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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STATEMENT OF EVIDENCE OF CHRISTOPHER WILLIAM DAY

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1 QUALIFICATIONS AND EXPERIENCE

1.1 My name is CHRISTOPHER WILLIAM DAY. I am a principal in the acoustical consulting practice of Marshall Day Acoustics Limited. I hold the degree of Bachelor of Engineering from Monash University, Australia. For the past 35 years I have worked in the field of acoustics, noise measurement and control in England, Australia and New Zealand. My work over the past 30 years has included noise control engineering and town planning work for various major corporations and city councils within New Zealand, and I have been engaged as an expert witness before the Environment Court.

1.2 I have been involved with major environmental impact assessments for Eden Park, the Ports of Auckland, Winstone Aggregates quarries, Mighty River Power hydro electric power stations and all the major airports in New Zealand.

1.3 Marshall Day Acoustics is Australasia's leading acoustical consulting practice with more than 50 consultants practicing in acoustics. Our offices in Melbourne, Sydney and Adelaide have worked on more than 24 wind farms in Australia. Marshall Day Acoustics has been involved with over 20 windfarms in New Zealand carrying out either the primary assessment of effects or in the peer review role. We have 5 NZ consultants who have significant experience through these projects – Graham Warren, Jon Farren, Damian Ellerton, Siiri Wilkening and Miklin Halstead.

1.4 In 2006, Marshall Day Acoustics was engaged jointly by the Wind Energy Association to undertake a significant study of wind farm noise prediction methodologies which involved extensive field testing and comparison with calculated noise levels from computer modelling.

2 CODE OF CONDUCT

2.1 I acknowledge that I have read the code of conduct for expert witnesses contained in the Environment Court Consolidated Practice Note (July 2006). I have complied with it when preparing my written statement of evidence and I agree to comply with it when I give this oral evidence before the Environment Court. I confirm that the evidence I have given and the opinions I have expressed in my evidence are within my area of expertise. I have not omitted to consider material facts known to me that might alter or detract from the opinions that I express.

3 INTRODUCTION

3.1 Marshall Day Acoustics has been engaged by Mighty River Power to carry out a detailed peer review of the Hegley Acoustic Consultants (HAC) Assessment of Noise Effects for the Turitea Wind Farm, report dated December 2008. Our work has included, a review of the ambient noise measurements carried out by HAC, our own computer noise modelling of the predicted noise levels from the wind farm and a comparison with the noise limits derived from the HAC noise measurements.

3.2 The MDA peer review report dated 27 April 2009 is attached to this evidence.

3.3 We have also had discussions with Mr Hegley during this review process, which have resulted in additions to the HAC report to clarify certain issues which are discussed in our report.

3.4 Within my firm, I often provide the overall advice on noise effects and community response and my colleagues provide the technical expertise required to run the computer modelling software that is used to produce noise contours and calculate noise levels at specific locations. For this project, Mrs Siiri Wilkening from my firm has carried out the computer modelling of noise levels from the proposed wind farm and assisted me with the preparation of our report.

3.5 I have read the HAC report in detail and reviewed the ambient noise data and subsequent criteria derived from the data. I have examined the computer calculations carried out by Mrs Wilkening and Mr Hegley and carried limited manual calculations of my own as a check.

3.6 Our work did not include any site noise surveys and I have not visited the subject site.

4 CONCLUSIONS

4.1 MDA concurs with the conclusions of the HAC assessment that the proposed Turitea Wind Farm project can be designed and managed to achieve compliance with NZS 6808:1998 , on the understanding that the accessory building at MP07 is not considered relevant for the purposes of this standard.

4.2 Further measurement and design work is proposed by HAC and MDA during the detailed design phase to ensure compliance with NZS6808.

Christopher W Day

27 April 2009

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PREPARED FOR: **Chancery Green**
PO Box 106 202
Auckland 1143

Attention: Helen Andrews

DATE: 27 April 2009

PROJECT: **Turitea Wind Farm**
Acoustic Peer Review

REPORT NO.: 2008600A 001 R06

PREPARED BY: Christopher Day and

Siiri Wilkening

REVIEWED BY: Miklin Halstead

EXECUTIVE SUMMARY

An assessment of noise effects from the proposed Turitea Windfarm has been undertaken by Hegley Acoustic Consultants (HAC). Marshall Day Acoustics (MDA) has carried out a peer review of the HAC assessment.

MDA concurs with the conclusions of the HAC assessment that the proposed project can be designed and managed to achieve compliance with NZS 6808:1998 (NZS6808), provided that the Windfarm is not required to achieve compliance at the gottage (MP07).

