Attachment 3

Noise Letter Report

BRUCE WALKER, PH.D., INCE BD. CERT.
ACOUSTICAL ENGINEERING AND RESEARCH
676 WEST HIGHLAND DRIVE
CAMARILLO, CA 93010
805-484-8000
NOISEYBW@AOL.COM

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Mr. Richard Nerzig
Chopin Wind, LLC
4365 Executive Drive, Suite 1470
San Diego, CA 92121

Subject: Chopin Wind project, Umatilla County, OR, updated review of revised configuration relative to acoustical impacts.

Dear Mr. Nerzig,

In accordance with your request, I have reviewed the study done by Channel Islands Acoustics (now retired) in 2010 for the Chopin project and made a comparison with the current revised plan options. In summary, based on information obtained as of December 12, 2015, the off-site noise levels resulting from any of the 10 MW revised project configurations would be well below the 36 dB(A) state noise standard and would be between 3 and 14 dB lower than predicted levels for the 99 MW project analyzed in 2010.

Figure 1 below shows the plan layouts of the original 99 MW and three alternative revised 10 MW Chopin Wind projects.

The original project consisted of 33 ea 3 MW Vestas V-112 turbines on 84-meter tall towers in two rows, with rated sound emission LWA 106.5 dB. The revised project consists of either 4 ea Nordex N117 on 91 meter towers, 5 ea 2 MW Vestas V-110 turbines on 80-meter tall towers or 6 ea GE 1.7-103 turbines on 80-meter tall towers, in a small cluster. In the figures, grid lines are 1,000 meters apart. In the original plan, the nearest residences were approximately 1,500 meters from the nearest turbine (with the exception of Ferguson, located between the two rows). In the revised plan, Ferguson is approximately 2,000 meters from the nearest turbine and all other residences are 3,500 m or more (two miles) from the nearest turbines.

