Appendix: J

Shadow Flicker & Sound Pressure Report

Final Report
Crowned Ridge Wind Farms
Sound and Shadow Flicker Study
Grant County, SD

September 12,

2018

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Report Update

EAPC bears no responsibility to update this report for any changes occurring subsequent to the final issuance of this report.

Revision History

Revision No.	Revision Purpose	Date	Revised By
0	Original	8/30/2018	J. Haley

Executive Summary

EAPC was hired to provide estimates of the potential sound and shadow flicker impacts for a proposed wind turbine layout for the Grant County portion of the Crowned Ridge and Crowned Ridge II wind farm projects in northeastern South Dakota. The scope of this report includes all proposed turbines from Grant County included in the Crowned Ridge and Crowned Ridge II projects that will be permitted separately through the South Dakota Public Utilities Commission. Locations of area existing residences and a wind turbine layout using a mixture of wind turbines manufactured by General Electric (GE) were provided to EAPC by Crowned Ridge Wind, LLC and Crowned Ridge Wind II, LLC. A computer model was built combining digital elevation data with the information supplied by Crowned Ridge Wind, LLC and Crowned Ridge Wind II, LLC to generate sound and shadow flicker models for the site. The resulting models were then used to perform sound and shadow flicker calculations for the area. Based on the calculations, site-wide realistic sound and shadow flicker maps were produced and an evaluation of the sound and shadow flicker impacts at 178 principle and accessory structures within Grant County was performed.

For the sound study, the 178 principle and accessory structures were modeled using a point-type sound sensor so that the highest sound pressure level at the perimeter of the structure could be calculated. Moderate ground attenuation was assumed.

For the shadow study, of the 178 principle and accessory structures, 36 principle structures were represented in the model by omni-directional shadow receptors that simulate a 1 m x 1 m window at 1 m above ground level. Reductions based on turbine operational time, turbine operational direction, and sunshine probabilities were used to calculate a realistic number of hours of shadow flicker to be expected at each shadow receptor. No obstacles were used so that shadow flicker reductions due to interference from trees and structures were not included, meaning that the “realistic” estimates are still somewhat conservative.

In summary, the maximum sound pressure level at the perimeter of principle and accessory structures is 47.7 dBA, therefore the project in Grant County as modeled, is in compliance with Grant County’s allowable sound pressure levels as described in Section 1211.04, paragraph 13 of the current Grant County Zoning Ordinance.

While there are currently no rules enforced by the state of South Dakota or Grant County to limit the number of shadow flicker hours allowed, Crowned Ridge Wind, LLC and Crowned Ridge Wind II, LLC has voluntarily limited the maximum shadow flicker hours to 30 hours per year at principle structures, which is consistent with the zoning ordinances in adjacent Counties. For the turbine array provided, no principle structure experienced more than 29 hours and 3 minutes of shadow flickering per year based on realistic assumptions regarding operational time and sunshine probability.

1. Introduction

EAPC was hired to conduct sound and shadow flicker studies for the regional development of two Crowned Ridge wind farm projects located in Codington, Grant and Grant Counties in northeastern South Dakota. The regional development's layout consists of 13 GE 1.7 MW wind turbines with a hub height of 80 meters, 15 GE 2.1 MW wind turbines with a hub height of 80 meters, and 264 GE 2.3 MW wind turbines with a hub height of 90 meters, for a total of 292 wind turbines. The locations of the proposed wind turbines were supplied by Crowned Ridge Wind, LLC and Crowned Ridge Wind II, LLC.

From the database of existing residences and coordinates supplied by Crowned Ridge Wind, LLC and Crowned Ridge Wind II, LLC, 178 principle and accessory structures in Grant County were found to be within 2 km of a wind turbine and were included in the sound and shadow models.

The area of interest for this report is located in Grant County near the town of Stockholm in northeastern South Dakota. The surrounding terrain has a change in elevation across the Grant County portion of the project site ranging from 426 to 621 meters (1,398 to 2,037 feet) at the wind turbine base. The region's vegetation is comprised primarily of agricultural land. Project overview maps can be found in Appendix B.

2. Background - Sound

To determine if the layout provided would be compliant with the Grant County regulations, detailed sound scenarios were analyzed using a computer model. The scenarios assumed that the wind turbines were operating at a wind speed that resulted in the loudest sound being emitted.

According to the GE sound documentation provided to EAPC by Crowned Ridge Wind, LLC and Crowned Ridge Wind II, LLC, the loudest normal operating sound pressure level emitted from the GE 1.7-103 is 107 dBA at 10 m/s and higher at 80 m above ground level (AGL).

For the GE 2.1-116, the sound emission specifications for the 2.3-116 were used, which is a conservative assumption since the sound emission levels for the 2.1-116 will likely be lower than for the larger 2.3-116.

For the 2.3-116, the loudest normal operating sound pressure level emitted is 107.5 at 10 m/s and higher at 90 m AGL.

The specifications for the three GE wind turbine models used in this study are included in Table 1 below. The table of wind turbine coordinates and sound profiles for the subset of turbines within 2 km of existing Grant County residences is included in Appendix A.

Table 1: Crowned Ridge wind energy projects wind turbine specifications.

Crowned Ridge wind energy projects wind turbine specifications						
Manufacturer	**Model**	**Hub Height (m)**	**Rotor Dia. (m)**	**Cut-In Wind Speed (m/s)**	**Cut-Out Wind Speed (m/s)**	**Max. Sound Press. Level (dBA)**
General Electric	GE 1.7	80	103	3	23	107
General Electric	GE 2.1	80	116	3	22	107.5
General Electric	GE 2.3	90	116	3	22	107.5

A safety margin of 2 dBA was added to both GE 1.7-103 and GE 2.3-116 sound profiles for the study.

The state of South Dakota does not have regulatory sound or shadow flicker limits for wind turbines. Grant County's current Ordinance Section 1211.04, paragraph 13 prescribes sound limits for wind turbine projects as follows:

"Noise level shall not exceed 50 dBA, average A-weighted Sound pressure including constructive interference effects at the perimeter of the principal and accessory structures of existing off-site residences, businesses, and buildings owned and/or maintained by a governmental entity."

Therefore, Grant County's only applicable sound limit is 50 dBA for all principle and accessory structures of existing off-site residences, businesses, and buildings owned and/or maintained by a governmental entity, which is what has been evaluated in this report.

3. *Study Methodology - Sound*

This sound analysis was performed utilizing windPRO[1], which has the ability to calculate detailed sound maps across an entire area of interest or at site-specific locations using sound sensitive receptors.

The analysis used the ISO 9613-2 "Attenuation of sound during propagation outdoors, Part 2" sound calculation model with "General" ground attenuation and an attenuation factor of 0.5, which represents typical mixed vegetation and crop cover. Realistic sound

[1] windPRO is the world's leading software tool for designing wind farms, including sound and shadow flicker analysis.

pressure levels were calculated at 1.5 m AGL at the non-participating existing residences. The term “realistic” in this case, means that some amount of ground attenuation is accounted for.

The inputs for the windPRO sound calculation include the following:

- Turbine Coordinates
- Turbine Specifications
- Sound Receptor Coordinates
- Wind Turbine Sound Emission Data
- USGS Digital Elevation Model (DEM) (height contour data)

Turbine Coordinates: The location of a wind turbine in relation to a sound receptor is one of the most important factors in determining sound impacts. Sound pressure levels drop as they travel farther from the source of emission. The attenuation comes from atmospheric absorption as well as from absorption by the ground cover between the turbine and the receptor. The sound pressure waves can also be reflected by hard or smooth surfaces such as ice or water.

Turbine Specifications: Sound emission data including 1/3rd octave data supplied by the manufacture is used assuming the loudest sound pressure levels are being emitted at the hub height of the turbine. A safety margin of 2 dBA was added to the loudest sound pressure levels for all blade types for the analysis.

Sound Receptor Coordinates: As with the wind turbine coordinates, the elevation, and distance of a sound receptor in relation to the wind turbines are the main factors in determining the sound impacts. EAPC was provided with coordinates for 178 structures found to be located within 2 km of the 292 proposed wind turbine locations.

USGS Digital Elevation Model (DEM) (height contour data): For this study, 3 m USGS National Elevation Database (NED) DEM’s were used to construct 10-foot interval height contour lines for the windPRO sound model. The height contour information is important to the sound calculation since it allows the model to place the wind turbines and the sound receptors at the correct elevations.

