Altissimo Consulting
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7 April 2021

Glenn Starr
Taumatatotara Wind Farm Ltd

via email: glenn@ventusenergy.co.nz

Dear Glenn
Taumatatotara Wind Farm – Noise questions from Waitomo District Council

1 Introduction

Altissimo Consulting has been engaged by Ventus to provide a response to the noise questions sent by Waitomo District Council to you on 3 February 2021.

The three questions are as follows.

Request	Where addressed in this letter
4. Please identify all dwellings surrounding the windfarm where acoustic compliance must be assessed.	Figure 1.1D included as Appendix A to this letter. Note the cyan turbines symbols labelled 12-22 are the ones no longer proposed
5. Please identify all turbine locations, including hub height as an absolute height.	Table 3
6. Please confirm the predicted noise levels at the assessment positions.	Table 5 and Figure 2

The revised turbine layout with 11 turbines and a hub height of 95m has been assessed using the Vestas V-136 as a candidate turbine, although we note that there are several other turbines that could be used.

2 Turbine details

As mentioned above, Ventus is considering taller turbines such as the Vestas V136. We note that other models such as the Enercon E-138 are being considered, and a specific turbine does not need to be confirmed to enable us to perform this assessment. The basic turbine parameters are listed in Table 1.

The V136 uses the same generator as the V117, which has a hub height of 60m, which could be installed as a right under the existing consent.

Sound power levels in octave bands are listed in Table 6 based on data from Vestas[1] for the model that includes Trailing Edge Serrations.

[1] Vestas datasheet DMS 0080-9147_00

Table 1 Turbine parameters

Parameter	Value
Hub height	95 m AGL
Blade length	66.7 m
Tip height	161.7 m AGL
Electrical power	4.3 MW
Sound power	103.9 dB L_{WA} (with Trailing Edge Serrations) 106.8 dB L_{WA} (without Trailing Edge Serrations)

Table 2 Turbine sound power levels (L_{WA})

Turbine	63 Hz	125 Hz	250 Hz	500 Hz	1000 Hz	2000 Hz	4000 Hz	A
Vestas V136	83	91	96	99	98	96	90	103.9

The locations of the turbines, including the elevation of the base and hub (metres above sea level) in Table 3.

Table 3 Turbine locations

Turbine	Easting	Northing	Base elevation (m)	Hub elevation (m)
1	1754674	5769664	254.8	349.8
2	1754752	5769427	295.7	390.7
3	1754875	5769240	319.8	414.8
4	1754964	5769069	327.1	422.1
5	1755114	5768891	326.6	421.6
6	1755230	5768650	309	404.0
7	1755680	5768142	306.5	401.5
8	1756222	5768055	306.5	401.5
9	1756406	5767847	301.4	396.4
10	1756505	5767595	313.1	408.1
11	1757147	5767353	316.5	411.5

3 Predicted sound levels

3.1 Noise modelling methodology

NZS 6808 refers to ISO 9613-2:1996 as an appropriate method for calculating wind farm sound levels. Predictions for the Taumatatotora wind farm have been conducted in accordance with that standard, implemented in Predictor v2021 acoustics modelling software. Input data used in the model and results are detailed below. The ISO 9613-2 prediction method used for this assessment gives results for light downwind conditions in all directions simultaneously. While this is not physically possible, it provides a conservative assessment.

Since NZS 6808:2010 was released, the UK Institute of Acoustics has released a Good Practice Guide (IoA GPG) for modelling noise from wind farms. This recommends different receiver

heights which in effect reduces the ground absorption considered. In addition, a correction is applied where sound travels over a valley between a wind turbine and a dwelling. The Predictor software can implement this correction. Most of the information considered in GPG were available at the time that NZS 6808:2010 was published, therefore the GPG has only been used as a sensitivity check rather than the primary prediction method.

Table 4 Model settings

Setting	NZS 6808:2010	IoA GPG
Receiver height	1.5m	4m
Ground absorption	0.5	0.5
Temperature / humidity	10° / 70%	10° / 70%
Other settings	Nil	Valley correction

3.2 Results

The results of the modelling are presented in Table 5, for both the NZS 6808 and IoA GPG methodologies.

Table 5 Predicted sound levels, dB $L_{A90(10min)}$

House ID	Owner	Vestas V136	
		NZS 6808 2010	IoA GPG
Northern dwellings			
22	Martin	29 dB	32 dB
23	Froggat / Walsh	25 dB	26 dB
24	Stokes & Co	23 dB	24 dB
25	Stokes & Co	23 dB	24 dB
Southern dwellings			
13	Galbraith and Panapa	18 dB	20 dB
14	Knight	21 dB	24 dB
15	Mitchell	19 dB	22 dB
16	Mitchell, McMahon, Williams	18 dB	21 dB
17	Mitchell, McMahon, Williams	17 dB	21 dB
18	Gilbert S	15 dB	17 dB
19	Gilbert C&D	14 dB	17 dB
20	Gilbert C&D	14 dB	16 dB
21	Awamarino	15 dB	15 dB

The GPG method is predicting an increase of 3 dB at the Martin property compared to ISO9613, due to the application of the "valley correction". The cross section between the house and the nearest turbine is provided below. The house is screened from the valley by intervening terrain and this increase in sound level is not expected to occur.

