



TETRA TECH

August 6, 2013

Mr. Darrell Nitschke  
Executive Secretary  
North Dakota Public Service Commission  
600 E. Boulevard Avenue, Department 408  
Bismarck, ND 58505

**SUBJECT: Thunder Spirit Wind Energy Project, Adams County, ND (Case No. PU-11-601)**

Dear Mr. Lein,

On behalf of Global Winds Harvest, please find an original and 10 copies of the Amendment to the Application for a Certificate of Site Compatibility for the Thunder Spirit Wind Energy Project for filing in Case No. PU-11-601.

After submission of the Certificate, additional modifications to the layout were necessary to avoid some potentially eligible cultural sites and to adhere to new exclusion and avoidance setbacks administered by the PSC. This Amendment will summarize the changes to the impacts as discussed in the Certificate submitted on June 3, 2013.

Please feel free to contact me at (617) 443-7552 or [Tracey.Dubuque@tetrattech.com](mailto:Tracey.Dubuque@tetrattech.com) if you have any questions. We look forward to your comments.

Sincerely,

**TETRA TECH, INCORPORATED**

**Tracey M. Dubuque, P.E.**  
Senior Project Manager

**Thunder Spirit Wind Energy Project  
Thunder Spirit Wind, LLC  
Adams County, North Dakota**

**AMENDMENT to the North Dakota Public Service Commission  
for a Certificate of Site Compatibility**



**Prepared for:**  
Thunder Spirit Wind, LLC  
103 Front Street  
Schenectady, NY 12305



**Prepared by:**  
Tetra Tech, Inc.  
160 Federal Street  
Boston, MA 02110



# **THUNDER SPIRIT WIND ENERGY PROJECT**

**Case No.: PU-11-601**

## **AMENDMENT to the North Dakota Public Service Commission for a Certificate of Site Compatibility**

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## REVISED FIGURES (FIGURE NUMBERS WERE NOT CHANGED)

Figure 3	Project Area (Topographical)
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Figure 17	Residential Receptor Distances to Closest Wind Turbine
Figure 18	Project Layout with Adams County Zoning Setbacks
Figure A (new)	Turbine Adjustments

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## REVISED APPENDICES

Appendix A	Studies and Assessments (Only those that were revised or were not provided in Certificate)
	<ul style="list-style-type: none"><li>▪ Shadow Flicker Analysis Report Addendum (Tetra Tech, 2013)</li><li>▪ Revised Acoustic Modeling Analysis Memorandum and Addendum (Tetra Tech, 2013)</li></ul>
Appendix B	Additional Agency Correspondence

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## 1. INTRODUCTION

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On June 4, 2013, Thunder Spirit Wind, LLC (Thunder Spirit), an affiliate of Global Winds Harvest, Inc., submitted an application for a Certificate of Site Compatibility (Certificate) to construct the Thunder Spirit Wind Energy Project (the Project). Since the submission of the Certificate, there were some modifications to some turbine locations. A total of 20 turbines were further micrositied or removed to avoid environmentally sensitive areas and meet setback requirements. Details on these adjustments are further described in this Amendment.

As mentioned in the Certificate, once the PSC issues the Certificate, Thunder Spirit will complete any additional studies that may be required by the Certificate or Thunder Spirit's siting process. Thunder Spirit will further evaluate the Project Area based on efficient construction of the Project. Thunder Spirit will seek further input from landowners regarding the location of wind turbines and associated facilities. Once these additional studies and communications are completed, turbine locations will be re-evaluated and any changes will be submitted to the PSC for approval prior to construction. A pre-construction meeting will be held with PSC staff to ensure that Thunder Spirit conforms to the Certificate requirements.

The table below lists the turbines that were moved and the old and new distance to the nearest receptor. Figure A shows the turbine relocations and differentiates between the locations submitted as part of the Application and the revised locations. Tables summarizing impacts (or lack thereof) relating to the latest round of layout adjustments are also included in this Amendment in the following section.

**Turbines Adjusted after the June Certificate Submission (Layout date of July 23, 2013)**

Turbine	Distance moved from original location	New Distance to Nearest Receptor (ft)	Previous Distance to Nearest Receptor (ft)	Distance moved closer or farther away from receptor
12	295 ft	3477	3431	46.00
13	180 ft	3343	3457	114.00
26	89 ft	3132	3216	84.00
31	101 ft	5738	5728	10.00
35	660 ft	3990	3904	86.00
36	349 ft	5298	5198	100.00
37	142 ft	6342	6363	21.00
60	364 ft	3879	4136	257.00
71	636 ft	4890	5057	167.00
A5	155 ft	2001	2046	45.00
A8	201 ft	4984	5093	109.00
A11	428 ft	9245	9526	281.00
A15	178 ft	2670	2708	38.00
A19	152 ft	2800	2689	111.00
A21	958 ft	2970	2743	227.00
A32	91 ft	4733	4737	4.00
A33	364 ft	5438	5694	256.00
34	REMOVED			
72	REMOVED			
A20	REMOVED			
Red indicates turbine moved closer to a receptor.				

## 2. PSC SITING CRITERIA

### 2.1 Exclusion Areas

In accordance with NDAC Section 69-06-08-01-1, the geographical areas listed in the following table shall be excluded in the consideration of a site for an energy conversion facility. Refer to the last column for any changes to Exclusion Areas.

**Exclusion Areas**

Exclusion Area	Present within Project Area?	Description	Turbine adjustment impacts?
Designated or registered national areas: parks; memorial parks; historic sites and landmarks; natural landmarks; historic districts; monuments; wilderness areas; wildlife areas; wild, scenic, or recreational rivers; wildlife refuges; and grasslands.	None	Of these exclusion areas, only native prairie (grasslands) are present within the Project Area; however, native prairie as mapped during field surveys represents 30 percent of the WEFP. These are not considered exclusion areas. They are considered avoidance areas.	Since the total number of turbines was not increased, there is <b>no change</b> to impacts originally presented for native prairie.
Designated or registered state areas: parks; forests; forest management lands; historic sites; monuments; historical markers; archaeological sites; grasslands; wild, scenic, or recreational rivers; game refuges; game management areas; management areas; and nature preserves.	Present	Cultural sites that are potentially eligible for the historic register will be avoided.	No change
County parks and recreational areas; municipal parks; parks owned or administered by other governmental subdivisions; hardwood draws; and enrolled woodlands.	None	N/A	No change
Prime farmland and unique farmland, as defined by the land inventory and monitoring division of the soil conservation service, United States department of agriculture, in 7 C.F.R. part 657; provided, however, that if the Commission finds that the prime farmland and unique farmland that will be removed from use for the life of the facility is of such small acreage as to be of negligible impact on agricultural productions, such exclusion shall not apply.	Present	Prime farmland has been avoided to the extent practical. Permanent impacts to prime farmland soils from turbine placement and access roads are expected to be up to 3 acres, which is a negligible percentage of the Project Area.	Since the total number of turbines was not increased, there is <b>no change</b> to impacts originally presented for prime farmland soils.
Irrigated land	None	No agricultural irrigation is currently known to take place within the Project Area.	No change
Areas critical to threatened or endangered animal or plant species	None	N/A	No change
Areas where animal or plant species that are unique or rare to this state would be irreversibly damaged.	None	N/A	No change

Exclusion Area	Present within Project Area?	Description	Turbine adjustment impacts?
Areas within 1,200 feet of the geographic center of an intercontinental ballistic missile (ICBM) launch or launch control facility	None	N/A	No change
Setbacks from Interstate or state roadways ROW, railroads, transmission lines, non-participating landowners, and county or township roadways.	Present	<ul style="list-style-type: none"> <li>1.1 x height of turbine from interstate or state roadways ROW</li> <li>1.1 x height of turbine from railroads</li> <li>1.1 x height of turbine from transmission lines (over 115 kV)</li> <li>1.1 x height of turbine from non-participating landowners</li> <li>1.1 x height of turbine plus 75' from centerline of any county or maintained township roadways</li> </ul>	All Vestas and Siemens Turbines have been adjusted to meet these setbacks. Nine Acciona turbines do not meet the county or maintained township roadways setback. If the Acciona turbine is selected these turbines will either not be used or will be sited to ensure compliance with setback.

### 2.1.1 Avoidance Areas

In accordance with NDAC Section 69-06-08-01-2, the geographical areas listed in the following table shall not be approved as a site for an energy conversion facility unless the applicant shows that, under the circumstances, there is no reasonable alternative. Refer to the last column for any changes to Avoidance Areas.

#### Avoidance Areas

Avoidance Areas	Present within Project Area?	Description and Proposed Buffer	Turbine adjustment impacts?
Historical resources which are not designated as exclusion areas	Present	A Class III cultural resources survey was completed for the Project. Sites with potential cultural significance will be avoided. A Class II Architectural survey was also conducted and a determination of No Historic Properties Affected was determined.	Turbines were relocated to ensure avoidance.
Areas within the city limits of a city or the boundaries of a military installation	None	N/A	No change
Areas within known floodplains as defined by the geographical boundaries of the 100-year flood	None	The Project Area is located in Flood Hazard Zone D: Areas in which flood hazards are undetermined, but possible.	No change
Areas that are geologically unstable	Present	Abandoned coal mines are present in and near the Project Area. Subsidence hazards related to the potential presence of abandoned underground coal mines will be mitigated	No change

Avoidance Areas	Present within Project Area?	Description and Proposed Buffer	Turbine adjustment impacts?
		through field studies and geotechnical analyses and subsequent micrositing.	
Wetlands	Present	Permanent impacts to wetlands will be avoided.	No change
Woodlands	None	The Project has 15.3 acres of deciduous forest mostly comprised of windbreaks around farming facilities.	No change
Native Prairie	Present	Native prairie as mapped during field surveys represents 30 percent of the WEFP. The Project Area has 4,527 acres (30% of the WEFP) of native prairie that may provide habitat suitable for sensitive species such as eagles, sharp tailed grouse, and Sprague's pipit.	Since the total number of turbines was not increased, there is <b>no change</b> to impacts originally presented for native prairie.
Areas of recreational significance which are not designated as exclusion areas	None	N/A	No change
Sound levels within 100' of an inhabited residence or a community building cannot exceed 50 dBA	None	The sound analysis was inclusive of this 100' buffer. No exceedances at occupied receptors with the exception of Receptor 28 which is a participating landowner and the structure is not occupied full time.	No impacts

### 2.1.2 Selection Criteria

In accordance with NDAC Section 69-06-08-01-3, a site shall be approved in an area only when it is demonstrated to the PSC by the applicant that any significant adverse effects resulting from the location, construction, and operation of the facility in that area, as they relate to the criteria listed in the following table. Refer to the last column for any changes to Selection Criteria.

**Selection Criteria**

Selection Criteria	Potential Adverse Effects	Turbine adjustment impacts?
The impact upon agriculture:		
Agricultural production	Approximately 92 acres of land will be affected by 85 turbines (up to 75 turbines will be constructed), associated access roads, O&M facility, and a substation during operation. Additional temporary impacts during construction for turbine installation, road construction, cable trenching, and laydown and contractor staging would be approximately 347 acres. These impacts represent a minor portion of the land area within the Project Area that is available for agricultural production. As a result, no adverse effects are expected.	Since the total number of turbines was not increased, there is <b>no change</b> to impacts originally presented for agricultural production.
Family farms and ranches	The Project will comply with setbacks for non-participating landowners as stipulated in the Adams Co. wind ordinance. Easement agreements and waivers of participating landowners contain language that stipulates landowners acquiescence to setback requirements. Although some land area will be permanently converted to wind turbine foundations and pads, access roads, and a substation, wind lease payments to farmers will provide a compensatory source of income.	No change
Land which the owner demonstrates has soil, topography, drainage, and an available water supply that cause the land to be economically suitable for irrigation	Participating landowners have not expressed concerns related to economically suitable irrigation on their land. No agricultural irrigation is currently known to occur within the Project Area. No adverse effects are expected.	No change
Surface drainage patterns and ground water flow patterns	No adverse effects are expected.	No change
The agricultural quality of the cropland	No impacts to the agricultural quality of the cropland are anticipated (except for areas converted to wind energy facility use). Thunder Spirit will work with the landowners to alleviate the compaction of any soils which occurs during construction,	No change
The impact upon the availability and adequacy of:		
Law enforcement	No adverse effects are expected.	No change
School systems and education programs	No adverse effects are expected.	No change
Governmental services and facilities	No adverse effects are expected.	No change
General and mental health care facilities	No adverse effects are expected.	No change
Recreational programs and facilities	No adverse effects are expected.	No change
Transportation facilities and networks	During construction, an increase in vehicle trips per day is anticipated for the duration of the Project construction. During facility operation, no significant impacts are anticipated.	No change
Retail service facilities	Local services such as motels, restaurants, and convenience stores are likely to experience an increase in business during Project construction. During facility operation, no significant impacts are anticipated.	No change

Selection Criteria	Potential Adverse Effects	Turbine adjustment impacts?
Utility services	No significant impacts are anticipated. Thunder Spirit will purchase station service from both MDU (to satisfy power requirements at the turbines and substation) and from Slope Electric (for requirements at O&M offices). Utilities will suggest appropriate configurations for the electrical system, and Thunder Spirit will abide by the recommendations to prevent impacts to the transmission system.	No change
The impact upon:		
Local institutions	No impacts are anticipated.	No change
Noise sensitive land uses	The only noise sensitive land uses within the Project Area are the residences near turbine locations. Only one exceedances of the North Dakota 50 dBa criterion was exceeded (Receptor 28). This is a participating landowner and the structure is not occupied full time.	See attachment for details
Rural residences and businesses	The Project will comply with local setback regulations, in accordance with the Adams Co. wind ordinance. No significant impacts are anticipated.	No change
Aquifers	No adverse effects are expected.	No change
Human health and safety	No impacts to human health and safety are anticipated based on the implementation of the mitigative measures discussed in Section 5.5.3 and maintenance schedules.	No change
Animal health and safety	No impacts to livestock are anticipated from construction or operation of the facility. Based on avian and bat surveys performed to date, mean avian raptor and non-raptor and bat use was generally low to low-moderate compared to other wind facilities. Thunder Spirit will implement measures to avoid and minimize impacts to wildlife by siting facilities away from active raptor nests and wetlands to the extent practicable. There will be no permanent impacts to wetlands, reducing impacts to migratory birds. In addition, Thunder Spirit will implement a minimum of one year of post-construction mortality monitoring for birds and bats.	No change
Plant life	The Project will result in approximately 176 acres of permanent impact. Project layout would permanently impact 27 acres of native grasslands.	No change
Temporary and permanent housing	No adverse impacts are anticipated. Temporary housing will be utilized during construction.	No change
Temporary and permanent skilled and unskilled labor	No adverse impacts are anticipated. Local contractors employed for construction will result in increased wages.	No change
The cumulative effect of the location of the facility in relation to existing and planned facilities and other industrial development	Wind energy development is anticipated to have a positive cumulative impact on air quality and minimal impacts to geology, soils, water, noise, safety and health issues, and cultural resources. Socioeconomic impacts are anticipated to be positive, as the rural economy and energy production is diversified. Wind energy development removes less total land from agricultural use than other forms of development.	No change

### 2.1.3 Policy Criteria

Refer to the last column for any changes to Policy Criteria.

#### Policy Criteria

Policy Criteria	Suitable Policy or Practice of Applicant	Turbine adjustment impacts?
Recycling of the conversion byproducts and effluents	Not applicable. The Project would not create byproducts or effluent.	No change
Energy conservation through location, process, and design	Thunder Spirit is developing the site to maximize energy output and will develop a site layout that optimizes wind resources while minimizing the impact on land resources and any potentially sensitive areas.	No change
Training and utilization of available labor in this state for the general and specialized skills required	Thunder Spirit will use local labor to the extent practicable.	No change
Use of a primary energy source or raw material located within the state	The energy generated at the site will utilize the wind resources of the State of North Dakota.	No change
Non-relocation of residents	No residents will be relocated as a result of the Project.	No change
The dedication of an area adjacent to the facility to land uses such as recreation, agriculture, or wildlife management	The Project will not interfere with adjacent land uses. As such, it is not anticipated that areas adjacent will be dedicated to recreation, agriculture, or wildlife management issues.	No change
Economies of construction and operation	Thunder Spirit will utilize local contractors to the extent practicable.	No change
Secondary uses of appropriate associated facilities for recreation and enhancement of wildlife	None.	No change
Use of citizen coordinating committees	Thunder Spirit will continue to work with landowners of properties for the Project.	No change
A commitment of a portion of the energy produced for use in this state	Energy produced will be injected into the MDU 230 kV line at the Hettinger Substation.	No change
Labor relations	No labor relations will be affected.	No change
The coordination of facilities	Existing facilities and facility corridors were considered in the location of the wind farm and associated facilities.	No change
Monitoring of impacts	Thunder Spirit and the EPC contractor will employ best management practices (BMPs) during construction to monitor soil impacts and to segregate topsoil. Storm water prevention plans will be prepared for all disturbance sites exceeding size threshold. Environmental monitors will be onsite during construction to ensure there will be no impacts to wetlands and documented archeological sites that require avoidance.	No change

## 3. ENVIRONMENTAL ANALYSIS - UPDATE

This section provides any information relating to changes to the impacts as discussed in the Certificate due to the adjustments of the layout.