4. *Results of Analysis - Sound*

The sound study indicates that no principle or accessory structures will be above 50.0 dBA. Therefore the project would be in compliance with Grant County’s allowable sound pressure levels as described in Section 1211.04, paragraph 13 of the current Grant County Zoning Ordinance. Table 2 shows the distribution of sound pressure levels for the project. The full table of results from the realistic case sound study can be found in Appendix C and the maps showing the sound iso-lines are in Appendix D.

Table 2: Existing residence realistic sound distribution

Realistic Sound (dBA)	Principle and Accessory Structures
0 to 25	0
25 to 30	0
30 to 35	7
35 to 40	49
40 to 45	70
45 to 50	52
+50	0

5. *BACKGROUND - SHADOW FLICKER*

Shadow flicker from wind turbines occurs when rotating wind turbine blades move between the sun and the observer. Shadow flicker is generally experienced in areas near wind turbines where the distance between the observer and wind turbine blade is short enough that sunlight has not been significantly diffused by the atmosphere. When the blades rotate, this shadow creates a pulsating effect, known as shadow flicker. If the blade's shadow is passing over the window of a building, it will have the effect of increasing and decreasing the light intensity in the room at a low frequency in the range of 0.4 to 0.875 Hz, hence the term "flicker." In this case, with a maximum rotational speed of 17.5 rpm for the GE 1.7-103, the frequency would be 0.875 Hz. This flickering effect can also be experienced outdoors, but the effect is typically less intense, and becomes less intense when farther from the wind turbine causing the flicker.

This flickering effect is most noticeable within approximately 1,000 meters of the turbine, and becomes more and more diffused as the distance increases. There are no uniform standards defining what distance from the turbine is regarded as an acceptable limit beyond which the shadow flicker is considered to be insignificant. The same applies to the number of hours of flickering that is deemed to be acceptable.

Shadow flicker is typically greatest in the winter months when the angle of the sun is lower and casts longer shadows. The effect is also more pronounced around sunrise and sunset when the sun is near the horizon and the shadows are longer. A number of factors influence the amount of shadow flicker on the shadow receptors.

One consideration is the environment around the shadow receptor. Obstacles such as terrain, trees or buildings between the wind turbine and the receptor can significantly reduce or eliminate shadow flicker effects. Deciduous trees may block the shadow flickering effect to some degree, depending on the tree density, species present and time of year. Deciduous trees can lead to a reduction of shadow flicker during the summer when the trees are bearing leaves. However, during the winter months, these trees are without their leaves and their impact on shadow flicker is not as significant. Coniferous trees tend to provide mitigation from shadow flicker year round. For this study, no credit was taken for any potential shading effects from any type of trees or other obstacles that would reduce the number of shadow flickering hours at the structures.

Another consideration is the time of day when shadow flicker occurs. For example, it may be more acceptable for private homes to experience the shadow flickering during daytime hours when family members may be at work or school. Likewise, a commercial property would not be significantly affected if all the shadow flicker impact occurred before or after business hours.

The climate also needs be considered when assessing shadow flicker. In areas with a significant amount of overcast weather, there would be less shadow flicker, as there are no shadows if the sun is blocked by clouds. Also, if the wind is not blowing, the turbines would not be operational and therefore not creating shadow flickering.

While there are no State or Grant County requirements to limit the amount of shadow flicker, Crowned Ridge Wind, LLC and Crowned Ridge Wind II, LLC has elected to limit the maximum amount of shadow flicker to 30 hours per year for principle structures, which is consistent with the ordinances in both Codington and Deuel counties.

6. *STUDY METHODOLOGY - SHADOW FLICKER*

This shadow flicker analysis was performed utilizing windPRO, which has the ability to calculate detailed shadow flicker maps across an entire area of interest or at site-specific locations using shadow receptors.

Shadow maps which indicate where the shadows will be cast and for how long, are generated using windPRO, calculating the shadow flicker in varying user-defined resolutions. Standard resolution was used for this study and represents shadow flicker being calculated every three minutes of every day over the period of an entire year over a grid with a 20 m by 20 m resolution.

In addition to generating a shadow flicker map, the amount of shadow flicker that may occur at a specific point can be calculated more precisely by placing a shadow receptor at the location of interest and essentially “recording” the shadow flicker that occurs as the relative sunrise to sunset motion of the sun is simulated throughout an entire year.

The point-specific shadow flicker calculation is run at a higher resolution as compared to the shadow flicker map calculation to utilize the highest precision available within windPRO. Shadow flicker at each shadow receptor location is calculated every minute of every day for an entire year. Shadow receptors can be configured to represent an omni-directional window of a specific size at a specific point (greenhouse mode) or a window facing a single direction of a specific size at a specific point (single direction mode). The shadow receptors used in this analysis were configured as greenhouse-mode receptors representing a 1 m x 1 m window located 1 m above ground level. This represents more of a "worst-case" scenario and thus will produce more conservative results since it assumes that all windows are always in direct line of sight with the turbines and the sun.

As a part of the calculation method, windPRO must determine whether or not a turbine will be visible at the receptor locations and not blocked by local topography or obstacles. It does this by performing a preliminary Zones of Visual Influence (ZVI) calculation, utilizing 10 m grid spacing. If a particular turbine is not visible within the 10 m x 10 m area that the shadow receptor is contained within, then that turbine is not included in the shadow flicker calculation for that receptor.

The inputs for the windPRO shadow flicker calculation include the following:

- Turbine Coordinates
- Turbine Specifications
- Shadow Receptor Coordinates
- Monthly Sunshine Probabilities
- Joint Wind Speed and Direction Frequency Distribution
- USGS Digital Elevation Model (DEM) (height contour data)

A description of each input variable and how they affect the shadow flicker calculation are included below.

Turbine Coordinates: The location of a wind turbine in relation to a shadow receptor is one of the most important factors in determining shadow flicker impacts. A line-of-site is required for shadow flicker to occur. The intensity of the shadow flicker is dependent upon the distance from the wind turbine and weather conditions.

Turbine Specifications: A wind turbine's total height and rotor diameter will be included in the windPRO shadow flicker model. The taller the wind turbine, the more likely shadow flicker could have an impact on local shadow receptors as the ability to clear obstacles (such as hills or trees) is greater, although in this analysis, no credit is taken for any such blockage from trees. The larger the rotor diameter is, the wider the area where shadows will be cast. Also included with the turbine specifications are the cut-in and cut-out wind speeds within which the wind turbine is operational. If the wind speed is below the cut-in threshold or above the cut-out threshold, the turbine rotor will not be spinning and thus shadow flicker will not occur.

Shadow Receptor Coordinates: As with the wind turbine coordinates, the elevation, distance and orientation of a shadow receptor in relation to the wind turbines and the sun are the main factors in determining the impact of shadow flicker. EAPC was provided with coordinates for 178 principle and accessory structures found to be located within 2 km of the 292 proposed wind turbine locations.

Monthly Sunshine Probabilities: windPRO calculates sunrise and sunset times to determine the total annual hours of daylight for the modeled area. To further refine the shadow flicker calculations, the monthly probability of sunshine is included to account for cloud cover. The greater the probability of cloud cover, the less of an impact from shadow flicker. The monthly sunshine probabilities for many of the larger cities across the United States are available from the National Climatic Data Center (NCDC). For this study, 18 years' worth of monthly sunshine probability data were retrieved for Huron, SD, which was the closest, most representative station, to create the long-term representative monthly sunshine probabilities. The long-term representative monthly average sunshine probabilities are presented below in Table 3.

Table 3: Huron, SD monthly sunshine probabilities.

Huron, SD Monthly Sunshine Probabilities (1965-1983)												
Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Sunshine %	0.62	0.62	0.62	0.59	0.66	0.69	0.76	0.74	0.69	0.59	0.51	0.51
retrieved from: http:// http://www1.ncdc.noaa.gov/pub/data/ccd-data/pctpos15.dat												

Joint Wind Speed and Direction Frequency Distribution: A set of long-term corrected wind distributions was provided by Crowned Ridge Wind, LLC and Crowned Ridge Wind II, LLC to represent the annual wind speed and direction distribution for the project site. This data was used to estimate the probable number of operational hours for the wind turbines from each of the 12 wind direction sectors. During operation, the wind turbine rotors will always be assumed to face into the wind and automatically orient themselves as the wind direction changes. Shadow flicker can only occur when the blades are turning and the wind turbine rotor is between the sun and the receptor. Shadow flicker is most significant when the rotor is facing the sun.

