APPENDIX B

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April 25, 2011

Terry Carlson & Amanda Sanvik
Prairie Wind Energy, LLC
PO Box 31
Parkers Prairie, MN 56361

Subject: Prairie Wind Noise and Shadow Impact

Dear Terry and Amanda:

Below and attached our EAPC Wind Energy's findings regarding shadow flicker and noise impacts to surrounding residences. The occupied residence locations have not been field verified by EAPC. It is possible that more locations need to be modeled, or assumed locations to be occupied are not so. The wind farm layout as of 04/22/2011 was evaluated for noise impacts and shadow flicker impacts on surrounding residences using the WindPRO software. The wind turbine generator (WTG) modeled was the Nordex 117 (N117). This machine was assumed to have a 91 m hub height and rotor diameter of 117 m.

Noise Analysis

The noise impacts for the whole wind farm and a single representative WTG were modeled in WindPRO. The full WindPRO reports are attached. Noise information provided by Nordex indicated that the loudest the turbine operates at is 105 dB. No octave data was provided. Two scenarios were modeled within WindPRO, referred to as "Worst Case" and "Realistic". These two scenarios have common settings, except for the ground attenuation methods applied. The Worst Case scenario assumes no ground attenuation, while the Realistic applies the "Alternative" ground attenuation, which takes into account terrain and a set value for attenuation due to land use. The common settings within WindPRO included using the ISO-9613-2 General noise model. The sensors within WindPRO were assumed to be at 1.5 m above the surface and had a threshold of 50 dB applied.

From a single turbine application, Figures 1 and 2 as well as Table 1 indicate the noise values compared to distance. Roughly 200 m from a single N117 the noise level would be below the 50 dB threshold. The WindPRO reports for the single typical turbine are attached.

When the noise was modeled for the wind farm collectively, only one sensor had a predicted noise value above 50 dB. Sensor NR 20 is estimated to have a noise level of 50.1 dB(A) assuming no ground attenuation, and 49.3 dB(A) with the Alternative ground attenuation. Attached is the WindPRO report for Worst Case and Realistic for the wind farm.

Table 1. Simulated noise levels for worst case (no ground attenuation) and realistic (Alternative ground attenuation) for typical N117 turbine.

Sensor	Distance from WTG (m)	Worst Case Noise (no ground att.) (dB(A))	Realistic Noise (Alt. ground att.) (dB(A))
A	80	55.1	55.0
B	167	51.1	51.1
C	235	48.5	48.5
D	303	46.4	46.4
E	370	44.7	44.2
F	447	43.0	41.7
G	525	41.5	39.8
H	611	40.0	37.9
I	699	38.7	36.2
J	792	37.5	34.7
K	884	36.3	33.3
L	1000	35.1	31.9