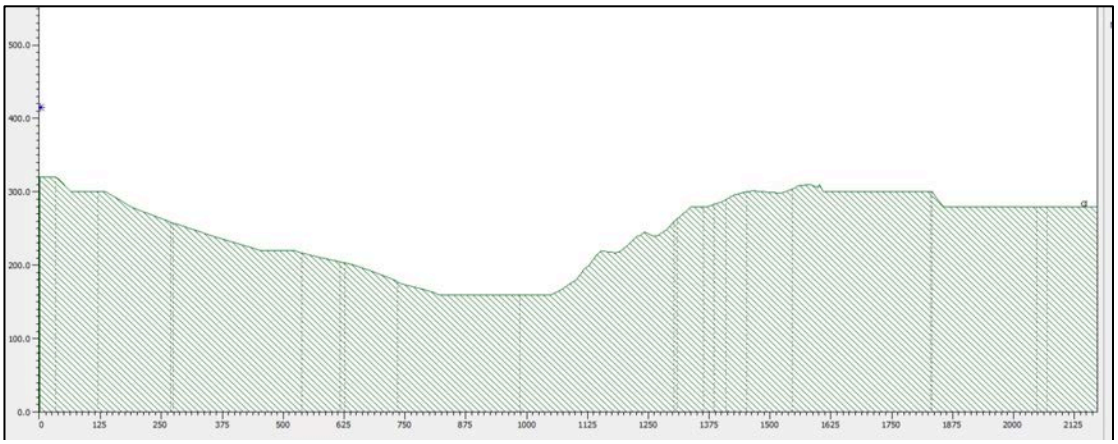

Figure 1 Cross section between turbine 6 and house 22

4 Comparison with lower turbine height

Condition 11 allows turbines with a sound power of up to 107.2 dB $L_{WA.}$ to be installed[2]. Predictions have been made for both the 22 turbine layout with a hub height of 60m, and the 11 turbine layout with a hub height of 95m. The sound power listed in Table 6 has been used for both scenarios. This is the V136 spectrum scaled to a total of 107.2 dB L_{WA}

Table 6 Turbine sound power levels (L_{WA})

Turbine	63	125	250	500	1000	2000	4000	A
Typical	86	94	99	102	102	99	93	107.2

The results of the modelling is presented in Table 7, and graphically in Figure 2.

[2] Condition 11 actually permits other turbine heights and sound power levels provided that the requirements of NZS 6808:1998 can be met – that is sound levels of 40 dB L_{A95} or below at receiver locations.

Table 7 Comparison of sound levels from turbine layouts at max sound power level

House ID	Owner	11x 95m turbines	22x 60m turbines	Difference
		NZS 6808:2010	NZS 6808:2010	
Northern dwellings				
22	Martin	32.4 dB	32.5 dB	-0.1 dB
23	Froggat / Walsh	27.7 dB	29.4 dB	-1.6 dB
24	Stokes & Co	26.6 dB	29.3 dB	-2.7 dB
25	Stokes & Co	26.6 dB	29.4 dB	-2.8 dB
Southern dwellings				
13	Galbraith and Panapa	20.9 dB	29.6 dB	-8.8 dB
14	Knight	23.6 dB	30.8 dB	-7.2 dB
15	Mitchell	21.9 dB	29.4 dB	-7.5 dB
16	Mitchell, McMahon, Williams	21.1 dB	28.5 dB	-7.4 dB
17	Mitchell, McMahon, Williams	20.5 dB	27.9 dB	-7.5 dB
18	Gilbert S	18.4 dB	30.7 dB	-12.3 dB
19	Gilbert C&D	16.7 dB	30.9 dB	-14.2 dB
20	Gilbert C&D	16.9 dB	31.7 dB	-14.8 dB
21	Awamarino	18.1 dB	36.6 dB	-18.5 dB

Note: sound levels should only be read to nearest dB. Additional significant figure included for comparison purposes only