MDA recognises the extensive noise level surveys undertaken in preparation of the HAC Turitea assessment. Any apparent anomalies in the survey results were discussed with and explained by HAC. However, in the event that consent is granted to the proposal, MDA recommends that additional background noise surveys be undertaken at these positions to provide robust criteria for compliance purposes.

MDA has carried out predictions of WTG noise for all receiver locations and identified some discrepancies between HAC calculations and MDA calculations. This is likely due to the different calculation methodologies utilised by MDA (SoundPLAN software) and HAC (HAC Software). MDA considers that the SoundPLAN using the calculation algorithms of ISO9613, is more appropriate for the prediction of windfarm noise.

The differences in predicted levels of up to 12 decibels occur for some sites. It is noted that MDA has not investigated these prediction differences in detail, as the predicted noise levels show that compliance with the estimated noise limit can be achieved, for the majority of assessment positions.

MP60 is a potential future dwelling site with no current dwelling. At present, an exceedance of 4 decibels is predicted at this position. However, should a dwelling be constructed on this site in the future, the assessment of noise effects would be undertaken at the detailed design phase of the wind farm. De-rating of WTG82 and WTG86 during certain wind directions, is predicted to achieve compliance with the most stringent noise limit of 40 dBA.

The HAC report provides an assessment of noise effects for 16 sites. This report provides an assessment of the remaining non-stakeholder positions.

If consent were granted, the detailed design phase would involve further background noise surveys to establish criteria and further noise calculations.

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1.0 INTRODUCTION

Marshall Day Acoustics Ltd (MDA) has been engaged by Chancery Green on behalf of Mighty River Power (MRP) to undertake a peer review of the acoustic assessment prepared by Hegley Acoustic Consultants (HAC) for the proposed Turitea Wind Farm in the Tararua Ranges.

The original HAC report "Proposed Wind Farm Turitea – Assessment of Noise Effects", dated August 2008, formed Appendix M of the Assessment of Environmental Effects. The project layout was subsequently revised and nine turbines removed, and the HAC report was amended to take account of these changes. This subsequent HAC report dated December 2008 formed the basis of the MDA peer review. In addition, the following documentation was examined:

- Section 92 reply by HAC, dated 17 September 2008,
- Consolidated Section 92 Responses by MRP, dated January 2009, and
- HAC letter "Turitea Wind Farm", dated 24 March 2009, in response to additional information request of MDA.

Turitea Wind Farm is located between the consented wind farms Te Rere Hau and Motorimu. Therefore, to ensure an appropriately conservative approach, all relevant cumulative effects have been taken into consideration when assessing Turitea.

Sound power data provided by the manufacturer for the Vestas V90 3.0 MW turbines includes noise data up to 10 m/s wind, with the highest noise level at 8.5 m/s wind speed. At this wind speed, generation output is at 95% of the rated power capacity. Because the measured sound power appears to reduce above 9 m/s, the assumption is that at a higher wind speed, the noise generated remains, at a worst case circumstance, the same as for 10 m/s. Without measurements of the WTG sound power at higher wind speeds (between 12 m/s and cut out at 25 m/s) the noise level at these conditions is an estimate only based on the assumption that the highest sound power level (for 8.5 m/s wind) would continue at higher wind speeds.

This peer review focuses on the following technical aspects of the HAC report:

- Noise performance standards
- Prediction methodology
- Surveys undertaken and required prior to establishment of Turitea Wind Farm
- Analysis of measured and predicted noise levels
- Construction noise assessment
- Assessment positions
- Operational noise assessment, including special audible characteristics
- Recommended conditions of consent.

This report concentrates on the differences and discrepancies in the noise studies as it is a peer review. It makes comment on some of the areas of agreement but does not concentrate on these and thus may have a negative feel overall. The general agreement with the HAC outcome should be remembered in this context.

2.0 NOISE PERFORMANCE STANDARDS

MDA concurs with HAC that NZS6808 is the most appropriate noise assessment standard for wind farms, and that this standard should be utilised for the assessment of the Turitea Wind Farm.

In 'Executive Summary', 3 Results of Assessments, HAC states that *"the wind farm will be able to operate within the noise requirements of the Palmerston North District Plan, the Tararua District Plan and the requirements of NZS6808 ... at all times".*

The HAC report contains information relating to the Palmerston North District Plan, which specifically refers to NZS6808 for the assessment of wind farms.

The noise provisions of the Tararua District Plan do not contain specific noise limits for the operation of wind farms. Noise limits for activities within the Rural Management Areas are as follows:

7.00 am – 7.00 pm daily	55 dBA L_{10}
7.00 pm – 7.00 am daily	45 dBA L_{10} and 75 dBA L_{max}.

