

**SECOND AGREEMENT REACHED AT ACOUSTIC EXPERT CAUCUSING 22  
MARCH 2010**

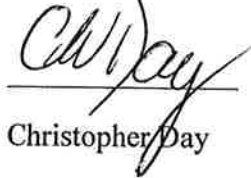
Lloyd, Hegley and Day have reviewed the new set of conditions provided by Dr Thorne on 22 March (evening) and find they are not in accordance with NZS6808:2010. The wording was difficult to understand and we cannot agree to them at this point.



Nigel Lloyd



Nevil Hegley



Christopher Day



## **Turitea Wind Farm Noise Management Conditions**

**On behalf of Huatau Marae**

### **Introduction**

The following model wind farm noise management conditions have been prepared on the basis of evidence given in different Hearings in New South Wales, Victoria and New Zealand, the Report of the New South Wales Parliament General Purpose Standing Committee No 5 'Rural Wind Farms' with respect to the unique characteristics of wind farm sound emissions, monitoring and compliance, various statutory delegation authorities, the Environment Protection and Heritage Council draft guidelines, relevant wind farm codes/guidelines/standards and Conditions of Approval for New South Wales, Victoria, South Australia, Queensland and New Zealand.

The Conditions provide an administrative process for certainty in application and addresses the primary question: "how can a noise complaint be satisfied?".

Condition 1 establishes a 2000 metres prohibition zone between wind turbines and dwellings or noise sensitive places.

Condition 2 establishes a 3500 metre buffer zone for noise mitigation between wind turbines and dwellings or noise sensitive places.

Condition 3 provides for circumstances when conditions 1 and 2 do not apply.

Condition 4 establishes the relevant operational noise criteria. The approach taken is by setting specific compliance levels. Different criteria are applied.

- The compliance levels are a equivalent continuous sound level (LAeq) of 35 dB(A) or the representative pre-installation measured background level plus 5 dB(A), whichever is the greater.
- Compliance is applied for times of calm or light breeze at a dwelling with an actual measured equivalent continuous sound level (LAeq) of 30 dB(A) or background level of 30 dB(A), whichever is the greater.

- A penalty for special ~~audible~~ characteristics apply in each case. If the sound has modulation, tonality or impulsive character the compliance criterion is reduced by 5 dB.

Condition 5 provides for circumstances when condition 4 and condition 6 do not apply.

Conditions 6 to 9 deal with stopping and removing turbines due to unreasonable noise using a demerit points system. The issue of abatement notices and enforcement orders are provided for. The turbines can be stopped by way of enforcement order served by either the Authorised Council Officer or an affected party.

Conditions 10 and 11 deal with noise mitigation of a dwelling or noise sensitive place.

Condition 12 provides definitions. The Authorised Council Officer is an enforcement officer of Council for these conditions and undertakes pre-installation and compliance monitoring. The Authorised Council Officer is independent of Council to allow the person to undertake the oversight necessary without the appearance of being influenced by any party.

Conditions 13 to 17 establish a Community Liaison Committee assisting the Authorised Council Officer for 2 years after the approval date of the wind farm. Strict performance conditions apply to the Authorised Council Officer.

Condition 18 establishes the broad parameters for a Noise Compliance Plan. The actual and reasonable costs are charged to the wind farm operator.

Conditions 19 to 22 provide for management of construction noise.

Conditions 23 to 25 provide for the management of operational noise, other than turbine or construction noise.

Conditions 26 to 29 provide for the assessment of special audible characteristics.

Condition 30 and 31 provide for the management of vibration.

Condition 32 provides for pre-installation prediction of sound levels. This condition takes the approach that prediction is required to assess the possibility that wind farm noise will exceed the requirements of Condition 4.

Condition 33 provides for 12 months' of sound level surveys prior to any work starting on the wind farm. An affected zone of 3500 metres from the wind farm turbines is to be considered.

Conditions 34 to 40 provide for post-installation testing of sound levels from the wind farm.