### Shadow flicker

The shadow flicker modeling was conducted using the latest layout to ensure no additional impacts above the acceptable range.

The WindPro model was used to update the shadow flicker impact analysis for the revised wind turbine layout design (dated 7/23/13) for the Thunder Spirit Wind Energy Project (Project). The revised layout design includes 82 potential turbine locations, compared to 85 locations considered in the original analysis. As described in the original report, only up to 75 turbines, depending on the turbine model selected, will be installed. The location of 17 additional turbines changed positions ranging in distance from 4 to 281 feet. While predicted shadow flicker impacts at some of the house receptors modeled increased slightly, maximum predicted impacts were either unchanged or decreased for the new layout design. Tables below compare the top ten worst case WindPro predicted shadow flicker impacts for the original and revised turbine layouts and for the three Project turbine model options.

**Comparison of WindPro Predicted Shadow Flicker Impacts for Original and Revised Turbine Layout Design for the Top Ten Predicted Impact Receptors – Turbine Scenario A (82 Vestas V100 2.0 Turbines)**

Original Turbine Layout Design			Revised Turbine Layout Design		
Receptor ID*	Receptor Description	Shadow Hours per Year (expected) [hh:mm / year]	Receptor ID*	Receptor Description	Shadow Hours per Year (expected) [hh:mm / year]
28	Participating Landowner	58:20	28	Participating Landowner	58:19
67	Abandoned/Participating	26:52	67	Abandoned/Participating	26:52
23	Non-participating Receptor	16:37	23	Non-participating Receptor	16:37
2	Non-participating Receptor	13:06	10	Non-participating Receptor	11:50
9	Non-participating Receptor	9:29	3	Non-participating Receptor	10:02
10	Participating Landowner	9:26	14	Participating Landowner	9:10
14	Non-participating Receptor	9:10	11	Non-participating Receptor	8:35
11	Participating Landowner	8:35	8	Participating Landowner	8:33
8	Participating Landowner	8:31	15	Participating Landowner	7:54
3	Non-participating Receptor	8:14	30	Non-participating Receptor	7:12

**Comparison of WindPro Predicted Shadow Flicker Impacts for Original and Revised Turbine Layout Design for the Top Ten Predicted Impact Receptors – Turbine Scenario B (82 Siemens SWT 2.3-108 Turbines)**

Original Turbine Layout Design			Revised Turbine Layout Design		
Receptor ID*	Receptor Description	Shadow Hours per Year (expected) [hh:mm / year]	Receptor ID*	Receptor Description	Shadow Hours per Year (expected) [hh:mm / year]
28	Participating Landowner	65:20	28	Participating Landowner	65:20
67	Abandoned/Participating	30:25	67	Abandoned/Participating	30:25
23	Non-participating Receptor	19:03	23	Non-participating Receptor	19:03
2	Non-participating Receptor	14:32	10	Non-participating Receptor	11:06
10	Participating Landowner	11:07	14	Participating Landowner	10:59
14	Non-participating Receptor	10:59	11	Non-participating Receptor	9:42
11	Participating Landowner	9:42	8	Participating Landowner	8:14
7	Non-participating Receptor	9:23	15	Non-participating Receptor	7:58
9	Non-participating Receptor	8:27	7	Non-participating Receptor	7:24
8	Participating Landowner	8:15	13	Participating Landowner	6:46

**Comparison of WindPro Predicted Shadow Flicker Impacts for Original and Revised Turbine Layout Design for the Top Ten Predicted Impact Receptors – Turbine Scenario C (82 Acciona AW116/3000 Turbines)**

Original Turbine Layout Design			Revised Turbine Layout Design		
Receptor ID*	Receptor Description	Shadow Hours per Year (expected) [hh:mm / year]	Receptor ID*	Receptor Description	Shadow Hours per Year (expected) [hh:mm / year]
28	Participating Landowner	76:58	28	Participating Landowner	76:57
67	Abandoned/Participating	34:40	67	Abandoned/Participating	34:40
23	Non-participating Receptor	24:59	23	Non-participating Receptor	24:56
2	Non-participating Receptor	21:15	10	Non-participating Receptor	17:52
14	Non-participating Receptor	16:44	14	Non-participating Receptor	16:38
7	Non-participating Receptor	15:30	3	Non-participating Receptor	14:32
9	Non-participating Receptor	14:50	11	Non-participating Receptor	12:25
10	Participating Landowner	14:31	8	Participating Landowner	12:11
3	Non-participating Receptor	12:59	30	Non-participating Receptor	12:02
11	Participating Landowner	12:25	15	Participating Landowner	11:01

The primary mitigation measure used for wind turbines is setback distance. Thunder Spirit is committed to a minimum 2,640-foot setback distance from all non-participating existing occupied residential structures. Because no significant impacts are anticipated, no additional mitigation is proposed at this time.

**Noise**

Thunder Spirit submitted an acoustic analysis on May 29, 2013 for a Project layout consisting of 85 wind turbine generators and a supporting collector substation. Since that time the Project layout was modified and reduced to 82 turbines. The location of the collector substation has not changed. The sound analysis was modeling using the latest layout to ensure no additional impacts above the acceptable range.

The three candidate turbine types being considered for the Project remain the same as under the previous analysis. Tetra Tech evaluated the new Project layout configuration using the same methodology used in the May 29th submittal. This memo provides the results of this evaluation and an assessment of Project compliance with the U.S. Environmental Protection Agency (EPA) noise guidelines used in the previous analysis as well as the recently adopted state of North Dakota noise regulations for wind energy projects. The primary mitigative measure used for wind turbines is setback distance. As stated in the Certificate, to meet county zoning setbacks, Thunder Spirit is committed to a minimum 2,640-foot setback distance from all non-participating occupied residential structures.

**Summary of Project Sound Levels at Receptors by turbine model**

Sound Level (dBA)	Number of Receptors Exceeding Sound Level Ranges								
	Acciona AW116/3000			Vestas V100 2.0			Siemens 2.3-108		
	Cut-in	Maximum	Maximum - Anomalous	Cut-in	Maximum	Maximum - Anomalous	Cut-in	Maximum	Maximum - Anomalous
> 50 North Dakota	1	1	1	0	1	1	0	1	1
> 48.6 EPA	1	2	3	0	1	2	0	1	3
> 50	1	1	2	0	1	1	0	1	1
45 to 50	7	8	11	0	2	3	0	7	10
40 to 45	11	11	11	0	12	15	0	11	12
35 to 40	5	4	2	2	8	7	1	5	3
< 35	2	2	0	24	3	0	25	2	0

Table 3 presents the modeling results and indicates that received sound levels under maximum rotation and maximum rotation during anomalous events may potentially exceed the EPA 48.6 dBA guideline criteria and North Dakota noise regulation at one or more receptors for each turbine model. The EPA guidelines are just that, guidelines and not regulatory limits; however, the State’s wind energy noise regulations require Project compliance. Therefore, EPA threshold exceedances are only provided for comparative purposes to the results in the May 29<sup>th</sup> memo while exceedances of the State of North Dakota regulation are described in the report (See attachment) in more detail. The Acciona turbine exhibited the worst case results, yielding the highest received sound levels at receptors with 1 potential exceedance of the North Dakota regulation under all operational scenarios evaluated (i.e., cut-in, max rotation, and max rotation anomalous). The one exceedance identified would occur at Receptor 28, which has been identified as a Project participant. Attachment 1 presents the tabular results for the turbines analyzed and sound contour figures of the maximum anomalous condition for each turbine type.

In conclusion, the acoustic modeling analysis, demonstrates the Project has been adequately designed inclusive of a number of conservative assumptions to generate sound levels below the North Dakota noise limit at all occupied non-participant receptors. If a complaint is registered and sound is measured above the 48.6 dBA level on more than a rare occasion, Thunder Spirit will provide improved insulation, landscaping, or other appropriate candidate mitigative measures. It should be noted that the acoustic model conservatively predicts outdoor sound levels and assumes no shielding or attenuation by trees or other vegetation.

**Cultural, Archaeological, and Historic Architectural Impacts**

***Class II Historic Architecture Survey***

The architectural historian reviewed the latest layout and determined that the revisions to the layout did not add or subtract properties from the APE.

***Class III Pedestrian Survey***

A Class III Pedestrian Survey of the APE based on the April 26, 2013 Project layout was conducted and as presented in the Certificate, some potentially eligible sites were identified. Revisions to the layout were necessary to ensure avoidance of sensitive resources which led to this Amendment. Should further revisions be necessary for project facilities, the areas will be revisited as necessary to determine if additional areas require avoidance. Results and recommendations will be submitted to SHPO for review and acceptance.

**Wetlands, Surface Water and Floodplain Resources**

The wetland and waters of the US delineation conducted in May 2013 included a buffer around the project components. WoUS and some wetlands were identified within the project area. Thunder Spirit has committed to avoiding all permanent impacts. If temporary impacts cannot be avoided, proper permits and notifications will be obtained/made as required. Therefore, information provided in the Certificate is still valid.

**3.1 Summary of Impacts**

The table below summarizes any changes to the impacts to the resources due to the revisions to the layout.

**Summary of Impacts and Mitigation (Only those with changes are listed)**

Resource	Impact	Mitigation
Noise	No impacts are anticipated to noise-sensitive resources (occupied residences). Receptor 28 is a participating landowner but the structure is not occupied full time.	Thunder Spirit has located turbines so the maximum level of 48.6 dBA is not exceeded at occupied non-participating residences. Thunder Spirit will also comply with the North Dakota 50 dBA criterion and the Adams County ordinance: Sustained noise of over 80 dB during the day and 70 dB at night is not allowed.

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Resource	Impact	Mitigation
Cultural, Archaeological, and Historic Architecture	No impacts to previously identified cultural resources are anticipated.	Thunder Spirit has conducted Class I, II, and III inventories for the proposed Project. Turbines and other Project facilities will be micro-sited to avoid impacts to newly documented archaeological sites that are potentially eligible to the NHRP. The sites that were identified during Project surveys will be evaluated for significance in consultation with SHPO and avoided as necessary.

## 4. POTENTIAL PERMITS AND APPROVALS

The table below lists an update to the potential Permits and Approvals Required for Construction and Operation of the Proposed Facility.

Agency	Type of Approval	Status*	Need and Further Details
<b>Federal Approvals</b>			
U.S. Army Corps of Engineers	Nationwide Permit	3	Wetland delineation was completed May 2013. Thunder Spirit has committed to no permanent impacts. If temporary impacts cannot be avoided, proper permits and notifications will be obtained/made.
Federal Aviation Administration	Determination of No Hazard to Air Navigation - Notice and approval are required for structures over 200 feet in height. FAA approval of lighting and marking of turbines is required.	1	Awaiting FAA determinations of no-hazard. Thunder Spirit will submit determination letters when received.
<b>State of North Dakota</b>			
Public Service Commission	Certificate of Site Compatibility	1	In process
North Dakota State Historic Preservation Office	Concurrence on results of Cultural Resources Inventory	1	Class I, Class II, and Class III surveys were completed May 2013; report submitted to SHPO for review. Thunder Spirit will submit concurrence letter when received.
North Dakota Department of Health	NPDES Permit: General Construction Storm Water	2	Will be prepared by Thunder Spirit or their contractor.
North Dakota Highway Patrol	Overheight/ Overweight Permit	2	Will be prepared by Thunder Spirit or their contractor.
North Dakota Department of Transportation	Road Approach/Access Permit	3	Will be prepared by Thunder Spirit or their contractor if necessary.
	Utility Permit/Risk Management Documents	3	Will be prepared by Thunder Spirit or their contractor if necessary.
<b>Local Permits</b>			
Adams County	Wind Energy Facility Siting Permit	1	Initial hearing held. Awaiting permit decision. Will forward once received.
	Building Permits	1	Adams County has determined that a single building permit will be issued for the entire proposed facility.
* Status Explanation: 1 Applied and/or Decision Pending 2 Will Apply Once Certificate is Received 3 Final Layout will Determine Whether Permit/Approval is Needed			

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**FIGURES**

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**Appendix A**  
**Studies and Assessments**  
*Those that were revised or not submitted with Certificate*

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**Appendix B**  
**Additional Agency Correspondence**

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**Appendix C**  
**Receptors Located Within ½ mile of a Turbine**  
**(Revised)**

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## FIGURES

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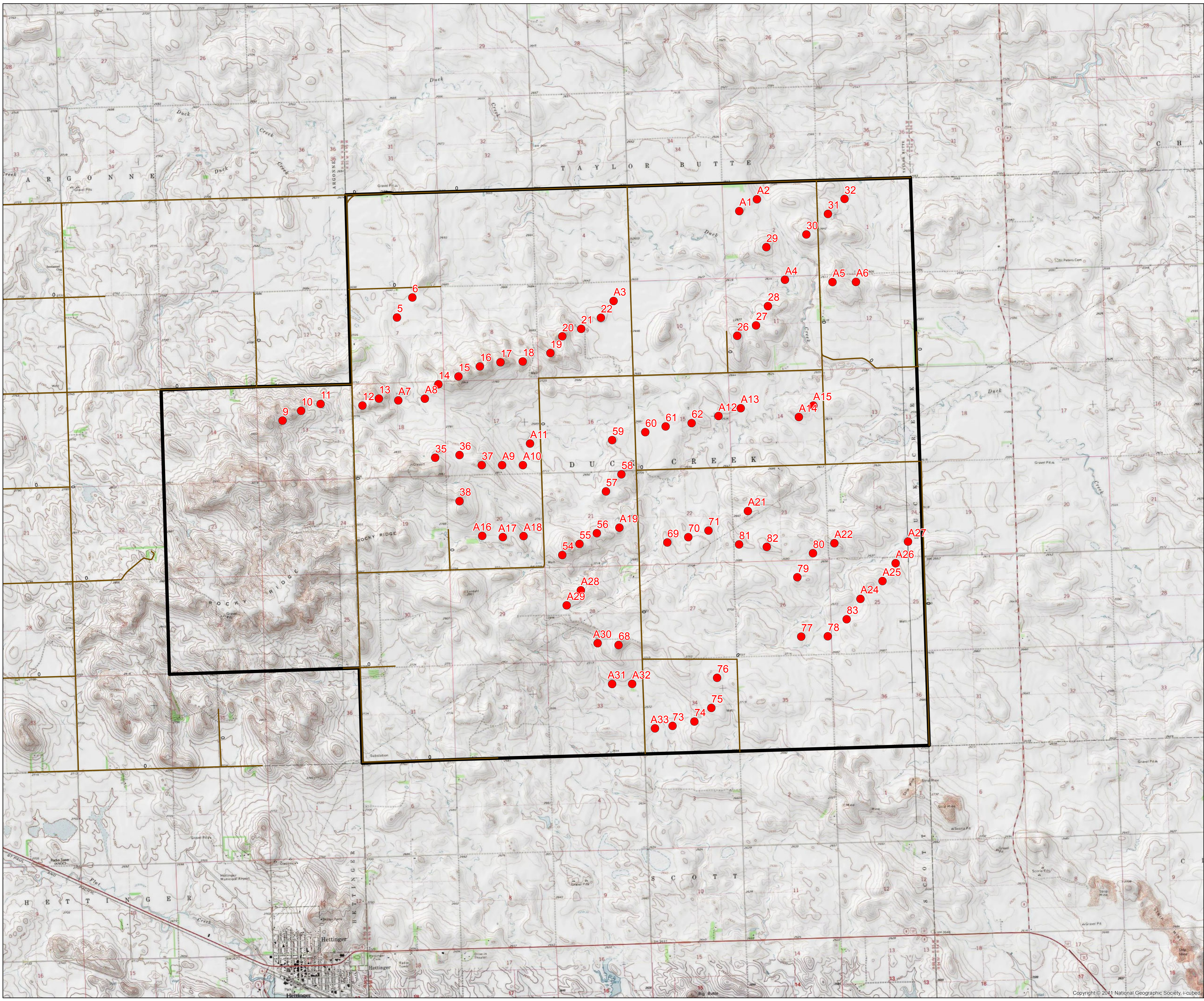
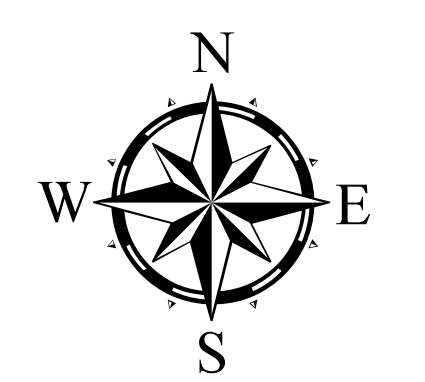
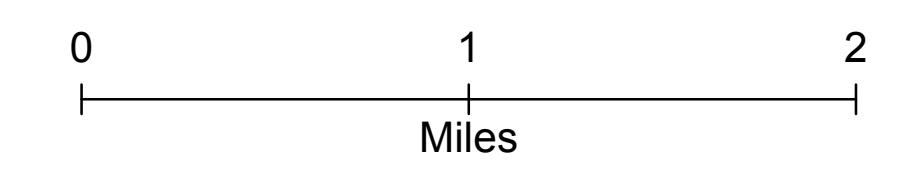
# Figure 3 Project Area

Topographic Map

Thunder Spirit Wind Energy Project  
Thunder Spirit Wind, LLC  
Adams County, North Dakota

August 2013

- Proposed Turbine Location (7/23/2013)
- ▭ Project Area
- Adams County Public Road



**Exclusion Areas**

Prime Farmland

**Avoidance Areas**

Abandoned Mine

NWI Wetland

**Native Prairie**

Native Prairie

Native Prairie/Hayfields

NOTE: FEMA Special Flood Hazard Areas (avoidance area) data not available in this area of North Dakota.  
NOTE: Archeological sites (exclusion area) not depicted.