A Glossary of Technical Terms is contained in Appendix A of this report.

MDA concurs with HAC that normal activity noise rules are not suitable to be applied to the operation of a windfarm, however, the district plan rules provide a good indication of acceptable noise levels for areas potentially affected by the windfarm.

The construction noise provisions of both District Plans are discussed by HAC and MDA concurs with these findings.

3.0 BACKGROUND NOISE LEVEL MEASUREMENT AND ASSESSMENT

The measurement and analysis of background noise levels forms the basis of the assessment of noise effects from windfarms in accordance with NZS6808. The measured background noise levels prior to the installation of the windfarm are used to determine the applicable noise criteria at existing residences.

Those measurements are difficult to undertake once the windfarm is established, therefore, they are normally carried out beforehand. NZS6808 "recommends that background sound level measurements be carried out where predicted sound levels of 35 dBA or higher are calculated for the relevant locations." (Refer Paragraph 4.5.1 of NZS6808). Noise level predictions show that over 70 dwellings are predicted to receive noise levels above 35 dBA. This is discussed in more detail in Section 3.3 below.

Normally details of the equipment used in a comprehensive survey such as this would be presented in the acoustic report. In particular the noise floor of the instrumentation should be reported as it can have a significant effect on the data analysis and subsequent setting of noise limits. In this case, the equipment details have been provided by HAC in the s92 information.

3.1 Noise surveys

The HAC report contains the results of sixteen background noise level surveys, which in our opinion form a suitable number for the initial assessment of this project. The results from these sixteen sites are discussed below.

The noise survey data points from a typical wind farm background noise survey, would normally follow a curve increasing with wind speed as shown in Figure 34 from the HAC report.

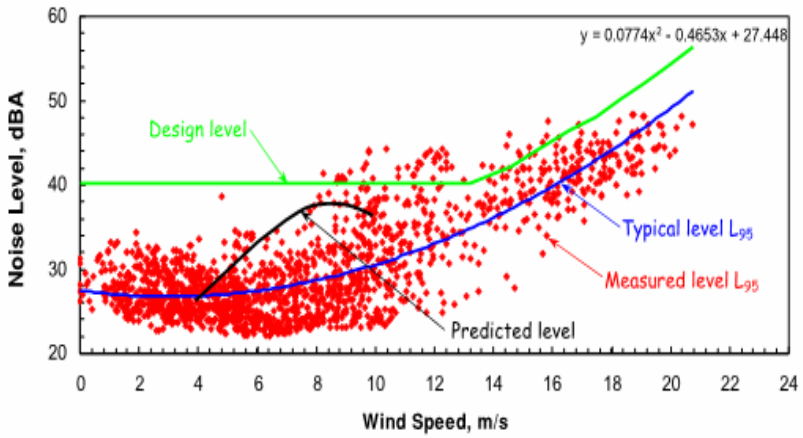

Figure 34. Design Limits for Site 15

Nine of the background surveys undertaken by HAC, show this normal correlation between wind speed and noise level (sites 3, 5, 7, 9, 10, 13, 14, 15 and 16).

At the remaining seven sites, MDA has observed that the measured noise level does not correlate well with the wind speed or shows other anomalies. This behaviour can be due to a variety of factors. As the measured background noise level determines the noise criterion for the assessment of noise effects and sets the limit for future compliance testing, any ambiguity in this area should be avoided.

The results from these seven sites can be generally classified under two types of anomaly and these are discussed in the following sub-sections.

3.1.1 *Type 1 – No gradient, low background noise level*

The noise levels measured at Site 2 show little correlation with wind speed as shown below in Figure 21 from the HAC report.

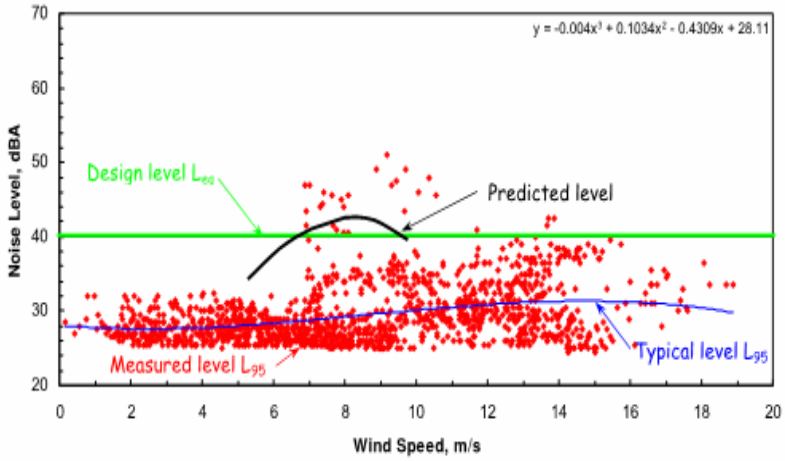

Figure 21. Design Limits for Site 2

The noise level generally remains low (25 to 30 dBA) with occasional high readings (up to 50dBA) at mid wind speeds.