Conditions 41 to 44 provide for continuous monitoring in locations approved by the Community Liaison Committee. The data from each monitoring station shall be available in real-time with automated analysis and display functions at the office of the Authorised Council Officer.

Condition 45 states sound monitoring measurement standards.

Conditions 46 to 48 provide for the reporting of analysed results. The analysed results are presented to show how noise levels are compared between the pre-installation, post-installation, and complaint noise levels to wind speed and direction, at the turbines and dwelling(s). The wind farm noise and wind data will be summarised and posted on the [Council] website within 14 days of each month.

## **WIND FARM NOISE MANAGEMENT CONDITIONS**

### **Wind Farm Operational Buffer Zones**

1. No wind turbine shall be installed within 2000 metres of any dwelling or noise sensitive place existing as at 1 January 2009.

2. No wind turbine shall be operated within 3500 metres of any dwelling or noise sensitive place existing as at 1 January 2009 unless the operator of the wind farm facility, at its own expense, mitigates any noise within the dwelling or noise sensitive place identified as being from that wind farm facility, to a level that is acceptable to the landowner of that dwelling or noise sensitive place.

3. Conditions 1 and 2 do not apply where the landowner of any dwelling or noise sensitive place has given written agreement for the development, or has explicitly waived their rights under Condition 2 in writing. This waiver or agreement shall only affect successors in title to the landowner where an appropriate covenant has been duly registered against the title of the land to which the dwelling or noise sensitive place is attached.

#### **Operational Noise (Turbines) Conditions**

4. The operation of the wind farm facility must comply with these conditions in relation to any dwelling or noise sensitive place existing at 1 January 2010. In determining compliance the following apply:

(a) The operation of the wind farm facility shall be maintained at all times to prevent noise that is unreasonable, annoying, disturbing to the quiet enjoyment or objectionable or injurious to personal comfort including sleep disturbance of persons residing in the locale. To avoid any dispute, noise from the wind farm facility that is the subject of complaint as being unreasonable, annoying, disturbing to the quiet enjoyment or objectionable or injurious to personal comfort including sleep disturbance of a person is a breach of this condition.

(b) When ground level wind speeds are above an average 3 metres/second within the notional boundary of a dwelling or noise sensitive place, the sound level from the proposed wind farm energy facility, measured as the equivalent continuous A-weighted sound level (LAeq) over any 10 minute period within the notional boundary of a dwelling or noise sensitive place, at any of the nominated wind speeds, shall not exceed the representative pre-installation measured equivalent continuous sound level (LAeq) of 35 dBA, or the

representative pre-installation measured background sound level (LA90) by more than 5 dBA, whichever is the greater.

(c) When ground level wind speeds are below an average 3 metres/second within the notional boundary of a dwelling or noise sensitive place, wind turbine sound levels shall be measured as being the actual equivalent continuous A-weighted sound level (LAeq) including both the ambient sound levels and the wind farm sound levels as one combined sound level. The combined sound level when measured over any 10 minute period within the notional boundary of a dwelling or noise sensitive place shall not exceed the actual measured equivalent continuous sound level (LAeq) of 30 dBA.

(d) Compliance at night must be separately assessed with regard to night-time data. For these purposes the night is defined as 10:00pm to 7:00am. For sleep protection purposes sound levels exceeding the levels set out condition 4(b) or condition 4(c), for 10% of the night, is a breach of the condition.

(e) When wind farm sound has a special ~~audible~~ characteristic such as modulation, tonality or impulsiveness the sound level criterion of condition 4(b) or 4(c) measured over any 10 minute period within the notional boundary a dwelling or noise sensitive place shall be reduced by 5 dB. Sound levels exceeding the levels set out condition 4(b) or condition 4(c), with the penalty included, is a breach of the condition.

(f) To avoid any dispute, a change in the measured unweighted LZeq turbine sound level of more than 3dB (represented by a rise and subsequent fall in peak-to-trough sound energy levels each of more than 3dB) occurring within a 2 second period not less than 5 times in any one minute and 6 minutes in any hour is an unreasonable special ~~audible~~ characteristic.