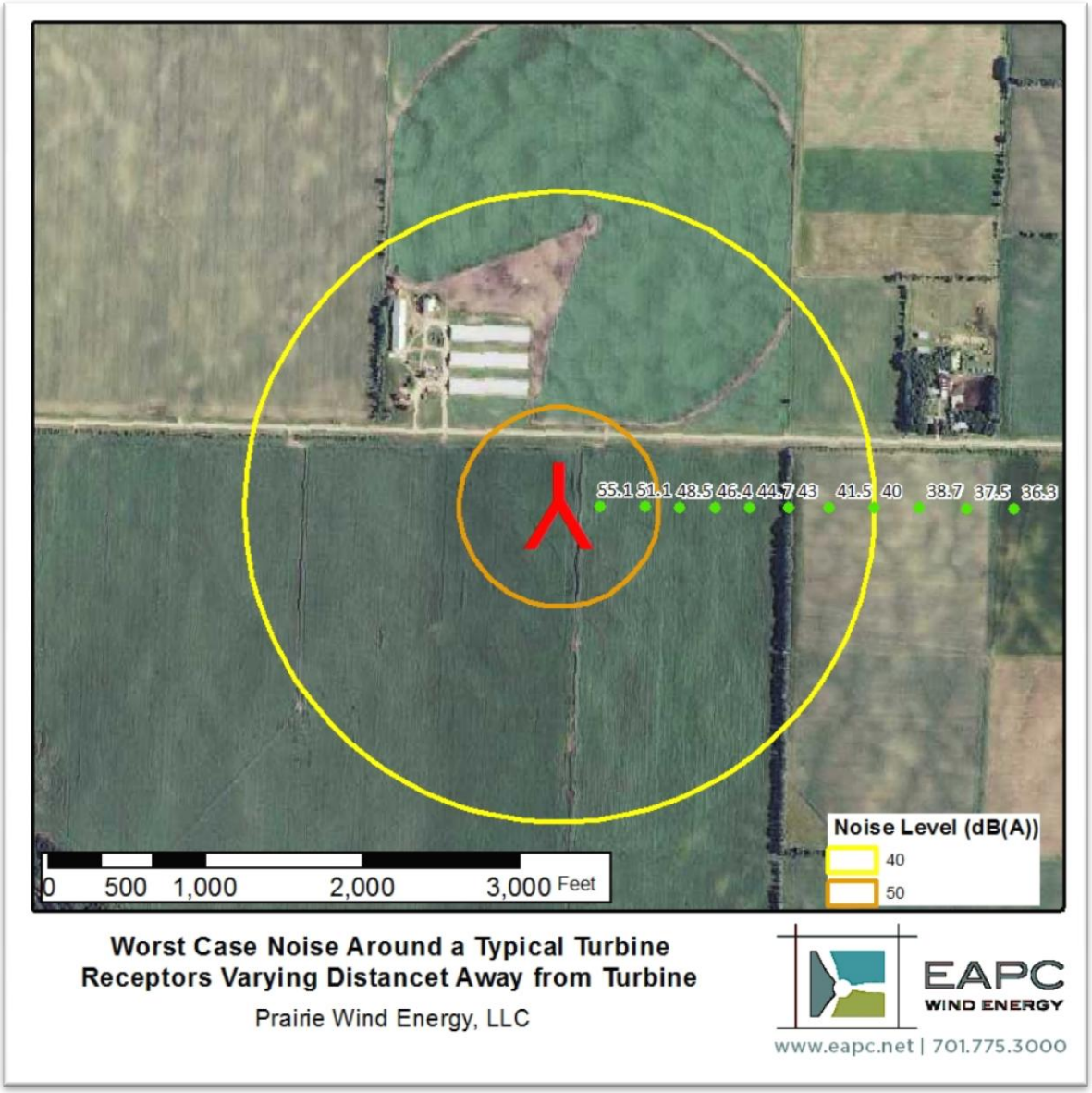

Figure 1. Noise sensor results (dB(A)) and isopleths depicting 40 and 50 dB(A) estimates from a single N117 modeled within WindPRO with no ground attenuation.