USGS Digital Elevation Model (DEM) (height contour data): For this study, 3 m USGS National Elevation Database (NED) DEM's were used to construct 10-foot interval height contour lines for the windPRO shadow flicker model. The height contour information is important to the shadow flicker calculation since it allows the model to place the wind turbines and the shadow receptors at the correct elevations. The height contour lines also allow the model to include the topography of the site when calculating the zones of visual influence surrounding the wind turbine and shadow receptor locations.

The actual calculation of potential shadow flicker at a given shadow receptor is carried out by simulating the environment near the wind turbines and the shadow receptors. The position of the sun relative to the turbine rotor disk and the resulting shadow is calculated in time steps of one minute throughout an entire year. If the shadow of the rotor disk (which in the calculation is assumed solid) at any time casts a shadow on a receptor window, then this step will be registered as one minute of shadow flicker. The calculation also requires that the sun must be at least 3.0° above the horizon in order to register shadow flicker. When the sun angle is less than 3.0°, the shadow quickly becomes too diffuse to be distinguishable since the amount of atmosphere that the light must pass through is 15 times greater than when the sun is directly overhead.

The sun's path with respect to each wind turbine location is calculated by the software to determine the paths of cast shadows for every minute of every day over a full year. The turbine runtime and direction are calculated from the site's long-term wind speed and direction distribution. Finally, the effects of cloud cover are calculated using long-term reference data (monthly sunshine probability) to arrive at the projected annual flicker time at each receptor.

7. *Results of Analysis - Shadow Flicker*

The term "realistic" as used in this report means that turbine operational hours and direction as well as local sunshine probabilities have been factored in, but no blocking or shading effects due to trees or structures have been accounted for. This means that the realistic estimates are still inherently conservative values. Also, the realistic shadow flicker hours predicted by windPRO assumes an availability factor of 100% which is very unlikely to be the case. Actual availability factors will likely be in the range of 95-98%, however, with a conservative approach to estimating shadow flicker totals, the realistic estimates are not discounted accordingly.

Of the 178 principle and accessory structures, a total of 36 principle structures within 2 km of a wind turbine were found and analyzed. Standard resolution realistic shadow flicker maps were generated for the turbine array.

The 36 shadow receptors were then modeled as greenhouse-mode receptors and the estimated shadow flicker was calculated for the array. No principle structure shadow receptors are expected to experience more than 29 hours and 3 minutes of shadow flicker per year. Of the 36 principle structure receptors, the number that registered no shadow flicker hours was 12 (33.3%). Table 4 contains the realistic shadow flicker distribution of the 36 principle structures. The full table of results from the realistic shadow flicker study can be found in Appendix E and the maps showing the shadow flicker iso-lines are in Appendix F.

Table 4: Principle structures realistic shadow flicker distribution

Realistic Shadow Flicker (hrs/year)	Number of Principle Structures
0	12
0 to 5	6
5 to 10	7
10 to 15	2
15 to 20	5
20 to 25	2
25 to 30	2
30+	0

8. *Conclusions*

The conservative results of this study indicate that, of the 178 principle and accessory structures modeled, none measured more than 50 dBA, therefore the Crowned Ridge wind farms would be in compliance with the current Grant County Ordinance.

The sound study assumes that all GE 2.1-116 turbines have the same sound profile as the GE 2.3-116, which is a conservative assumption since the sound emission levels of the GE 2.1-116 would be lower than for the larger GE 2.3-116. In all cases, an additional 2 dBA was added to the sound pressure emission levels to provide for more conservative results.

The shadow flicker impact on the receptors was calculated with reductions due to turbine operational direction and sunshine probabilities included. No principle structures are expected to experience more than 29 hours and 3 minutes of shadow flicker per year.

This shadow flicker analysis is based on a number of conservative assumptions including:

- No credit was taken for the blocking effects of trees or buildings.
- The receptors were omni-directional rather than modeling specific facades of buildings.
- Study assumes 100% turbine availability
- Study assumes all turbine locations, including alternates, are built and operating

The overall effect of using these conservative assumptions indicate that realistically, the number of hours of shadow flicker that would be observed will be less than those predicted by this study.

APPENDIX A: WIND TURBINE COORDINATES

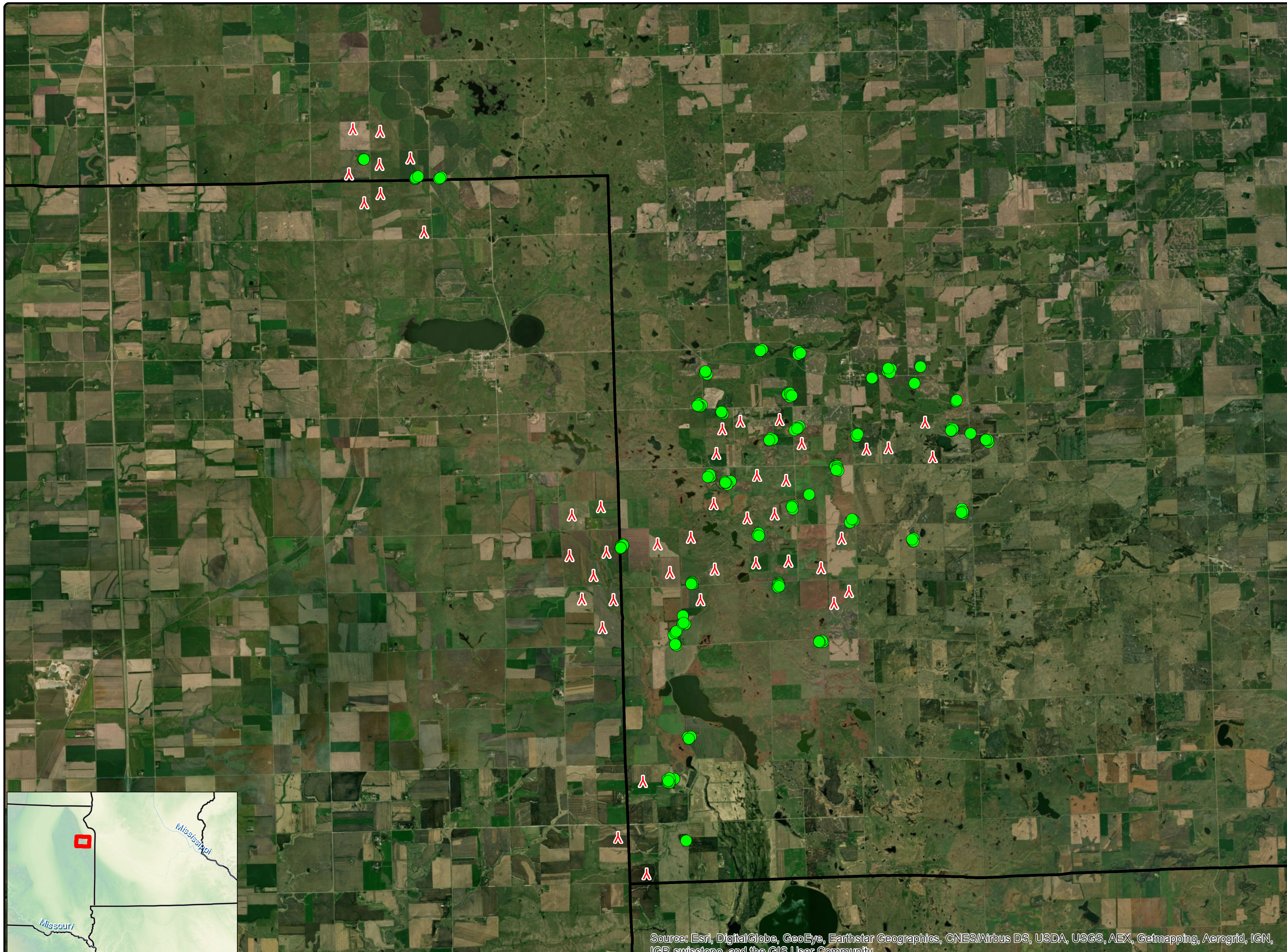
Crowned Ridge and Crowned Ridge II in Grant County
GE 1.7-103-80 m HH, GE 2.1-116-80 m HH, GE 2.3-116-90 m HH
UTM NAD83 Zone 14