From information provided by HAC (letter dated 24 March 2009), the reason for the consistently low background noise level is that *"this site was located well clear of any vegetation in an open paddock on the side of a hill screened from the winds and to the west of the Ngahere Park development."*

Site 4 shows background noise levels with significant variation from 26dBA to 59 dBA with little correlation with wind speed, though the resulting noise limit appears reasonable.

3.1.2 *Type 2 – No gradient, high background noise level*

Some other positions showed no gradient with increase wind speed but with a consistently high background noise level. This occurs for five survey sites in the HAC report (Sites 1, 6, 8, 11 and 12). An example is shown below.

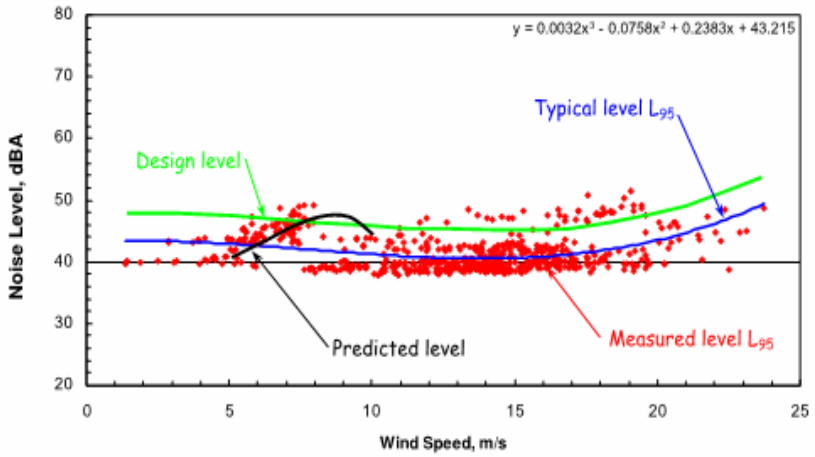

Figure 31. Design Limits for Site 12

These results are unusual in our experience and may be a seasonal effect. It is noted that situations such as those described above may lead to a noise limit being determined which is higher than the most stringent 40 dBA limit, and will need robust justification.

HAC provided the following explanation for the noise level survey results (HAC letter dated 24 March 2009):

"At sites 1 and 6 there was vegetation in the immediate area so the slightest wind influenced the noise level.

Site 8 was located adjacent to trees around the house. As the topography at this site is flat the slightest wind in any direction generates noise in the trees.

Site 11 was at the top of the hill adjacent to a pine tree plantation. This site was monitored twice as the results of the first monitoring were considered unusual. The second site was 50 m away from the original monitoring position and gave similar results. The slightest wind at this site generates noise in the trees.

Site 12 is located in the North Range Road on top of a ridge with vegetation around it. The wind blows all the time here due to the exposed location so the background sound is influenced by wind noise."

In the event that consent is granted to the proposal, MDA recommends that additional background noise surveys be undertaken at these positions to provide robust criteria for compliance purposes.

3.2 Future background noise surveys

It is noted that in Section 2 'Design Criteria' HAC states: *"It is noted that prior to developing the wind farm the noise level at each of the houses within the predicted 35 dBA noise contour will be determined."*

This would mean that noise surveys would be required for 58 assessment positions (excluding those which have already been measured for the current HAC assessment). MDA considers that this is a particularly thorough and robust approach which may be unnecessarily extensive. Alternatively, it might be sufficient for additional background noise surveys be undertaken at representative positions for clusters of dwellings which could be agreed on prior to measurement by the client and respective Councils.

4.0 PREDICTION METHODOLOGY

The propagation of sound outdoors is a complex matter involving the physical interaction of a number of parameters including distance from source to receiver, air absorption, ground effects, topographical screening etc. There are several procedures available for the calculation of sound propagation outdoors. NZS6808 refers to two methods: the 'Simplified Approach (Equation 1)' and ISO9613.

4.1 NZS6808

NZS6808 'Equation 1' uses simplified hemispherical propagation for the calculation of noise levels at receiver locations. This calculation is referred to as 'simplified' because it takes no account of terrain screening or ground absorption and uses only a single value for air absorption.

NZS6808 acknowledges that this will result in a conservative approach by over predicting noise levels from a wind farm by up to 12 decibels in some cases. Section 4.3.3 of NZS6808 includes a reference to ISO9613 for further information on the attenuation of sound outdoors.

