BEFORE THE HEARING COMMISSIONERS
AT PALMERSTON NORTH

IN THE MATTER	of the Resource Management Act 1991 (the Act)
AND	
IN THE MATTER	of a review by **PALMERSTON NORTH CITY COUNCIL** of the conditions of consent for Te Rere Hau Windfarm under section 128 of the Act

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STATEMENT OF EVIDENCE OF MICHAEL MIKLIN HALSTEAD ON BEHALF OF NZ WINDFARMS LIMITED

DATED 25 August 2017

[redacted] ATKINS | HOLM | MAJUREY

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SUMMARY

1. This evidence addresses the acoustical matters relating to the proposed consent conditions which are to control Te Rere Hau (TRH) wind farm noise emissions.

2. The key issues relate to the establishment of high amenity noise limits; the assessment of tonality and amplitude modulation; details of compliance assessment including what noise data and measurement methods may be used; what measurements near turbines are required; when any resulting mitigations are to apply; and how to assess compliance of any new turbines.

3. In general I support most of PNCC's proposed new consent conditions and in particular the move from the older (1998) version of the noise standard NZS6808 to the newer (2010).

4. However there are a number of matters that I disagree with in the proposed conditions, and my view on these matters is as follows:

   (a) the assessment of a high amenity limit should be made at or within the notional boundary of a property;

   (b) the high amenity limit should only apply at wind speeds up to 6 m/s;

   (c) the tonality assessment method described in the revised version of NZS6808:2010 is sufficient to resolve the shortcomings of the original consent condition concerning this matter--the additional stringency of penalising an entire wind condition based on 10% of the corresponding data points exceeding the threshold is unjustified;

   (d) the assessment of amplitude modulation using the methodology described in NZS6808:2010 is adequate;

   (e) previously collected data should be specifically allowed to be used in assessments of compliance which follow from these consent conditions;

   (f) where additional data is to be collected, the methods of NZS6808:2010 including on/off testing should be permitted;

(g) condition 10.4 should be amended to allow the investigators to determine the amount of testing required to establish the complete list of potential tones from turbines;

(h) condition 10.7 should be slightly reworded to recognise that the high amenity limits only apply at night-time; and

(i) condition 12.4 which requires turbines to not exceed the manufacturer's stated sound power level for the turbine is not consistent with the approach to wind farm noise assessment in New Zealand, and should be deleted.

5. In my opinion, given the acoustic environment at TRH, the application of NZS6808:2010 and the conditions proposed by NZ Windfarms (Attachment 1 to the evidence of Mr Low) will adequately control noise emissions from TRH, will ensure unreasonable noise is avoided, and will protect the amenity of the neighbouring community.

INTRODUCTION

Qualifications and Experience

1. My name is Michael Miklin Halstead. I am an Associate with Marshall Day Acoustics.

2. I have the following qualifications and experience relevant to the evidence I shall give:

   (a) I hold a Bachelors degree in Industrial Engineering;

   (b) I am a member of the New Zealand Acoustical Society and the Resource Management Law Association;

   (c) I have had 26 years' experience assessing and advising on the environmental sound effects of various projects, including wind farms, gas production plants, electricity substations and roading projects for corporate, industrial and public sector clients;

   (d) My experience with wind farms includes consenting for the Te Apiti, Waitahora, Castle Hill, and Te Rere Hau Eastern Extension (TRH extension) wind farms, measurements for Tararua 3 and West Wind, compliance monitoring for Te Rere Hau, and research on propagation of wind turbine noise; and

   (e) I served as Chair of the NZS6801-6802 (noise measurement and assessment standards) revision committee, and I was a member of the NZS6808 (wind farm noise) 2010 standard revision committee.

Expert Witness Code of Conduct

3. Although this is a Council hearing I confirm that I have read and agree to comply with the Code of Conduct for Expert Witnesses set out in the Environment Court's Practice Note. This evidence is within my area of expertise except where I have stated that I am relying on the evidence of another person. I have not omitted to consider material facts known to me that might alter or detract from my expressed opinions.