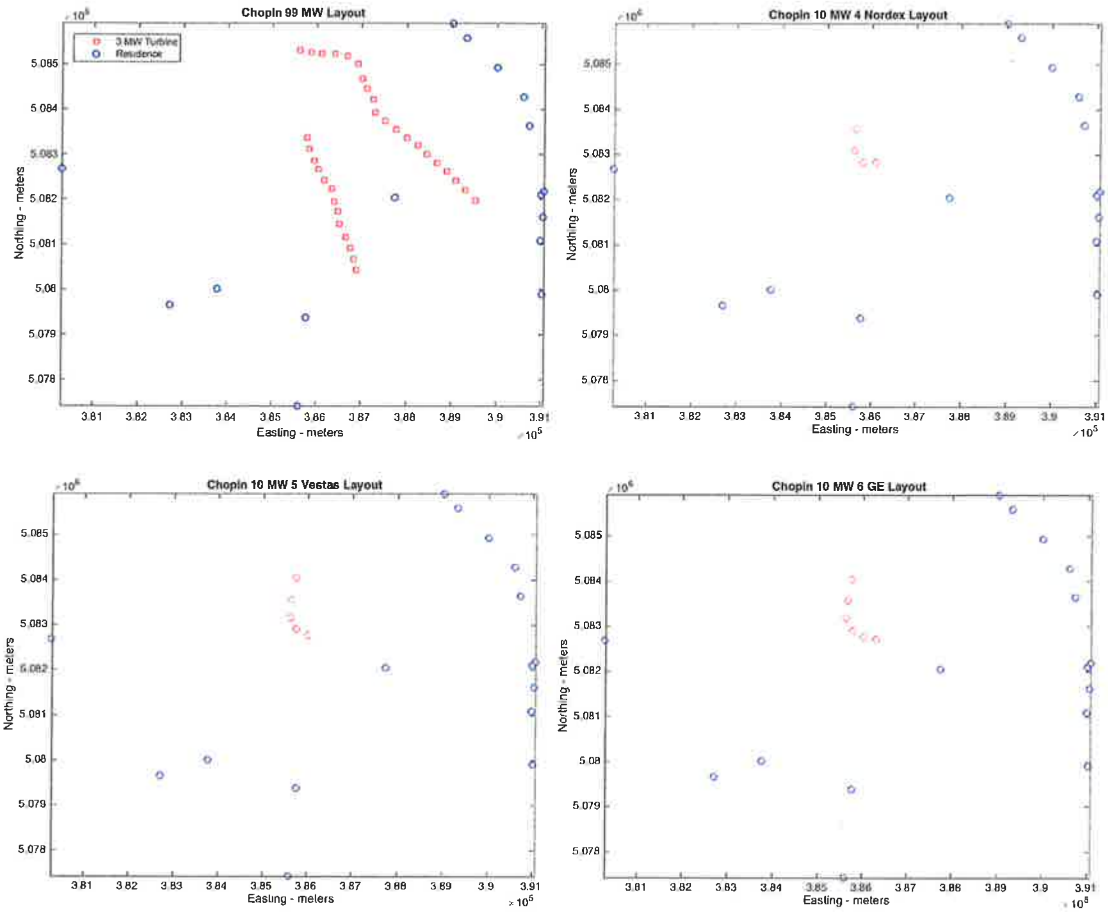

Figure 1. Configuration Plans of 99 MW and 10 MW Projects. Nearest Residences Shown in Blue

Noise contours on 5 dB increments were computed for the original using SoundPlan (ISO 9613) with turbine sound emission levels adjusted to LWA (A-weighted Sound Power Level) 110 dB from the manufacturer stated 106.5 dB per state policy at the time. Results are shown in Figure 2. With the exception of Ferguson, surrounding residences are just outside the 35 dB(A) contour.