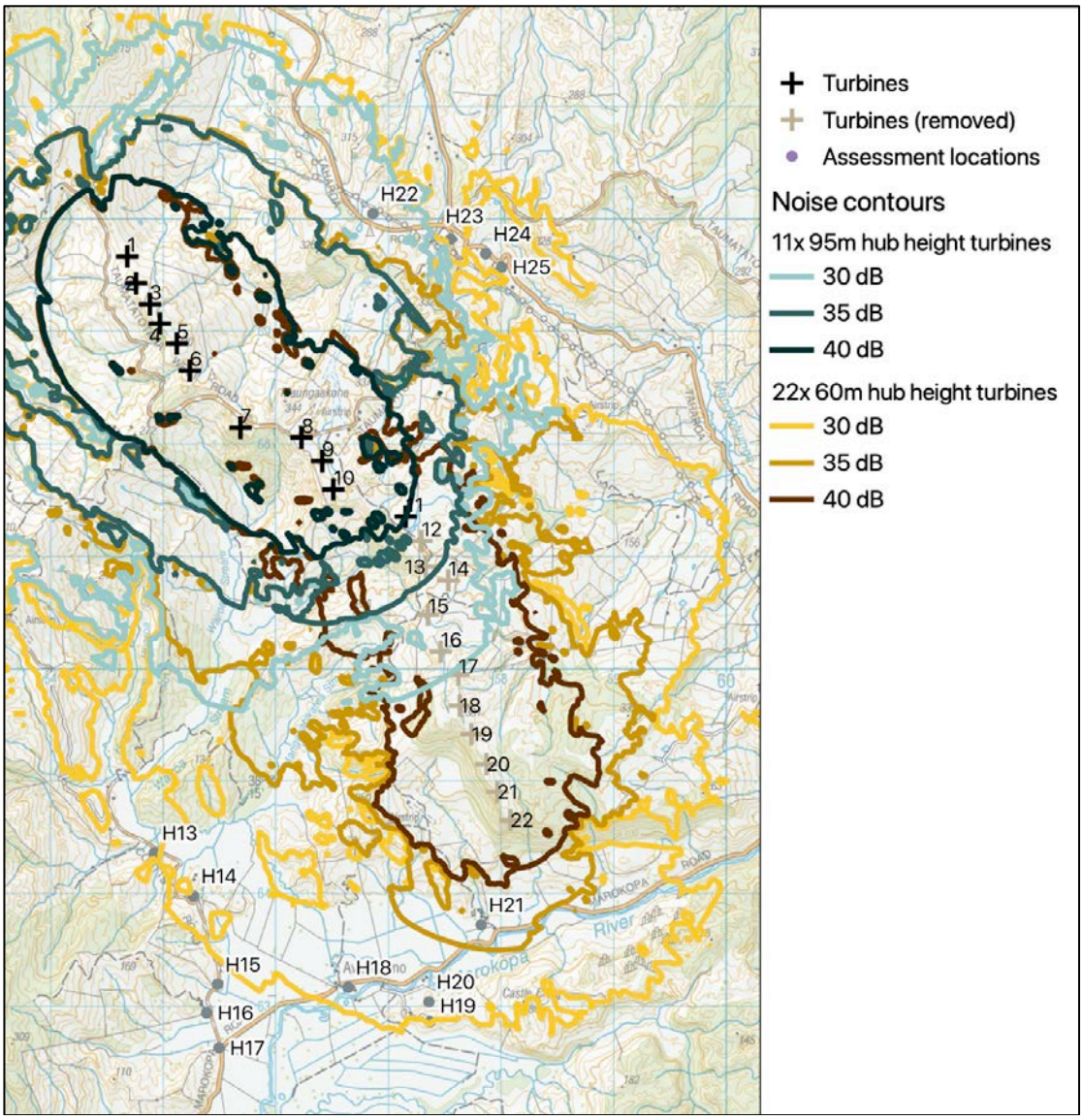

Figure 2 Comparison of noise emissions, dB $L_{A90(10min)}$

5 Conclusion

In response to the request for further information, Altissimo Consulting has:

- Provided an updated map confirming the locations of affected dwellings
- Predicted sound levels for the candidate turbines using current modelling practices
- Compared the sound levels for the 11x 95 hub height, with the layout of 22x 60m hub height turbines using maximum sound power level from Condition 11

Yours sincerely
Altissimo Consulting Ltd

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Appendix A – Location of assessment locations

Taumatatotara Windfarm

Separation distances to 3rd Party Houses

house	e_nztm	n_nztm
13	1,754,915	5,764,366
14	1,755,263	5,763,983
15	1,755,476	5,763,198
16	1,755,379	5,762,945
17	1,755,489	5,762,635
18	1,756,636	5,763,170
19	1,757,363	5,762,866
20	1,757,354	5,763,043
21	1,757,818	5,763,727
22	1,756,856	5,770,045
23	1,757,546	5,769,819
24	1,757,858	5,769,689
25	1,757,999	5,769,570

Turbine	E_NZTM	N_NZTM
1	1,754,674	5,769,664
2	1,754,752	5,769,427
3	1,754,875	5,769,240
4	1,754,964	5,769,069
5	1,755,114	5,768,891
6	1,755,230	5,768,650
7	1,755,680	5,768,142
8	1,756,222	5,768,055
9	1,756,406	5,767,847
10	1,756,505	5,767,595
11	1,757,147	5,767,353

House of third party

House on windfarm area

250 0 250 500 750

metres

Scale: 1:20 000 (A3)

Map Version 1.1D
Photo Ref: Aerial Surveys Ltd flown 10/03/18
Coordinates in NZTM (NZGD2000)
Cadastral Ref: LandOnline 06/02/219
Manawatu Aerial Photo Services RN 09/02/21