurs for the individual directions, rather than the noise radiation into the receiver positions. As already noted, this design approach provides a more accurate understanding of the noise that is likely to be received than the artificial worst case modelled and discussed by Mr Lloyd. However, as also noted above, I do not believe there will be as many affected properties requiring assessment as Mr Lloyd suggests.

5.20 Mr Lloyd has proposed that controls on noise from all activities on site other than wind turbine operation and construction be measured "*at or within the boundary of any site other than the wind farm site*" (page 27 condition 3). In this regard, I note that every New Zealand Standard from 1991 to 2008 has adopted the notional boundary concept (the 1977 Standard did not directly address rural boundaries at all). The aim of noise controls is to protect people at their houses, not people working around the farm, which is classed as an industrial activity. The condition Mr Lloyd has proposed would potentially impose noise controls at boundaries that are over 1km from the associated

residence, where there is also intervening noise attenuation or screening as a result of topography. I consider that such a requirement is both unreasonable and unrealistic.

5.21 In condition 9 (on page 29), Mr Lloyd has recommended that prior to installation of any wind turbine, the applicant be required to provide a report demonstrating that the wind farm will not exceed the relevant Principal and Secondary noise limits. I consider that for the sake of clarity, this condition should be amended by including the words "*as applicable*" at the end.

6. EVIDENCE OF JEFF BAKER

6.1 To the extent Mr Baker comments on matters that are within my area of expertise, I comment as follows.

6.2 At paragraph 51, Mr Baker states that "*the evidence does not demonstrate how the applicant can comply with noise limits other than to suggest it may be necessary to de-rate some turbines. The potentially offending turbines have not been identified in the evidence and it is possible the applicant may need to de-rate a large number of turbines in order to comply*". I disagree that it is likely to be necessary to de-rate a large number of turbines, given the results of the noise predictions (and the conservatism inherent in those) undertaken by both Mr Day and myself. Further, any de-rating would be required during wind conditions that only occur for a small percentage of the time, and would therefore have minimal impact on the operation of the proposed wind farm.

6.2 In my opinion, Mr Baker's suggestion (at paragraph 52) that complying with the noise conditions will require a high level of management, particularly with an easterly wind, appears to be based on incorrect information provided by Mr Lloyd, as outlined in paragraphs 4.1 and 4.2 above.

7. CONCLUSIONS

7.1 I have considered the evidence of Messrs Thorne, Lloyd and Baker. Although they have raised a number of issues with both my assessment methodology and resulting conclusions, the majority of their concerns appear to be based on incorrect information or assumptions.

7.2 I do not consider that anything raised in any of the evidence presented on behalf of submitters has altered the opinions and conclusions I outlined in my original assessment, and my evidence in chief.

Nevil Ian Hegley

5 June 2009