5. Condition 4 and condition 6 do not apply:

(a) to any dwellings and noise sensitive places where an agreement has been reached with the relevant landowner whereby the landowner accepts predicted noise levels and / or appropriate acoustic attenuation measures are installed for the landowner to ensure a reasonable level of acoustic amenity in relation to indoor habitable areas of any dwelling, and acknowledges that the

operation of the wind farm facility may still generate noise which may from time to time exceed the criteria stated in these conditions.

(b) To the dwellings or noise sensitive places on land on which the turbines are erected and where the dwellings or noise sensitive places are occupied by the persons deriving rent from turbines on the land and their immediate family or persons employed by the wind farm operator and their immediate family.

(c) The agreement in Condition 5(a) may not be transferred to successive landowners of the dwelling or noise sensitive place without their express agreement in writing.

(d) Under Condition 5(a) the wind farm operator warrants that the predicted noise levels and effects presented to the landowner are a true and accurate reflection of the likely noise levels under all representative meteorological conditions for that wind farm.

#### **Turbine shut-down due to noise**

6. Where a complaint that wind farm noise is unreasonable, annoying, disturbing to quiet enjoyment or objectionable or injurious to personal comfort including sleep disturbance is received by the Authorised Council Officer or when condition 4 is found to have been breached in any part the Authorised Council Officer shall within 24-hours of the complaint or breach notify the wind farm facility operator, with a request to show cause why it should continue to operate that turbine or facility given the apparent breach. The wind farm operator shall also provide the relevant meteorological circumstances at the time of the complaint or breach and to reduce the noise from the operation of the relevant turbine or turbines in such circumstances. The wind farm operator shall provide the wind data and identify the relevant turbine(s) within 24-hours of the request. The Authorised Council Officer shall, within 24-hours of notifying the wind farm facility operator of the request, also advise in writing the person(s) making the complaint a summary of the meteorological conditions, identify the relevant turbine(s) and state the action taken. Failure to reply to a show cause notice based on a complaint is accorded 10 demerit points. Failure to provide complete information is accorded 10 demerit points.

7. In circumstances where thirty (30) demerit points have been recorded concerning the same turbine or turbines or breach in similar circumstances, within 24 hours of the complaint being received that satisfies thirty (30)

demerit points, the Authorised Council Officer shall notify the wind farm facility operator with a request to selectively shut down the operation of the relevant turbine or turbines in those circumstances. The request will be complied with within 48 hours of service of the notice. If sound emissions cannot be reduced such that they comply then, subject to further complaint resulting in a total fifty (50) demerit points, the Authorised Council Officer shall issue an abatement notice lodged pursuant to the Resource Management Act 1991 by requiring the operator of the wind farm facility to immediately cease to operate the noncompliant wind turbine(s) until modifications are made and certified to reduce the noise. Further operation of non-compliant wind turbine(s) shall only be for sound measurement checks as specifically agreed with the Authorised Council Officer to demonstrate compliance. The Authorised Council Officer, within 24-hours of serving an abatement notice on the wind farm facility operator, shall advise in writing the person(s) making the complaint of the action taken.

8. In circumstances where one hundred (100) demerit points have been recorded concerning the same turbine or turbines or breach in similar circumstances, the relevant turbine(s) shall be stopped and decommissioned within one month of notification by the Authorised Council Officer, or removed. The Authorised Council Officer, within 24-hours of serving notice on the wind farm facility operator, shall advise in writing the persons making the complaint of the action taken. Failure to comply with the notification shall be subject to an enforcement order lodged pursuant to the Resource Management Act 1991 by the Authorised Council Officer or affected party. A condition of the enforcement order shall be that the relevant turbine(s) shall be stopped from the date of the enforcement order.

9. In determining whether the sound from the wind farm facility is unreasonable, annoying, disturbing to quiet enjoyment or objectionable or injurious to personal comfort including sleep disturbance, regard must not be had to the number of persons affected or that may be affected by such sound. For the purposes of condition 6, a complaint from an affected resident shall be taken as a complaint notified by the Authorised Council Officer.