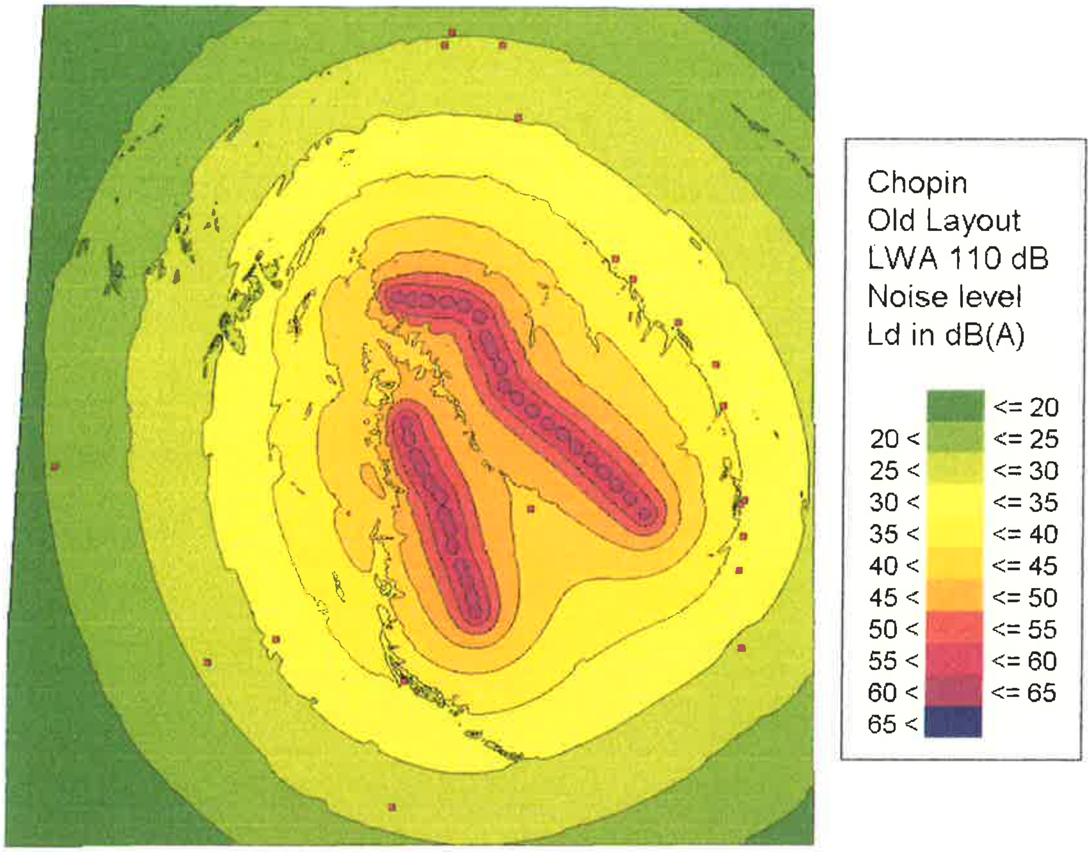

Figure 2. SoundPlan Noise Contour Model of Original 99 MW Project. Residences are Shown as Small Red Squares

A simplified SoundPlan model was used to compute residence location noise levels for the four configurations. Terrain configuration effects were ignored to reduce computation time. Turbine noise emissions were modeled in octave frequency bands as shown in Figure 3. Adjusted sound power levels were estimated from the manufacturer-provided worst case noise vs wind speed data in each octave band and corrected upward per state policy to be roughly comparable to the original modeling.

Nordex – 108.5 dB

Vestas – 111 dB

GE – 111 dB

Table 1. Project Noise Comparison (A-weighted SPL re 10 μPa), without Terrain Shielding

Name	X m	Y m	Z m	99 MW dB(A)	4 Nordex	5 Vestas	6 GE	Minimum Reduction
Res 1	380287	5082680	1.5	26.6	12.5	21.9	23.7	2.9
Res 2	382712	5079654	1.5	29.5	16.1	23.8	25.8	3.7
Res 3	383774	5080008	1.5	32.4	20.2	26.4	28.4	4
Res 4	385615	5077420	1.5	29.5	12.1	21.2	23.5	6
Res 5	385781	5079376	1.5	36.5	20.3	26.3	28.5	8
Ferguson	387749	5082042	1.5	43.8	29	32.5	35.4	8.4
Res 7	389026	5085905	1.5	35.6	17.3	25.2	27.2	8.4
Res 8	389319	5085587	1.5	35.6	17.1	25	27	8.6
Res 9	390007	5084927	1.5	35.2	16	24.1	26.2	9
Res 10	390602	5084276	1.5	34.8	14.6	23.1	25.3	9.5
Res 11	390725	5083640	1.5	35.7	14.6	23	25.3	10.4
Res 12	390988	5081089	1.5	34.4	12.4	21.5	23.9	10.5
Res 13	391008	5082108	1.5	36.0	13.3	22.1	24.5	11.5
Res 14	391024	5079899	1.5	31.5	10.5	20.4	22.7	8.8
Res 15	391049	5081615	1.5	35.2	12.8	21.8	24.1	11.1
Res 16	391067	5082182	1.5	35.7	13.2	22	24.4	11.3

