GEC
GLOBAL ENERGY CONCEPTS
THE Wind Resource

Sound Mapping for Desert Claim Project

enXco2-001

CONFIDENTIAL

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Overview

enXco, Inc. contracted with Global Energy Concepts, LLC (GEC) to perform sound mapping for the proposed Desert Claim wind power project located approximately 8 miles north of Ellensburg, Washington. This report summarizes findings for the project area and for individual residences in the project vicinity.

The findings indicate that the wind turbines will produce sound levels of no more than 50 decibels on the A-weighed scale (dBA) at the project boundaries. The study also evaluated expected changes in sound level at nearby residences, and concluded that at the residences the change to the background sound levels would be minimal.

Sound Impacts

Sound moves through air as waves of pressure fluctuations caused by vibrations. As sounds move away from their source, the sound pressures decrease because the sound is spread over an increasing area and attenuated (dissipated) by obstructions, obstacles, and the atmosphere. The most common unit of measure used to describe the magnitude of sound levels is the decibel (dB). Sound levels are often stated in terms of decibels on the A-weighted decibel scale (dBA), which is weighted to reflect the response of the human ear by attenuating, or discounting, some of the noise in the low- and high-frequency ranges to which the human ear is less responsive. Sound pressure levels differ from sound power levels. Sound power levels are characteristic of a sound source. Sound pressure levels are what is perceived by the human ear and vary with distance from the source. Wind turbines are often rated at a particular sound power level which is calculated from measurements performed according to a standard (such as International Electrotechnical Commission Standard IEC 61400-11). This sound power rating is a property of the equipment and is not dependent on distance from the source or environmental factors.

The dBA scale is logarithmic, so individual dBA ratings for different sources cannot be added directly to calculate the sound level for combined sources. For example, two sources, each producing 50 dBA will, when added together logarithmically, produce a combined sound level of 53 dBA. In typical situations, a 3 dBA change in sound levels is considered a just-perceivable difference, while a 10 dBA change is considered an approximate doubling of perceived loudness. Typical sound levels include about 110 dBA for construction noise, 90 dBA for a heavy truck accelerating, 60 dBA for a conversation, and 50 dBA for a quiet office. (Additional background information on sound measurements can be found at www.jimprice.com/prosound/db.htm).

When operating, wind turbines produce a "swishing" or "whooshing" sound as their rotating blades encounter turbulence in the passing air, as well as some sounds from the mechanical parts such as the gearbox, generator, and cooling fans. At a distance of several hundred meters (approximately 600 to 900 feet), the sounds generated by a wind turbine are frequently masked by the "background noise" of winds blowing through trees or moving around obstacles. Wind turbines are typically quiet enough for people to hold a normal conversation while standing at the base of the tower. If mechanical sounds are significant, it usually means something in the nacelle needs maintenance or repair.

Project Area Impacts

A sound contour map was generated using WindFarm software assuming the REpower MM92 turbine specifications and using the IEC 61400-11 acoustic reference wind speed of 8.0 meters per second (m/s) (18 miles per hour (mph)) wind speed measured at a reference height of 10 m (33 ft) above ground level. Figure 1 represents a sound contour map of the project area, calculated at the reference conditions. The sound power rating used to produce the reference condition map is 105.0 dBA as described in *Sound Power Level of REpower MM92.*[1] This rating would produce a sound pressure level of about 50 dBA at about 185 m (600 ft) away from the base of an isolated turbine under the acoustic reference condition (8.0 m/s measured at 10 m above ground level[2]).

Sound Power Level of REpower MM92 also indicates that the maximum sound power rating of 105.0 dBA is not exceeded at wind speeds above the 8.0 m/s reference wind speed. At higher wind speeds, sounds from the wind turbine become less noticeable because background noise associated with the wind itself increases and tends to cover or mask that being generated by the turbine.