Involvement in project

4. I have been involved with the Te Rere Hau (TRH) wind farm since 2009, when Marshall Day Acoustics (MDA) was engaged to measure the tonality of sound near to residences, to assist with compliance measurements, and to comment on matters of tonality relating to the TRH extension application.

5. That engagement extended in 2011 to measuring noise emission from TRH and the TRH extension, culminating in the preparation of a compliance report dated 18 February 2014. Throughout that time I also participated in the Environment Court proceedings relating to the application for declaration lodged by Palmerston North City Council (PNCC).

6. I have made many visits to the wind farm and to residences in the vicinity of the wind farm. I have spoken with residents at these properties on numerous occasions, and have taken part in an open day where residents toured the wind farm to listen to and comment on noise near the turbines. I have also measured noise from these turbines near to the towers.

Purpose and scope of evidence

7. On this occasion I have been engaged by New Zealand Windfarms Limited (NZ Windfarms) to provide acoustic evidence in relation to the review under section 128 of the Resource Management Act 1991 (Act) by PNCC of the conditions of consent for TRH in Palmerston North.

8. In this evidence I will address the following:

   (a) context and site description;

   (b) the acoustic issues with the conditions proposed by the Council;

   (c) the changes sought by submitters; and

   (d) my conclusion.

CONTEXT AND SITE DESCRIPTION

9. Ninety-six Windflow 500 turbines are in operation across two sites – the original TRH wind farm in Palmerston North (65 turbines) and the adjacent TRH extension in the Tararua District (31 turbines). Following three stages of turbine installation, the 65 turbines on TRH have been in full operation

since 2011. Turbines are located on a complex terrain, typical of wind farms in New Zealand.

10. The land around the windfarm includes forestry, farming, roading, and lifestyle properties. Adjacent wind farms include Tararua (on adjacent land, operating), Te Apiti (across the Gorge, operating) and Turitea (on adjacent land, not yet constructed).

11. Background sound levels have been measured at a number of properties around TRH, and during the night typically experience noise levels between 22 and 35 decibels under calm wind conditions. These noise levels are quieter than one would expect from a suburban area, but not as quiet as the remote rural areas where wind farms are often located. For example, near the proposed Castle Hill wind farm, night-time noise levels would often drop to less than 15 dBA.

12. As wind speeds at TRH wind farm increase, noise from vegetation around the wind farm increases, as does noise from the wind turbines. The relationship between these sources of noise has been described in my report Rp008 R03 2011095W dated 18 February 2014.

13. In that report, compliance with the original noise conditions was tested and discussed. The wind farm is shown to comply with those conditions, although there has been debate over the interpretation of some noise conditions – particularly the method by which the old noise standard intends the assessment of tonality penalty to be imposed.

CONDITIONS

14. In this section I comment on the protection provided by the noise standard, I provide some general comments on wind turbine noise, and I set out the areas of agreement and disagreement and I explain the reasons for my disagreement.

NZS6808:2010 protection

15. In 2010 the New Zealand noise standard dealing with wind turbine noise (NZS6808) was updated. Like the preceding version of NZS6808, the 2010 version states that its methodology is "*intended to avoid adverse noise effects on people caused by the operation of wind farms while enabling sustainable management of natural wind resources*." It goes on to state that: "*the Resource*

Management Act includes a duty to avoid unreasonable noise (section 16). The Act does not require the avoidance of all noise, only noise that is considered unreasonable. The noise limits recommended in this Standard provide a reasonable rather than an absolute level of protection of health and amenity."

16. The approach taken by NZS6808 is consistent with how noise from other sources is evaluated in New Zealand. It is not expected that noise from these sources will be inaudible, but rather that where the noises are audible they are within normally accepted limits. This is to avoid there being an unreasonable constraint on carrying out productive activities. In my opinion NZS6808 sets noise limits and penalty criteria which achieve a reasonable degree of protection of amenity.