NZS6808 recommends that background sound levels be measured where noise levels of 35 dBA or higher are predicted in accordance with Equation 1.

The HAC report does not include the results of the Equation 1 calculations which would normally be used to determine the noise survey positions. However, MDA considers that the number of noise surveys undertaken by HAC is appropriate for this project at this stage of the assessment.

4.2 HAC Software/Concawe

The HAC noise predictions utilise their own in-house software, which uses the Concawe method for propagation and Maekawa theory for barrier attenuation. Concawe (the propagation of noise from petroleum and petrochemical complexes to neighbouring communities) was developed in 1981 for the assessment of noise levels from oil refineries. The model provides a detailed section on meteorological effects on noise propagation, with the potential to define the Pasquill Stability Class, wind direction, speed etc and thus provides noise level predictions for specific circumstances.

While Concawe has been used for some previous wind farm studies, it is not referred to in NZS6808 and in our opinion, it is not as suitable for windfarm noise prediction as the more recent International Standard ISO9613 (refer discussion below).

4.3 SoundPLAN/ISO9613

MDA has undertaken noise prediction calculations using the ISO9613 methodology referenced in NZS6808. MDA uses the SoundPLAN software (which uses the ISO9613 methodology) to predict noise levels at individual houses as well as calculating noise level contours. SoundPLAN is an internationally recognised program and has been developed and tested over more than 20 years by hundreds of users.

A recent study, commissioned jointly by the NZ Wind Energy Association and the EECA, concluded that ISO9613, with accurate terrain data (as implemented by SoundPLAN) can more closely estimate the actual wind farm noise level than both NZS6808 and Concawe methods. In addition, NZS6808 Section 4.3.3 includes a reference to ISO9613 for further information on the attenuation of sound outdoors.

4.4 Downwind Propagation

On pages 42 and 43, the HAC report states that downwind noise propagation in all directions is used for all noise calculations. This means that the predicted noise levels represent a 'worst case' (highest noise level) scenario and are thus conservative. MDA agrees with this approach.

4.5 Noise Prediction Results

The following Table 1 shows the predicted noise level for individual receivers as predicted by HAC (in accordance with Concawe) and MDA (in accordance with ISO9613) for comparison. All predictions are for the highest sound power level of the WTG which is at 8.5 m/s wind. The difference between the two calculation techniques is also reported in the table.

A difference of +/- 2 decibels for these types of predictions is considered to be acceptable. Most of the predictions (58 of the 75 positions) are within this range and, therefore, are in reasonable agreement. However, the largest differences range from -5 dB to +12 dB.

For eighteen positions, HAC predicts noise levels between three and five decibels higher than MDA. For six positions, HAC predicts noise levels between four and twelve decibels lower than MDA.

It is noted that MDA has not investigated the difference in prediction in detail as the predicted noise levels show that for the majority of assessment positions compliance with the estimated noise limit can be achieved. Those receivers where potential non-compliance is shown are addressed in detail in the following sections of the report.

A more detailed table of predicted noise levels is shown in Appendix B of this report.

Table 1 – Predicted Noise Levels – MDA & HAC Comparison

Pos.	MDA	HAC	Diff.	Pos.	MDA	HAC	Diff.	Pos.	MDA	HAC	Diff.
	dBA	dBA	dBA		dBA	dBA	dBA		dBA	dBA	dBA
MP01[1]	40	28	11	MP26	39	40	-1	MP63	41	44	-2
MP02	39	37	2	MP27	40	42	-2	MP64	42	44	-3
MP03	38	37	1	MP28	42	43	-1	MP65	40	43	-3
MP04	38	37	1	MP29	42	44	-1	MP66	38	41	-3
MP05	37	37	0	MP30	46	46	0	MP67[3]	44	45	-1
MP06	35	37	-2	MP31[3]	41	42	-1	MP68[3]	48	47	1
MP07[1,2]	58	50	8	MP32	39	42	-2	MP69[3]	47	46	2
MP08	36	37	-1	MP33	37	40	-3	MP70	45	46	-1
MP09	38	39	-1	MP34	37	40	-3	MP80	39	39	0
MP10	38	38	0	MP35	37	40	-3	MP81	38	40	-3
MP11	38	39	-1	MP36	35	39	-4	MP90[3]	41	43	-2
MP12	39	40	-1	MP37	36	38	-2	MP91[3]	40	41	-1
MP13	41	42	-2	MP50	35	37	-1	MP92[3]	43	44	0
MP14	40	43	-3	MP51	36	38	-2	MP93[3]	41	41	-1
MP15	40	43	-3	MP52[1]	36	32	4	MP943	37	39	-2
MP16	39	42	-3	MP53[3]	39	40	-2	MP95[3]	42	44	-3
MP17	38	40	-2	MP54[3]	39	40	-1	MP96[3]	44	44	0
MP18	37	41	-4	MP55[3]	40	42	-2	MP97[1,2,3]	55	49	6
MP19	40	42	-2	MP56[3]	40	43	-3	MP98[2,3]	57	55	2
MP20[1]	41	37	4	MP57	40	42	-2	MP99[2,3]	48	50	-2
MP21	36	40	-4	MP58	41	41	-1	MP100[3]	48	47	1
MP22	36	41	-5	MP59	38	40	-2	MP101[3]	47	47	0
MP23	40	43	-3	MP60[1, 3]	44	41	3	MP102[3]	47	46	2
MP24	39	41	-2	MP61	38	42	-4	MP103	40	41	-1
MP25	39	37	1	MP62	40	41	-1	MP104	36	38	-1