In the model, the generated sound is represented as a point source at the wind turbine's hub, which is consistent with how the turbine sound power level ratings are typically defined. This approximates the sound pressure waves produced by the blades over their entire path of travel. Sound will decrease over distance due to other factors such as atmospheric damping, terrain absorption, and interference of obstacles; however, the primary mechanism for the decrease of sound is distance attenuation. There is no assumed change of sound due to vegetation, obstacles, or sound being propagated by the wind. Background noise is not taken into account in the model. The model assumes an attenuation coefficient of 0.005 dBA/m. This is equivalent to typical sound attenuation with distance due to the divergence of sound energy (about 6-8 dBA per doubling of distance) up to a distance of 400 m (1300 ft) from a turbine.

The sound level at the project boundary was investigated. For the acoustic reference wind condition producing the maximum hub-height sound power level of 105.0 dBA, the maximum calculated sound pressure level along the project boundary is 50 dBA or less. Under site wind conditions of less than 8.0 m/s, the sound pressure level along the project boundary would be lower.

[1] *Sound Power Level of REpower MM92*, Document: SD-2.9-WT.SL-1-A-EN, March 5, 2005.
[2] For this reference, a site average vertical shear coefficient of 0.14 is assumed.

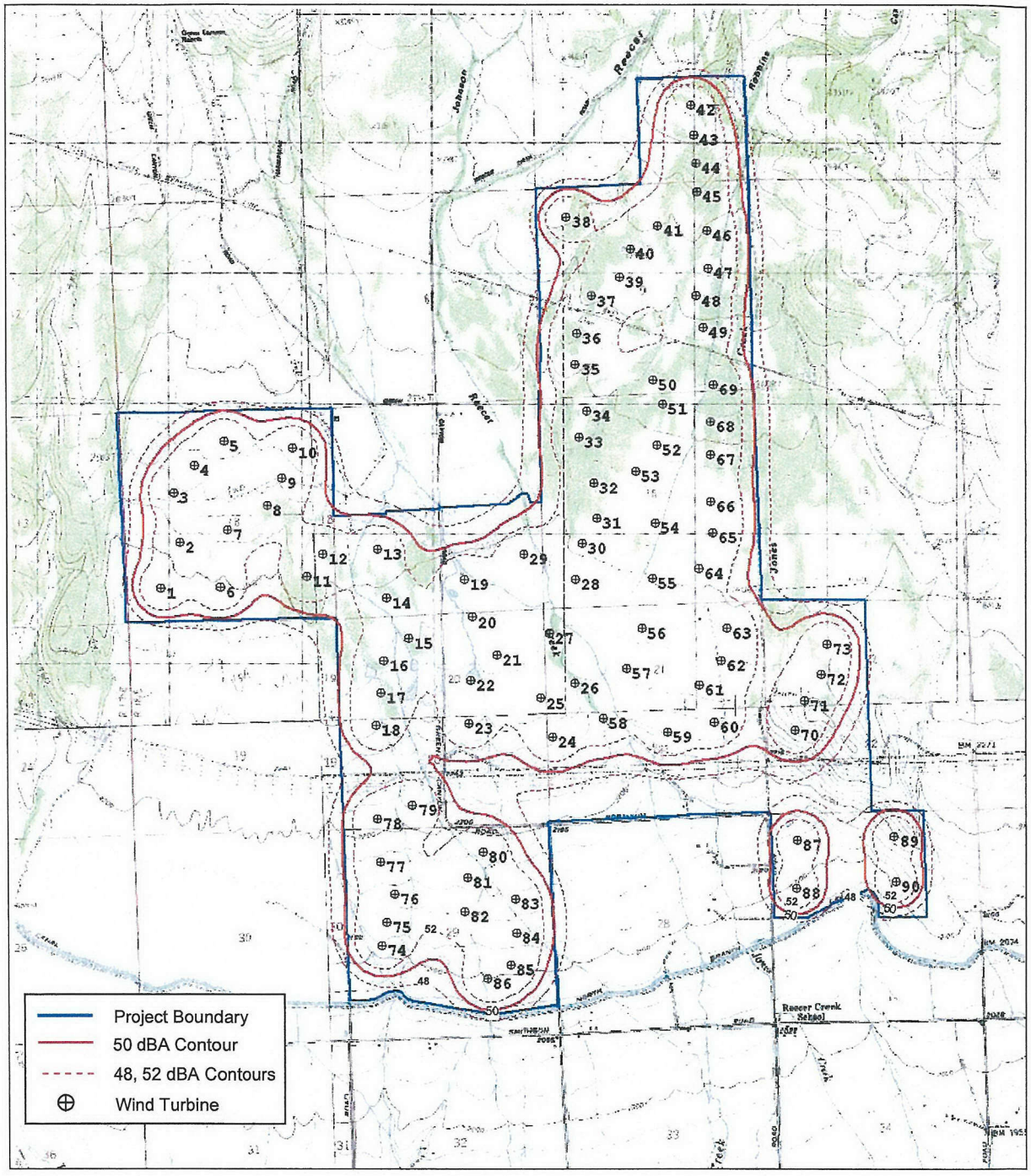

Figure 1. Sound Contour Map for Desert Claim Project Area at Reference Conditions: 8 m/s Wind Speed at 10-m Height

Impacts on Identified Receptors

In addition to modeling the expected sound levels from the turbines, GEC analyzed the incremental change in sound levels that is expected to be perceived by observers at nearby residences. Sound impacts for residences in the project area were modeled using WindFarm software assuming the REpower MM92 turbine specifications and the IEC 61400-11 acoustic reference wind speed of 8.0 m/s (18 mph) wind speed measured at a height of 10 m (33 ft). Both background noise and turbine noise will vary with wind speed. Both low wind speed and high wind speed impacts were modeled using wind speeds of 4.0 m/s (9 mph) and 8.0 m/s (18 mph), respectively, at a height of 10 m (33 ft). Figure 2 shows the identified receptor locations for nearby residences provided by enXco. The sound impact results for turbines on each receptor were then combined with background noise levels to provide an estimate of the total sound level at each residence for both 4 m/s and 8 m/s wind speeds. The resulting impacts are shown in Table 1.

Table 1 compares background sounds at each group of residences with the sounds produced by the wind turbines at low and high wind speeds. These results show that the change to the background noise levels at the residences would be minimal or non-significant across the range of operating wind speeds.