17. The standard generally carries forward the same assessment methodology as was used in the 1998 version (which formed the basis for the original TRH consent conditions). However a number of matters were amended to provide clarity and consistency, and to update the standard's application in light of industry best practice. Specific matters which were updated include:

- the division of data points by wind directions;
- the assessment of tonality and imposition of tonality penalties;
- the consideration of amplitude modulation penalties; and
- the circumstances under which high amenity noise limits should be imposed, and what those limits should be – while high amenity limits were permitted in the 1998 version, their implementation (what the limit should be and when it should apply) was not prescribed.

18. These are matters which have arisen in the discussion of the TRH consent conditions, so it is relevant to note that much deliberation has gone into these matters in the course of the standard revision, and that this knowledge can be directly applied to the assessment of TRH wind farm noise simply by requiring the standard to be used in its measurement and assessment.

19. In my opinion any requirements which go beyond what is recommended in NZS6808:2010 should be regarded with caution, as they may shift the balance between noise amenity and productivity in ways which are different to what is normally regarded as reasonable.

Wind turbine noise – general comments

20. Many of the uncertainties which arose during the recent evaluation of noise from TRH were related to issues that have been addressed in the most recent revision of the wind turbine noise standard NZS6808. In my opinion the recommendations of NZS6808:2010 form the best and most applicable New Zealand – specific advice relating to these matters. The clauses of this standard should form the starting point for drafting of noise conditions, and where possible the advice in this standard should be directly applied.

Areas of agreement and disagreement

21. There is a high degree of agreement between NZ Windfarms and PNCC regarding what constitutes a suitable set of conditions. This is the result of a considerable amount of review and consultation between the parties and their noise experts, which I have taken part in.

22. I note that NZ Windfarms have accepted some conditions which are above and beyond what is required in NZS6808:2010, in order to provide noise reductions (and certainty of noise reductions) to neighbours and to the PNCC. These additional constraints come at the expense of productivity, as discussed by Mr Worth.

23. The disputed conditions include:

    (a) Condition 4 – high amenity noise limits;

    (b) Conditions 8.1 and 8.5 – tonality assessment;

    (c) Condition 8.2 – amplitude modulation;

    (d) Condition 10, 10.4 and 10.7 – compliance assessment details; and

    (e) Condition 12.4 – assessment of new turbines.

24. In general these conditions move beyond the advice in NZS6808:2010, and in my opinion this should only be accepted where strong evidence supports a deviation from

the standard. The evidence of Dr Stephen Chiles will specifically address these deviations.

25. In the following sections I present my opinions on these matters, drawing from my direct experience measuring and assessing noise from TRH over the past eight years.

Operating limits – condition 4

26. Condition 4 of the original consent set a noise limit of 40 dB LA95, or 5 decibels above the pre-construction background noise level, whichever is the higher. This measurement and assessment is based on the methodology described in NZS6808:1998, and is a comparison of the regression lines through the pre- and post-construction "noise level vs wind speed" graphs. This methodology is well established and accepted in the assessment of wind farm noise in New Zealand.

27. Condition 4 is proposed to be changed to include a more stringent noise limit for properties which are in the Rural Residential zone as defined in the notified version of Plan Change 15. The more stringent limit is the "high amenity" limit defined in NSZ6808:2010.

28. I disagree that dwellings in this area should be considered "high amenity" and I disagree that a high amenity limit is needed to adequately control noise emission from TRH and protect the amenity of the neighbouring community.

29. In my view the measurement data does not justify a high amenity noise limit. The noise levels are not unusually low, and in almost all cases are significantly affected by wind, and in many cases by other noise sources causing the outliers which locate above the slope of the wind effect. In such situations the standard states (at 5.3.1) "*A high amenity noise limit should not be applied in any location where background sound levels… are already affected by other specific sources, such as road traffic sound*." The area also does not qualify for high amenity status by consideration of the district plan permitted activity noise limit – "*when evening and night-time noise limits in the plan for general sound sources are more stringent than 40 dB* $L_{Aeq(15min)}$ *or 40 dBA* L_{10}".

30. However, I note NZ Windfarms has accepted that a high amenity limit applies to the properties captured by the definition in the notified version of PNCC Plan Change 15.

31. Given this starting point (that a high amenity limit will apply at these properties), I agree that the noise limit described in the new Condition 4 (35 dBA or Background + 5) is the correct limit. However, I have two concerns with the drafting and application of this condition.