WTG	Turbine Type	Easting (m)	Northing (m)	Base Elev. AMSL (m)	Sound Profile
CR- 1	GE2.3 116RD 90HH r2.madE	659,443	5,003,083	610.1	Normal Operation
CR- 2	GE2.3 116RD 90HH r2.madE	660,185	5,003,010	598.1	Normal Operation
CR- 3	GE2.3 116RD 90HH r2.madE	661,008	5,002,288	584.2	Normal Operation
CR- 4	GE2.3 116RD 90HH r2.madE	660,173	5,002,120	602.5	Normal Operation
CR- 5	GE2.3 116RD 90HH r2.madE	659,337	5,001,862	609.9	Normal Operation
CR- 6	GE2.3 116RD 90HH r2.madE	660,193	5,001,329	610.5	Normal Operation
CR- 7	GE2.3 116RD 90HH r2.madE	659,753	5,001,074	618	Normal Operation
CR- 8	GE2.3 116RD 90HH r2.madE	661,380	5,000,282	588.3	Normal Operation
CR- 43	GE2.3 116RD 90HH r2.madE	666,181	4,992,815	577.8	Normal Operation
CR- 44	GE2.3 116RD 90HH r2.madE	665,399	4,992,589	577.2	Normal Operation
CR- 51	GE2.3 116RD 90HH r2.madE	666,337	4,991,578	573.7	Normal Operation
CR- 52	GE2.3 116RD 90HH r2.madE	665,335	4,991,491	576	Normal Operation
CR- 54	GE2.3 116RD 90HH r2.madE	665,979	4,990,946	573.7	Normal Operation
CR- 58	GE2.3 116RD 90HH r2.madE	665,663	4,990,303	585	Normal Operation
CR- 59	GE2.3 116RD 90HH r2.madE	666,523	4,990,291	573	Normal Operation
CR- 67	GE2.3 116RD 90HH r2.madE	666,226	4,989,531	574.9	Normal Operation
CR- 99	GE2.3 116RD 90HH r2.madE	672,521	4,990,188	556.7	Normal Operation
CR- 100	GE2.3 116RD 90HH r2.madE	668,885	4,990,286	585	Normal Operation
CR- 101	GE2.3 116RD 90HH r2.madE	672,921	4,990,513	580.8	Normal Operation
CR- 102	GE2.3 116RD 90HH r2.madE	668,059	4,991,023	582	Normal Operation
CR- 103	GE2.3 116RD 90HH r2.madE	669,279	4,991,115	573	Normal Operation
CR- 104	GE2.3 116RD 90HH r2.madE	672,161	4,991,157	566.7	Normal Operation
CR- 105	GE2.3 116RD 90HH r2.madE	670,399	4,991,291	557.4	Normal Operation
CR- 106	GE2.3 116RD 90HH r2.madE	671,278	4,991,335	550.5	Normal Operation
CR- 107	GE2.3 116RD 90HH r2.madE	667,723	4,991,800	497.6	Normal Operation
CR- 108	GE2.3 116RD 90HH r2.madE	672,727	4,991,953	561	Normal Operation
CR- 109	GE2.3 116RD 90HH r2.madE	670,897	4,992,616	516	Normal Operation
CR- 110	GE2.3 116RD 90HH r2.madE	670,157	4,992,504	531.4	Normal Operation
CR- 111	GE2.3 116RD 90HH r2.madE	671,220	4,993,526	544.9	Normal Operation
CR- 112	GE2.3 116RD 90HH r2.madE	670,419	4,993,665	536.3	Normal Operation
CR- 113	GE2.3 116RD 90HH r2.madE	675,201	4,994,165	517.3	Normal Operation
CR- 114	GE2.3 116RD 90HH r2.madE	669,318	4,994,256	504.8	Normal Operation
CR- 115	GE2.3 116RD 90HH r2.madE	673,402	4,994,374	522	Normal Operation
CR- 116	GE2.3 116RD 90HH r2.madE	671,642	4,994,527	509.8	Normal Operation
CR- 117	GE2.3 116RD 90HH r2.madE	669,488	4,994,930	516	Normal Operation
CR- 118	GE2.3 116RD 90HH r2.madE	669,973	4,995,134	513	Normal Operation
CR- 119	GE2.3 116RD 90HH r2.madE	674,992	4,995,107	555	Normal Operation
CR- 120	GE1.7 103RD 80HH r4 1.715 Max	671,034	4,995,179	546	Normal Operation
CR-Alt1	GE2.3 116RD 90HH r2.madE	673,995	4,994,412	544.6	Normal Operation
CR-Alt2	GE2.3 116RD 90HH r2.madE	669,250	4,992,900	553.5	Normal Operation
CR-Alt3	GE2.3 116RD 90HH r2.madE	668,624	4,991,988	582	Normal Operation

Crowned Ridge and Crowned Ridge II in Grant County
GE 1.7-103-80 m HH, GE 2.1-116-80 m HH, GE 2.3-116-90 m HH
UTM NAD83 Zone 14
continued

WTG	Turbine Type	Easting (m)	Northing (m)	Base Elev. AMSL (m)	Sound Profile
CRII- 115	GE2.1 116RD 80HH rev2.mad	667,423	4,982,834	539.2	Normal Operation
CRII- 121	GE2.3 116RD 90HH r2.madE	666,651	4,983,822	555	Normal Operation
CRII- 128	GE2.3 116RD 90HH r2.madE	667,329	4,985,347	561	Normal Operation

APPENDIX B: CROWNED RIDGE WIND ENERGY PROJECTS SITE OVERVIEW MAP



0 0.75 1.5 3 Mile

EAPC WIND ENERGY

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Crowned Ridge Wind Farms
Overview Map

Client

SWCA Environmental Consultants

Project Description

Wind turbine layout with existing principle and accessory structures in Grant County and wind turbines within 2 km.

Location: Watertown, SD

Project #: 20174430

Issue Dates

#	Description	Date
1	Original	2018.09.10

Drawn By: AS *Checked By: JH*

Legend

- Turbines within 2 km
- Principle and Acc. Structures
- County Lines

N W E S

APPENDIX C: TABLE OF SOUND RESULTS

Crowned Ridge and Crowned Ridge II in Grant County
Realistic case sound results at principle and accessory structures
Results using GE 1.7-103-80 m HH, GE 2.1-116-80 m HH, GE 2.3-116-90 m HH WTG's
UTM NAD83 Zone 14

Noise Receptor #	Easting (m)	Northing (m)	Elevation AMSL (m)	Real Case Sound (dB(A))	Distance to Nearest Turbine (ft)
CR2-G8-P	668,054	4,985,395	576	41.3	2,382
CR2-G9-NP	668,173	4,985,425	571	40.3	2,782
CR1-G12-NP	668,229	4,989,039	575	39.1	4,623
CR1-G13-NP	672,216	4,989,142	558	38.6	3,576
CR1-G14-NP	668,156	4,989,332	574	40	3,940
CR1-G15-P	668,396	4,989,607	576	41.5	2,746
CR1-G16-NP	668,419	4,989,861	576	43.3	2,067
CR1-G18-P	668,678	4,990,722	585	46.8	1,581
CR1-G19-P	671,018	4,990,744	570	44.2	2,116
CR1-G21-P	666,766	4,991,807	577	46.2	1,594
CR1-G22-NP	674,670	4,991,955	528	35.9	6,375
CR1-G23-NP	670,471	4,992,104	560	46.8	1,670
CR1-G24-P	673,058	4,992,440	539	43.1	1,932
CR1-G25-P	671,391	4,992,858	549	45.7	1,801
CR1-G26-NP	672,589	4,993,869	531	41.6	3,140
CR1-G27-NP	676,630	4,994,642	481	35.3	4,941
CR1-G28-P	673,113	4,994,772	514	44.7	1,614
CR1-G32-P	669,477	4,995,401	546	46.5	1,545
CR1-G33-P	668,911	4,995,550	549	41.4	2,779
CR1-G34-NP	671,320	4,995,798	531	42.1	2,238
CR1-G35-P	674,702	4,996,176	489	37.7	3,632
CR1-G36-NP	673,559	4,996,344	498	36.7	6,211
CR1-G37-NP	668,998	4,996,452	549	37.8	5,246
CR1-G38-NP	673,972	4,996,493	495	36.2	5,646
CR1-G39-P	674,866	4,996,625	486	35.5	4,997
CR1-G41-P	671,563	4,997,050	498	39.4	3,983
CR1-G42-NP	670,566	4,997,097	519	39.5	3,819
CR1-G43-NP	661,141	5,001,721	583	44.3	1,909
CR1-G44-NP	661,781	5,001,732	584	40.2	3,123
CR1-G45-P	659,757	5,002,278	610	47.7	1,460
CR1-G59-P	675,755	4,994,888	488	41.2	2,605
CR1-G60-P	675,830	4,995,687	477	37.8	3,346
CR1-G65-P	671,496	4,994,973	537	46.7	1,542
CR1-G66-P	670,802	4,994,681	540	45.5	1,801
CR1-G67-P	669,597	4,993,440	556	45.3	2,106
CR1-G68-NP	669,159	4,993,632	565	44.8	2,113
CR1-G77-NP	676,031	4,992,629	503	34.2	5,728
CR1-G101-NP	676,224	4,994,810	487	37.6	3,966
CR1-G102-NP	671,443	4,994,898	532	47.4	1,381