Figure 5

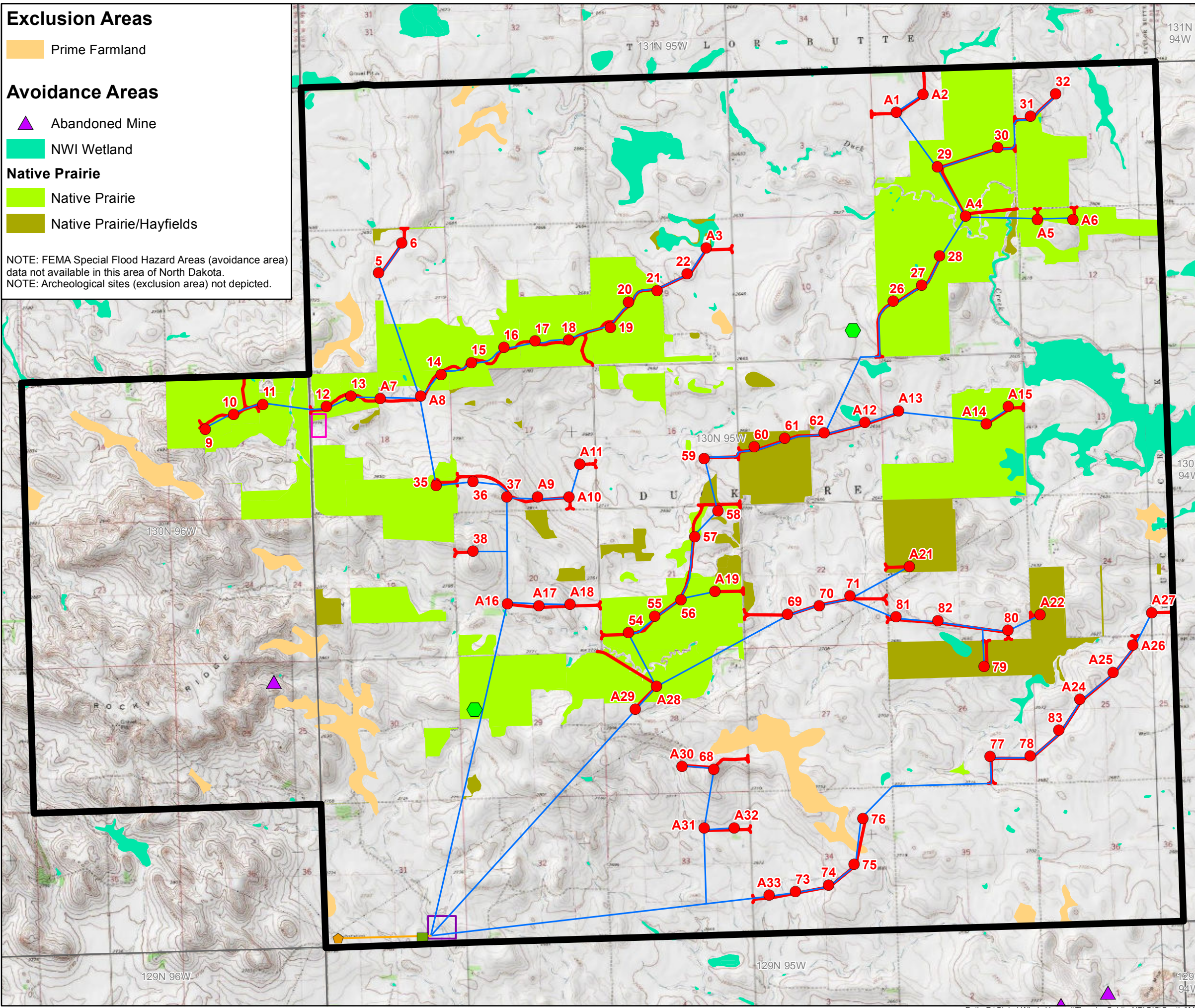
Exclusion and Avoidance Areas

Thunder Spirit Wind Energy Project  
Thunder Spirit Wind, LLC  
Adams County, North Dakota

August 2013

**Legend**

- Proposed Turbine Location (7/23/2013)
- ⬠ Met Tower Location
- ⬠ Approximate POI
- Proposed Collector Substation (5/2/2013)
- Overhead Line (4/8/2013)
- Collection Line (7/23/2013)
- Access Road (7/23/2013)
- Construction Laydown Area (10 Acres)
- Collection Substation, O&M Facility, and Additional Laydown Area
- ▭ Project Area
- ▭ Township Boundary



**REFERENCE MAP**

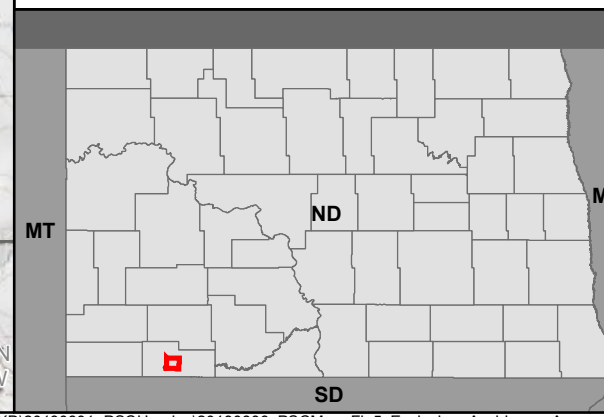


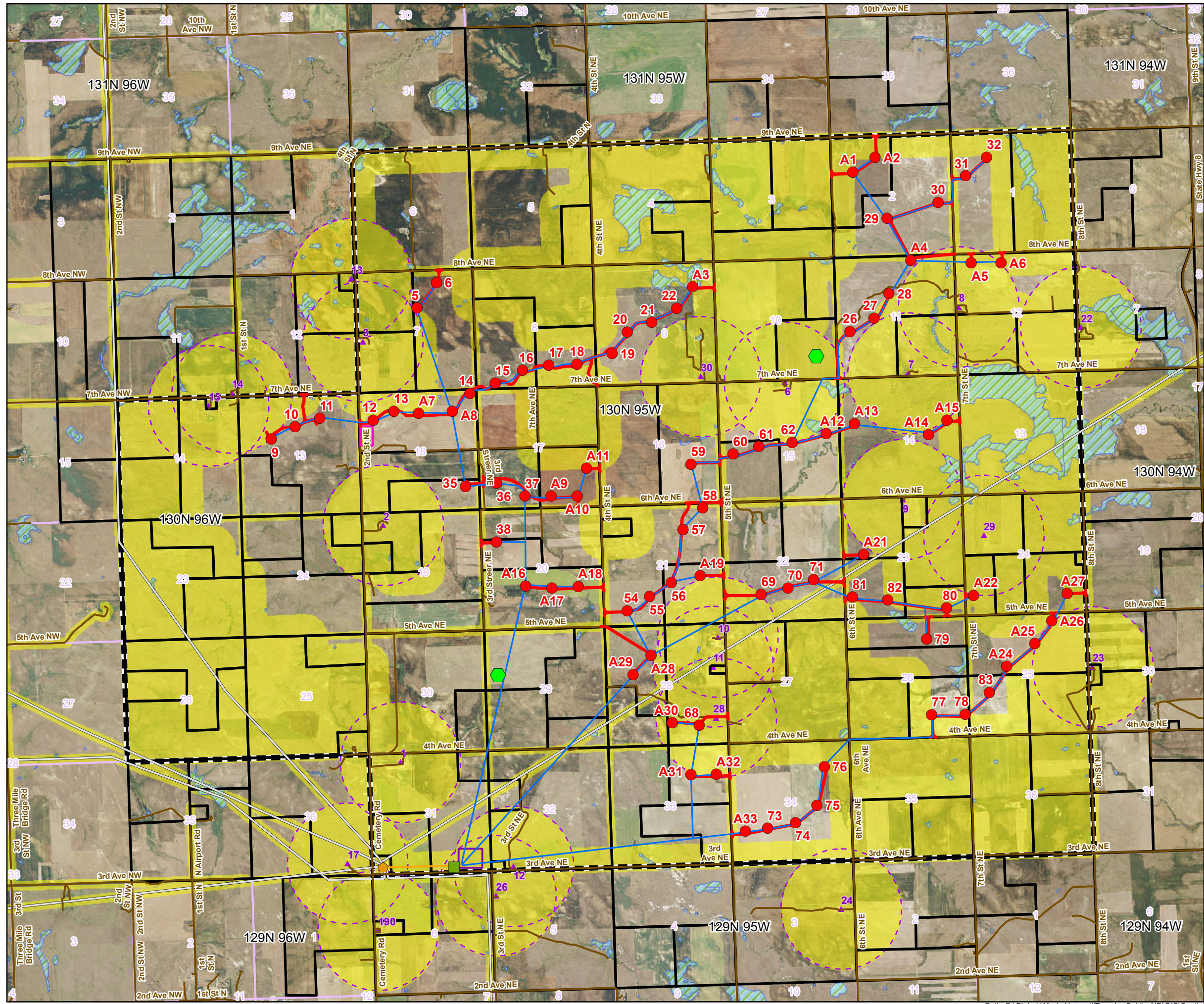


Figure 18

Project Layout with Adams County Zoning Setbacks

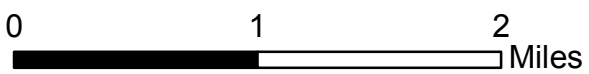
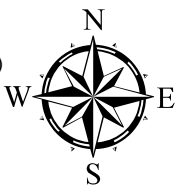
Thunder Spirit Wind Energy Project  
Thunder Spirit Wind, LLC  
Adams County, North Dakota

August 2013



Legend

- Proposed Turbine Location (7/23/2013)
- ◆ Met Tower Location
- ◆ Approximate POI
- Proposed Collector Substation (5/2/2013)
- Overhead Line (4/8/2013)
- Collection Line (7/23/2013)
- Access Road (7/23/2013)
- Construction Laydown Area (10 Acres)
- Collection Substation, O&M Facility, and Additional Laydown Area
- Existing Road
- Existing Transmission Line
- Parcel Boundary
- PLSS Township
- PLSS Section Boundary
- ▲ Occupied Residence
- Occupied Residence Buffer (0.5 miles)
- Project Area
- NWI Wetland
- Setbacks (See Table 12 in PSC Application)



REFERENCE MAP

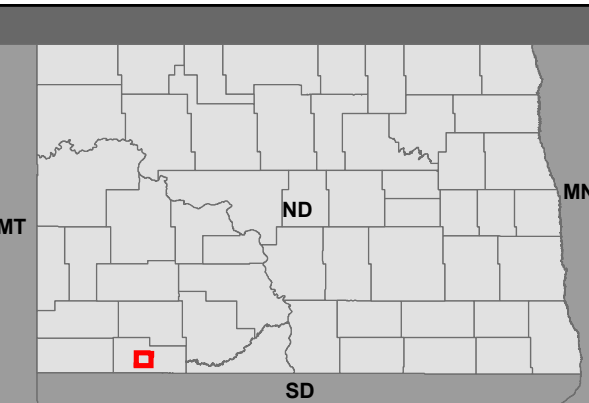
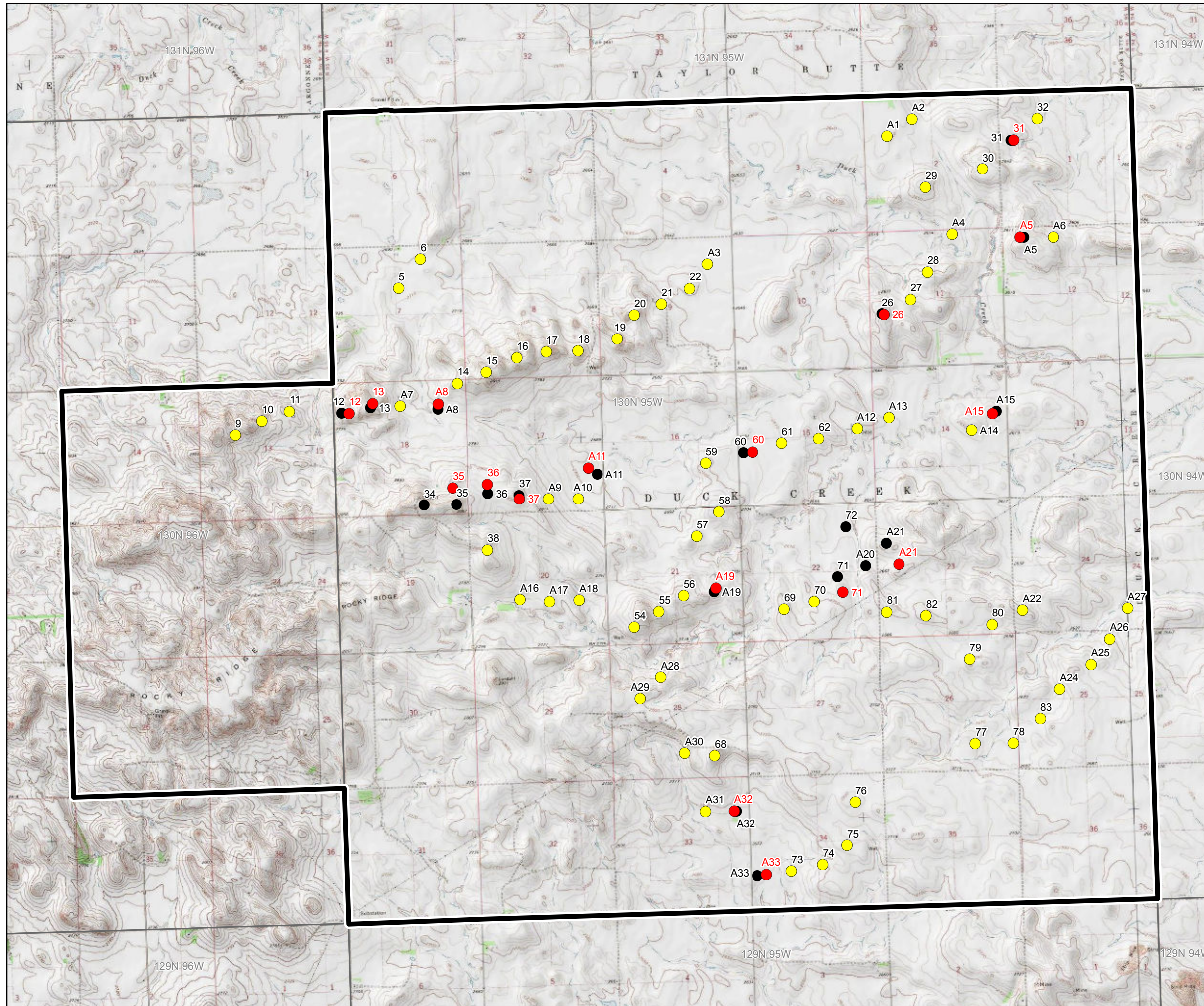