32. The condition presently omits reference to the notional boundary as the appropriate assessment point. I consider it is important that this is included in the condition for clarity and for consistency with both NZS6808 and with Condition 5 which includes such a reference in relation to the non-high-amenity limit.

33. The condition imposes the high amenity limit to winds below 8m/s instead of the 6 m/s threshold which is recommended in NZS6808:2010. In my opinion, a change to 8 m/s is not warranted.

34. NZS6808:2010 5.3.2 recommends the wind speed threshold of 6 m/s, but states that justifications based on meteorological, topographical, and acoustical grounds are necessary to justify a different threshold. The justifications provided by Mr Evans do not appear to recognise that wind speeds of even 6 m/s do not correspond to the quietest times at these sites -- (C5.3.2) states that deviations from the recommended threshold would be made if wind speeds higher than 6 m/s "*would generally coincide with the periods of the lowest background sound levels at the noise sensitive locations*." This would be identified by looking for the point on the background noise level vs wind speed curve where noise level starts to increase with wind speed. That is, if the noise level stayed constant as wind speed increased until 8 m/s, but increased after that point, then 8 m/s would be justifiably the wind speed beneath which "*the lowest background noise levels*" occurred.

35. In the background sound level measurements without the turbines operating (illustrated in pages 16 – 26 of MDA Rp 008, Feb 2014), it can be seen that in only one out of 24 cases is this slope non-positive. The one case where this could be said to occur is at 662 Pahiatua-Aokautere Road, under NNW winds. In this case it should be noted that the slope of this line is significantly influenced by several data points which appear to be outliers to the positive slope.

36. The meteorological and topographical influence on the appropriate wind speed threshold in my opinion is not

relevant in this case, given that the consent requirements already divide the assessment into wind direction sectors which account for the influence of the topography and wind direction on the wind/noise relationship.

37. As outlined previously, I do not consider the properties close to TRH to be a high amenity area, nor do I consider that a high amenity noise limit is necessary to adequately control noise emission from TRH and protect the amenity at these properties. To step even further beyond the standard high amenity description (which applies below 6m/s) into a yet more stringent noise limit (applying up to 8m/s) is not supported by the noise standard, and in my opinion is not appropriate. I understand that although the amount of energy generated at these wind speeds is somewhat less than at higher wind speeds, it tends to be "valuable energy" as the overall generation of wind farms nationwide is less under these conditions as explained in the evidence of Mr Worth.

Assessment of tonality – conditions 8.1 and 8.5

38. The methodology of tonality assessment was the primary point of difficulty with the original conditions of consent. The original consent (condition 5(l)) referred to a noise standard for measurement of turbine noise emissions, which did not include a means for determining the threshold at which a tonal penalty would be imposed. It was therefore necessary to adopt an implied threshold from a different methodology (Joint Nordic Method Version 1) to decide how to impose a noise penalty (by imposing a 5 dB penalty in a single step when tonal audibility exceeds a certain value).

39. While this was consistent with the intent of the original NZS6808 section on tonality, it has since been established that a more appropriate penalty is imposed as a sliding scale, where the penalty depends on the audibility of the tone. This penalty scheme has been incorporated in the latest version of NZS6808.

40. Condition 8.1 describes a more stringent version of the method in NZS6808. It is more stringent in that it assesses tones over sub-periods of two minutes out of the 10-minute measurement period which is prescribed in NZS6808. This means that over the course of a 10-minute period, if the tone appears for two minutes and disappears for the next eight, the entire 10-minute period is penalised as if the tone

continued throughout the 10-minute period. While this approach is consistent with the way that tones are identified by the sound power level standard which was referenced in the original consent, it is more stringent than if the entire 10-minute period were analysed, should the tone vary in audibility during this time.

41. Condition 8.5 then adds another layer of conservatism to this methodology, by imposing a tonal penalty on an entire wind speed / wind direction sector if 10% of the data points within the bin are penalised. In my view this circumvents the natural weighting of the penalty, which is intended to reflect the frequency with which a tone occurs. Allowing the penalties to affect the regression line or bin average in this manner is the method described in NZS6808:2010.