Crowned Ridge and Crowned Ridge II in Grant County
Realistic case sound results at principle and accessory structures
Results using GE 1.7-103-80 m HH, GE 2.1-116-80 m HH, GE 2.3-116-90 m HH WTG's
UTM NAD83 Zone 14
continued

Noise Receptor #	Easting (m)	Northing (m)	Elevation AMSL (m)	Real Case Sound (dB(A))	Distance to Nearest Turbine (ft)
CR1-G182-NP	668,543	4,986,562	571	36.9	5,636
CR1-G183-NP	668,627	4,986,566	571	36.7	5,843
CR1-G184-NP	668,575	4,986,519	571	36.9	5,610
CR1-G185-NP	668,576	4,986,511	571	36.9	5,597
CR1-G195-NP	668,213	4,989,077	575	39.2	4,541
CR1-G196-NP	668,202	4,989,079	575	39.2	4,550
CR1-G197-NP	668,207	4,989,393	575	40.2	3,678
CR1-G198-NP	668,227	4,989,432	575	40.4	3,537
CR1-G199-NP	668,410	4,989,855	576	43.2	2,103
CR1-G212-NP	672,188	4,989,173	558	38.7	3,504
CR1-G213-NP	672,127	4,989,135	556	38.4	3,688
CR1-G214-NP	672,108	4,989,167	555	38.6	3,615
CR1-G215-NP	672,110	4,989,151	555	38.5	3,661
CR1-G244-NP	674,640	4,991,901	528	35.9	6,276
CR1-G245-NP	674,657	4,991,873	528	35.9	6,335
CR1-G246-NP	674,673	4,991,872	527	35.8	6,391
CR1-G247-NP	674,637	4,991,930	528	35.9	6,266
CR1-G248-NP	675,992	4,992,757	503	34.7	5,298
CR1-G249-NP	676,026	4,992,666	503	34.3	5,613
CR1-G250-NP	676,015	4,992,687	504	34.4	5,535
CR1-G251-NP	675,976	4,992,661	504	34.5	5,551
CR1-G252-NP	670,436	4,992,035	559	46.4	1,791
CR1-G253-NP	670,475	4,992,031	561	46.3	1,870
CR1-G254-NP	669,140	4,993,689	565	44.9	1,949
CR1-G255-NP	669,091	4,993,625	564	44.6	2,198
CR1-G256-NP	672,533	4,993,919	528	41.7	3,218
CR1-G257-NP	672,556	4,993,915	528	41.7	3,159
CR1-G258-NP	672,611	4,993,925	528	41.7	2,982
CR1-G259-NP	672,610	4,993,875	531	41.6	3,071
CR1-G260-NP	672,628	4,993,843	531	41.6	3,081
CR1-G261-NP	672,631	4,993,798	531	41.4	3,156
CR1-G262-NP	672,581	4,993,818	531	41.5	3,251
CR1-G263-NP	676,710	4,994,564	478	34.9	5,121
CR1-G264-NP	676,687	4,994,618	480	35	5,098
CR1-G265-NP	676,695	4,994,637	480	34.9	5,141
CR1-G266-NP	676,645	4,994,641	481	35.2	4,987
CR1-G267-NP	671,266	4,995,903	528	41.4	2,493
CR1-G268-NP	671,252	4,995,878	529	41.6	2,402

Crowned Ridge and Crowned Ridge II in Grant County
Realistic case sound results at principle and accessory structures
Results using GE 1.7-103-80 m HH, GE 2.1-116-80 m HH, GE 2.3-116-90 m HH WTG's
UTM NAD83 Zone 14
continued

Noise Receptor #	Easting (m)	Northing (m)	Elevation AMSL (m)	Real Case Sound (dB(A))	Distance to Nearest Turbine (ft)
CR1-G269-NP	671,319	4,995,907	527	41.2	2,566
CR1-G270-NP	671,334	4,995,846	529	41.6	2,398
CR1-G271-NP	671,369	4,995,834	529	41.6	2,415
CR1-G272-NP	669,073	4,996,413	546	38	5,052
CR1-G273-NP	669,029	4,996,482	549	37.8	5,312
CR1-G274-NP	669,013	4,996,482	549	37.7	5,325
CR1-G275-NP	669,021	4,996,494	549	37.7	5,354
CR1-G276-NP	670,513	4,997,056	517	39.3	3,963
CR1-G277-NP	673,566	4,996,315	499	36.7	6,132
CR1-G278-NP	673,541	4,996,324	498	36.7	6,214
CR1-G279-NP	673,549	4,996,317	499	36.7	6,178
CR1-G280-NP	673,989	4,996,548	493	36.1	5,761
CR1-G281-NP	674,068	4,996,563	493	36	5,659
CR1-G282-NP	674,035	4,996,457	495	36.3	5,426
CR1-G283-NP	673,987	4,996,582	493	36	5,856
CR1-G335-P	671,574	4,995,000	537	46.2	1,568
CR1-G336-P	671,544	4,994,955	536	46.7	1,440
CR1-G337-P	671,516	4,994,940	536	46.9	1,417
CR1-G338-P	670,845	4,994,643	540	45.4	1,863
CR1-G339-P	670,756	4,994,629	540	45.1	2,021
CR1-G340-P	669,500	4,995,344	547	47.5	1,362
CR1-G341-P	669,458	4,995,357	546	47	1,404
CR1-G342-P	669,454	4,995,383	546	46.6	1,489
CR1-G348-P	668,065	4,985,353	574	41.2	2,415
CR1-G349-P	668,038	4,985,314	574	41.5	2,329
CR1-G350-P	667,999	4,985,329	576	41.9	2,198
CR1-G351-P	668,000	4,985,367	576	41.9	2,201
CR1-G352-P	667,992	4,985,413	576	41.9	2,185
CR1-G353-P	668,047	4,985,437	576	41.3	2,372
CR1-G354-P	668,014	4,985,370	576	41.7	2,247
CR1-G355-P	668,474	4,989,626	576	41.8	2,552
CR1-G356-P	668,399	4,989,649	576	41.7	2,628
CR1-G357-P	668,425	4,989,662	576	41.9	2,543
CR1-G358-P	668,679	4,990,764	585	46.7	1,706
CR1-G359-P	668,655	4,990,773	585	46.6	1,765
CR1-G360-P	668,634	4,990,753	585	46.6	1,739
CR1-G361-P	668,631	4,990,741	585	46.6	1,709
CR1-G362-P	668,633	4,990,723	585	46.7	1,657