Figure A  
**Turbine Adjustments**  
**(After June 4, 2013 PSC Filing)**

Thunder Spirit Wind Energy Project  
 Thunder Spirit Wind, LLC  
 Adams County, North Dakota

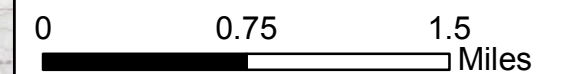
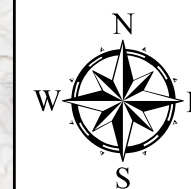
August 2013



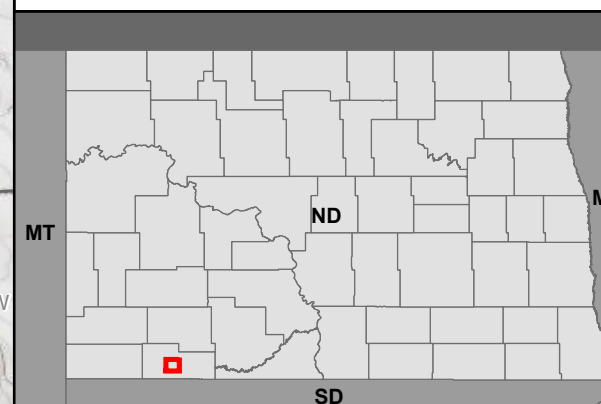
**Legend**

**Turbine Layout (7/23/2013)**

- New Location
- Location Consistent with PSC Filing
- Eliminated/Shifted Turbine
- Project Area
- Township Boundary



**REFERENCE MAP**



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**Appendix A**  
**Studies and Assessments**  
*Those that were revised or not submitted with Certificate*

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**Shadow Flicker Impact Analysis  
for the  
Thunder Spirit Wind Energy Project**  
Adams County, North Dakota

*Prepared for*



**Thunder Spirit Wind, LLC**  
103 Front Street  
Schenectady, New York 12305

*Prepared by*



**Tetra Tech, Inc.**  
160 Federal Street – 3rd Floor  
Boston, Massachusetts 02110

**August 2013**

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## ATTACHMENT

Attachment A. Detailed Summary of WindPro Shadow Flicker Analysis Results

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## 1.0 OVERVIEW

A wind turbine's moving blades can cast a moving shadow on locations within a certain distance of a turbine. These moving shadows are called shadow flicker, and can be a temporary phenomenon experienced at nearby residences or public gathering places. The impact area depends on the time of year and day (which determine the sun's azimuth and altitude angles) and the wind turbine's physical characteristics (height, rotor diameter, blade width, and orientation of the rotor blades). Shadow flicker generally occurs during low angle sunlight conditions, typically during sunrise and sunset times of the day. However, when the sun angle gets very low (less than 3 degrees), sunlight passes through more atmosphere and becomes too diffused to form a coherent shadow. Shadow flicker will not occur when the sun is obscured by clouds or fog, at night, or when the source turbine(s) are not operating.

Shadow flicker intensity is defined as the difference in brightness at a given location in the presence and absence of a shadow. Shadow flicker intensity diminishes with greater receptor-to-turbine separation distance. Shadow flicker intensity for receptor-to-turbine distances beyond 2,000 meters (6,562 feet) is very low and generally considered imperceptible. In general, increasing proximity to turbines may make shadow flicker more noticeable, with the largest number of shadow flicker hours, along with greatest shadow flicker intensity, occurring nearest the wind turbines.

Thunder Spirit Wind, LLC (Thunder Spirit), an affiliate of Global Winds Harvest, Inc., is proposing to install up to 75 wind turbines with a maximum nameplate capacity of 150 MW (the number of turbines depending on the size of turbine used) as part of the Thunder Spirit Wind Energy Project (the Project) in Adams County, North Dakota. Because the Project is using a minimum turbine siting setback requirement of 2,640 feet (805 meters) to all non-participating residences, the most sensitive receptors (potentially occupied non-participating residences) are generally not located in potential shadow flicker impact zones.

The three wind turbine models being considered for the Project, and evaluated for potential shadow flicker impacts, have the following characteristics:

- **Vestas V100 2.0** – 3-blade 100-meter diameter rotor, with a hub height of 80 meters. The Vestas V100 2.0 has a normal high rotor speed of 14.9 rotations per minute (rpm) which translates to a blade pass frequency of 0.7 Hertz (Hz) which is less than 1 alternation per second. Although 82 Vestas turbines are included in this impact analysis to account for alternate locations that may be used, a maximum of 75 of these turbines will be constructed.
- **Siemens Energy, Inc. (Siemens) SWT 2.3-108** – 3-blade 108-meter diameter rotor, with a hub height of 80 meters. The Siemens SWT 2.3-108 has a normal high rotor speed of 16 rpm which translates to a blade pass frequency of 0.8 Hz (less than 1 alternation per second). Although 82 Siemens turbines are included in this impact analysis to account for alternate locations that may be used, a maximum of 65 of these turbines will be constructed.

- **Acciona AW116/3000** – 3-blade 116-meter diameter rotor, with a hub height of 92 meters. The Acciona AW116/3000 has a normal high rotor speed of 15.6 rpm which translates to a blade pass frequency of 0.8 Hz (less than 1 alternation per second). Although 82 Acciona turbines are included in this impact analysis to account for alternate locations that may be used, a maximum of 50 of these turbines will be constructed.

The project layout has been designed so that any of the three turbine models can be sited within the 82 locations. Because the layout has not been finalized, the shadow flicker impact analysis considered all 82 turbines, which represents 10-35 more turbines than will be constructed for the three scenarios.

Shadow flicker frequency is related to the wind turbine's rotor blade speed and the number of blades on the rotor. From a health standpoint, the low flicker frequencies associated with wind turbines, are harmless. For comparison, strobe lights used in discotheques have frequencies which range from about 3 Hz to 10 Hz (1 Hz = 1 flash per second). As a result, public concerns that flickering light from wind turbines can have negative health effects, such as triggering seizures in people with epilepsy are unfounded. Epilepsy Action (working name for the British Epilepsy Foundation) states that there is no evidence that wind turbines can cause seizures (Epilepsy Action 2008). However, they recommend that wind turbine flicker frequency be limited to 3 Hz. Since the proposed Project's wind turbine blade pass frequency is approximately 0.7-0.8 Hz (less than 1 alternation per second), no negative health effects to individuals with photosensitive epilepsy are anticipated.

Shadow flicker impacts are not regulated in applicable state or federal law, and there is no permitting threshold with regard to hours per year of anticipated impacts to a receptor from a wind energy project. Due to the significant growth of the wind energy industry in recent years, some states have published model bylaws for local governments to adopt or modify at their own discretion which sometimes include guidance and recommendations for shadow flicker levels and mitigation. In lieu of specific regulations, a general precedent has been established in the industry both abroad and in the United States that fewer than 30 hours per year of shadow flicker impacts is acceptable to receptors in terms of nuisance and well below health hazard concerns. In a German court case, for example, a judge found 30 hours of actual shadow flicker per year at a certain neighbor's property to be tolerable (WindPower 2003). The 30 hours per year threshold value has been widely used in the industry as a target value in the absence of formal guidelines. However, predicted shadow flicker greater than this threshold does not necessarily create a nuisance and is still well below concerns for impacts to health.

## 2.0 WINDPRO SHADOW FLICKER ANALYSIS

An analysis of potential shadow flicker impacts from the Project was conducted using the WindPro software package. The turbine array dated July 23, 2013, which includes 82 turbines, was included in the analysis. The analysis evaluated the following three turbine scenarios:

- Scenario A – 82 Vestas V100 2.0 turbines (only 75 of these turbines would be constructed)
- Scenario B – 82 Siemens SWT 2.3-108 turbines (only 65 of these turbines would be constructed)
- Scenario C – 82 Acciona AW116/3000 turbines (only 50 of these turbines would be constructed)

The WindPro analysis was conducted to determine shadow flicker impacts under realistic impact conditions (actual expected shadow). This analysis calculated the total amount of time (hours and minutes per year) that shadow flicker could occur at receptors out to one mile (5,280 feet). The realistic impact condition scenario is based on the following assumptions:

- The elevation and position geometries of the wind turbines and surrounding receptors (potentially occupied residences). Elevations were determined using United States Geological Survey (USGS) digital elevation model (DEM) data. Positions geometries were determined using geographic information system (GIS) and referenced to Universal Transverse Mercator (UTM) Zone 13 (NAD83).
- The position of the sun and the incident sunlight relative to the wind turbine and receptors on a minute-by-minute basis over the course of a year.
- Historical sunshine availability (percent of total hours available). Historical sunshine rates for the area (as summarized by the National Climatic Data Center (NCDC 2008) for nearby Bismarck, North Dakota) used in this analysis are as follows:

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
53%	53%	58%	58%	61%	64%	73%	72%	65%	58%	43%	47%

- Estimated wind turbine operations and orientation (based on approximately 1 year of wind data from June 2011 through May 2012 (wind speed / wind direction frequency distribution) measured at on-site meteorological towers).
- Receptor viewpoints (i.e., house windows) are assumed to always be directly facing turbine to sun line of sight (“greenhouse mode”).

WindPro incorporates terrain elevation contour information and the analysis accounts for terrain elevation differences. The sun’s path with respect to each turbine location is calculated by the software to determine the cast shadow paths every minute over a full year. Sun angles less than 3 degrees above the horizon were excluded, for the reasons identified earlier in this section.

It should be noted however, that WindPro provides a conservative estimate of shadow flicker as obstacles such as trees, haze, and visual obstructions (window facing, coverings) are not fully accounted despite the likelihood of their reducing or eliminating shadow flicker impacts to receptors. A total of 26 receptor locations (potentially occupied residences) were identified within one mile of proposed Project turbines. A receptor in the model is defined as a 1 meter squared area (approximate size of a typical window), 1 meter (3.28 feet) aboveground level. Approximate eye level is set at 1.5 meters (4.94 feet). Figure 1 shows the receptor locations and proposed Project turbines considered for Scenarios A, B, and C.

### 3.0 SHADOW FLICKER ANALYSIS RESULTS

As expected, WindPro predicts that shadow flicker impacts will be greatest at locations nearer to the wind turbines. Figures 2A, 2B, and 2C describe the WindPro predicted shadow flicker impact areas for turbine Scenarios A, B, and C, respectively. A detailed WindPro shadow flicker analysis summary, for each of the modeled receptor location, is provided in Attachment A. Tables 1A, 1B, and 1C present the WindPro predicted shadow flicker impacts for the top ten worst case receptors for turbine Scenarios A, B, and C, respectively. Considering all turbine scenarios, only 2 of the 26 receptors modeled had expected shadow flicker impacts of more than 30 hours per year. The maximum predicted shadow flicker impact at a receptor is 76 hours 57 minutes per year (Receptor 28), which is approximately 1.7 percent of the potential available daylight hours. This is a participating landowner and the structure is not occupied full time.

**Table 1A. WindPro Predicted Shadow Flicker Impacts for Receptors with Maximum Expected Impacts – Turbine Scenario A (82 Vestas V100 2.0 Turbines)**

Receptor ID*	Receptor Description	Shadow Hours per Year (expected) [hh:mm / year]
28	Participating Landowner	58:19
67	Abandoned/Participating	26:52
23	Non-participating Receptor	16:37
10	Non-participating Receptor	11:50
3	Non-participating Receptor	10:02
14	Participating Landowner	9:10
11	Non-participating Receptor	8:35
8	Participating Landowner	8:33
15	Participating Landowner	7:54
30	Non-participating Receptor	7:12

**Table 1B. WindPro Predicted Shadow Flicker Impacts for Receptors with Maximum Expected Impacts – Turbine Scenario B (82 Siemens SWT 2.3-108 Turbines)**

Receptor ID*	Receptor Description	Shadow Hours per Year (expected) [hh:mm / year]
28	Participating Landowner	65:20
67	Abandoned/Participating	30:25
23	Non-participating Receptor	19:03
10	Non-participating Receptor	11:06
14	Participating Landowner	10:59
11	Non-participating Receptor	9:42
8	Participating Landowner	8:14
15	Non-participating Receptor	7:58
7	Non-participating Receptor	7:24
13	Participating Landowner	6:46

**Table 1C. WindPro Predicted Shadow Flicker Impacts for Receptors with Maximum Expected Impacts – Turbine Scenario C (82 Acciona AW116/3000 Turbines)**

Receptor ID*	Receptor Description	Shadow Hours per Year (expected) [hh:mm / year]
28	Participating Landowner	76:57
67	Abandoned/Participating	34:40
23	Non-participating Receptor	24:56
10	Non-participating Receptor	17:52
14	Non-participating Receptor	16:38
3	Non-participating Receptor	14:32
11	Non-participating Receptor	12:25
8	Participating Landowner	12:11
30	Non-participating Receptor	12:02
15	Participating Landowner	11:01

The shadow flicker impact prediction statistics are summarized in Tables 2A, 2B, and 2C.

**Table 2A. Statistical Summary of WindPro Predicted Shadow Flicker Impacts at Modeled Receptor Locations – Turbine Scenario A (82 Vestas V100 2.0 Turbines)**

Cumulative Shadow Flicker Time (expected)	Number of Receptors
Total	26
= 0 Hours	8
> 0 Hours < 10 Hours	13
≥ 10 Hours < 20 Hours	3
≥ 20 Hours < 30 Hours	1
≥ 30 Hours	1

**Table 2B. Statistical Summary of WindPro Predicted Shadow Flicker Impacts at Modeled Receptor Locations – Turbine Scenario B (82 Siemens SWT 2.3-108 Turbines)**

Cumulative Shadow Flicker Time (expected)	Number of Receptors
Total	26
= 0 Hours	9
> 0 Hours < 10 Hours	12
≥ 10 Hours < 20 Hours	3
≥ 20 Hours < 30 Hours	0
≥ 30 Hours	2

**Table 2C. Statistical Summary of WindPro Predicted Shadow Flicker Impacts at Modeled Receptor Locations – Turbine Scenario C (82 Acciona AW116/3000Turbines)**

Cumulative Shadow Flicker Time (expected)	Number of Receptors
Total	26
= 0 Hours	8
> 0 Hours < 10 Hours	8
≥ 10 Hours < 20 Hours	7
≥ 20 Hours < 30 Hours	1
≥ 30 Hours	2

The slightly higher shadow flicker impacts for Scenario C (Acciona turbines), can be explained by the difference in turbine design specifications (i.e., its taller tower and longer blades). Note: Although 82 turbines were used in the model, only 50 of these turbines will actually be constructed.

#### 4.0 CONCLUSION

The analysis of potential shadow flicker impacts from the Project on nearby receptors shows that shadow flicker impacts within the area of study are expected to be minor and well within acceptable ranges for avoiding nuisance and/or health hazards. The two receptors that exceed the target of 30 hours per year under the most conservative conditions are participating landowners, with land under lease to Thunder Spirit and have both verbal and contractual agreements with Thunder Spirit providing allowance for such potential nuisance issues. The analysis assumes that the receptors all have a direct in-line view of the incoming shadow flicker sunlight and does not account for trees or other obstructions which may block sunlight. In reality, the windows of many houses will not face the sun directly for the key shadow flicker impact times. Adding to the analysis' conservatism is that potential shadow flicker impacts for wind turbines up to one mile (5,280 feet) away from a receptor were determined, and Thunder Spirit will only construct 150 MW (i.e. not all 82 turbines modeled will be constructed). For these reasons, shadow flicker impacts are expected to be considerably less than estimated in this conservative analysis, and shadow flicker is not expected to be a significant environmental impact. Mitigation measures such as strategic vegetative screening and/or installation of curtains and blinds on the windows facing the turbine casting the shadows are effective and economically viable options that Thunder Spirit could consider on an individual basis with landowners, if necessary.