## **Noise Mitigation**

10. In applying Condition 2, the owner of the dwelling or noise sensitive place shall provide a noise assessment and building design report to the operator of the wind farm facility. The report shall be prepared by a suitably qualified person appointed by the owner of the dwelling or noise sensitive place. The report shall state the noise at issue, the acceptable level to be achieved and the remedial matters that must be undertaken. The report shall establish objective and measurable remedial mitigation and shall be subject to mediation if agreement cannot be reached between the parties. The report shall be lodged with the appropriate Council as part of the property documentation. The operator of the wind farm facility shall be responsible for the payment of the actual and reasonable cost of the report. The mitigation work shall be completed within 3 month's of the report being received by the operator of the wind farm, or such longer time as may be agreed between the landowner and the operator.

11. The mitigation work shall be certified as being complete by the person who prepared the report pursuant to Condition 10. Certification shall not be final until the owner of the dwelling or noise sensitive place has formally stated in writing that the acceptable level of mitigation required has been satisfactorily completed. This shall be an evidence based comparison of before and after measures. The report shall be lodged with the appropriate Council as part of the property documentation.

### **12. Definitions.**

"Abatement notice" is a notice served by the Authorised Council Officer pursuant to the Resource Management Act 1991.

"Authorised Council Officer" means a qualified acoustics enforcement officer employed by the Council to:

- (a) perform independent compliance monitoring and transparent reporting of results to all parties;
- (b) perform pre installation and post installation sound level measurements and calibrated level sound meter recordings;
- (c) audit compliance with these conditions;

- (d) to issue abatement notices and enforcement orders, and
- (e) The acoustics enforcement officer shall not be engaged in or be available for any work for organizations seeking wind farm consents or other such consents.

"Class 1 instrumentation" means a sound level meter meeting the Class 1 requirements of IEC 61672-1:2002 *Electroacoustics-Sound Level Meters-Part 1: Specifications* or such other relevant standard.

"Council" means the territorial local government in whose district the wind farm facility is primarily situated, being the Palmerston North City Council.

"Enforcement Officer" is the Authorised Council Officer.

"Enforcement order" is an order served by the Authorized Council Officer pursuant to the Resource Management Act 1991.

"existing" means physically constructed and able to be habited, or holding all land use authorities or consents necessary for future construction and habitation.

"landowner" is the person in legal possession of a dwelling or noise sensitive place, and was the person in legal possession of that dwelling or noise sensitive place, as at 1 January 2009. "landowner" may include the successors in title, and the agents to that owner except where specifically excluded by a Condition of these Conditions.

"Noise" means unwanted sound and includes vibration.

"Noise sensitive place" includes a dwelling, marae, retreat, hotel, motel, child care centre, educational institution, hospital or private workplace. "dwelling" and "noise sensitive place" shall have their natural meanings in law and will include only legally established dwellings or noise sensitive places. References to adverse affects on dwellings and noise sensitive places refer to adverse affects on the occupiers, residents or tenants of those dwellings or noise sensitive places.

"Notional boundary" is defined as a line 20 metres from any side of a dwelling or noise sensitive place or the legal boundary where this is closer to the dwelling.

"Qualified" means a person with suitable technical qualifications and experience, consistent with membership of an appropriate acoustical society or similar professional body.

"real-time" means the time period as the sound under investigation occurs.

"Relevant Community Organisation(s)" means the lead community organisation(s) representing the community at the wind farm approval hearing; being Huatau Marae.

"relevant meteorological data" includes wind direction, wind speed, temperature, humidity, air pressure and meteorological conditions as determined by the Authorised Officer as being necessary to assess background levels or compliance. Such data to be measured at the stations maintained by the operator at the wind farm and specified assessment locations.

"relevant turbine data" includes a statement as to the operational status of the turbine including whether it was operating or on standby, in a noise reduction mode, or such other relevant information determined by the Authorised Officer as being necessary to assess background levels or compliance.