42. The effect of basing a penalty on only 10% of data points (which in turn are based on only 20% of the data within each data point) is that in some conditions where wind data is relatively sparse, a single 2-minute period of a tone would penalise an entire year of measurement data. This arises because the data is already so finely divided (by wind speed and wind direction) that each bin contains few points, in many cases fewer than 10.

43. The intention of dividing wind speeds and directions into bins, or wind directions along separate regression lines, is to identify specific conditions where specific noise effects occur. If after all of this specificity it is still the case the tones are only occasionally audible, then in my opinion it is appropriate to impose a weaker penalty than if the tone occurs for the entire period of this wind condition.

44. For this reason I consider that condition 8.5 is unnecessarily conservative, and destroys the sensible scaling of the penalty to the effect, and "double dips" on conservatism given that we already impose a penalty on a 10-minute period as a result of 2 minutes of tonal audibility. I would delete this condition.

Amplitude modulation – condition 8.2

45. Amplitude modulation (the intensity of the swishing sound from blades) is a matter which has recently garnered attention, and was not specifically considered in the original conditions of consent. The assessment of a penalty for unreasonable amplitude modulation (AM) was introduced in

the 2010 version of NZS6808, albeit by recommending an "interim test method".

46. Since that time, refinements have been made by the international community on assessing AM. The proposed conditions require that data be analysed using a new methodology published by the UK Department of Environmental and Climate Change in August 2016.

47. While NZS6808:2010 foresees improved methodologies replacing the interim method, it does not require that any new method developed should immediately do so. The UK method does not yet have a confirmed track record which demonstrates that its penalty has a good relationship with subjective response to AM. I would be uncomfortable seeing a relatively new methodology written into consent conditions, before this method has been adequately tested.

48. I would recommend that the condition be changed to the following:

> *"If the AM threshold described in NZS6808:2010 B3.2 Interim Test Method are exceeded on a regular basis, an adjustment of +5 dB shall be applied to the wind farm sound level at that location for the wind conditions under which the modulation occurs."*

49. I note also that the AM penalty appears to also be subject to condition 8.5, imposing a penalty for an entire wind sector based on 10% of points attracting a penalty. As I discussed earlier in relation to tonal penalties, this would significantly skew the intention of the penalty scheme, particularly in the common cases where few data points exist within a wind sector. The AM penalty requirement in NZS6808:2010 is that a penalty is imposed when AM occurs on a "regularly varying basis", making it clear that it is not occasional occurrences which are to be penalised.

Post amendment noise compliance assessment – conditions 10, 10.4 and 10.7

Condition 10

50. Condition 10 requires that a compliance noise monitoring report shall be submitted to PNCC within 12 months of the conditions being amended. In my opinion, some additional clarification is useful to ensure that this can be done in the most effective and efficient way possible.

51. A very large amount of noise data, relating both to the "turbines off" (background sound levels) and "turbines on"

conditions, has been collected between 2011 and the present. Much of this data is directly applicable to determining whether the existing TRH wind farm complies with the new set of conditions, although in some cases it may need to be processed and presented in different ways than in previous reports relating to the old noise conditions.

52. Nevertheless, to avoid any uncertainty about the admissibility of previously collected data, I recommend that condition 10 is amended to specifically allow the use of previously collected data (provided it meets the requirements of NZS6808:2010 and the consent conditions finally approved).

53. Furthermore, where additional data is to be collected, in my opinion it should be specifically stated that the on/off measurement method described in NZS6808:2010 is one of the tools available for establishing the difference between pre-construction and post-construction noise levels. This is particularly useful where a new measurement site is to be considered, where pre-construction noise levels were not measured prior to establishment of the wind farm.

Condition 10.4

54. In Condition 10.4, it is proposed that "near field tonality assessments shall also consider the wind speeds and wind directions defined in Condition 7."

55. While measurements near to turbines are not relevant to the assessment of compliance under NZS6808:2010, it is useful to know which frequencies are associated with turbine emissions, so that when analysing noise measured at residences, those frequencies can be singled out for closer inspection.