## **5.0 REFERENCES**

Epilepsy Action. 2008. British Epilepsy Association.

[http://www.epilepsy.org.uk/info/photo\\_other.html](http://www.epilepsy.org.uk/info/photo_other.html). Accessed 3/1/10.

National Climatic Data Center (NCDC). 2008. Sunshine Average Percent of Possible.

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WindPower. 2003. Danish Wind industry Association. Shadow Casting From Wind Turbines.

<http://guidedtour.windpower.org/en/tour/env/shadow/index.htm>, Accessed 4/28/10

## **FIGURES**

**Figure 1. Receptors Modeled with WindPro to Predict Potential Shadow Flicker Impacts**








Figure 1

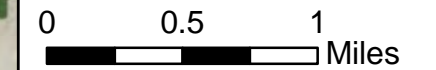
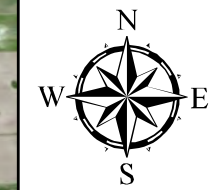
Residential Receptors Modeled  
With WindPro to Predict Expected  
Shadow Flicker Impacts

Thunder Spirit Wind Energy Project  
Thunder Spirit Wind, LLC  
Adams County, North Dakota

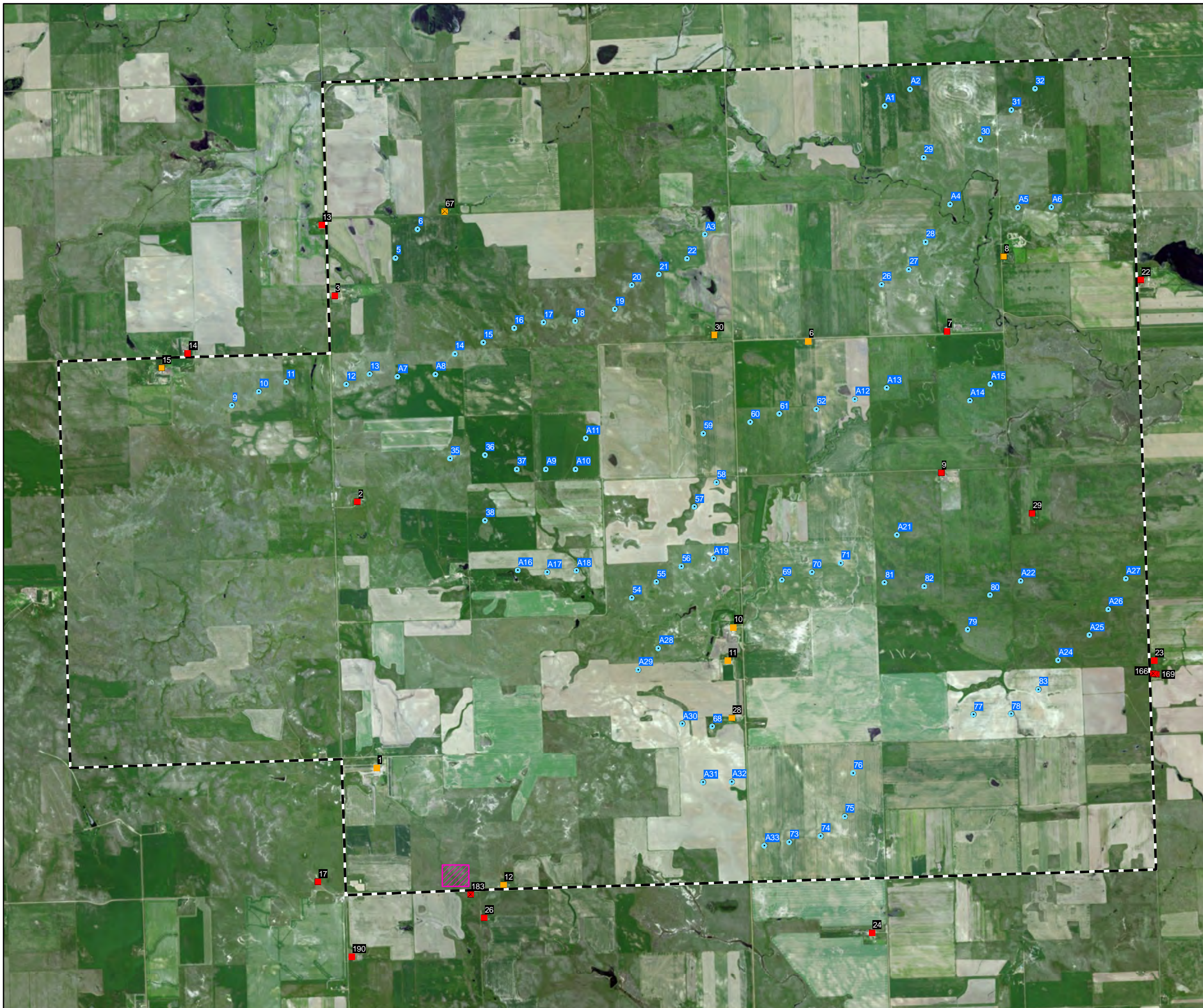
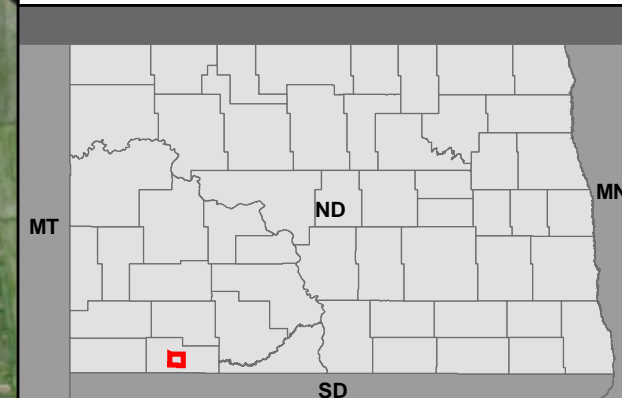
August 2013

**Legend**

-  Proposed Turbine Location (7/23/2013)
-  Collector Substation  
Construction Footprint (20 Acres)
-  Project Area
- Receptor**
-  Signed Easement (Occupied)
-  Signed Easement (Unoccupied)
-  Not Signed (Occupied)
-  Not Signed (Unoccupied)



**REFERENCE MAP**



**Figure 2A. WindPro Predicted Expected Shadow Flicker Impact Areas – Turbine Scenario A (82 Vestas V100 2.0 Turbines)**













Figure 2A

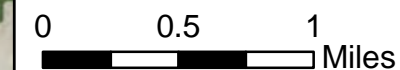
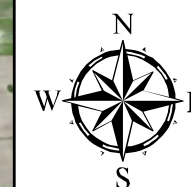
WindPro Predicted Expected  
Shadow Flicker Impact Areas:  
Vestas Turbines

Thunder Spirit Wind Energy Project  
Thunder Spirit Wind, LLC  
Adams County, North Dakota

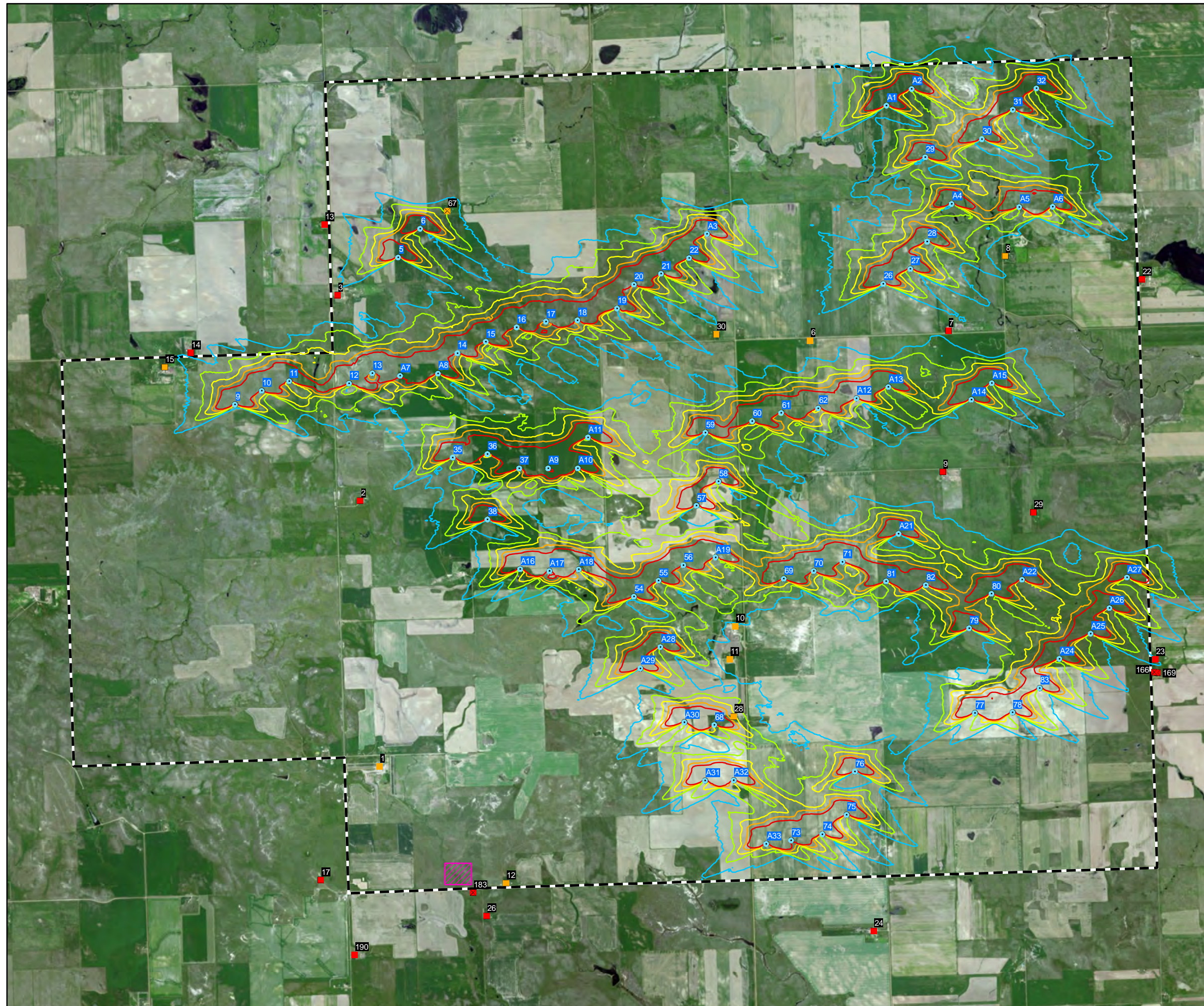
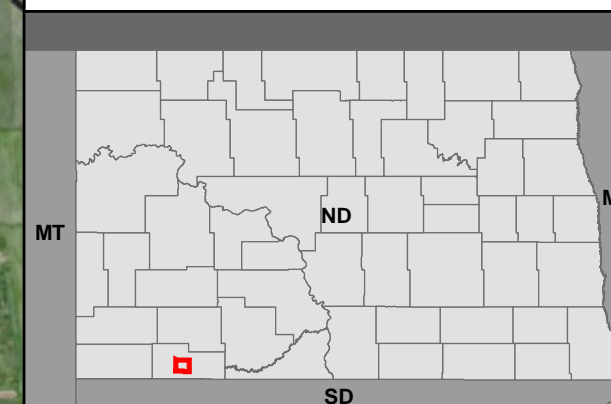
August 2013

**Legend**

-  Proposed Turbine Location (7/23/2013)
-  Collector Substation  
Construction Footprint (20 Acres)
- Shadow Flicker Iso Line (Vestas)**
  -  15 hrs/yr
  -  30 hrs/yr
  -  50 hrs/yr
  -  75 hrs/yr
  -  100 hrs/yr
-  Project Area
- Receptor**
  -  Signed Easement (Occupied)
  -  Signed Easement (Unoccupied)
  -  Not Signed (Occupied)
  -  Not Signed (Unoccupied)



**REFERENCE MAP**



**Figure 2B. WindPro Predicted Potential Shadow Flicker Impact Areas – Turbine Scenario B (82 Siemens SWT 2.3-108 Turbines)**













Figure 2B

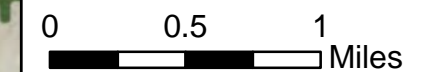
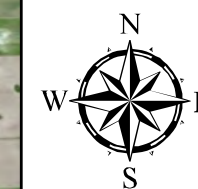
WindPro Predicted Expected  
Shadow Flicker Impact Areas:  
Siemens Turbines

Thunder Spirit Wind Energy Project  
Thunder Spirit Wind, LLC  
Adams County, North Dakota

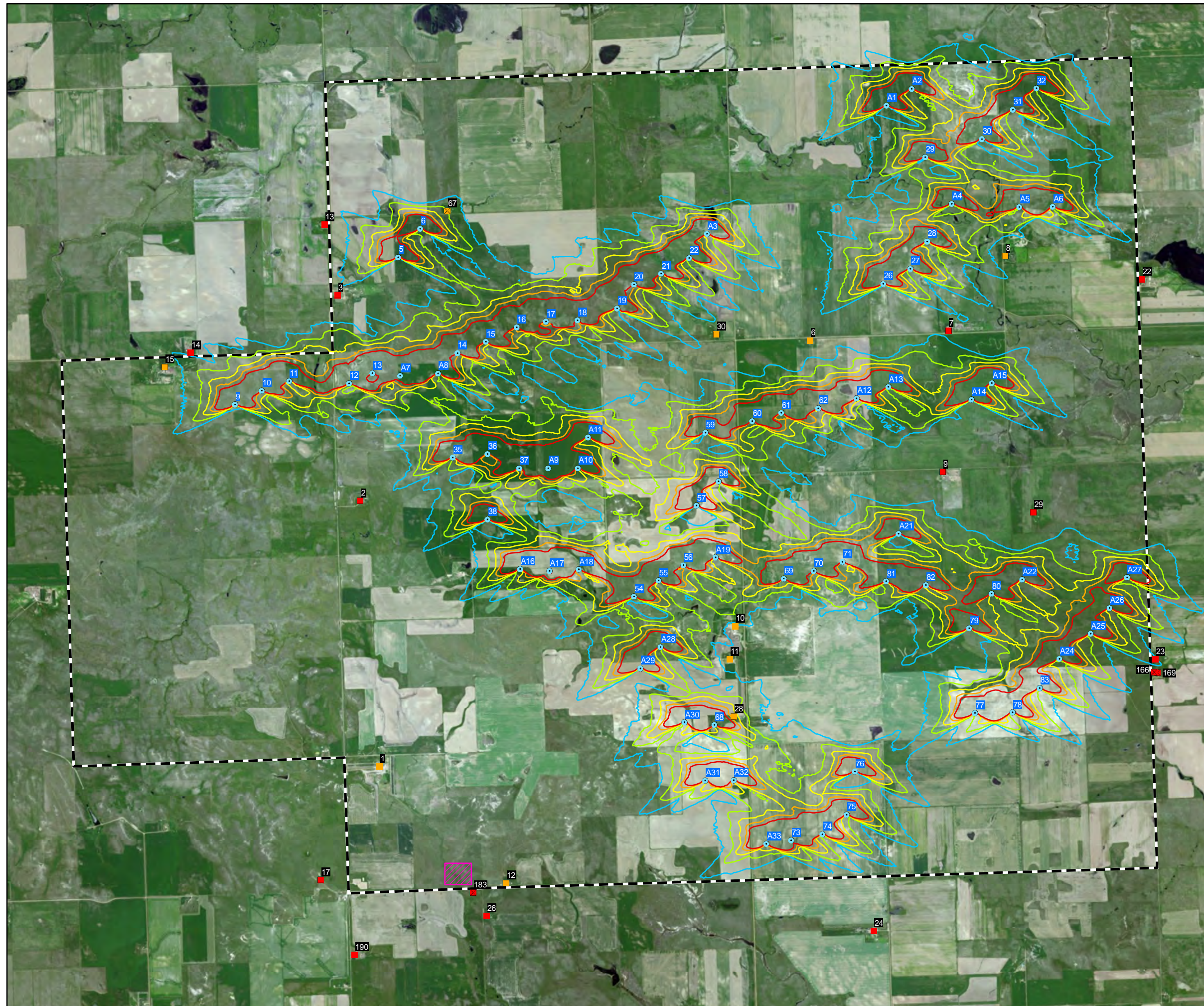
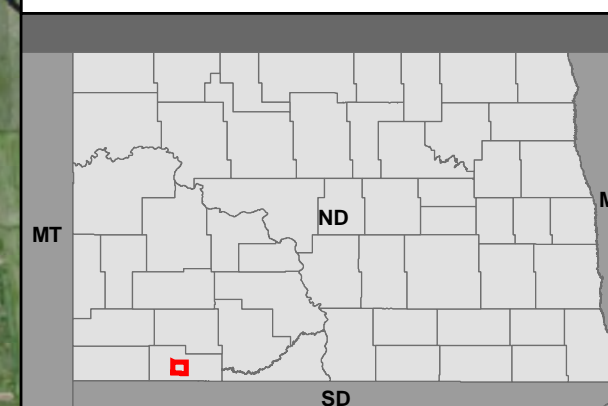
August 2013