"Unreasonable noise" is a sound or vibration that is:

- (i) annoying to a reasonable person;
- (ii) injurious to personal comfort or health, including sleep disturbance;
- (iii) a disturbance to the quiet enjoyment of land including the grazing of stock or keeping of animals;
- (iv) observed to have a detrimental affect on wildlife or the environment.

#### **Authorised Council Officer and Community Liaison Committee**

13. The Authorised Council Officer shall be appointed within two month's of date of consent being given for the wind farm facility. The Council, as a charge to the wind farm facility, shall be responsible for the remuneration and actual and reasonable expenses of the Authorised Council Officer including all instrumentation, plant, equipment and such staff as necessary to implement these Conditions as they apply to the Authorised Council Officer. As a condition of appointment the Authorised Council Officer may be appointed on a part-time, full-time or contracted period.

14. The Council shall, as a charge to the wind farm facility, in association with the representatives of the community groups who presented evidence at the Hearing appoint for a term of 24-months a Community Liaison Committee within two month's of date of consent being given for the wind farm facility. The Community Liaison Committee members and co-opted technical experts shall be remunerated at an hourly rate for work done plus actual and

reasonable expenses as for Council Committee Chairpersons or equivalent. The purpose of the Community Liaison Committee is to assist the Authorised Council Officer to prepare and implement the Noise Compliance Plan. The Council shall appoint 1 member, the operator of the wind farm facility shall appoint 1 member and the Relevant Community Organisation(s) shall appoint 1 member. A community group member cannot be any person who benefits directly from royalties or other financial benefits from the turbines, or lease of land for the turbines or the transmission lines.

15. Unless otherwise agreed, the Committee shall meet on the 4<sup>th</sup> Wednesday of each month. Additional support representatives, such as technical experts, may be co-opted by any party to any meeting. Such co-opted persons may be heard but will not have voting authority.

16. The person nominated to the Community Liaison Committee shall be responsible for ensuring:

- (a) Liaison with residents;
- (b) Overseeing assessment procedures;
- (c) Receiving and actioning complaints;
- (d) Development and continuing implementation of the Noise Compliance Plan.

17. The Authorised Council officer is responsible to both the Environment Court and the Council for the enforcement of these Conditions. The Chief Executive Officer shall develop a performance review process in association with the Authorised Council Officer. If three or more non-vexatious complaints are received in any one year by Council's Chief Executive Officer concerning the failure of the Authorised Council Officer to enforce these conditions then the person shall receive formal counselling and a formal warning that further non-performance will result in employment being terminated immediately.

#### **Noise Compliance Plan**

18. Prior to the commencement of the wind farm the Authorised Council Officer, in association with the wind farm facility operator, shall prepare and implement a Noise Compliance Plan to determine compliance with these Conditions. The operator of the wind farm facility shall pay all actual and

reasonable costs associated with the purchase and maintenance of instrumentation, pre- and post installation background measurements, continuous sound level monitoring and compliance testing including the instrumentation and the expenses of the Authorised Council Officer and associated staff. The Noise Compliance Plan shall not contain any item that may in any way modify or negate the intent of these Conditions. The Noise Compliance Plan shall include, but not be limited to, the following:

- (a) A methodology or methodologies to implement Condition 4;
- (b) A methodology for the implementation of a mechanism to stop the wind turbine generators to ensure compliance with Condition 6;
- (c) Assessing periods of low background sound conditions to ensure the derived regression curves are appropriate;
- (d) An assessment of the contribution to the overall sound levels from individual wind turbine generators;
- (e) A methodology or methodologies to implement the assessment and remedies for of special audible characteristics as they occur within real-time and affect residents;

Note: "real-time" means the time period as the sound under investigation occurs.

- (f) An assessment, on a regular basis, of potential or actual reported adverse health effects due to wind noise;
- (g) A construction Noise Compliance Plan;
- (h) An operational (non-turbine) Noise Compliance Plan;
- (i) Noise mitigation by building design to noise sensitive places;
- (j) Continued assessment of the control measures to judge the success and to update where more information provides for improvement in noise management or technical measures;
- (k) A complaint response process so the wind farm facility operator can respond immediately, day or night, to complaint about wind turbine noise. The response process shall include procedures to mitigate noise including immediately shutting down turbines.