56. I understand that condition 10.4 seeks to ensure that the list of tonal frequencies which are likely to be turbine-related is complete – on the premise that the tones may shift at different wind speeds and when measured at different locations around the base of the turbine.

57. While I agree that a complete list of potential turbine tones is useful, in my opinion it is not necessary to exhaustively consider each integer wind speed and each wind direction, as implied by condition 10.4. Rather, it is useful to observe the relevant range of wind speeds from a range of positions around the turbine. In my experience there is no particular

frequency which occurs at one direction relative to a turbine and not at another – although the intensity may change relative to wind direction.

58. In my opinion it is more reasonable to draw this matter to the investigator's attention by requiring that "the relevant tones are considered" when analysing tonality at the residence, and that the acoustic expert shall take responsibility for ensuring that this is the case.

Condition 10.7

59. Condition 10.7 seeks to apply any necessary mitigations at all times, rather than only at a particular time of day.

60. In respect of mitigations seeking to allow the wind farm to comply with Condition 5 (the noise rule which applies during all hours of the day and at all wind speeds) I agree. The fact that noise measurements are conducted only at night is in aid of measurement accuracy – avoiding contamination from traffic and farming and other noise. If the turbine noise is found to be in excess of the noise limits set in Condition 5 on the basis of these measurements, it is reasonable that the mitigation measures should apply to those wind conditions at all times of the day, unless some extenuating circumstances exist.

61. However I do not agree that this is the case for situations in which the "high amenity" noise limits of Condition 4 are exceeded, if the normal Condition 5 limits are not also exceeded. The High Amenity noise limits only apply at night-time, and any mitigations required to achieve compliance solely with this rule should not need to be applied during daytime hours.

Assessment of new turbines – condition 12.4

62. The proposed consent conditions impose several particular requirements on the process of installing any further turbines on the site (including those which were consented in the original application, but are not yet constructed).

63. The scrutiny over these new turbines is similar to that required of a new wind farm. In the context of the current situation this appears reasonable, and essentially reinforces the requirement that the entire wind farm complies with its noise limits.

64. However Condition 12.4 imposes a significantly different compliance test, which is that the sound power level of the turbine itself must not exceed the sound power indicated in the pre-installation documentation. While this would be a requirement that the developer might impose on the turbine supplier as a matter of internal agreement, it should not be imposed as a consent condition as it does not necessarily relate to noise effects. Noise effects are directly measured by other tests in these conditions at noise sensitive locations.

65. In my opinion this condition should be removed, and instead the determination of compliance is made by Condition 12.5 – carrying out monitoring at noise sensitive locations.

CHANGES SOUGHT BY SUBMITTERS

66. The changes sought by submitters also include some of the matters noted above. In this section I just respond to the additional conditions or changes sought by submitters that I have not specifically addressed above. These include:

(a) Huffman Devey – Criteria for inclusion of data points;

(b) Wallace – Wind sectors, amount of data, infrasound, and wind farm shutdowns; and

(c) Irvine – Mandatory dynamic curtailment.

Huffman Devey – Criteria for inclusion of data points

67. Lee Huffman and Graham Devey raise concern over condition 7.4, which describes the conditions which must be met for a wind farm noise data point to be considered valid. The first point of concern appears to be the words "available for generation", which the submitter proposes to replace with "operating for generation".

68. The term "available for generation" means that the turbine's operating logic will control how it stops and starts in response to wind speed and wind direction. In some wind conditions the turbine may be available for operation, yet not rotating – for instance if the wind speed is too high or too low. These conditions are part of the normal operation of the wind farm, and are valid contributors to the noise vs wind speed relationship, and should be included in the assessment as required by NZS6808:2010.

69. Changing the word "available" to "operating" confuses this issue. Although technically the turbine could be considered

to be "operating" if it is parked as it should be under high or low wind conditions, this is not as clear as saying that the turbine is "available for operation". This term correctly distinguishes this status from the case where the turbine is manually switched off – an intervention to the normal operation of the wind farm, which places it into a condition that should not be considered part of the operating regime to be measured.