**Legend**

-  Proposed Turbine Location (7/23/2013)
-  Collector Substation  
Construction Footprint (20 Acres)
- Shadow Flicker Iso Line (Siemens)**
  -  15 hrs/yr
  -  30 hrs/yr
  -  50 hrs/yr
  -  75 hrs/yr
  -  100 hrs/yr
-  Project Area
- Receptor**
  -  Signed Easement (Occupied)
  -  Signed Easement (Unoccupied)
  -  Not Signed (Occupied)
  -  Not Signed (Unoccupied)



**REFERENCE MAP**



**Figure 2C. WindPro Predicted Potential Shadow Flicker Impact Areas – Turbine Scenario C (Acciona AW116/3000 Turbines)**













Figure 2C

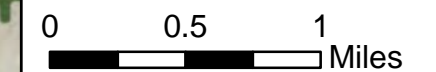
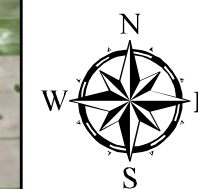
WindPro Predicted Expected  
Shadow Flicker Impact Areas:  
Acciona Turbines

Thunder Spirit Wind Energy Project  
Thunder Spirit Wind, LLC  
Adams County, North Dakota

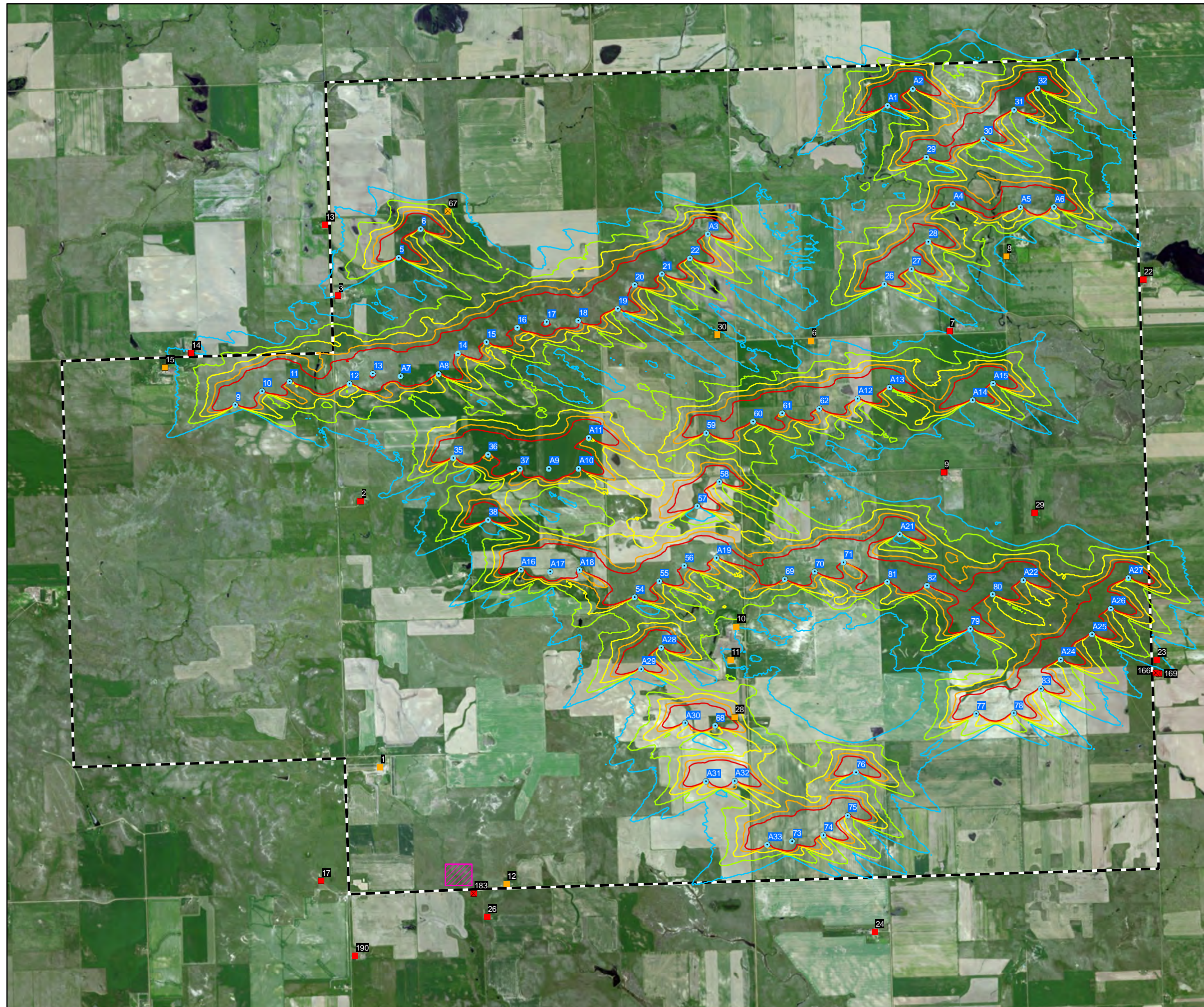
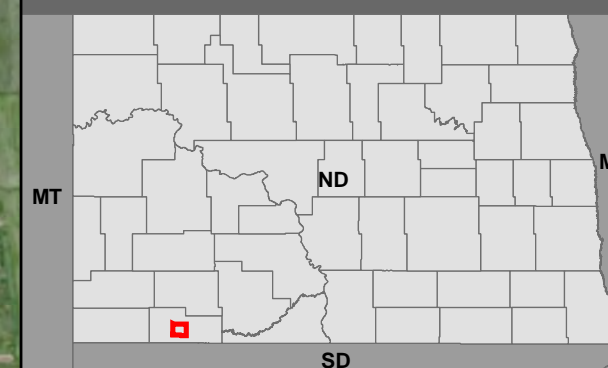
August 2013

**Legend**

-  Proposed Turbine Location (7/23/2013)
-  Collector Substation  
Construction Footprint (20 Acres)
- Shadow Flicker Iso Line (Acciona)**
  -  15 hrs/yr
  -  30 hrs/yr
  -  50 hrs/yr
  -  75 hrs/yr
  -  100 hrs/yr
-  Project Area
- Receptor**
  -  Signed Easement (Occupied)
  -  Signed Easement (Unoccupied)
  -  Not Signed (Occupied)
  -  Not Signed (Unoccupied)



**REFERENCE MAP**



**ATTACHMENT A.**

**Detailed Summary of WindPro Shadow Flicker Analysis Results**

**Thunder Spirit Wind Energy Project  
WindPro Shadow Flicker Analysis Results Summary  
Turbine Scenario A (82 Vestas V100 2.0 Turbines)**

Thunder Spirit Receptor ID	UTM-E (m)	UTM-N (m)	WindPro Predicted Expected Shadow Flicker (Hours per Year)
1	684417	5101848	0:00
2	684186	5105014	3:07
3	683913	5107467	10:02
6	689550	5106924	4:13
7	691200	5107045	6:43
8	691878	5107932	8:33
9	691131	5105359	2:59
10	688659	5103520	11:50
11	688595	5103125	8:35
12	685925	5100457	0:00
13	683758	5108307	6:03
14	682164	5106780	9:10
15	681853	5106609	7:54
17	683711	5100496	0:00
22	693510	5107659	0:00
23	693669	5103124	16:37
24	690307	5099887	0:00
26	685692	5100065	0:00
28	688638	5102441	58:19
29	692214	5104878	4:20
30	688431	5107000	7:12
67	685223	5108470	26:52
166	693657	5102971	4:24
169	693696	5102962	5:25
183	685531	5100343	0:00
190	684117	5099602	0:00

**Thunder Spirit Wind Energy Project  
WindPro Shadow Flicker Analysis Results Summary  
Turbine Scenario B (82 Siemens SWT 2.3-108 Turbines)**

Thunder Spirit Receptor ID	UTM-E (m)	UTM-N (m)	WindPro Predicted Expected Shadow Flicker (Hours per Year)
1	684417	5101848	0:00
2	684186	5105014	2:37
3	683913	5107467	6:06
6	689550	5106924	3:05
7	691200	5107045	7:24
8	691878	5107932	8:14
9	691131	5105359	0:00
10	688659	5103520	11:06
11	688595	5103125	9:42
12	685925	5100457	0:00
13	683758	5108307	6:46
14	682164	5106780	10:59
15	681853	5106609	7:58
17	683711	5100496	0:00
22	693510	5107659	0:00
23	693669	5103124	19:03
24	690307	5099887	0:00
26	685692	5100065	0:00
28	688638	5102441	65:20
29	692214	5104878	2:49
30	688431	5107000	4:13
67	685223	5108470	30:25
166	693657	5102971	5:18
169	693696	5102962	6:11
183	685531	5100343	0:00
190	684117	5099602	0:00

**Thunder Spirit Wind Energy Project  
WindPro Shadow Flicker Analysis Results Summary  
Turbine Scenario C (82 Acciona AW116/3000 Turbines)**

<b>Thunder Spirit Receptor ID</b>	<b>UTM-E (m)</b>	<b>UTM-N (m)</b>	<b>WindPro Predicted Expected Shadow Flicker (Hours per Year)</b>
1	684417	5101848	0:00
2	684186	5105014	6:06
3	683913	5107467	0:00
6	689550	5106924	7:31
7	691200	5107045	10:12
8	691878	5107932	12:11
9	691131	5105359	6:57
10	688659	5103520	17:52
11	688595	5103125	12:25
12	685925	5100457	0:00
13	683758	5108307	8:37
14	682164	5106780	16:38
15	681853	5106609	11:01
17	683711	5100496	0:00
22	693510	5107659	0:52
23	693669	5103124	24:56
24	690307	5099887	0:00
26	685692	5100065	0:00
28	688638	5102441	76:57
29	692214	5104878	7:21
30	688431	5107000	12:02
67	685223	5108470	34:40
166	693657	5102971	7:22
169	693696	5102962	8:17
183	685531	5100343	0:00
190	684117	5099602	0:00



**To:** Global Winds Harvest Inc. and Thunder Spirit Wind, LLC  
**From:** Tetra Tech, Inc.  
**Subject:** Thunder Spirit Wind Farm –Revised Acoustic Modeling Analysis  
**Date:** August 6, 2013

---

Global Winds Harvest Inc. and Thunder Spirit Wind, LLC (Thunder Spirit) are proposing to construct and operate the Thunder Spirit Wind Farm (the “Project”) in Adams County, North Dakota. Tetra Tech submitted an acoustic analysis on May 29, 2013 for a Project layout consisting of 85 wind turbine generators (WTGs) and a supporting collector substation. Since that time the Project layout was modified and reduced to 82 WTGs. The location of the collector substation has not changed. The three candidate WTG types being considered for the Project remain the same as under the previous analysis. Tetra Tech evaluated the new Project layout configuration using the same methodology used in the May 29<sup>th</sup> submittal. This memo provides the results of this evaluation and an assessment of Project compliance with the U.S. Environmental Protection Agency (EPA) noise guidelines used in the previous analysis as well as the recently adopted state of North Dakota noise regulations for wind energy projects.

#### Applicable Noise Criteria

Tetra Tech completed a regulatory review which was summarized in the May 29<sup>th</sup> technical memo. This summary covered the Adams County Zoning Ordinance noise requirements and the EPA guidelines. The Adams County Zoning Ordinance prescribes a daytime and nighttime noise limit of 80 and 70 dBA, respectively. Recently adopted at the state level, North Dakota Chapter 69-06-08-01(4) specifies noise requirements:

*“Additional avoidance areas for wind energy conversion facilities. A wind energy conversion facility site must not include a geographic area where, due to operation of the facility, the sound levels within one hundred feet of an inhabited residence or a community building will exceed fifty dBA. The sound level avoidance area criteria may be waived in writing by the owner of the occupied residence or the community building.”*

The previously referenced EPA noise guidelines are slightly more conservative than the North Dakota regulations; therefore, adherence to the EPA thresholds, or received sound levels of no more than 48.6 dBA  $L_{eq}$  at noise sensitive receptors (NSRs), also results in compliance with the State’s noise regulations, or 50 dBA  $L_{eq}$  at NSRs.

#### Acoustic Model Results

Sound modeling was completed to address multiple operating scenarios; 1) cut-in (onset of WTG operation), 2) maximum rotation (full power), and 3) maximum rotation under anomalous meteorological conditions (i.e., full power during atypical conditions that affect long range propagation). Table 3 summarizes the number of NSRs within selected sound pressure level ranges under each of the identified operational conditions. The tabulated results are independent of the existing acoustic environment, (i.e. are representative of expected Project-generated sound levels only). In addition, in consideration of the North Dakota noise regulation, the analysis included a 100 foot buffer around each residential structure.

**Table 3. Summary of Project Sound Levels at NSRs by WTG Model**

Sound Level (dBA)	Number of NSRs Exceeding Sound Level Ranges								
	Acciona AW116/3000			Vestas V100 2.0			Siemens 2.3-108		
	Cut-in	Maximum	Maximum - Anomalous	Cut-in	Maximum	Maximum - Anomalous	Cut-in	Maximum	Maximum - Anomalous
> 50 North Dakota	1	1	1	0	1	1	0	1	1
> 48.6 EPA	1	2	3	0	1	2	0	1	3
>=50	1	1	2	0	1	1	0	1	1
45 to 50	7	8	11	0	2	3	0	7	10
40 to 45	11	11	11	0	12	15	0	11	12
35 to 40	5	4	2	2	8	7	1	5	3
< 35	2	2	0	24	3	0	25	2	0

Table 3 presents the modeling results and indicates that received sound levels under maximum rotation and maximum rotation during anomalous events may potentially exceed the EPA 48.6 dBA guideline criteria and North Dakota noise regulation at one or more NSRs for each WTG model. There are no exceedances of the Adams County Zoning Ordinance noise limits. The EPA guidelines are just that, guidelines and not regulatory limits; however, the State's wind energy noise regulations require Project compliance. The EPA threshold exceedances are only provided for comparative purposes to the results in the May 29<sup>th</sup> memo. The Acciona WTG exhibited the worst case results, yielding the highest received sound levels at NSRs. With respect to the EPA guidelines, there was 1 potential exceedance at cut-in wind speed, 2 potential exceedances at maximum rotation and 3 potential exceedances at maximum rotation under anomalous meteorological conditions. However, these exceedances occurred at NSR ID 28, which has been identified as a Project participant, and at NSR IDs 67 and 183, which have both been identified as abandoned residences. With respect to the North Dakota regulation, there was one potential exceedance under all operational scenarios evaluated (i.e., cut-in, max rotation, and max rotation anomalous). The one exceedance identified would occur at NSR ID 28, which is a Project participant. Attachment 1 presents the tabular results for the WTGs analyzed as well as a sound contour figure for the AW116/3000 WTG model at maximum rotation under anomalous meteorological conditions.

In conclusion, the acoustic modeling analysis, demonstrates the Project has been adequately designed inclusive of a number of conservative assumptions to generate sound levels below the EPA guidelines and North Dakota noise limit at all occupied non-participant NSRs.