[1] Denotes MDA predictions are more than 3 dB above HAC predictions.
[2] Denotes WTG within 300m, tonal penalty may apply
[3] Denotes sites which have given written approval, effects on this site should not be taken into consideration

5.0 ASSESSMENT OF OPERATIONAL NOISE EFFECTS

5.1 Introduction

The HAC report contains information relating to measured background noise levels at sixteen survey positions (Sites 1 to 16), and predicted windfarm noise levels for 75 assessment positions (MP01 to 104). A figure showing survey sites and assessment positions is contained in Appendix C of this report.

The HAC report has carried out a comparison of the predicted noise levels with the proposed noise limit at the 16 sites. No comparison with noise limits is provided for the other 59 sites as noise limits have not been assigned to the other receiver positions. MDA has accordingly used the measured noise levels at Sites 1 to 16 to estimate background noise levels (and thus noise limits) at the other house sites to enable a meaningful assessment of effects and compliance with the relevant noise limits for all 75 sites.

Through visual inspection of the physical layout and the computer noise model, MDA has attempted to group assessment positions with their representative noise level survey position so that they can be assessed against their respective noise limits.

The table in Appendix B shows the extended table of all receiver positions, associated noise survey positions, predicted noise levels and noise level differences between HAC and MDA predictions and a comparison with the proposed noise limits. The values in the table show that compliance with the relevant noise limits can be achieved at most positions, with a small number of positions showing potential exceedance of the limits by between one and four decibels. It is considered that a potential exceedance of one decibel is regarded to be insignificant and can be managed.

5.2 Stakeholder Positions

Not all of the 75 receiver positions are required to comply with the noise limits, as some owners are involved in the windfarm project by having turbines or transmission lines on their sites and are therefore stakeholder positions. This implies that approval has been obtained from these sites, and it is understood the effects of the proposal do not have to be taken into consideration with respect to these sites. A number of neighbouring land owners are also understood to have provided written approval to the proposal, and the effects on these properties have also not been taken into consideration.

In Table 1 in Section 4.5 above, sites which do not require an assessment of noise effects are annotated (3). A figure showing the sites which are part of the development is contained in Appendix C of this report.

This issue was clarified in the Section 92 reply and the HAC letter "Turitea Wind Farm", dated 24 March 2009.

5.3 Position MP60

Appendix B shows that the MDA predicted noise levels at assessment position MP60, exceed the proposed noise limit by four decibels. The MDA predicted noise levels are higher than the HAC predictions for this site by three dB.

The ambient noise level at this position has recently been surveyed by HAC, and it is understood that the resultant noise limit is 40 dBA.

As discussed with HAC, the site does not currently contain a dwelling but may be a future residential site. Should this occur, potential effects at MP60 should be reassessed during the detailed design phase, including measurement of the background noise level at a relevant location in the vicinity of the building site.

Should a potential exceedance of the appropriate noise limit be shown at that stage of the development, this can be managed by de-rating WTG 82 and 86 as discussed by HAC.

5.4 Position MP07

It is understood that position MP07 is not considered an assessment position at this time as the building on site is not of a residential nature. This is discussed in detail by Mighty River Power's legal and planning advisors.

Nevertheless, position MP07 has been included in the assessment for completeness. Should this position be considered to constitute a dwelling, the predicted noise level of 58 dBA (MDA) (HAC 50 dBA) is well in excess of the derived noise limit of 45 dBA.

In addition to the above issues, the closest WTG (WTG123) would be approximately 94 m from this position thus increasing the likelihood of a special audible characteristic adjustment applying to the assessment of the closest turbine. This would increase the predicted exceedance by a further 5 decibels.