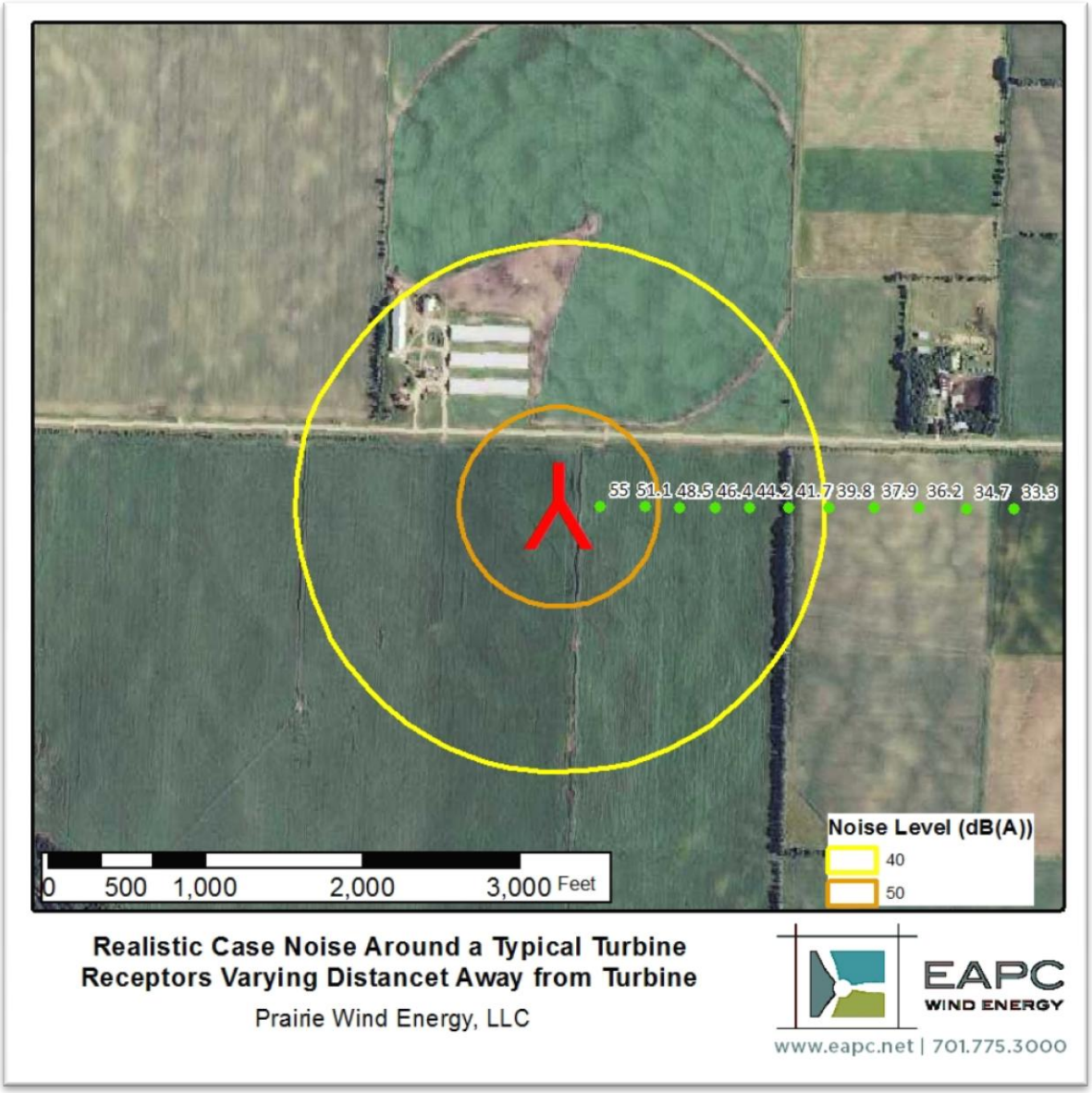

Figure 2. Noise sensor results (dB(A)) and isopleths depicting 40 and 50 dB(A) estimates from a single N117 modeled within WindPRO with Alternative attenuation.

Shadow Flicker Analysis

Shadow flicker for the whole wind farm and an individual representative turbine were evaluated within WindPRO. Two scenarios were considered, Worst Case and Realistic. The Worst Case scenarios assume that the wind turbines are always in operation, always facing into the sun, and that there is no cloud cover. The Realistic case statistically reduces the shadow flicker hours by taking into consideration the wind speed (cut in wind speed) and directional distribution and sunshine probabilities. Both scenarios used "greenhouse" sensors (shadows viewable from all angles), assumed no vegetation or obstacles block the shadows, a shadow is possible when the sun is 3 degrees above the horizon, and a distance limit of 1,500 m.

No standard of acceptable hours has been adopted by the State of Minnesota. A threshold of 25 hours a year is an arbitrary value selected for comparison purposes. When evaluating the wind farm collectively, the worst case scenario, 47 receptors had more than 25 shadow flicker hours a year. The realistic scenario reduced this too 16 receptors. Full results can be found in the attached WindPRO report.

The shadow flicker impact and footprint for a single typical N117 can be found in Table 2 and Figures 3 and 4. Due to the sun angle at this location, receptors southwest, south, and southeast 1000 ft away from the turbine would experience no shadow flicker hours. Full WindPRO reports are attached.

Table 2. Worst case (no clouds, no operational data, etc.) and realistic (reduced probability) shadow flicker impacts 1000 ft away from a single N177 turbine.

Sensor	Worst Case (hrs/yr)	Shadow days per year	Max shadow (hrs / day)	Realistic Case (hrs/year)
North	95.1	78	1.5	28.5
Northeast	180.3	137	1.5	45.5
East	144.6	134	1.4	52.9
Southeast	0.0	0	0.0	0.0
South	0.0	0	0.0	0.0
Southwest	0.0	0	0.0	0.0
West	156.3	149	1.4	58.3
Northwest	186.1	150	1.5	65.7