## **ATTACHMENT 1**

### **Tabulated Results and Sound Contour Figure**

Received Sound Levels by NSR for each WTG Type

NSR ID	Receptor Type	Landowner Status	UTM Coordinates		Received Sound Level (dBA)								
			Easting (m)	Northing (m)	Acciona AW116/3000			Vestas V100-2.0			Siemens 2.3-108		
					Cut-in	Maximum	Anomalous Meteorological Conditions	Cut-in	Maximum	Anomalous Meteorological Conditions	Cut-in	Maximum	Anomalous Meteorological Conditions
1	Residence	Participant	684417	5101848	39	39	42	27	39	42	23	39	42
2	Residence	Non-Participant	684186	5105014	41	42	44	27	39	40	25	42	43
3	Residence	Non-Participant	683913	5107467	43	44	45	29	41	42	27	44	44
6	Residence	Participant	689550	5106924	45	46	47	31	43	44	29	45	46
7	Residence	Non-Participant	691200	5107045	45	46	47	31	43	43	29	45	46
8	Residence	Participant	691878	5107932	46	47	47	32	43	44	29	46	47
9	Residence	Non-Participant	691131	5105359	44	45	46	30	41	43	28	44	45
10	Residence	Participant	688659	5103520	46	47	48	32	43	44	30	46	47
11	Residence	Participant	688595	5103125	46	47	47	32	43	44	29	46	47
12	Residence	Participant	685925	5100457	39	40	43	28	39	42	23	40	42
13	Residence	Non-Participant	683758	5108307	41	41	42	26	38	39	24	41	42
14	Residence	Non-Participant	682164	5106780	41	42	43	27	39	40	25	42	42
15	Residence	Participant	681853	5106609	39	40	41	25	37	38	23	40	41
17	Residence	Non-Participant	683711	5100496	33	34	37	21	33	36	17	33	36
22	Residence	Non-Participant	693510	5107659	37	38	40	23	35	37	21	38	39
23	Residence	Non-Participant	693669	5103124	43	44	45	29	41	41	27	44	44
24	Residence	Non-Participant	690307	5099887	39	40	41	25	36	38	22	39	41
26	Residence	Non-Participant	685692	5100065	43	44	47	33	44	47	28	44	47
28	Residence	Participant	688638	5102441	54	54	55	39	51	51	37	54	54
29	Residence	Non-Participant	692214	5104878	43	44	45	29	41	42	27	43	45
30	Residence	Participant	688431	5107000	45	45	46	30	42	43	28	45	46
67	Residence - Abandoned	Participant	685223	5108470	48	49	50	34	46	46	32	48	49
166	Residence - Abandoned	Non-Participant	693657	5102971	43	43	44	29	40	41	26	43	44
169	Residence - Abandoned	Non-Participant	693696	5102962	42	43	44	28	40	41	26	42	43
183	Residence - Abandoned	Non-Participant	685531	5100343	47	48	50	36	48	50	31	48	50
190	Residence	Non-Participant	684117	5099602	33	34	37	22	33	36	17	34	36

Note: Values in red indicate exceedances of the North Dakota 50 dBA criterion.














**Figure 1. Received Sound Levels –Acciona AW116/3000 WTG at Maximum Rotational Wind Speed under Anomalous Conditions**

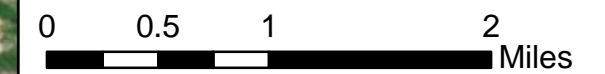
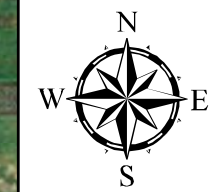
Figure 1

Received Sound Levels:  
AW116/3000 WTG at  
Maximum Rotational Wind Speed  
under Anomalous Conditions  
Thunder Spirit Wind Energy Project  
Thunder Spirit Wind, LLC  
Adams County, North Dakota

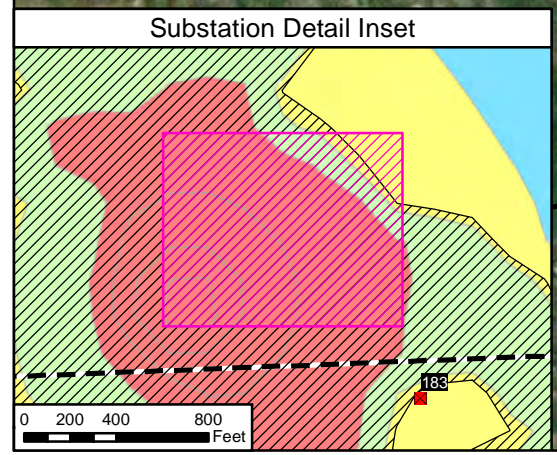
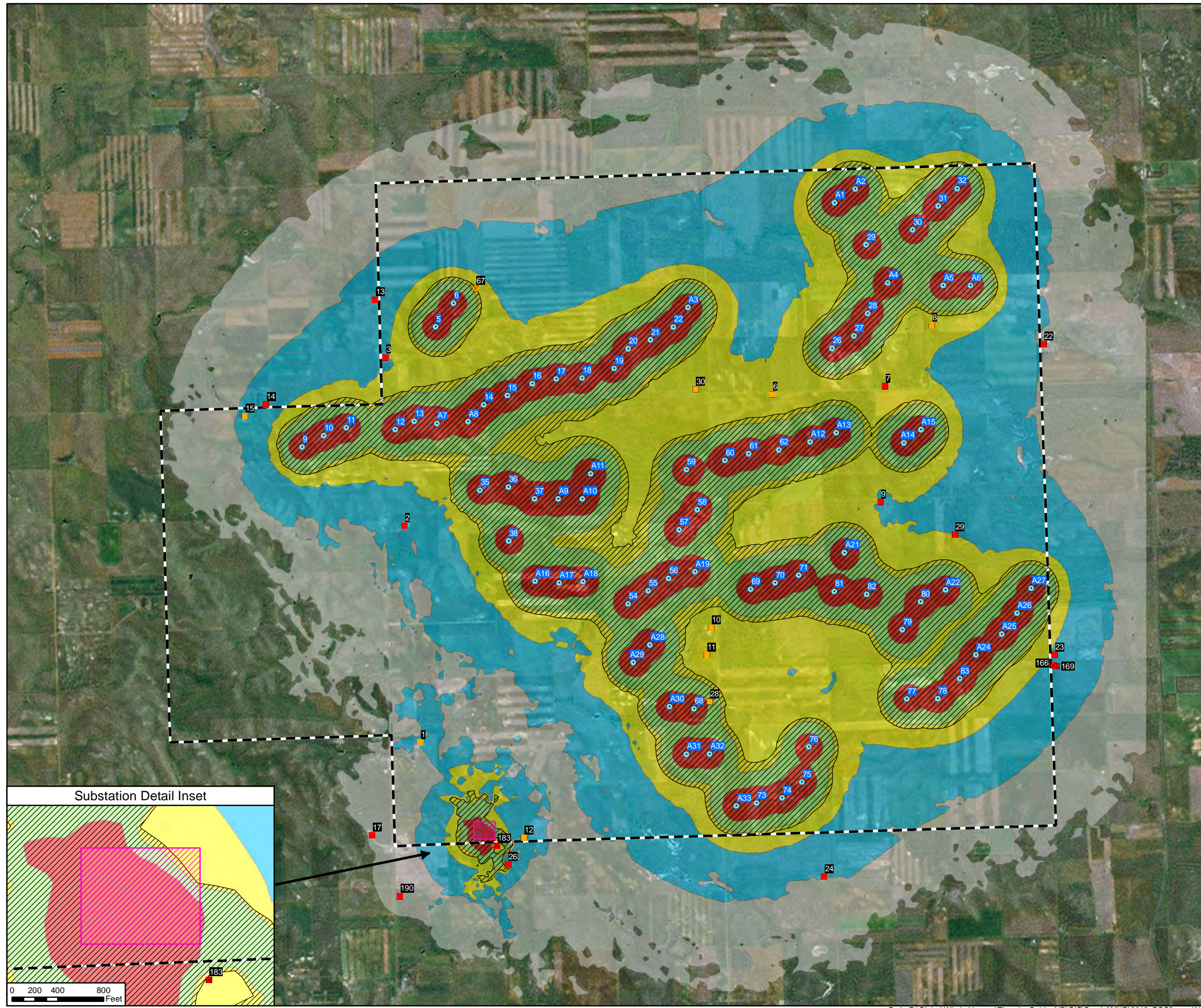
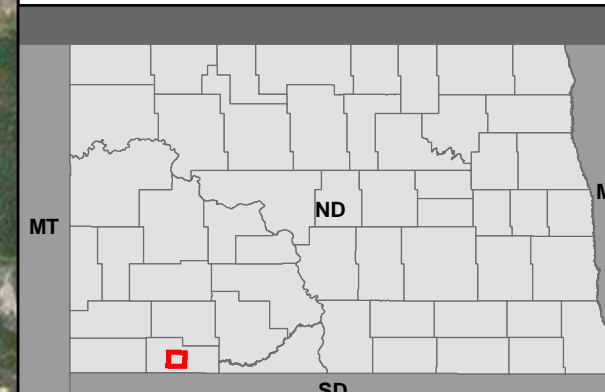
August 2013

**Legend**

-  Proposed Turbine Location (7/23/2013)
-  Collector Substation Construction Footprint (20 Acres)
-  Project Area
- Isopleth Ranges (dBA)**
  -  35 - 40
  -  40 - 45
  -  45 - 50
  -  50 - 55
  -  > 55
-  Isopleth Range Exceeding EPA Guideline (>48.6 dBA)
- Receptor**
  -  Signed Easement (Occupied)
  -  Signed Easement (Unoccupied)
  -  Not Signed (Occupied)
  -  Not Signed (Unoccupied)



**REFERENCE MAP**



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**Appendix B**  
**Additional Agency Correspondence**

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REPLY TO  
ATTENTION OF

**DEPARTMENT OF THE ARMY**  
**CORPS OF ENGINEERS, OMAHA DISTRICT**  
**NORTH DAKOTA REGULATORY OFFICE**  
1513 SOUTH 12TH STREET  
BISMARCK ND 58504-6640

May 28, 2013

North Dakota Regulatory Office

[NWO-2013-0939-BIS]

Mr. Tracey Dubuque, PE  
Tetra Tech, Inc.  
160 Federal Street, 3rd Floor  
Boston, Massachusetts 02110

Dear Mr. Dubuque:

This is in response to your letter dated April 22, 2013, requesting US Army Corps of Engineers (Corps) comments concerning the proposed Thunder Spirit Wind Energy Project. The project would be located on up to 40 square miles of private property, 2 miles northeast of the City of Hettinger, in Adams County, North Dakota.

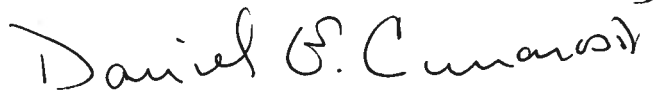
The Corps regulatory offices administer Section 10 of the Rivers and Harbors Act (Section 10) and Section 404 of the Clean Water Act (Section 404). Section 10 regulates work impacting navigable waters; however, there are no Section 10 waterways within the identified project area. Section 404 of the Clean Water Act regulates the discharge of dredged or fill material (temporarily or permanently) in waters of the United States. Waters of the United States may include, but are not limited to, rivers, streams, ditches, coulees, lakes, ponds, and their adjacent wetlands. Fill material includes, but is not limited to, rock, sand, soil, clay, plastics, construction debris, wood chips, overburden from mines or other excavation activities and materials used to create any structure or infrastructure in waters of the United States.

Your letter indicates that the project would involve numerous structures, roads, utility lines and operation and maintenance facilities. In order for us to determine if a Department of the Army permit is required under Section 404, you must narrow your area of emphasis to those which will involve work (specifically, the discharge of dredge or fill material) and delineate the presence of all affected wetlands, streams, rivers, ponds, lakes and other waters. The Corps can provide a Jurisdictional Determination for all delineated waters that are proposed to be affected by the project. The discharge of dredge or fill material into waters of the United States, requires prior authorization from Corps (Section 404 permit).

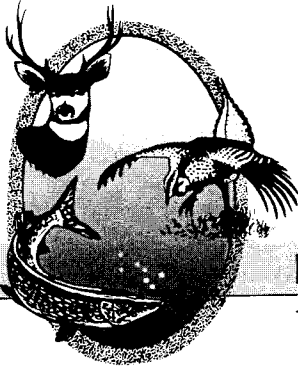
Your delineation report must be conducted in accordance with the Great Plains Regional Supplement to the 1987 Manual (Version 2.0). You should also identify of all other waters, including streams, rivers, ponds and lakes etc.

If you have questions about our program, delineations or permit requirements, please feel free to contact Mr. Matthew J. Mikulecky, of this office, by letter or telephone (701) 255-0015, and reference Corps identification number NWO-2013-0939-BIS.

Sincerely,

A handwritten signature in black ink that reads "Daniel E. Cimarosti". The signature is written in a cursive style with a prominent initial "D" and a flourish at the end.

Daniel E. Cimarosti  
State Program Manager  
North Dakota Regulatory Office



"VARIETY IN HUNTING AND FISHING"

**NORTH DAKOTA GAME AND FISH DEPARTMENT**

100 NORTH BISMARCK EXPRESSWAY BISMARCK, NORTH DAKOTA 58501-5095 PHONE 701-328-6300 FAX 701-328-6352

May 29, 2013

Tracey Dubuque, P.E.  
Senior Project Manager  
Tetra Tech Inc  
160 Federal Street, 3<sup>rd</sup> Floor  
Boston, MA 02110

Dear Ms. Dubuque:

RE: Thunder Spirit Wind Energy Project – Adams County, North Dakota  
(Case No. PU-11-601)

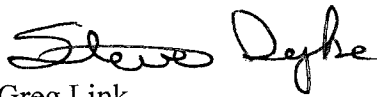
The North Dakota Game and Fish Department has reviewed this project for wildlife concerns.

Our primary concern with wind power development is the disturbance of native prairie associated with construction of turbines, access roads, and other associated facilities. We ask that work within native prairie be avoided to the extent possible. This could include micro-siting turbines onto adjacent previously disturbed land, locating access roads on existing section line trails rather than across undisturbed native prairie, etc.

The National Wetland Inventory indicates various wetlands located within the proposed project area. We recommend that any unavoidable wetland impacts be replaced in kind, above-ground appurtenances not be placed in wetland areas, and no alterations be made to existing drainage patterns.

We also recommend that routine monitoring for avian and bat mortality be included as part of the facility maintenance plan for the life of the project. We would appreciate being kept informed as this project progresses, and if possible, we would like the GPS coordinates for each turbine after the site has been established.

Sincerely,



(for) Greg Link  
Chief  
Conservation & Communication Division

js



**TETRA TECH**

5/29

May 17, 2013

Mr. Terry Steinwand  
Director  
North Dakota Game and Fish Department  
100 N. Bismarck Expressway  
Bismarck, ND 58501-5095

**RE: Application to the North Dakota Public Service Commission for Certificate of Site Compatibility for the Thunder Spirit Wind Energy Project in Adams County, North Dakota (Case No. PU-11-601)**

Dear Mr. Steinwand:

Tetra Tech has been contracted by Thunder Spirit Wind, LLC to prepare an application for a Certificate of Site Compatibility, in accordance with Section 49-22-07 NDCC. The proposed Thunder Spirit Wind Energy Project (Project) would be constructed on up to 40 square miles of leased private property approximately 2 miles northeast of Hettinger, North Dakota. As currently planned, the Project would produce approximately 150 megawatts (MW) and would consist of up to 75 wind turbine generators as well as meteorological towers, access roads, underground collection lines, a substation, and operations and maintenance facilities. There will be one section of tie-line (less than a mile in length) connecting the Project substation to an existing substation located in the southwest corner of Section 31 of Township 130 North, Range 95 West. The proposed Project area shown in the attached figure is the primary focus of our investigation.

Per Section 69-06-01-05 of the North Dakota Public Service Commission (PSC)'s administrative rules, we are consulting with the North Dakota Game and Fish Department for assistance in identifying concerns or issues within the boundaries as shown on Figure 1 that would influence a decision regarding the use of the land, as well as applicable permits that may be required from your office.

This information will be used to help guide Project development in a manner that identifies and avoids impacts to sensitive resources where practicable. We have sent similar query letters to other agencies including, but not limited to, the U.S. Fish and Wildlife Service and the U.S. Army Corps of Engineers.

We have prepared a summary of biological information prepared to date for the Project for your review, attached as Appendix 1.

We would appreciate a response by May 31, 2013. Please contact me at [Tracey.Dubuque@tetrattech.com](mailto:Tracey.Dubuque@tetrattech.com) or (617) 433-7552 if you have any questions. Thank you for your assistance.