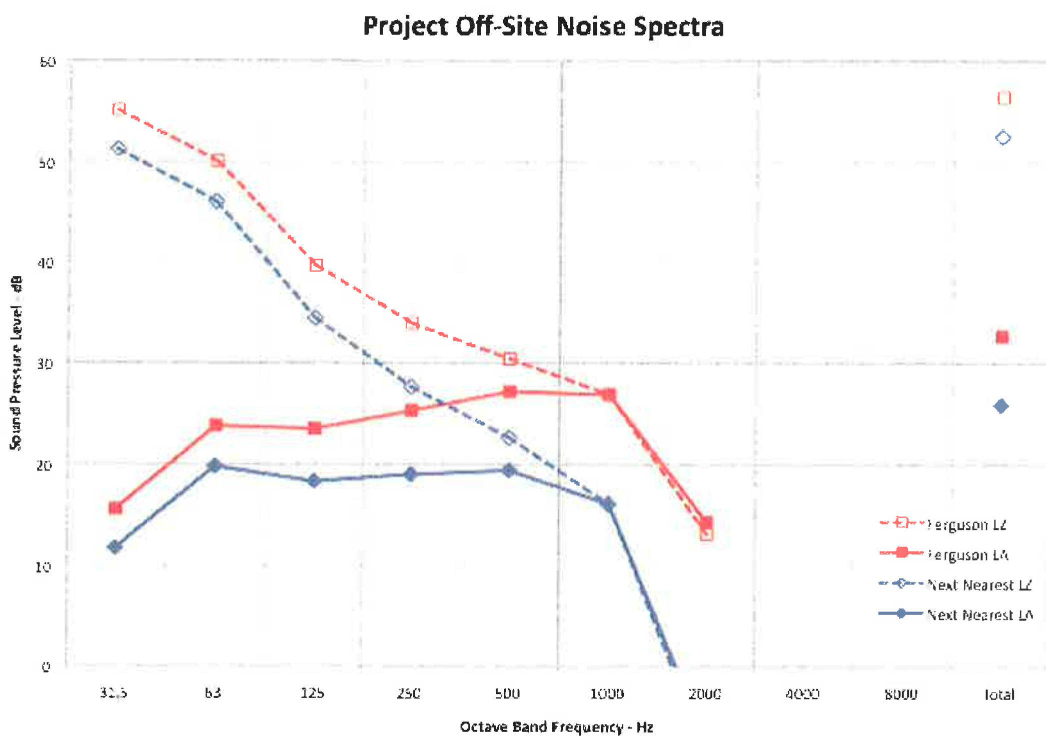

Figure 4. Example of Computed Off-Site Noise Spectra from 10 MW Project

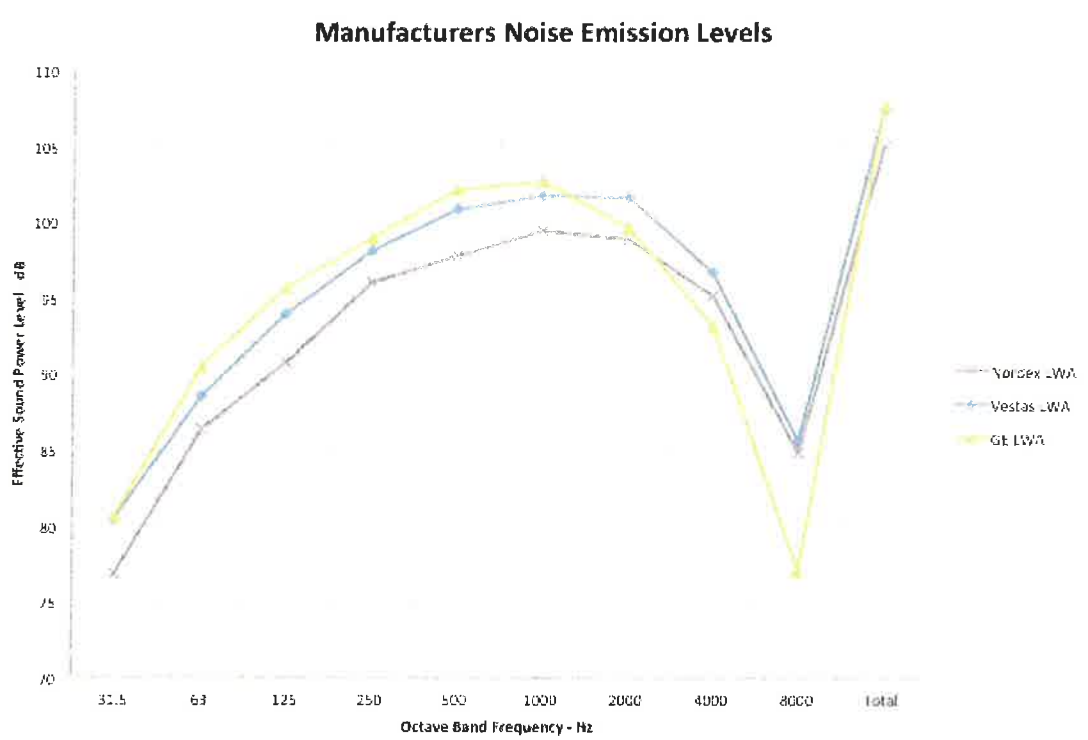

Figure 3. Manufacturers Noise Emission Spectrum the three alternative turbines

The results of the comparison computations are shown in Table 1. It may be noted that the Ferguson residence has been reduced to below 35 dB(A), all other residence locations are well below 35 dB(A) and most are below the state's presumptive 26 dB(A) ambient noise level.

Representative A-weighted and Z-Weighted octave band spectra computed by SoundPlan are shown in Figure 4. Components above 2,000 Hz are below 0 dB due to atmospheric absorptionl The predicted overall Sound Pressure Level (unweighted or Z-weighted) at the nearest off-site residence location is 52-53 dB while the predicted A-weighted level is 26 dB. The spectrum Next Nearest LZ corresponds to Preferred Noise Criterion 20, which is 5 points below the bottom of the PNC 25-40 range recommended for bedrooms in Beranek *Noise and Vibration Control* (p 585).

An issue that has come to the fore in the time since the original 99 MW project analysis is the sound frequency range below 20 Hz, or "Infrasound." For five turbines at a distance of 4,000 meters, infrasound is very unlikely to have a significant effect, but the following is a brief overview in case the issue is raised.