The HAC report considers there is a practical design option to control the noise at the building (MP07) should this be required. MDA agrees with that approach.

5.5 Assessment of Effects

The HAC report in Section 3 'Existing Noise Environment' states that *"Based on complying with the design requirements of NZS6808:1998, Acoustics – The Assessment and Measurement of Sound from Wind Turbine Generators, the noise effects form the proposed Turitea Wind Farm will be no more than minor, even in a low background sound environment."*

In the opinion of MDA, compliance with the noise criteria determined using NZS6808 means that the adverse effects from wind turbine noise are generally reasonable, considering the rural environment and the national/regional importance of this renewable energy resource. However, the extent of this adverse effect varies between the different sites surrounding this windfarm. At some sites the predicted noise level is well below the most stringent NZS6808 criterion and the noise is only slightly above

the background noise level. At other sites, the predicted noise level may just comply with the NZS6808 criterion (by 1 decibel) and be 15 decibels above the ambient noise level. In this case, the adverse effects may be more than minor, as the noise will be clearly noticeable. However, overall the effects are still considered acceptable.

In our opinion, it is helpful to examine the extent of the adverse effect for each site rather than only providing a general statement about the overall effect of the entire windfarm. The more detailed approach allows individual residents to anticipate the likely audibility of the wind turbine noise when it is installed.

In our opinion this information would reduce the likelihood of a negative response when a resident notices the background noise level has increase by 15 decibels but the measurements show it complies with the NZS6808 noise limit. It helps to pre-empt or change the resident's expectation of what the effects are likely to be – noticeable, but reasonable.

5.6 Low Frequency Noise

Sections 6.2 and 6.3 of the HAC report address the issue of low frequency noise and infrasound. We agree with the general conclusions of this section as MDA are unaware of any scientific research that shows that WTG produce unusual levels of low frequency noise.

6.0 CONSTRUCTION NOISE

6.1 General Comments

The HAC report correctly identifies that NZS6803:1999 is the most recent and applicable construction noise standard which is also referred to in both relevant District Plans.

This Standard references L_{eq} levels rather than L_{10} levels. There are several references of L_{10} levels in the HAC report which we understand have been corrected to L_{eq} in later documentation.

6.2 Assessment Position MP07

Should the gottage at MP07 be identified as a dwelling, compliance with the relevant noise limits of NZS6803 would be required. As this building is in close proximity to WTG123 (94 m only), construction at this site may require additional management, particularly if night time work is proposed.

6.3 Assessment Position MP60

Should a dwelling be constructed at MP60, this position would require reassessment during the detailed design phase. Currently, a four decibel exceedance of the 40 dBA noise limit is predicted.

Should this be confirmed at the time of dwelling construction, de-rating of WTG 82 and 86 during certain wind directions could be used to mitigate noise levels. This de-

rating is predicted to achieve compliance with the most stringent noise limit of 40 dBA.

7.0 RECOMMENDED CONDITIONS OF CONSENT

MDA understands that noise conditions of consent are being prepared as part of this process. It is recommended that consent conditions should be in line with the objectives of NZS6808, should not be unnecessarily complicated and where practicable, be similar to those applying to the consent granted for the Te Uku wind farm.

Appendix A – Glossary of Terminology

dBA	A measurement of sound level which has its frequency characteristics modified by a filter (A-weighted) so as to more closely approximate the frequency bias of the human ear.
L_{eq}	The time averaged sound level (on a logarithmic/energy basis) over the measurement period (normally A-weighted).
L_{95}	The sound level which is equalled or exceed for 95% of the measurement period. L_{95} is an indicator of the mean minimum noise level and is used in New Zealand as the descriptor for background noise (normally A-weighted).
L_{10}	The sound level which is equalled or exceeded for 10% of the measurement period. L_{10} is an indicator of the mean maximum noise level and is used in New Zealand as the descriptor for intrusive noise (normally A-weighted).
L_{max}	The maximum sound level recorded during the measurement period (normally A-weighted).
Noise	A sound that is unwanted by, or distracting to, the receiver.
NZS 6801:1991	New Zealand Standard NZS 6801:1991 *"Measurement of Sound"*
NZS 6802:1991	New Zealand Standard NZS 6802:1991 "Assessment of Environmental Sound".
NZS 6803:1999	New Zealand Standard NZS 6803:1999 "Acoustics – Construction Noise".
NZS 6808:1998	New Zealand Standard NZS 6808:1998 "Acoustics – The Assessment and Measurement of Sound from Wind Turbine Generators"
Ambient Noise	Ambient Noise is the all-encompassing noise associated with any given environment and is usually a composite of sounds from many sources near and far.

