May 2010

Public Utilities Commission

# Site Permit Application for a Large Wind Energy Conversion System Prairie Rose Wind Farm

Rock and Pipestone Counties, Minnesota

Prepared for Prairie Rose Wind LLC and Geronimo Wind Energy LLC

Prepared by:
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May 13, 2010

Dr. Burl Haar
Executive Secretary
Minnesota Public Utilities Commission
121 Seventh Place East, Suite 350
St. Paul, MN 55101

**Re: In the Matter of a Site Permit Application for a Large Wind Energy Conversion System for the Prairie Rose Wind Farm in Stearns County, Minnesota**
**PUC Docket IP6843/WS-10-425**

Dear Dr. Haar:

Please find attached the Site Permit Application (Application) for a Large Wind Energy Conversion System for the Prairie Rose Wind Project in Rock and Pipestone Counties, Minnesota. This Application is being submitted via the Commission's efiling system by Prairie Rose Wind, LLC, an unregulated wholly owned subsidiary of Geronimo Wind Energy, LLC. of Edina, Minnesota.

Prairie Rose Wind, LLC seeks a Site Permit authorizing construction of up to a 101 Megawatts (MW) Large Wind Energy Conversion System for the Prairie Rose Wind Farm. Associated facilities will include gravel access roads, an electrical collection system, project substation, permanent meteorological towers, SODAR or LIDAR unit, and an operations and maintenance building.

I request that processing this Application be combined to the extent practicable with the associated Certificate of Need for the Project, PUC docket number IP-6838/CN-10-80.

No confidential information is included in the Application. Therefore only a public version is being electronically filed. I will have hard copies of the Application delivered on May 14, 2010. Please send us an invoice for the filing fee.

Sincerely,

Patrick Smith
Director of Environmental Planning
(952) 988-9000

cc: Ms. Deborah Pile – Minnesota Office of Energy Security
Mr. David Birkholz – Minnesota Office of Energy Security

# *Public Utilities Commission Site Permit Application for a Large Wind Energy Conversion System*

## Prairie Rose Wind Project
## Pipestone and Rock Counties, Minnesota

PUC Docket Number: IP6843/WS-10-425

***Prepared for:***

**May, 2010**

***Prepared by:***

**HDR Engineering, Inc.**
701 Xenia Ave S, Suite 600
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| | |
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# 1.0 INTRODUCTION

## 1.1 PROJECT SUMMARY

Prairie Rose Wind, LLC (Prairie Rose Wind), a wholly owned subsidiary of Geronimo Wind Energy (GWE), is submitting this application for a site permit to construct and operate the Prairie Rose Wind Farm (the Project) to the Minnesota Public Utilities Commission (PUC). The proposed Project is a Large Wind Energy Conversion System (LWECS), as defined in the Wind Siting Act, Minnesota Statutes Chapter 216F. The Project is located in Rock and Pipestone counties, Minnesota (Figure 1-1). The Project will be up to 101 megawatts (MW) in nameplate capacity, consisting of up to 67 wind energy generators and will likely be going online in the third quarter of 2011 or first quarter 2012. Prairie Rose Wind has not made a final selection of wind turbine generators for the Project. Prairie Rose Wind proposes to permit the Project for a range of wind turbines sized from 1.5 to 2.3 MW. The application uses three turbines to span the spectrum of typical turbine models in the 1.5 to 2.3 MW range (General Electric (GE) 1.5 SLE MW, the Vestas V90 1.8 MW, and the Siemens 101 SWT 2.3 MW turbine models). Associated Project facilities include gravel access roads, a step-up substation, a wind electrical collection system, an Operations and Maintenance (O&M) building, permanent meteorological towers, and a Sonic Detection and Ranging (SODAR) unit or Light Detection and Ranging (LIDAR) unit. In addition to the Prairie Rose Wind Farm, Prairie Rose Wind LLC proposes, via its wholly owned subsidiary Prairie Rose Transmission LLC, to develop an approximately 24-mile, 115 Kilovolt (kV) transmission line to connect the project to the Split Rock substation near Brandon, South Dakota. The transmission line will be permitted through the PUC routing and Certificate of Need process because it crosses state lines into South Dakota. The route permit for the transmission line will be filed under Docket IP6843/TL-10-134 and the certificate of need for the transmission line can be found, paired with the certificate of need for the Prairie Rose Wind Farm, in Docket IP6838/CN-10-80. GWE is a Minnesota-based wind energy developer with a focus on building projects in the Upper Midwest. GWE prides itself in strong community relationships, having built two Community Based Energy Development-certified wind farms, the Odin Wind Farm near Odin, Minnesota, and the Marshall Wind Farm near Marshall, Minnesota. GWE and its subsidiaries strive to partner with community members to meet common goals while constructing new wind energy generation sources that benefit the state and the region. GWE is committed to using Minnesota's wind resource wisely and efficiently, as consistent with the State of Minnesota PUC and Statutory objectives. GWE has evaluated and will continue to evaluate the site to optimize its wind resource while avoiding and minimizing impacts to human and natural environments.Project Summary