It should be noted that various explanations and theories are being posited for explaining the subjective impact of turbine infrasound. Much of the lore is based on studies conducted at signal amplitudes many, sometimes thousands, of times greater than experienced at reasonable distances from wind turbines.

A turbine rotor turning in a stratified flow field radiates a pressure fluctuation that is periodic at a frequency equal to the rotation rate time the blade count. In a narrow region upwind of the support tower the interaction between the turbine blade and the tower results in radiated pulses that are typically approximately 88 dB in peak level at 100 meters and 1/10 to 1/5 seconds in width. A measured wave example 150 meters from a 2.7 MW turbine is shown in Figure 5. Sound Pressure 0.4 pascals (Pa) corresponds to peak sound pressure level 86 dB. The shaft order spectrum for this wave is also shown in Figure 5. [To convert from shaft order to frequency, divide by approximately 4.]

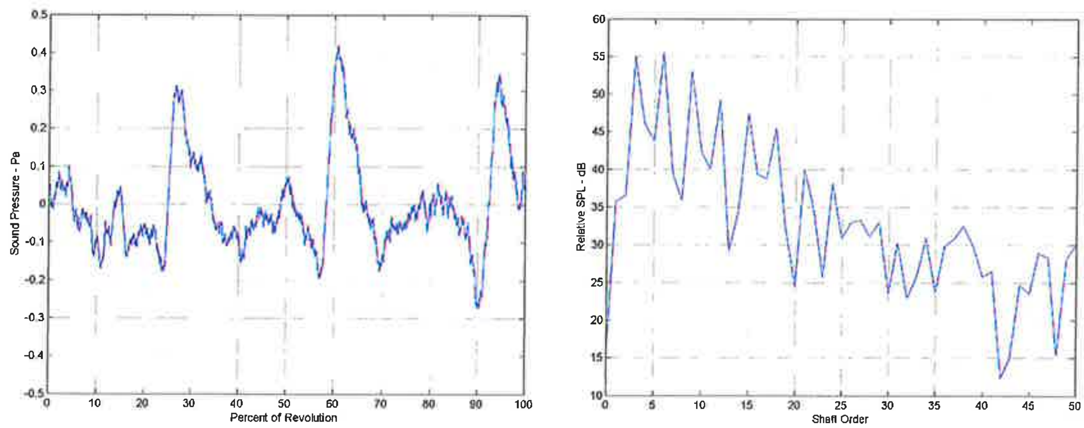

Figure 5. Measured Wave Form and Shaft Order Spectrum of Turbine Infrasound at 150 meters