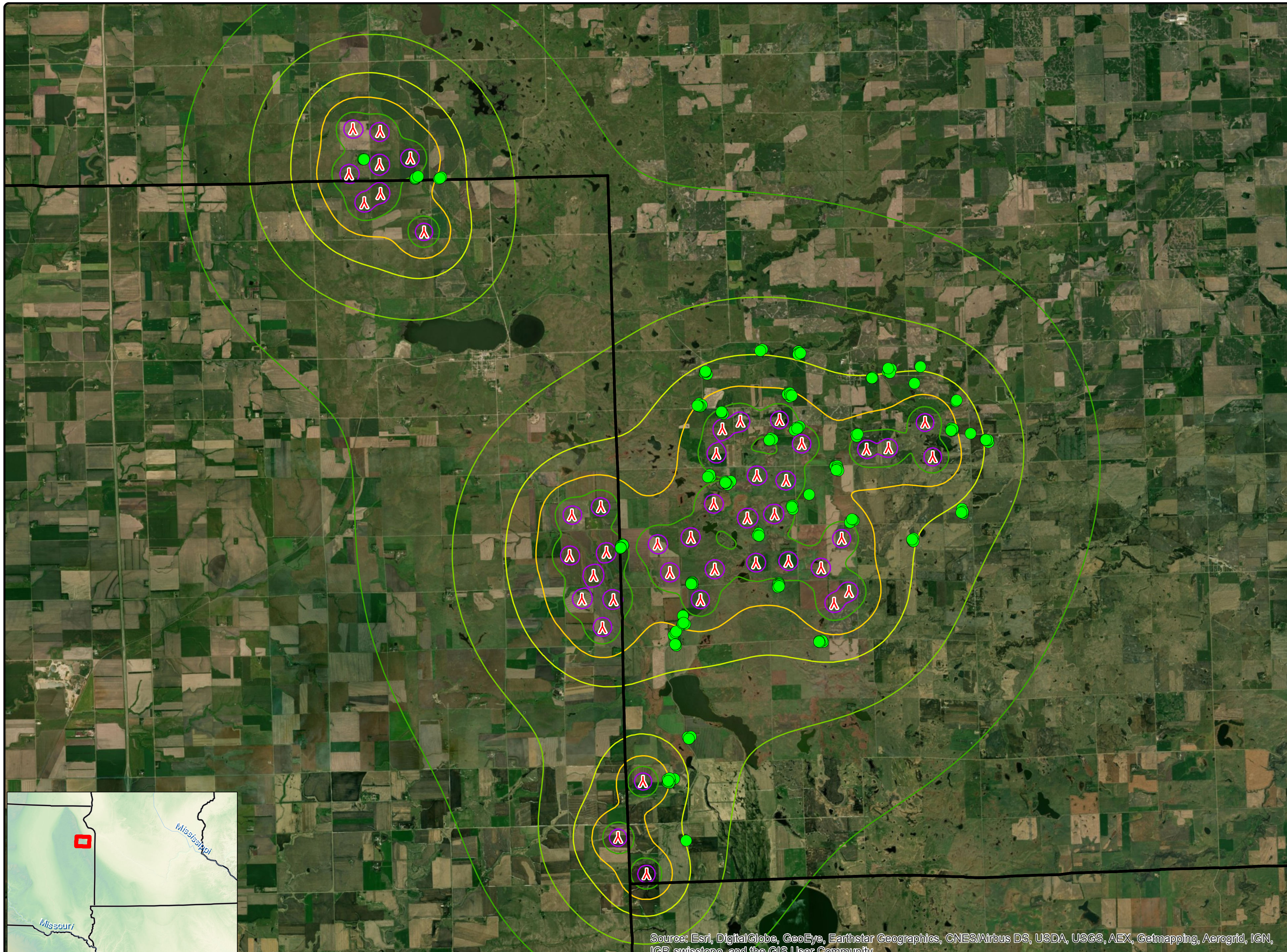
Crowned Ridge and Crowned Ridge II in Grant County
Realistic case sound results at principle and accessory structures
Results using GE 1.7-103-80 m HH, GE 2.1-116-80 m HH, GE 2.3-116-90 m HH WTG's
UTM NAD83 Zone 14
continued

Noise Receptor #	Easting (m)	Northing (m)	Elevation AMSL (m)	Real Case Sound (dB(A))	Distance to Nearest Turbine (ft)
CR1-G363-P	666,717	4,991,683	576	47.4	1,293
CR1-G364-P	666,744	4,991,787	577	46.6	1,499
CR1-G365-P	666,737	4,991,780	577	46.7	1,470
CR1-G366-P	666,725	4,991,762	576	46.9	1,411
CR1-G367-P	666,721	4,991,745	576	47	1,375
CR1-G368-P	666,750	4,991,737	576	46.7	1,453
CR1-G369-P	666,793	4,991,761	577	46.2	1,611
CR1-G370-P	666,789	4,991,772	577	46.2	1,614
CR1-G371-P	666,720	4,991,715	576	47.2	1,335
CR1-G372-P	666,720	4,991,700	576	47.3	1,319
CR1-G373-P	670,994	4,990,716	570	43.9	2,234
CR1-G374-P	671,031	4,990,721	570	44	2,172
CR1-G375-P	671,017	4,990,700	570	43.8	2,254
CR1-G376-P	670,994	4,990,676	571	43.6	2,352
CR1-G377-P	670,988	4,990,628	572	43.2	2,507
CR1-G378-P	671,025	4,990,658	569	43.5	2,372
CR1-G390-P	672,953	4,992,392	537	44.4	1,621
CR1-G391-P	673,027	4,992,469	539	43	1,959
CR1-G392-P	673,003	4,992,483	538	43	1,962
CR1-G393-P	671,839	4,993,146	534	43.3	2,382
CR1-G394-P	671,401	4,992,754	550	45.6	1,716
CR1-G395-P	671,359	4,992,841	549	46	1,686
CR1-G396-P	671,366	4,992,818	549	45.9	1,676
CR1-G397-P	669,619	4,993,504	556	45.2	2,323
CR1-G398-P	669,591	4,993,512	556	45.2	2,300
CR1-G399-P	669,557	4,993,498	557	45.2	2,205
CR1-G400-P	669,626	4,993,468	555	45.2	2,234
CR1-G401-P	669,712	4,993,507	555	45.3	2,379
CR1-G402-P	669,617	4,993,420	556	45.3	2,087
CR1-G403-P	669,571	4,993,463	556	45.3	2,126
CR1-G404-P	669,586	4,993,472	556	45.2	2,175
CR1-G405-P	669,561	4,993,470	557	45.2	2,129
CR1-G406-P	675,749	4,994,921	487	41.2	2,556
CR1-G407-P	675,708	4,994,937	487	41.6	2,415
CR1-G408-P	675,706	4,994,956	487	41.6	2,395
CR1-G409-P	675,701	4,994,915	487	41.7	2,411
CR1-G410-P	675,703	4,994,878	487	41.7	2,451
CR1-G411-P	675,749	4,994,933	487	41.2	2,546

Crowned Ridge and Crowned Ridge II in Grant County
Realistic case sound results at principle and accessory structures
Results using GE 1.7-103-80 m HH, GE 2.1-116-80 m HH, GE 2.3-116-90 m HH WTG's
UTM NAD83 Zone 14
continued

Noise Receptor #	Easting (m)	Northing (m)	Elevation AMSL (m)	Real Case Sound (dB(A))	Distance to Nearest Turbine (ft)
CR1-G412-P	675,698	4,994,894	487	41.7	2,418
CR1-G413-P	675,849	4,995,708	478	37.6	3,435
CR1-G414-P	673,129	4,994,732	514	45.4	1,476
CR1-G415-P	673,158	4,994,793	513	44.9	1,591
CR1-G416-P	669,454	4,995,395	546	46.4	1,532
CR1-G417-P	668,848	4,995,621	549	40.7	3,091
CR1-G418-P	668,920	4,995,589	548	41.2	2,854
CR1-G419-P	668,866	4,995,542	549	41.2	2,864
CR1-G420-P	668,836	4,995,549	549	41	2,949
CR1-G421-P	668,807	4,995,567	549	40.7	3,058
CR1-G422-P	671,554	4,997,041	498	39.3	4,009
CR1-G423-P	671,558	4,996,995	498	39.2	4,163
CR1-G424-P	671,540	4,996,953	498	39.1	4,298
CR1-G425-P	671,602	4,996,991	496	39.1	4,186
CR1-G519-P	659,714	5,002,264	611	47.5	1,578
CR1-G520-P	659,735	5,002,251	611	47.7	1,499
CR1-G521-P	659,744	5,002,252	610	47.7	1,473
CR1-G522-NP	661,844	5,001,779	584	39.9	3,212
CR1-G523-NP	661,808	5,001,754	584	40.1	3,156
CR1-G524-NP	661,132	5,001,722	583	44.4	1,900
CR1-G525-NP	661,132	5,001,744	583	44.5	1,827
CR1-G526-NP	661,151	5,001,757	583	44.6	1,801
CR1-G527-P	661,215	5,001,799	583	44.6	1,742
CR2-G1-NP	668,497	4,983,740	577	38.9	4,610
CR2-G10-NP	668,577	4,986,538	571	36.9	5,663

APPENDIX D: STANDARD RESOLUTION SOUND MAP



0 0.75 1.5 3 Mile

EAPC WIND ENERGY

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Crowned Ridge Wind Farms Sound Iso-Lines

Client

SWCA Environmental Consultants

Project Description

Wind turbine layout with existing principle and accessory structures in Grant County and wind turbines within 2 km.