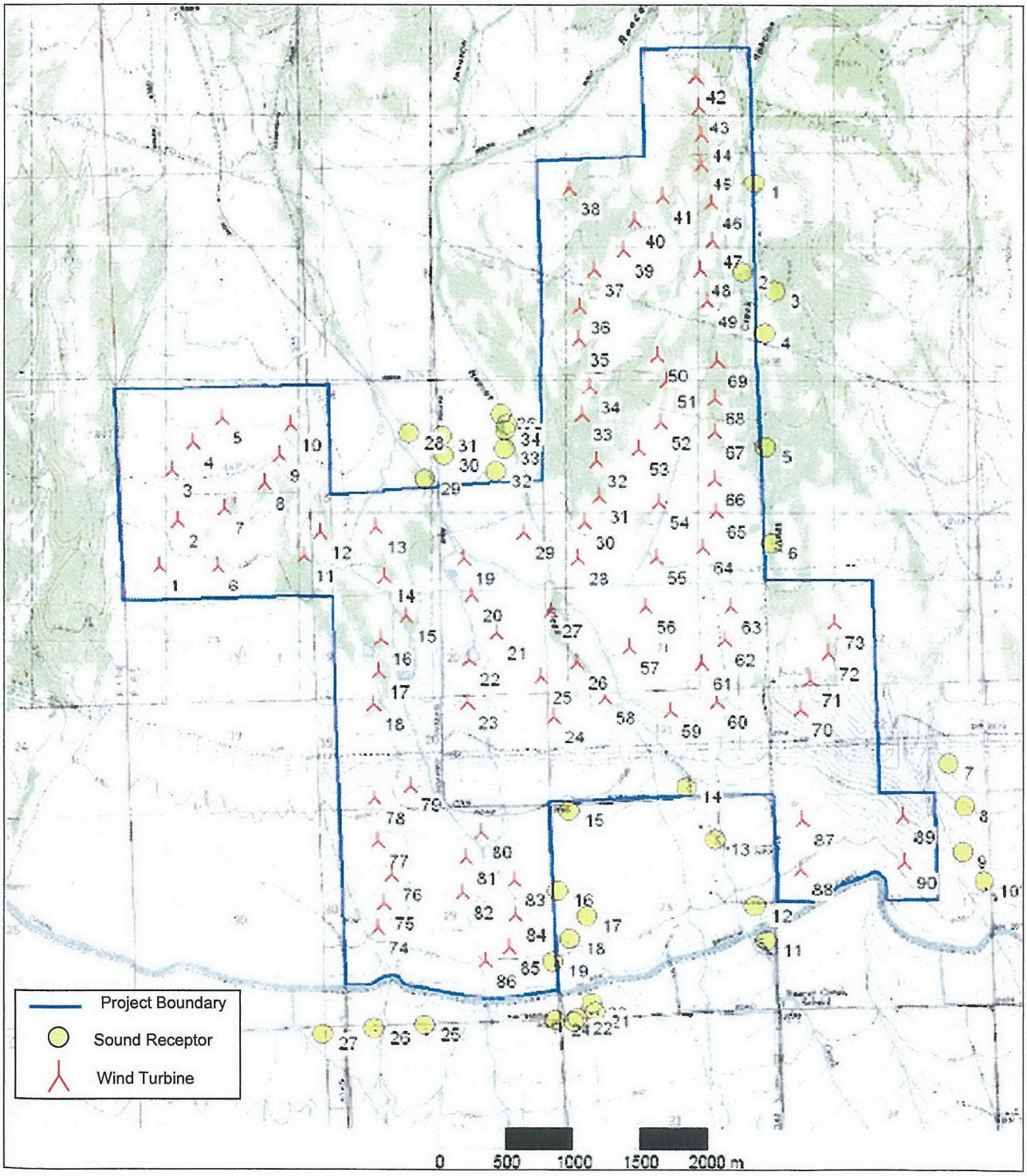

Figure 2. Identified Residential Sound Receptors

Table 1. Sound Impacts for Varying Background Noise Levels and Wind Speeds

Residence ID	4 m/s Wind Speed			8 m/s Wind Speed		
	Background Sound Levels* (dBA)	Turbine Sound Impact (dBA)	Total Turbine and Background Combined (dBA)	Background Sound Levels* (dBA)	Turbine Sound Impact (dBA)	Total Turbine and Background Combined (dBA)
1	39	38	42	47	49	51
2	39	40	43	47	51	52
3	39	36	41	47	47	50
4	39	38	41	47	48	51
5	39	38	42	47	49	51
6	39	38	41	47	48	51
7	34	32	36	42	43	45
8	34	33	37	42	44	46
9	34	34	37	42	44	46
10	34	30	35	42	41	44
11	40	30	40	57	41	57
12	40	33	41	57	44	57
13	40	33	41	57	43	57
14	40	35	41	57	45	57
15	40	35	41	57	46	57
16	40	39	42	57	49	58
17	40	35	41	57	45	57
18	40	36	42	57	47	57
19	40	38	42	57	48	58
20	40	31	40	57	41	57
21	40	30	40	57	40	57
22	40	31	40	57	41	57
23	40	31	40	57	41	57
24	40	32	41	57	43	57
25	40	32	41	57	43	57
26	40	30	40	57	41	57
27	40	28	40	57	39	57
28	44	33	44	58	44	58
29	44	36	45	58	46	58
30	44	34	44	58	45	58
31	44	34	44	58	44	58
32	44	37	45	58	47	58
33	44	36	45	58	47	58
34	44	36	45	58	47	58
35	44	36	45	58	47	58
36	44	36	45	58	46	58

* From Section 3.9, Desert Claim Wind Power Project Final EIS, August 2004.