It is seen from the spectrum that most of the energy is below shaft order 25 (6 Hz). Downwind sound propagation at these very low frequencies has been shown to be slower than the normal spherical divergence rate of 6 dB per distance doubling. Computed pulse peak SPL for 4000 meters downwind is 68-69 dB for a single turbine. The effect of multiple turbines on these pulse waves is also different from the usual 3 dB per doubling of sources, and is dependent upon the relative synchronization of the turbines. The theoretical maximum combined effect for 5 turbines would be +14 dB, or a total of 82-83 dB peak SPL at 4000 meters. For turbines running at slightly different speeds, this theoretical maximum increase is highly improbable. For a technical paper at the International Wind Turbine Noise conference in 2011, a five-turbine array was modeled for 6 hours of operation and the peak SPL relative to that of a single turbine was computed once per rotation.

The +14 condition was never encountered, and the single turbine level was exceeded by 10 dB or more only once, for about one minute.

Controlled tests of synthesized pulses with spectra similar to Figure 5 have shown that peak levels of 94-100 dB (12-18 dB above the theoretical maximum for five turbines at 4000 meters) are required to elicit subjective response. Recent data from Australia has shown that some turbines produce pulses with spectral components that extend into the audible frequency range, illustrated by the spectral peaks in the range 40-55 Hz in Figure 6. Although at 4,000 meters, these sounds would be below hearing threshold, the turbine manufacturer should provide assurance that no blade-passage periodic signal components are audible at residences.

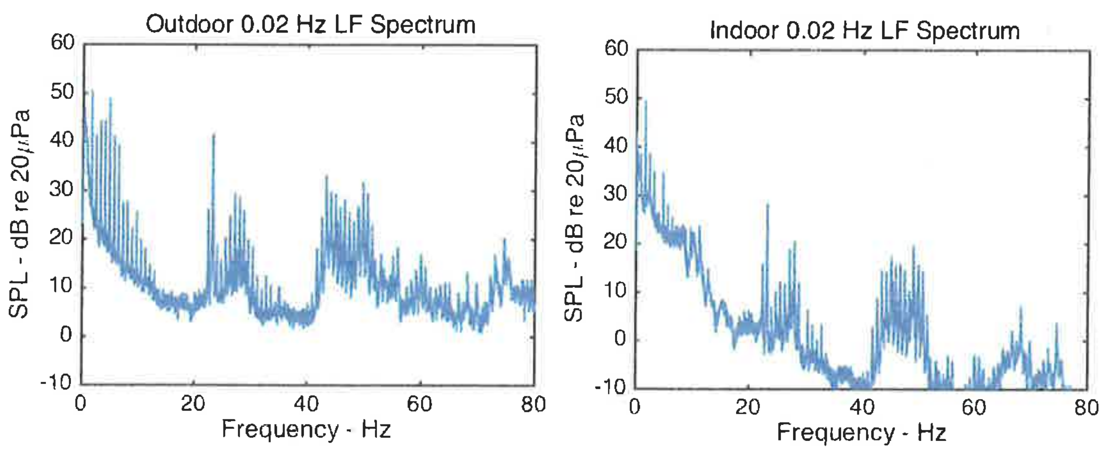

Figure 6. Outdoor and Indoor Spectra from Australian Data, 1400 meters from Nearest Turbine

In conclusion, comparison calculations show that all three of the the revised 10 MW configurations at Chopin Wind development would produce several dB less audible noise at surrounding residences and would be well below the 36 dB(A) state noise limit. Low-frequency noise from the five-turbine array would be below accepted levels for bedroom environments. Turbine-generated infrasound would be at a level that has not been demonstrated to elicit subjective response in absence of synchronized audible signals.

Respectfully,

Bruce Walker

Bruce Walker, Ph.D., INCE Bd. Cert.