Predicted sound pressure levels at principle and accessory structures.

Location: Watertown, SD

Project #: 20174430

Issue Dates

#	Description	Date
1	Original	2018.09.10

Drawn By: AS *Checked By: JH*

Legend

- Turbines within 2 km
- Principle and Acc. Structures
- County Lines

Sound Pressure (dBA)

- 25
- 30
- 35
- 40
- 45
- 50

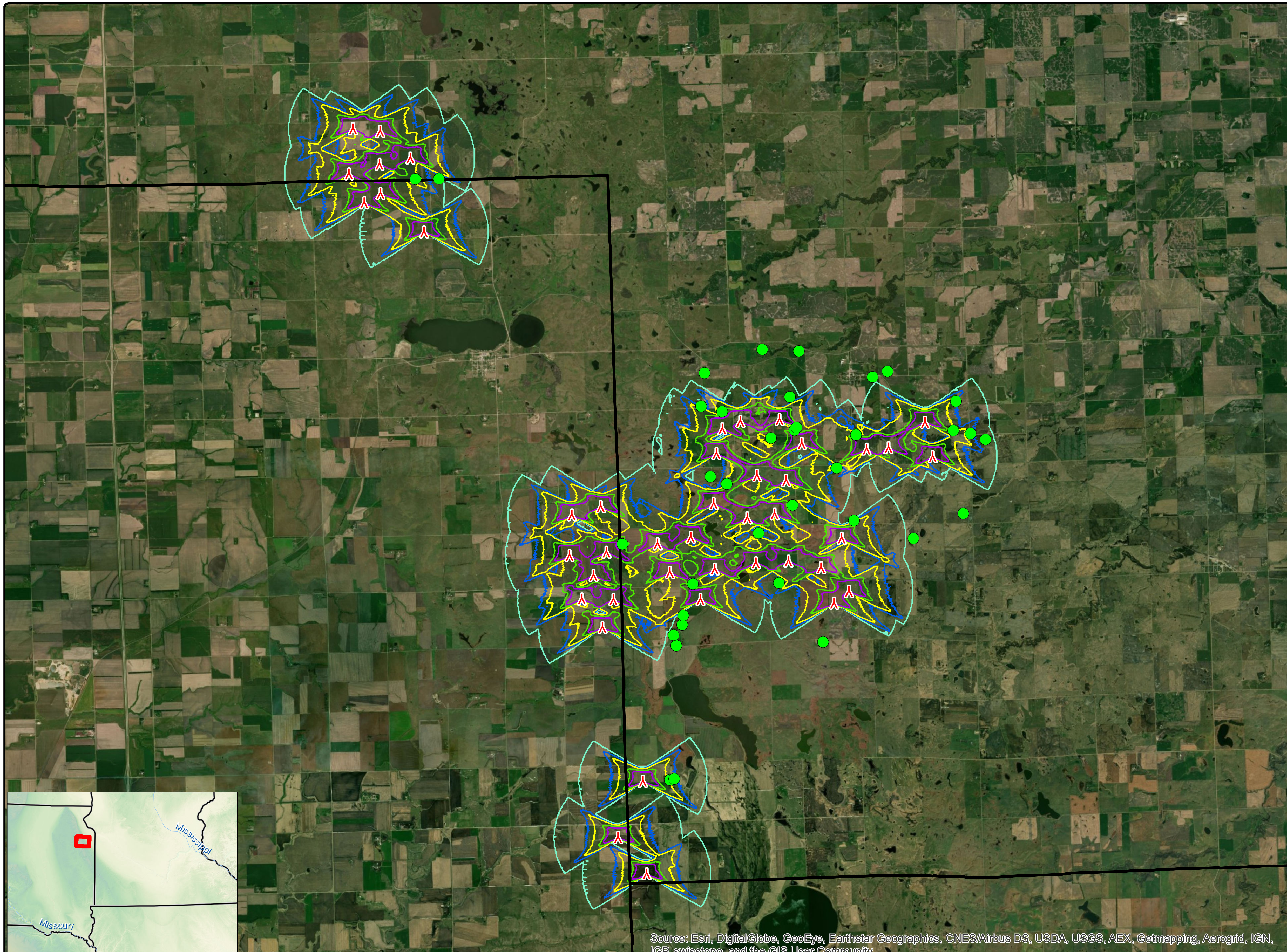
N W E S

APPENDIX E: TABLE OF SHADOW FLICKER RESULTS

Crowned Ridge and Crowned Ridge II in Grant County
Realistic case shadow results at principle structures
Results using GE 1.7-103-80 m HH, GE 2.1-116-80 m HH, GE 2.3-116-90 m HH WTG's
UTM NAD83 Zone 14

Shadow Receptor #	Easting (m)	Northing (m)	Elevation AMSL (m)	Real Case Shadow (hrs/year)	Distance to Nearest Turbine (ft)
CR1-G12-NP	668,229	4,989,039	575	0:00	4,623
CR1-G13-NP	672,216	4,989,142	558.0	0:00	3,576
CR1-G14-NP	668,156	4,989,332	574.0	0:00	3,940
CR1-G15-P	668,396	4,989,607	576.0	0:00	2,746
CR1-G16-NP	668,419	4,989,861	576.0	0:00	2,067
CR1-G18-P	668,678	4,990,722	585.0	22:24	1,581
CR1-G19-P	671,018	4,990,744	570.0	3:37	2,116
CR1-G21-P	666,766	4,991,807	577.1	29:03	1,594
CR1-G22-NP	674,670	4,991,955	527.6	0:00	6,375
CR1-G23-NP	670,471	4,992,104	559.8	5:16	1,670
CR1-G24-P	673,058	4,992,440	539.4	5:20	1,932
CR1-G25-P	671,391	4,992,858	549.0	18:40	1,801
CR1-G26-NP	672,589	4,993,869	531.0	8:14	3,140
CR1-G27-NP	676,630	4,994,642	480.8	2:54	4,941
CR1-G28-P	673,113	4,994,772	513.8	22:52	1,614
CR1-G32-P	669,477	4,995,401	546.0	18:39	1,545
CR1-G33-P	668,911	4,995,550	548.9	3:43	2,779
CR1-G34-NP	671,320	4,995,798	531.0	1:30	2,238
CR1-G36-NP	673,559	4,996,344	498.3	0:00	6,211
CR1-G37-NP	668,998	4,996,452	549.0	0:00	5,246
CR1-G38-NP	673,972	4,996,493	494.5	0:00	5,646
CR1-G41-P	671,563	4,997,050	497.8	0:00	3,983
CR1-G42-NP	670,566	4,997,097	518.9	0:00	3,819
CR1-G43-NP	661,141	5,001,721	583.3	19:10	1,909
CR1-G44-NP	661,781	5,001,732	583.8	2:50	3,123
CR1-G59-P	675,755	4,994,888	487.7	12:51	2,605
CR1-G60-P	675,830	4,995,687	477.0	5:43	3,346
CR1-G65-P	671,496	4,994,973	537.0	27:51	1,542
CR1-G66-P	670,802	4,994,681	539.7	15:55	1,801
CR1-G67-P	669,597	4,993,440	555.9	11:59	2,106
CR1-G68-NP	669,159	4,993,632	564.9	2:09	2,113
CR1-G77-NP	676,031	4,992,629	503.1	0:00	5,728
CR1-G101-NP	676,224	4,994,810	486.8	6:28	3,966
CR1-G102-NP	671,443	4,994,898	531.8	15:44	1,381
CR2-G8-P	668,054	4,985,395	576.0	9:00	2,382
CR2-G9-NP	668,173	4,985,425	570.9	6:31	2,782

APPENDIX F: STANDARD RESOLUTION SHADOW FLICKER MAP



0 0.75 1.5 3 Mile

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Crowned Ridge Wind Farms Shadow Flicker Iso-Lines

Client

SWCA Environmental Consultants

Project Description

Wind turbine layout with existing principle structures in Grant County and wind turbines within 2 km.