Respectfully submitted,

TETRA TECH, INC

Tracey Dubuque, P.E.  
Senior Project Manager

160 Federal Street, 3<sup>rd</sup> Floor, Boston, MA 02110  
Tel 617.443.7500 Fax 617.737.3480  
[www.tetrattech.com](http://www.tetrattech.com)

## Dubuque, Tracey

---

**From:** Dubuque, Tracey  
**Sent:** Friday, August 02, 2013 3:27 PM  
**To:** Dubuque, Tracey  
**Subject:** FW: WAPA telecom tower in Adams Co.

For PSC pre-file RE: Microwave tower

**Tracey M. Dubuque, P.E.** | Director of Onshore Wind Energy  
Direct: 617.443.7552 | Main: 617.443.7500 | Fax: 617.737.3480 | Cell: 617.784.4601  
[Tracey.Dubuque@tetrattech.com](mailto:Tracey.Dubuque@tetrattech.com)

**Tetra Tech** | Energy Program  
160 Federal Street, Third Floor | Boston, MA 02110 | [www.tetrattech.com](http://www.tetrattech.com)

---

**From:** Scheibe, Mike [<mailto:Scheibe@wapa.gov>]  
**Sent:** Friday, August 02, 2013 12:10 PM  
**To:** 'dan albano'  
**Cc:** Harrington, Bruce; Meyers, Todd; Winter, Jack  
**Subject:** RE: WAPA telecom tower in Adams Co.

Dan,

Thanks for contacting and informing us to what Global Winds Harvest is working on in this area. You have captured our conversation accurately and my response is just to confirm. Let me know if you have any other concerns.

Mike

**Michael Scheibe**  
**Supervisory Engineer**  
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**From:** dan albano [<mailto:dalbano@globalwinds.com>]  
**Sent:** Friday, August 02, 2013 10:40 AM  
**To:** Scheibe, Mike  
**Subject:** WAPA telecom tower in Adams Co.

Hi Mike

Thanks for our conversation on the phone just now in regard to the WAPA microwave tower located along 2<sup>nd</sup> St. in Duck Creek Township, Adams Co., ND. As I mentioned, we were unable to find any information about the tower from our NTIA database search (or any other searches of private telecommunication facilities). So we finally relied on information from the landowner leasing the site to identify it as a WAPA tower. Our concern was that, despite its apparently not

being in operation at present, that WAPA might have future plans for using the tower that our proposed wind energy facility, Thunder Spirit Wind, might possibly interfere with.

After our conversation, my understanding is that the tower was formally used by WAPA as an analog microwave system, but WAPA has since converted their signal transmission to a fiber optic network that is routed via transmission lines. Although WAPA has discussed the possibility of turning the site over to Adams Co. for their potential use by the sheriff's department, nothing has been decided in that regard at present. In all likelihood, WAPA will not apply to re-license the tower.

Could you please confirm whether this is a fair summary of WAPA's current plans for the tower?

Thanks for your help.

Dan

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## Summary of Thunder Spirit Wildlife Studies

May 2013

On behalf of Thunder Spirit Wind, LLC, Western EcoSystems Technology, Inc. (WEST) conducted two years of avian point count surveys, one season of sharp-tailed grouse surveys, one season of raptor nest surveys and two years of passive acoustic bat monitoring surveys within the proposed Thunder Spirit Wind Resource Area (Project) in Adams County, North Dakota in 2007 and 2011-2012 (Figure 1). The Project area has both grasslands and agricultural areas with limited wetland areas. The overall methodology and level of effort expended thus far to identify, avoid, and mitigate potential wildlife and habitat impacts is in accordance with the tiered approach described in the *Land-Based Wind Energy Guidelines* (USFWS 2012). In particular, the field work conducted in 2007 was intended as a Tier 1 Preliminary Site Evaluation, the more extensive and focused work of 2011-2012 as a Tier 2 Site Characterization effort, and ongoing studies to learn more about eagle use of the project area are in keeping with Tier 3 efforts (Field Studies to Document Site Wildlife Conditions and Predicted Project Impacts).

### *Avian Point Count Surveys*

The first season of avian point count surveys were conducted at 20 locations within the Project area from 5 June 2007 to 29 October 2007 (Derby et al. 2008). An additional year of avian point count surveys were conducted at 25 point locations within the Project area from 6 April 2011 to 13 March 2012 (Derby et al. 2013). Surveys were conducted in accordance with industry-standard due diligence avian survey protocol. In 2007, surveys were conducted biweekly, at approximately 14 day intervals, during the summer season (June 5 – August 10) and weekly, at approximately 7 day intervals, during the fall season (August 24 – October 29). The 2011-2012 surveys were conducted biweekly, at approximately 14 day intervals, during spring (March 15 – May 31) and fall (September 1 – November 15) seasons and reduced to once per month, at approximately 28 day intervals, during the summer (June 1 – August 31) and winter seasons (November 16 – March 14).

In the 2007 avian surveys, 57 avian species were observed during the avian point count surveys, including six species observed only incidentally to point count surveys (Derby et al. 2009). Four species dominated the observations, European starling, horned lark, ring-necked pheasant and western meadowlark, which accounted for 61.5 percent of all observations (Derby et al. 2009). Nine species of raptors were observed, including golden eagles (2 individuals). Golden eagle observations occurred during the fall surveys and the individuals were observed flying within the anticipated rotor-swept area (RSA; Derby et al. 2009). Fourteen sensitive species listed as North Dakota Species of Conservation Priority (including the golden eagle) were observed. No other threatened or endangered (T&E) species were observed during these surveys.

In the 2011-2012 avian surveys, 73 avian species were observed during the avian point count surveys, including five species observed only incidentally to point count surveys (Derby et al. 2013). Two species, sandhill crane and horned lark, accounted for 53.5 percent of all observations with 7.1 percent of the horned larks and 95.6 percent of all sandhill cranes recorded flying within the anticipated RSA (Derby et al. 2013). These cranes were all observed among 4 flocks on a single day in April 2012. Eight species of raptors were observed, including golden and bald eagles (6 individuals and 1 individual, respectively). Golden eagles were observed in all survey seasons in 2011-2012 with four observations recorded flying within the anticipated RSA (Derby et al. 2013). The bald eagle was observed perched during the winter survey. Twenty-one sensitive species, listed as North Dakota Species of Conservation Priority, (including the eagles) were observed including the federal candidate species Sprague's pipit (Derby et al. 2013). One Sprague's pipit was observed during the spring point count survey while two other individuals were observed during the late spring as incidental observations. No other threatened or endangered species were observed during these surveys.

### *Sharp-tailed Grouse Lek Surveys*

One season of sharp-tailed grouse lek surveys were conducted in spring 2011 (Derby and Thorn 2013). Three aerial transect surveys (fixed-wing plane) were conducted over a single nine-day period in late April-early May 2011. Surveys followed a protocol that is consistent with prairie-chicken aerial leks surveys, as described by Martin and Knopf (1981). The leks observed were defined as either confirmed (1 lek; observed courtship behavior during more than one surveys), probable (3 leks; observed courtship behavior during one surveys) and possible (1 lek; little to no courtship behavior but individuals observed in same general location during more than one survey)(Derby and Thorn 2013).

Five grouse leks were identified, including one confirmed lek, three probable leks, and one possible lek (Derby and Thorn 2013). The confirmed lek was located within the Project area in planted grassland habitat. Two of the three probable leks were located in native prairie habitat outside of the Project area while the third was within the Project area in alfalfa hay cropland (Derby and Thorn 2013). The one possible lek was located in an unknown grassland habitat type inside the Project area (Derby and Thorn 2013). The two leks outside the Project area were within the 1.6 kilometer (km; 1 mile) survey buffer (Derby and Thorn 2013)

### *Raptor Nest Surveys*

Aerial and ground raptor nest surveys were conducted in spring 2011 (Derby and Thorn 2013). Aerial nest surveys were conducted within the Project area and 16.1 km (10 mile) buffer from a fixed-wing aircraft and, focused on potential nest structures for eagles. Ground-based raptor nest surveys were conducted concurrent to avian point count surveys.

Two active raptor nests were identified including one nest occupied by great-horned owls within the Project area and one nest occupied by Swainson's hawks approximately 1.2 km (0.75 miles) east of the Project (Derby and Thorn 2013). Although no eagle nests were identified during the aerial surveys, WEST requested a database review of known eagle nest locations within 10 miles of the Project area from USFWS. One known historic golden eagle nest approximately 5 miles west of the Project boundary was identified by the USFWS, but was not identified during the 2011 season.

### *Passive Acoustic Bat Monitoring Surveys*

The first year of passive acoustic monitoring surveys was conducted from 23 July to 15 October, 2007 with two ground-level AnaBat II (Titlery<sup>TM</sup> Scientific, Australia) ultrasonic bat call detectors placed in the southwestern and northwestern portions of the Project area; (Derby et al. 2008). A second year of passive acoustic monitoring surveys was conducted within the Project area from 25 May to 20 October 2011 using AnaBat SD1 ultrasonic bat call detectors (Derby and Sichmeller 2013). Incoming echolocation calls are digitally processed and stored by the detector. The integrated zero crossings analysis interface module (ZCAIM) produces a file that, when viewed in appropriate software (i.e., Analook®; 2008, C. Corben), displays digital sonograms of the echolocation calls that show change in frequency over time (Derby and Sichmeller 2013). Frequency versus time displays were used to separate bat calls from other types of ultrasonic noise (e.g. wind, insects, etc.) and to identify the call frequency classification and species (when possible) of bat that generated the calls (Derby and Sichmeller 2013). One pair of detectors was placed at a pre-existing meteorological tower in the southwest corner of the Project area with one unit placed near the approximate turbine rotor-swept area (50m) and another at ground-level. Two additional ground-level detectors were placed in suitable bat foraging habitat in shortgrass habitats near agricultural fields in the south-central and northwest sections of the Project area.

In 2007, detectors collected 126 bat passes, defined as a sequence of echolocation calls produced by an individual bat as indicated by at least two calls (pulses) with no pause between calls of more than one second (Derby et al. 2009). Overall bat activity was 1.13 bat passes per detector night, and the bat activity between detectors was relatively similar (1.0 bat passes per detector night at the northwestern detector, and 1.13 bat passes per detector night at the southwestern detector; Derby et al. 2009). Of the bat passes not identifiable to species, calls were mainly low frequency species, such as silver-haired bat, big

brown bat, Townsend's bat and hoary bat. Bat passes identifiable to species included the hoary and eastern red bat (Derby et al. 2009). Neither of the bat species identified to species are "Species of conservation priority," although both have been identified as fatalities at wind projects in North America.

In 2011, bat detectors were operational for approximately 82% of the survey period, and collected 406 bat passes (Derby and Sichmeller 2013). Overall bat activity was 0.78 bat passes per detector night, and the majority of calls were recorded at the ground-level detectors (364 bat passes; Derby and Sichmeller 2013). Of bat passes not identifiable to species, calls were mainly high-frequency bats, defined by report authors as *Myotis* species and eastern red bat. Of bat passes identifiable to species, hoary and eastern red bat were identified (Derby and Sichmeller 2013). Neither of these species are "Species of conservation priority," although both have been identified as fatalities at wind projects in North America.

#### *Habitat Mapping*

In 2011, WEST conducted a desktop habitat mapping of the Project area using 2004 GAP Land Data for North Dakota. In 2013, Tetra Tech conducted additional field reconnaissance to determine the location and potential impacts to any wetlands and to verify the condition of the grassland habitat features with respect to potential impacts to native prairie. This reconnaissance included additional information on the dominant plant species which were then used to identify grassland habitats that are pasture and hayfields from actual native prairie habitats. Project facilities are located on land parcels comprised of the following categories:

<b>Vegetation Class</b>	<b>Acres*</b>
Agriculture	7240.4
Developed Lands	193.6
Native Prairie	3727.9
Native Prairie/Hayfields	799.3
Pasture/Hayfields	2464.7
Road	137.2
Shrubs/Trees	42.2
Wetlands	269.5

\*Acres calculation is comprised from the Wind Energy Facility Perimeter as shown on Figure 1.

#### **ONGOING STUDIES**

##### *Helicopter Surveys for Eagle Nests*

Because eagles were observed in all seasons during the 2011-2012 field effort, in 2013, WEST is implementing a dedicated eagle nest survey using a helicopter within the Project area and a surrounding 10-mile buffer area. Detection levels can be higher using this type of aircraft compared to a fixed-wing. WEST will also request another database search to determine whether eagle nests have been documented and reported since 2011.

##### *Grassland Surveys*

Thirty six turbines are currently sited in Native Prairie and Native Prairie/Hayfields based on the 2011 desktop survey. Current 2013 survey efforts are underway to update the current land use by refining and differentiate between actual native prairie and planted herbaceous grasslands such as hayfields and pastures for cattle. Hayfields and pastures are often planted with species that are introduced, such as smooth brome, crested wheatgrass, alfalfa and sweet clover although some plantings are native grass species. In addition to planted fields, smooth brome and other non-native species often invades into areas of native prairie and further degrades the value of the habitat for wildlife. It is also very likely that additional areas classified as grasslands may have been turned into agriculture or some other form of development since the 2011 desktop mapping. Updated land use may help further site Project features away from sensitive areas.

### *Bird and Bat Conservation Strategy*

Thunder Spirit and WEST are currently developing a Bird and Bat Conservation Strategy (BBCS) that outlines the species of concern for the Project, how investigations were done to identify use of the area and results of those studies, what actions were done and will be done to avoid, minimize, and mitigate potential impacts, and what measures will be taken during the operation of the Project. This plan will include specific sections on golden eagles, Sprague's pipit, and sharp-tailed grouse but will also include other species of concern.

### *PSC Site Compatibility Permit Process*

As part of the PSC process, Thunder Spirit will continue to gather information in order to arrive at a determination as to whether the location, construction, and operation of the proposed Project facilities produce minimal adverse effects on the environment and upon the welfare of the citizens of North Dakota. Also, Thunder Spirit will demonstrate whether the proposed Project is compatible with the environmental preservation and the efficient use of resources. The application is currently scheduled to be submitted to the PSC in June 2013.

### **REFERENCES**

- Derby; C., A. Dahl, and K. Seginak. 2009. Baseline Wildlife Studies for the Two Creeks Wind Resource Area Adams County, North Dakota – Final Report: June 2007 – October 2007. Prepared for Two Winds, LLC. 65 pp.
- Derby; C. and T. Sichmeller. 2013. Bat Acoustic Studies for the Thunder Spirit Wind Resource Area, Adams County, North Dakota – Final Report: May – October 2011. Prepared for Thunder Spirit Wind, LLC. 40 pp.
- Derby; C. and T. Thorn. 2013. Wildlife Baseline Studies for the Thunder Spirit Wind Resource Area, Adams County, North Dakota - Sharp-tailed Grouse Lek and Raptor Nest Report: Spring 2011. Prepared for Thunder Spirit Wind, LLC. 10 pp.
- Derby; C., A. Dahl, and S. Nomani. 2013. Wildlife Baseline Studies for the Thunder Spirit Wind Resource Area, Adams County, North Dakota – Final Report: April 2011 – March 2012. Prepared for Thunder Spirit Wind, LLC. 76 pp.
- Martin; S.A. and F.L. Knopf. 1981. Aerial Survey of Greater Prairie Chicken Leks. Wildlife Society Bulletin 9(3): 219-221.
- USFWS 2012. Draft U.S. Fish and Wildlife Service Land-Based Wind Energy Guidelines. September 13, 2011. Available online at [http://www.fws.gov/windenergy/docs/WEG\\_final.pdf](http://www.fws.gov/windenergy/docs/WEG_final.pdf), accessed February 2013.

**Date:** May 16, 2013

**Type of Notification:** New

**Project:** Thunder Spirit Wind

**County:** Adams

**State:** North Dakota

**Project Sponsor:** Thunder Spirit Wind , LLC - Dan Albano <dalbano@globalwinds.com>

**Turbine Description:**

**Number of Turbines:** N/A  
**Turbine Hub Height AGL (meters):** 92  
**Turbine Blade Diameter (meters):** 116  
**Maximum Blade Tip Height AGL (meters):** 150

**Turbine Locations:** N/A

**Wind Farm Boundary Points:**

Identifier	Latitude	Longitude
Pt1	46:01:30.360	102:28:00.480
Pt2	46:01:30.360	102:38:43.800
Pt3	46:08:00.240	102:38:43.800
Pt4	46:08:00.240	102:28:00.480

**Maps:**