Appendix B – Individual Receiver Noise Level Predictions

(max. WTG Lw @ 8.5 m/s wind)

Name	MDA (ISO 9613) dBA	HAC (Concawe) dBA	Difference MDA vs. HAC decibels	Closest Survey position Site No.	MDA Est. Limit dBA	Exceedance (MDA est. limit)	Comment
MP01	40	28	11	6	42		similar dist. to WTG as MP02, no shielding to WTG121, similar noise level expected
MP02	39	37	2	6	42		
MP03	38	37	1	1	40		
MP04	38	37	1	1	40		
MP05	37	37	0	13	40		
MP06	35	37	-2	14	40		
MP07	58	50	8	16	45	13	Closest WTG at 94 m, potential special audible characteristics
MP08	36	37	-1	7	42		
MP09	38	39	-1	7	42		
MP10	38	38	0	7	42		
MP11	38	39	-1	7	42		
MP12	39	40	-1	9	40		
MP13	41	42	-2	2	40	1	
MP14	40	43	-3	2	40		
MP15	40	43	-3	2	40		
MP16	39	42	-3	2	40		
MP17	38	40	-2	10	40		
MP18	37	41	-4	10	40		
MP19	40	42	-2	10	40		
MP20	41	37	4	10	40	1	similar dist. to WTG as MP19, similar noise level expected
MP21	36	40	-4	3	40		closest WTG 2.2 km, lower noise level expected
MP22	36	41	-5	3	40		closest WTG 2.4 km, lower noise level expected
MP23	40	43	-3	3	40		
MP24	39	41	-2	3	40		
MP25	39	37	1	3	40		
MP26	39	40	-1	3	40		
MP27	40	42	-2	11	43		
MP28	42	43	-1	11	43		
MP29	42	44	-1	11	43		
MP30	46	46	0	12	46		
MP31	41	42	-1	n/a	n/a		
MP32	39	42	-2	4	40		
MP33	37	40	-3	8	42		closest WTG at about 2.2 km, several WTG contributing
MP34	37	40	-3	8	42		closest WTG at about 2.2 km, several WTG contributing
MP35	37	40	-3	8	42		
MP36	35	39	-4	5	40		closest WTG at about 2.6 km, several WTG contributing
MP37	36	38	-2	5	40		
MP50	35	37	-1	15	40		
MP51	36	38	-2	14	40		
MP52	36	32	4	n/a	n/a		similar position to MP08, similar noise level expected
MP53	39	40	-2	n/a	n/a		
MP54	39	40	-1	n/a	n/a		
MP55	40	42	-2	n/a	n/a		
MP56	40	43	-3	n/a	n/a		
MP57	40	42	-2	2	40		
MP58	41	41	-1	2	40	1	
MP59	38	40	-2	10	40		
MP60	44	41	3	10	40	4	closest WTG approx. 580m, HAC level lower than expected
MP61	38	42	-4	2	40		
MP62	40	41	-1	2	40		
MP63	41	44	-2	2	40	1	
MP64	42	44	-3	11	43		
MP65	40	43	-3	11	43		closest WTG 1.2km, similar to MP95
MP66	38	41	-3	11	43		
MP67	44	45	-1	n/a	46		
MP68	48	47	1	n/a	46		
MP69	47	46	2	n/a	46		
MP70	45	46	-1	12	46		
MP80	39	39	0	6	42		
MP81	38	40	-3	6	42		
MP90	41	43	-2	n/a	n/a		
MP91	40	41	-1	n/a	n/a		
MP92	43	44	0	n/a	n/a		
MP93	41	41	-1	n/a	n/a		
MP94	37	39	-2	n/a	n/a		
MP95	42	44	-3	n/a	n/a		
MP96	44	44	0	n/a	n/a		
MP97	55	49	6	n/a	n/a		closest WTG at approx. 88m, spec. audible characteristics possible
MP98	57	55	2	n/a	n/a		
MP99	48	50	-2	n/a	n/a		
MP100	48	47	1	n/a	n/a		
MP101	47	47	0	n/a	n/a		
MP102	47	46	2	n/a	n/a		
MP103	40	41	-1	12 or 4	42		
MP104	36	38	-1	5	40		

Predicted noise level exceeds limit by >1 dB

WTG or transmission line on site or provided written approval

Survey Site may not be appropriate to set limit for this assessment position

MDA predicts >3 dB higher than HAC

MDA predicts >3 dB lower than HAC

MPxxx WTG within 300m, tonal penalty

Appendix C – Site Layout

Figure 1: Site Layout, Survey positions, Assessment Positions, Compliance Positions

MARSHALL DAY Acoustics

Figure 1: Turitea Windfarm Site Layout