Predicted shadow flicker at principle structures.

Location: Watertown, SD

Project #: 20174430

Issue Dates

#	Description	Date
1	Original	2018.09.10

Drawn By: AS *Checked By:* JH

Legend

- Principle Structures
- Turbines within 2 km
- County Lines

Shadow Flicker (hr/yr)

- 0
- 5
- 10
- 30
- 50

N W E S

Appendix: K

Decommissioning Report

DECOMMISSIONING SUMMARY | Grant County

Crowned Ridge Wind, LLC and Crowned Ridge Wind II, LLC (collectively, Crowned Ridge Wind) currently estimates that the Project will have a useful life of at least 30 years based on our experience operating projects, on models, and technology. One (1) year in advance of the anticipated Project decommissioning, Crowned Ridge Wind will provide notice to Grant County that decommissioning will occur. After that time, the Project would be decommissioned, and the existing equipment would be removed. In the event a turbine is found to be inactive for a period of twelve (12) consecutive months, Grant County has the ability to initiate the decommissioning process as described below for the inactive turbine.

INTENDED DISPOSITION OF TURBINES & SITE:

The goal of Project decommissioning is to remove the installed power generation equipment and to return the site to a condition as close to a pre-construction state as feasible. The major activities required for the decommissioning may be as follows:

- Creation of temporary work areas to enable decommissioning of equipment;
- Wind turbine and meteorological tower removal;
- Electrical system removal;
- Structural foundation removal per ROW grant requirements;
- Road removal;
- Re-grading;
- Re-vegetation; and
- Restoration of temporary work areas.

The decommissioning activity most notable to the general public will be the removal of the wind turbines and meteorological towers. Removal of the facilities shall include removing the caisson and all other components to a depth of no less than four (4) feet below grade unless a lesser depth is otherwise agreed to by the landowner. The disassembly and removal of this equipment will essentially be the same as its installation, but in reverse order. The large components that make up a wind turbine will be disassembled in the reverse order they were assembled. The rotor (hub and blades) are removed from the nacelle and, with the help of a smaller crane, turned horizontally and set on the ground. Next, the nacelle will be removed from the top of the tower, followed by each portion of the tower. The meteorological tower will similarly be disassembled by a crane, starting with the upper tower section and moving downward. Once the turbine rotor has been removed, a crew and small crane will disassemble it into the hub and three loose turbine blades. The most efficient manner for component removal will be for each large component (other than the rotor) to be placed directly onto a truck bed when it is removed from the turbine. These trucks could then immediately take the component off the site. This approach will limit the need for clearing an area around the turbine base to just enough area to set down the rotor. When the rotor is disassembled, the blades will be placed into a carrying frame, which can then be loaded onto a truck for removal from the site. The hub can also be removed once it is disassembled from the blades.

Between each of the turbine locations will be a buried electrical cable and fiber optic cable. The respective Project owners will consult with the landowners at the time of decommissioning to determine if the landowners desire the Project owners to remove the cables or to leave to them in place. Removing the cables will cause some environmental impact that would need to be mitigated, but leaving them in place could impact future uses for the site. If the cables are to be removed, a trench will be opened and the cables pulled out. The cables will be cut into manageable sections and removed from the site. The trenches will then be filled with native soil, compacted, tilled and returned to a condition suitable for growing crops. Once the Project and transmission line is de-energized, the substation will be disassembled. Major components will be removed from their foundations and placed onto trucks using a small crane. Fences and fence posts will be taken down and removed. The aggregate base and concrete foundations at the collection substation will be removed, and native soils will be spread on-site to return it to its prior condition and to assist in preventing erosion.

The Project owners will review if the substation grounding grid is to be removed or left in place. Assuming the transmission line no longer serves a purpose for the site; it will be disassembled and removed. Initially, the wires will be removed from the tower hangers and collected for recycling. The tower structures will then be disassembled and removed, including grounding rods to 5 feet below grade unless a lesser depth is otherwise agreed to by the landowner. The areas around the poles, along with any access roads that were necessary, will be reclaimed.

When the wind turbines and substation components are removed from their foundations, the concrete and steel within the deeper wind turbine foundations will be broken-up and removed to a depth of four (4) feet below grade unless a lesser depth is otherwise agreed to by the landowner. Fully removing the wind turbine foundations would require major excavation/disturbance at each tower site, as well as additional truck haul-away traffic. The foundation sections below 4 feet, that are proposed to remain, are composed of non-leaching elements, concrete and steel, that should not present a hazard to the environment.

The landowners will have the choice, when the Project is decommissioned, as to whether the Project access roads are to be removed. To facilitate the various uses for the property, the owner may choose to leave the roads in place. If the roads are left, maintenance of the roads will become the responsibility of the respective landowner. Once all the necessary equipment and materials have been removed from an area and the road to that area is no longer needed, it can be removed. The road surface and bed materials will be removed down to grade. Any materials native to the site will be scattered across the site, and foreign materials will be removed. For areas where equipment or materials are removed, those areas will be re-graded back to near pre-construction contours (if possible). Removed roads will be re-graded to original contours if cuts and fills make such re-grading practical. Crane pads will also be re-graded. All disturbed areas will be seeded and mulched.

Restoration areas shall be filled and covered with top soil and restored to a state compatible with the surrounding land and will be completed within ninety (90) days of abandonment.

Appendix: L

Soil Erosion

SOIL EROSION SUMMARY | Grant County

Crowned Ridge respectfully requests the ability to submit a Stormwater Pollution Prevention plan (SWPPP), prior to construction. Crowned Ridge is currently developing a SWPPP. The SWPPP will incorporate planned infrastructure in coordination with Codington, Deuel, and Grant Counties. Crowned Ridge will submit the SWPPP to Grant County at the same time the project is filled the with South Dakota Department of Environment & Natural Resources.

The SWPPP will incorporate measurers for erosion control for each Facility phase. The SWPPP will incorporate plans for grading, construction and drainage of roads and turbine pads, necessary soil information, and detailed design features to maintain downstream water quality. A revegetation plan to maintain and ensure adequate erosion control and slope stability will also be included.

Crowned Ridge will meet or exceed all County and State requirements for Soil Erosion and Stormwater Pollution and Protection.

Appendix: M
Environmental Consultation

ENVIRONMENTAL CONSULTATION I Grant County

Crowned Ridge has been in routine coordination with the US Fish and Wildlife Service (USFWS), South Dakota Department of Game, Fish, and Parks (SDGFP), and South Dakota Historic Preservation Office (SHPO) since April 2017. This coordination was initiated in spring 2017:

April 19, 2017 – two technical memoranda were provided to USFWS and SDGFP descripting the project and summarizing natural resources-related surveys completed to-date and in-progress.

April 20, 2017 – Crowned Ridge held a conference call with the USFWS and SDGFP to review the technical memoranda, reintroduce the project to the agencies, and invite agency input.

June 14, 2017 – two technical memoranda were provided to SHPO and Sisseton Wahpeton Oyate (SWO) Tribal Historic Preservation Office (THPO) describing the project, known cultural resources, and establishing methods for field surveys and subsequent reporting.

June 19, 2017 – Crowned Ridge and SHPO reviewed the information and approach set forth in the two memoranda via conference call.

Since that time and through the present, Crowned Ridge have continued substantial coordination efforts with the USFWS and SDGFP related to potential natural resources in the project vicinity. Coordination has included routine information gathering and sharing. Crowned Ridge's data requests and agency responses have included those related, and not limited, to USFWS wetland and grassland easement information, raptor nest location data, and threatened and endangered species occurrence data.

Crowned Ridge also is in active, continuous contact, and working directly with the SWO THPO on address of traditional cultural properties. The SWO THPO is serving as project liaison for coordinating with other concerned tribes in the region. Additionally, Crowned Ridge is in periodic contact with the SHPO, and has conducted various files searches and refreshes of files on known resources in the project area between June 2017 and May 2018. Further, following the 2017 fieldwork, on March 12, 2018, a follow-up call was held with SHPO, reviewing project status, results to date, and potential reporting schedule.