70. In my opinion it is more appropriate and clear to retain the wording "available for operation".

71. The submitter also wishes to modify the condition to disallow any measurements made under a "curtailment" condition. The intention of this part of the condition is to acknowledge that, should the assessment of noise indicate that some turbines need to be switched off in order to allow the wind farm to comply, it will then be necessary to measure with these turbines switched off to demonstrate compliance. With the wording as proposed by the submitter, no such measurements would be allowed.

72. The submitter may be concerned that such measurements could be introduced as representing the "unmitigated" wind farm – I agree that this would not be appropriate, and this is addressed in the condition as it stands by requiring that the assessor explicitly state whether a measurement represents such a curtailed state.

73. In my opinion Condition 7.4 adequately describes the conditions which should be met in order to properly represent the wind farm noise output.

74. Finally, I note that the submitter wishes to ensure that measurements at their property are only taken when both of the nearest turbines T103 and T104) are online and available for generation. I agree that this is a reasonable inclusion.

Wallace – Wind sectors, amount of data, infrasound, shutdowns

75. The Wallace submission presents a number of issues, some of which have been addressed above. I address other relevant issues as follows.

Relevant wind directions and number of data points

76. A particular issue which is raised concerns the wind directions during which data is collected, and the number of data

points that should be collected to establish a good representation of the noise vs wind speed relationship.

77. The wind directions that have been required to be considered in the original consent condition relate to the most frequent wind directions experienced at the particular site. This was determined by wind surveys conducted prior to the establishment of the wind farm.

78. In the NZS6808:2010 methodology, it is recommended that the noise expert separate data from different wind directions if this is necessary to separate out different wind/noise behaviours. At Te Rere Hau, the specific 45 degree wind direction sectors do this effectively, but at the cost of increased measurement time and cost.

79. The wind sectors which are not considered represent a small fraction of the wind experienced at the site, and correspondingly a small part of the noise experience by residents. In my opinion, little would be gained from requiring that a minimum number of data points be collected from sectors other than those indicated in the existing consent conditions.

80. I note also that the cost of requiring a minimum number of points to be collected under uncommon conditions extends to the community and the council – in the form of delayed and protracted compliance reports, where certain wind conditions are not forthcoming.

81. In my opinion, a more appropriate approach is to require that data be collected for a reasonable period of time, and divided as necessary to produce a set of distinct, simple wind/noise curves. While the separation of wind directions in the original and proposed consent conditions is more prescriptive than this, I agree that it sets out a reasonable approximation of this division of wind directions and is a workable approach.

82. The minimum number of data points in each sector is less useful, as it forms an arbitrary threshold which invalidates an assessment taken during a period that does not serve up these conditions. However I consider that providing some minimum number of data points does serve to require the assessment period to be extended if a particular wind condition is not sufficiently observed, and the proposed requirement to collect a minimum number of points from

each of the SE sectors does protect residents in what has proven to be a particularly relevant set of circumstances.

Infrasound

83. The submission proposes that infrasound (sound pressure fluctuations which occur at a frequency lower than that detectable by human hearing) should be measured.

84. There have been no suggestions previously that any effects that could be due to infrasound are present – all of the complaints I have reviewed relate to audible noise which is adequately considered by the measurements proposed in NZS6808:2010.

85. NZS6808:2010 (5.5.2) refers to a large body of work that shows that levels of infrasound produced by wind farms is well below the levels that can affect human health, and recommends that no controls on infrasound from wind farms are necessary or desirable.

86. I note that the submitter is not recommending any particular action be taken with respect to infrasound except to measure baseline levels. This would incur a cost to the developer which does not in, my opinion, offer any benefit to residents. I therefore do not consider any conditions addressing infrasound are required.

Wind Farm Shutdowns

87. The submitter suggests that half the wind farm should be shut down under high wind speed conditions (although the context of the section suggests it may intend to refer to lower wind speeds). Additionally, the submission suggests that half the wind farm could be shut down automatically in response to phoned-in complaints.