#### **Construction Noise Criteria**

19. The construction noise limits at the notional boundary of any dwelling or noise sensitive place that has not given written approval for the development shall be the upper limits set out in Table 1 of this section. The measurement

+5dB for tonality shall be applied if the level ( $L_{eq}$ ) in any one third octave band exceeds the arithmetic mean of the  $L_{eq}$  levels in the two adjacent bands by more than the values given in Table 3.

Table 3 – One-Third Octave Band Level Differences

One-third octave band	Level difference
25 - 125Hz	12dB
160 - 400Hz	8dB
500 - 10,000Hz	5dB

28. In cases where this analysis does not result in a tonal component being defined although the sound is perceived as being tonal it will be necessary to undertake a narrow band analysis in order to determine if a sound is tonal using International Standard ISO 1996-2 second edition, *Acoustics - description, assessment and measurement of environmental noise - part 2: Determination of environmental noise levels*.

29. Additional tests for modulation may include:

- (a) if the measured peak to trough amplitude of the complex under investigation measured at a sampling rate of 50 milliseconds or 125 milliseconds, for example, exceeds 3 dB on a regularly varying basis, or
- (b) if modulated spectral characteristics of the complex under investigation exhibit an audible frequency variation of 1 Hz to 4 Hz, for example, on a regularly varying basis, or a combination of both. Note: "modulation" is defined as being a periodic change in the salience, amplitude or frequency of a sound (beating). A +5dB penalty shall apply if modulation is present.

#### Assessment of Vibration Effects

30. When vibration within a dwelling or noise sensitive place is attributed to a wind farm the condition shall be assessed in accordance with British Standard *BS6472:1992 Evaluation of human exposure to vibration in buildings (1 Hz to 80 Hz)* and *Assessing Vibration: a technical guideline* published by the New South Wales Department of Environment and Conservation, 2006, or their successors. A vibration dose value of  $0.26 \text{ m/s}^{1.75}$  at night shall be the criterion

level above which mitigation measures must be implemented by the wind farm operator.

31. Vibration assessment shall be made by a person or persons competent in the speciality of vibration measurement as a technical expert assisting the Authorised Council Officer.

#### **Pre-Installation Noise Prediction**

32. Prior to the installation of any wind turbine generator the consent holder shall furnish to the Authorised Council Officer:

(a) An acoustic emissions report to the Council for each of the selected wind turbine generators. The report shall be in accordance with *IEC6140011, 2002 Wind Turbine Generators Part 11, Acoustic noise measurement techniques* and shall include the A-weighted sound power levels, spectra, and tonality at integer wind speeds from 6-10 m/s and up to 95% of rated power for each type and mode of the wind turbine(s) to be installed.

(b) A noise prediction report and risk assessment from a suitably qualified and experienced person or persons who have not acted for any wind farm applicant to the whether the sound levels will comply with Condition 4. All assumptions, including modes of operation and the type of turbine, representative annual meteorological conditions (different wind directions, stable conditions at receivers, inversion conditions and day / night variations) must be included in the predictions.

(c) The report shall include calculations of the LAeq sound level from the wind farm under operational conditions at all dwellings or noise sensitive places existing at 1 January 2010 within 3500 metres of the wind farm. A representative sound level contour of the 35 dBA LAeq sound levels shall be produced.

(d) The report shall include an assessment of the risk of adverse sound character from wake and turbulence effects where the proposed turbines are situated within 10 rotor diameters of each other.

(e) The report shall include tower vibration and resonance assessment of the wind farm at representative dwellings or noise sensitive places within 500 metres of the nearest turbines within the wind farm facility.