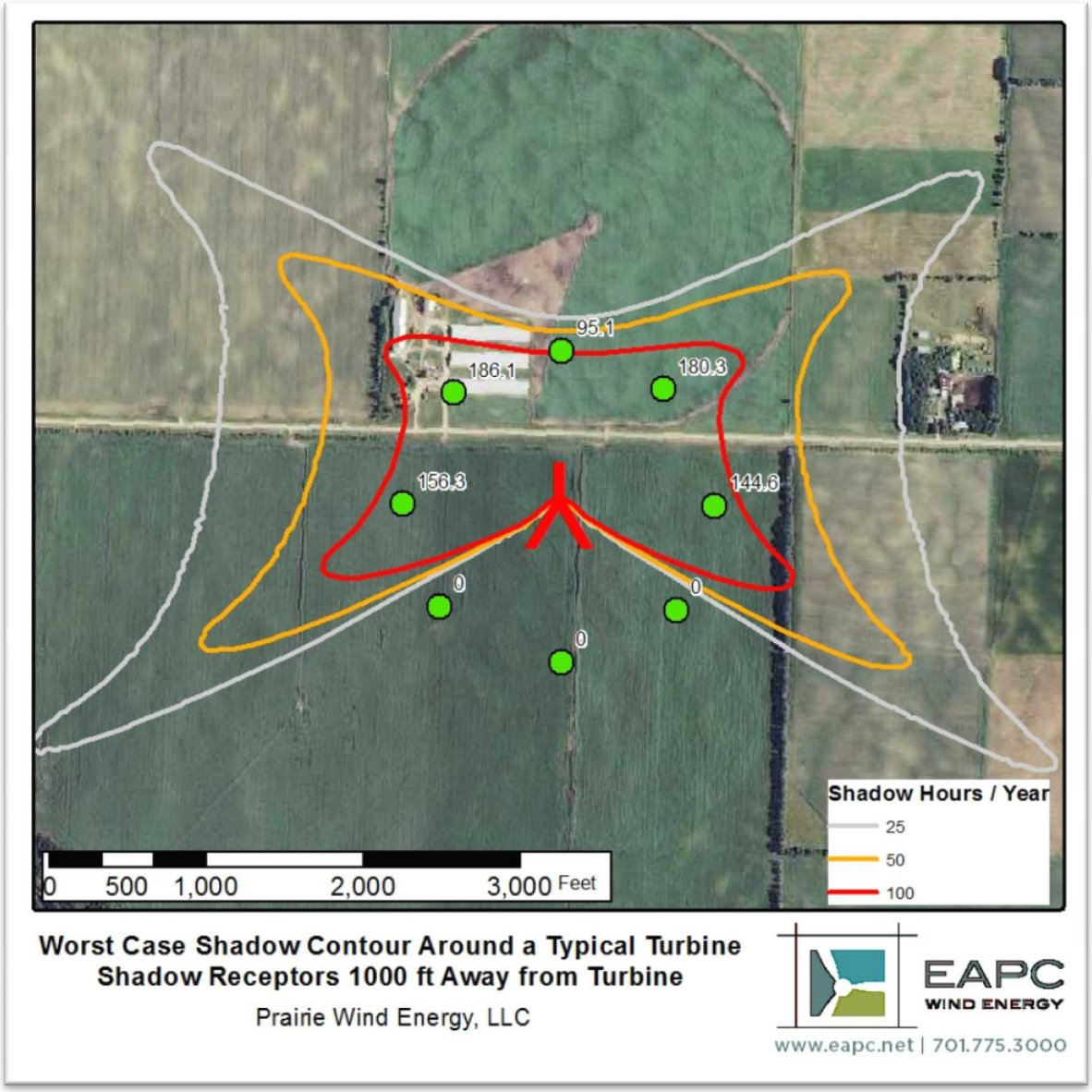

Figure 3. Worst Case shadow flicker results for a typical N117 location. Receptors 1000 ft away from the turbine and shadow hours per year labeled.

