

BEFORE THE BOARD OF INQUIRY

IN THE MATTER of the Resource Management Act 1991

AND

IN THE MATTER of a Board of Inquiry appointed under section 146 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.

MEMORANDUM OF COUNSEL FOR MIGHTY RIVER POWER LIMITED

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1. During the questioning of the noise experts on 23 March 2010, Mrs Vanderpoel asked a question of Mr Hegley regarding the consistency of modelling results from Messrs Day and Hegley in respect of the revised design.
2. As described in the evidence of Messrs Day and Hegley, the noise prediction results they have produced are obtained through computer modelling, with each using different computer programs. Mr Hegley's predictions were carried out using the Concawe calculation method, while those presented by Mr Day used the ISO9613 (*SoundPLAN*) calculation method. These programs use slightly different algorithms to predict the noise effects of proposals, and therefore result in similar, but slightly different, predicted noise levels.
3. In understanding how these models work it is necessary to understand the different factors that affect how noise travels. These include:
 - **distance:** noise reduces over distance because it loses energy and is absorbed and scattered from its direct path;
 - **meteorological conditions:** in down wind conditions, noise rays are bent down towards the ground, thus making it louder on the downwind side. the opposite occurs in the upwind direction; Other conditions include temperature inversions where noise travels in a thin stable layer of the atmosphere for longer distances, though this is uncommon for wind farms as it only occurs in still conditions;
 - **shielding:** terrain and structures can cause the acoustic line-of-sight to be interrupted thus reducing the noise level; for wind farms this is less common because of the height of the noise source and the long distances involved, though terrain can provide some shielding;
 - **ground absorption:** soft ground such as grassed areas absorb some of the sound rays while hard surfaces such as concrete or water do not; and
 - **air absorption:** higher frequencies are absorbed by air over large distances, while air has very little effect on the low frequencies.
4. Mr Day has reviewed the predictions of both himself and Mr Hegley, and considers that where the two models differ is in respect of the effect of the air absorption, and that this factor has caused the difference between the two noise prediction models. He has undertaken several checks using different spreadsheets, and hand calculations, which have provided the same results to the SoundPLAN model, and therefore has confidence in the accuracy of his modelling.
5. Mr Hegley concurs with the comments regarding the differences in the atmospheric attenuation, with the Marshall Day model (as used by Mr Day) having greater attenuation effects at the higher frequencies than the Concawe model that he (Mr Hegley) uses. This means that the Concawe model used by Mr Hegley does not factor in as much air absorption in the algorithms used for noise predictions as Mr Day's prediction model. This means that the results from Mr Hegley's prediction model are

higher than those of Mr Day, as the predicted noise to be received does not factor in as high a reduction due to air absorption.

6. Mr Hegley has also noted that there may also be some differences caused by the level of ground absorption incorporated into the different models. He has based his noise predictions on the basis that the ground is hard, rather than Mr Day's model, which has used soft ground. Where soft ground is modelled, the higher frequencies of noise are attenuated to a greater degree than the lower frequencies, so a lower noise levels are predicted.
7. In any event, both the prediction models used by Mr Hegley and Mr Day are conservative, as they are based on the assumption that the all receivers are downwind from all turbines. This was explained previously to be not possible in reality, but instead is a theoretical 'worst-case' assessment. Therefore, actual noise levels would generally be lower than those predicted by both Messrs Hegley and Day. It is also noted that the calculations undertaken by Mr Hegley (which are higher than those given by Mr Day) have been used for the contours and are thus even more conservative.



K R Price

Counsel for Mighty River Power Limited
29 March 2010