### **Pre Instalment Measurements**

33. Prior to any construction commencing of the wind farm facility or roading network, the Authorised Council Officer shall undertake not less than 12-months background sound and ambient wind speed and direction monitoring after the date of the consent at not less than 8 dwellings or noise sensitive places within 3500 metres of the proposed outermost turbine locations. The dwellings or noise sensitive places shall be chosen from properties not owned by, or leased by, the wind farm operator. The wind farm sound levels shall be measured as follows:

- (a) The 10 minute equivalent continuous (LAeq) and background (LA90) sound levels shall be measured within the notional boundary of a dwelling or noise sensitive place. The background sound level at a monitoring location should be representative of the sound character of the locale as a whole. Depending on topography and the location of ambient sound generators such as streams and vegetation in the area this distance of 20 metres may be varied.
- (b) In addition, measurement locations shall also be selected for all dwellings or noise sensitive places within the predicted 35dBA LAeq sound level contour. Sound level monitoring shall be for a period of not less than 10 weeks spaced over the 12 month period.
- (c) Ten-minute average wind speed and wind direction data at the wind farm shall be referenced to the hub height of the wind turbines and wind speed measurements shall be recorded at the same time as 10 minute equivalent continuous (LAeq) and background (LA90) measurements and the representative dwellings or noise sensitive places.
- (d) Ten-minute average ground level wind speed and direction measurements shall be recorded in the vicinity of the dwelling or noise sensitive place at the same time as 10 minute equivalent continuous (LAeq) and background (LA90) sound level measurements. Sound levels at a dwelling or noise sensitive place shall be correlated with wind speed at the wind farm and at the dwelling or noise sensitive place. 'Ground level' means a height of 10 metres or 3.5 metres above existing ground level.
- (e) Sufficient data must be collected to assess the following:
  - Operation wind speeds of the wind turbines from the cut-in wind speed (nominally 3 m/s) up to the related power wind speed (nominally 15 m/s) at the wind farm;

- The prevailing wind directions at the wind farm [specify wind directions in degrees];
- Temperature profiles from wind farm to monitored dwellings or noise sensitive places;
- The possibility of wind shear effects modifying audible sound character;
- The possibility of increased sound levels due to temperature inversion effects;
- The best-fit regression curves for day (7am to 6pm), evening (6pm to 10pm) and night (10pm to 7am) hours on a weekly basis for the whole 12 months
- Sound level data as LA90 and LAeq levels in overall 10 minute intervals; LAeq 125 ms data for the whole time period and LZeq one-third octave bands over the range 8 Hz to 16,000 Hz in 10 minute intervals.

(f) Care will be taken to eliminate periods of contamination of the noise data by other noise sources, i.e. seasonal cicadas, crickets, frogs, rainfall periods, etc.

(g) As background monitoring takes place at each site the wind farm operator shall provide to the Authorised Council Officer, before the 7th day of each month, the raw results of wind monitoring from the previous month that will allow the Authorised Council Officer to undertake analysis and assessment of the results.

(h) The Authorised Council Officer shall provide a report detailing the pre-installation testing to the Council, wind farm facility operator and the owner of the respective monitoring location within 14 days of the end of each month. The report must be written in plain English and formatted for reading by lay people and contain, as a minimum:

- The 10-minute measured A-weighted background (LA90) sound levels and A-weighted equivalent continuous (LAeq) sound from each monitoring location;
- The 10-minute wind speed and direction at the wind farm and at each monitoring location; and
- An assessment for each monitoring location of the detail required in 33(e).

#### **Post Installation Testing**

34. Post installation compliance testing of the wind farm shall commence by the Authorised Council Officer commencing as each turbine is installed and commissioned. If possible the testing shall be carried out at the same locations as the background sound monitoring or, if that position is not available, then at a nearby location where the background sound monitoring is still representative.

35. The same parameters as in Condition 33 required for the background noise monitoring shall also be measured for the post installation compliance testing. The cut-in operation times of the wind turbine generators shall also be recorded and this shall be indicated on the results.

36. The best fit regression curves shall be provided in accordance with Condition 33.

37. As compliance testing takes place at each site the Authorised Council Officer shall provide, before the 14th day of each month, the raw results of noise monitoring from the previous month to the wind farm operator in a form that will allow the wind farm operator to undertake its own analysis and assessment of the results should the wind farm operator choose to do so.