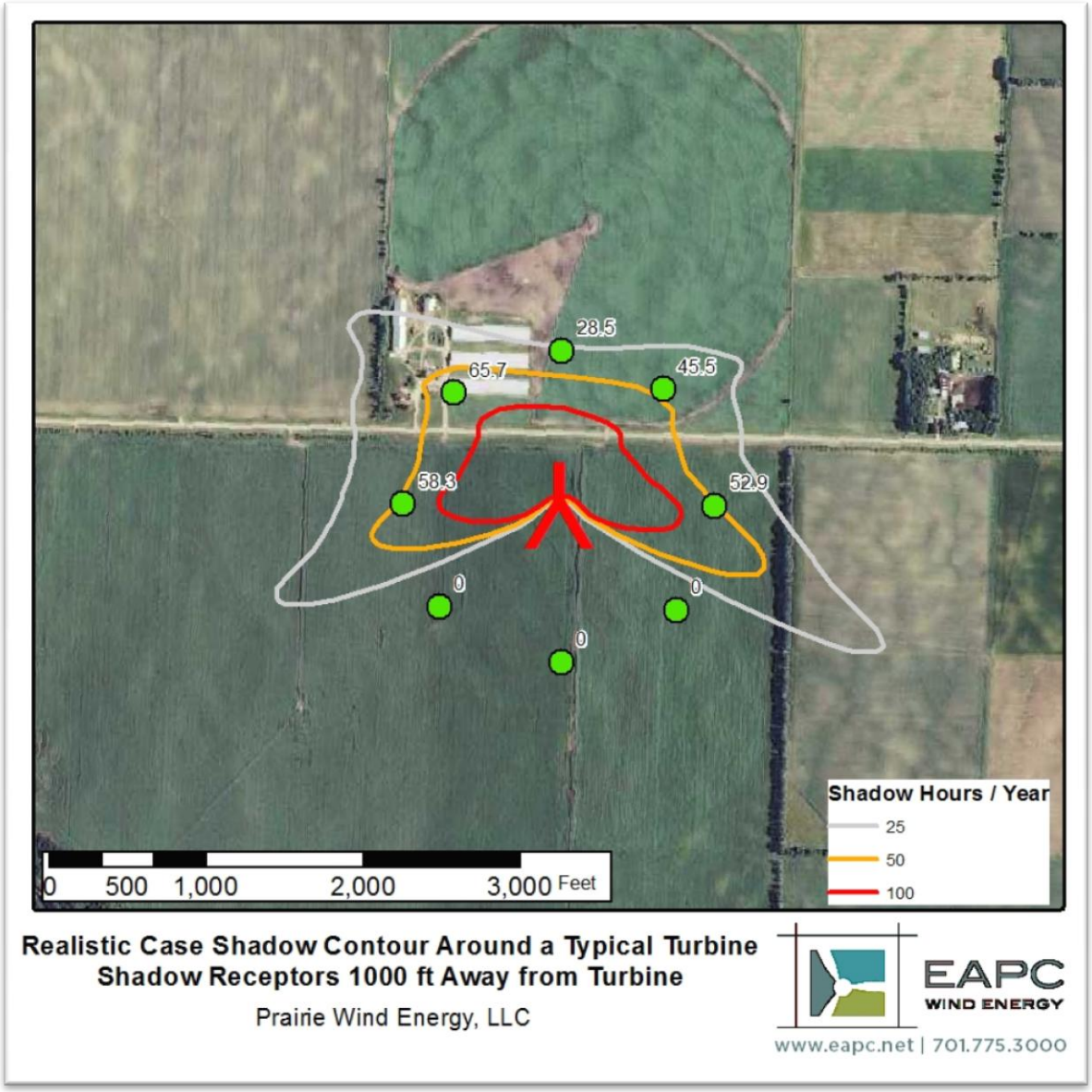

Figure 4. Realistic shadow flicker results for a typical N117 location. Receptors 1000 ft away from the turbine and shadow hours per year labeled.

The shadow flicker hours could be greatly reduced at many of the receptors if trees and out buildings were modeled. This has not been done at this point due to the time required. Additional modeling of this detail could be done for "problematic" receptors.

Mitigation options such as blinds, curtailment, tree rows being planted could also be considered if the current results are found unacceptable.

Kind Regards,

Brandon Storm, PhD,
Senior Meteorologist
EAPC Wind Energy

List of Attachments:

Attachment 1: Worst Case Noise Single Turbine
(110422_PrW_NOISE_N117_WorstCase_SingleTurbineImpact.pdf)
Attachment 2: Realistic Case Noise Single Turbine
(110422_PrW_NOISE_N117_RealisticCase_SingleTurbineImpact.pdf)
Attachment 3: Worst Case Noise Wind Farm
(110422_PrW_Noise_N117_WorstCase_AllTurbines.pdf)
Attachment 4: Realistic Case Noise Wind Farm
(110422_PrW_Noise_N117_RealisticCase_AllTurbines.pdf)
Attachment 5: Shadow Flicker Wind Farm
(110422_PrW_SHADOW_N117_AllTurbines.pdf)
Attachment 6 Shadow Flicker Single Turbine
(110422_PrW_SHADOW_N117_SingleTurbineImpact.pdf)