88. I note that neither of these suggestions appears to be related to objective sound levels, and instead base curtailment on audibility or subjective response. This is not consistent with the effects based approach of the Act and the noise standard.

89. I note however that there are ongoing engagements between the current management of NZ Windfarms and the community, in an effort to find ways to lessen the times when the wind farm operates in high-audibility / low productivity periods. These matters are outlined further in the evidence of Mr Worth. This effort may result in achieving some of the

additional benefits the submitter seeks in this section; however as it steps outside the objective structure of the Act and NZS6808:2010, in my opinion it should not be a matter included in the consent conditions.

Irvin – Mandatory dynamic curtailment

90. The Irvin submission refers to the voluntary curtailment efforts that NZ Windfarms are currently trialling, and suggests that it should be incorporated into the consent conditions, along with several suggestions on how it should be implemented.

91. In my opinion, the controls recommended in NZS6808:2010 deliver the appropriate balance between noise amenity and productivity of the wind resource, and it is these limits which should be enforced by the consent conditions.

92. I note that the curtailments that NZ Windfarms are trialling are seeking to provide lower-than-required noise levels to residents at times that are mutually agreeable, and I consider this to be a commendable approach which I actively support. However I do not believe this should be confused with the process of striking the balance of amenity vs productivity that is required under the Act.

CONCLUSION

93. In general I support the most of PNCC's proposed new consent conditions and in particular the move from the older (1998) version of the noise standard NZS6808 to the newer (2010).

94. While I consider that a simple application of NZS6808:2010 provides adequate protection to the noise amenity of a community near a wind farm, I recognise that in this case there is a history of particular issues, tied to particular noise conditions, that benefit from being specifically addressed through updated noise conditions.

95. I have discussed a number of matters that I disagree with in the proposed conditions as follows:

    (a) Setting aside my objection to the area being considered "high amenity", I note that the assessment of a high amenity limit should be made at the notional boundary of a property, and that the high amenity limit should only apply at wind speeds up to 6 m/s as recommended by NZS6808:2010. The evidence presented in support of a higher wind

speed threshold does not in my opinion address the issue of "protecting the quietest situations" that is intended in the standard.

(b) On the assessment of tonality, I am of the opinion that the method described in the revised version of NZS6808:2010 is sufficient to resolve the shortcomings of the original consent condition concerning this matter. In my opinion that additional stringency imposed by Mr Evans' suggestion of penalising an entire wind condition based on 10% of the corresponding data points exceeding the threshold is unjustified, and does not allow the penalty to reflect the severity of the tonal audibility.

(c) The method of amplitude modulation assessment that has been recommended may prove to be effective, but as a new and unproven methodology I am of the opinion it is yet proven to a degree that warrants its use in New Zealand consent conditions. In my opinion this matter is adequately addressed using the methodology described in NZS6808:2010.

(d) To allow efficient and reasonable execution of the compliance assessment, previously collected data should be specifically allowed to be used. Where additional data is to be collected, the methods of NZS6808:2010 including on/off testing should be permitted, in in my opinion these matters should be specifically referenced in Condition 10.

(e) While I agree that all of the relevant tones being emitted by the turbines should be considered in tonality assessment, I am not of the opinion that it is necessary to exhaustively measure in all wind directions near to a turbine to determine what these are, and I believe that condition 10.4 should be relaxed to allow the investigators to carry out what they consider to be a sufficient amount of testing to establish this.

(f) The wording in Condition 10.7 should be slightly reworded to recognise that the high amenity limits only apply at night-time.

(g) In assessing the noise effects from any new turbines, the same tests should be used as required for the existing wind farm (or any other wind farm in New

Zealand). The proposed requirement in condition 12.4 to not exceed the manufacturer's stated sound power level for the turbine is not consistent with the approach to wind farm noise assessment in New Zealand, and should be deleted.

96. In my opinion, given the acoustic environment at TRH, the application of NZS6808:2010 and the conditions proposed by NZ Windfarms (Attachment 1 to the evidence of Mr Low) will adequately control noise emissions from TRH, will ensure unreasonable noise is avoided, and will protect the amenity of the neighbouring community.

Michael Miklin Halstead

25 August 2017