38. The Authorised Council Officer may reasonably direct testing to take place at any location.

39. Nothing in these conditions shall prevent compliance monitoring of wind farm noise from being undertaken at any wind speed and direction or time of day.

40. Compliance testing shall be carried out by the Authorised Council Officer to investigate complaints regarding noise from the wind farm or any change in the character of the noise emanating from the wind turbine generators.

#### **Compliance Monitoring**

41. Continuous sound level monitoring shall be undertaken over the life of the wind farm facility at a minimum of 4 measurement locations which are representative of the dwellings or noise sensitive places existing at 1 January

2009. These measurement locations are to be agreed with the Authorised Council Officer and the operator of the wind farm facility. Measurements shall be made in accordance with the requirements of Condition 4 and the requirements contained within the 'Pre' and 'Post-installation Testing' conditions for these agreed locations. Each continuous monitoring station shall record continuous monitoring of ground vibration in accordance with condition 30.

42. The data from each continuous monitoring station from the date of commissioning the first turbine within 3500 metres of the station shall be available in real-time with automated analysis and display functions at the office of the Authorised Council Officer. Real-time audio capability shall allow a sound to be heard as it occurs and shall allow for the capture, recording and analysis of nuisance conditions relating to modulated, tonal or impulsive sound.

43. Portable sound and wind monitoring instrumentation shall be made immediately available for monitoring complaints. Measurements shall be made in accordance with the requirements of Condition 4.

44. The operator of the wind farm facility shall provide all necessary wind data required to carry out the compliance testing, including wind speed and direction at hub height during periods of pre- and post installation testing and the operational status of the individual wind turbines.

#### **Sound monitoring measurement standards**

45. Sound monitoring shall conform to the following measurement standards:

(a) The complete measurement and analysis method system shall conform to the requirements of an appropriate acoustical national or international standard approved by the Authorised Council Officer.

(b) Microphones shall be fitted with a wind shield such that the noise generated by wind on the wind shield is, to the extent practicable, at least 10dBA below the noise being measured.

(c) The instrumentation shall save audio recordings in uncompressed format approved by the Authorised Council Officer.

(d) All sound monitoring shall be carried out by suitably qualified and experienced competent person or persons who have not acted for the wind farm applicant or operator of the wind farm facility.

(e) The operator of the wind farm facility shall provide all necessary wind data required to carry out the compliance testing, including wind speed and direction at hub height during periods of pre- and post installation testing and the operational status of the individual wind turbines. This information shall be maintained on a confidential basis by the Authorised Council Officer and not released to any other party other than in a summarised form.

#### **Reporting of Compliance Monitoring Program**

46. A report prepared by the Authorised Council Officer summarising the results of the monitoring program, the data collected and indicating compliance or non-compliance with these Conditions and complaints received must be forwarded to the Council within 14 days of the end of each month. The results must be written in plain English and formatted for reading by lay people:

- (a) Numbers of complaints received by date and a summary of each complaint;
- (b) Wind speed and direction at the wind farm at the time of each complaint;
- (c) Wind speed and direction at the affected dwelling or noise sensitive place at the time of each complaint;
- (d) Sound levels and audio recording at the affected dwelling or noise sensitive place at the time of each complaint;
- (e) A comparison of sound and weather data associated with the complaint to the pre-installation and post-installation sound and weather data for similar weather conditions;
- (f) A risk assessment of those operational parameters that have led to complaints; and
- (g) A statement of compliance with condition 4.

47. Audio recordings from each continuous monitoring station shall be kept for not less than 90 days' after the date of recording. The Authorised Council Officer shall make the raw sound level data, summarised wind data and audio recordings available to the public on request without payment of a fee.

48. Summary results of the sound level data from the continuous monitoring stations shall be posted on the Council website within 14 days of the end of each month. The Authorised Council Officer shall develop the format of the information to be presented. The data shall include the analysed results of condition 47 and details of any non-compliance. The results shall be written in plain English, formatted for reading by lay people, and made readily available to the public without payment of a fee.