Prairie Rose Wind, a limited liability company, proposes to develop, design, construct, own, and operate the Prairie Rose Wind Farm. Prairie Rose Wind may develop up to an additional 200 MW within the Project boundary at a later date, but will apply for an additional LWECS permit when plans for the future phase are more defined. Prairie Rose Wind plans to begin construction of the Project in first quarter, 2011.

### 1.1.1 PROPOSED SITE

The proposed site is located west of Hardwick, and south and east of Jasper in Rock and Pipestone counties, Minnesota (Figure 1-1). Table 1-1 and Figure 1-2 identify the townships and sections within the project boundary.

**Table 1-1. Project Location**

| County | Township Name | Township | Range | Section |
|---|---|---|---|---|
| Rock | Denver | 104N | 45W | 2-10, 15-22, 27-34 |
| Rock | Rose Dell | 104N | 46W | 1-2, 11-16, 21-28, 33-36 |
| Rock | Springwater | 103N | 46W | 1-4, 9-12 |
| Pipestone | Elmer | 105N | 45W | 20, 29-34 |
| Pipestone | Eden | 105N | 46W | 36 |

The Project Boundary encompasses approximately 35,335 acres, of which approximately 14,000 acres are under site control. The Project's preliminary site layout for up to 101 MW, based on the GE 1.5 SLE MW, the Vestas V90 1.8 MW, and the Siemens 101 SWT 2.3 MW turbine models, is shown in Figures 1-3, 1-4, and 1-5, respectively. See Section 3.0 for a description of the Project area.

### 1.1.2 PROJECTED OUTPUT

The project will have a nameplate capacity of up to 101 MW. Assuming annual net capacity factors of between 39 and 45 percent, Project annual average output will be between 341,640 Megawatt hours (MWh) and 394,200 MWh. Annual energy output and net capacity factor will be dependent on final turbine layout, site specific conditions and the wind turbine type selected for the project.

### 1.1.3 SITING PLAN

The wind turbines and associated facilities will be sited primarily on agricultural land. Prairie Rose Wind will prepare the final project layout to optimize wind resources while minimizing the impact on land, residents, and sensitive resources. The topography of the site, the selected turbine technology, impacts on area residents and PUC setback requirements will dictate turbine spacing. A description of the proposed turbine technology is provided in Section 4.2; the differences in technology influence the potential location of turbines. The minimum turbine spacing within the Project area will range from three Rotor Diameters (RD) east-west to five RD north-south. Up to 20 percent of the turbines may have closer spacing as described in the Minnesota PUC Wind Siting Guidelines (Minnesota Rules 2002). Turbines will be setback 5 RD on the north-south axis and 3 RD on the east-west access to preserve wind rights on non-participating properties. Table 1-2 depicts the range of setback distances based on several possible turbine RDs.

**Table 1-2. Minimum Turbine Spacing Distances**

| Rotor Diameter* | Internal East-West Spacing | Internal North-South Spacing | N-S Perimeter Setback | E-W Perimeter Setback |
|---|---|---|---|---|
| | 3 RD | 5 RD | 5 RD | 3 RD |
| 77 m RD | 231 m (758 ft) | 385 m (1263 ft) | 385 m (1263 ft) | 231 m (758 ft) |
| 90 m RD | 270 m (886 ft) | 450 m (1476 ft) | 450 m (1476 ft) | 270 m (886 ft) |
| 101 m RD | 303 m (994 ft) | 505 m (1657 ft) | 505 m (1657 ft) | 303 m (994 ft) |

The listed RDs provide the range of rotor sizes; depending on the final turbine selection, the RD could vary slightly from the listed values, but would remain between 78 m to 100 m.The perimeter setback ranges between a quarter mile to a third of a mile on the north-south axis and ranges between a fifth and an eighth of a mile in the east-west axis. Siting guidelines from the Minnesota Department of Commerce Office of Energy Security (OES) identify minimum setbacks from residences of 500 ft (plus the distance required to meet the state noise standard) and setbacks from public or developed roads of 250 ft. In general, GWE has a policy of siting turbines at least 1,000 ft from residences, unless other arrangements have been made with specific residents. Even if other arrangements are made, turbines will still comply with the State's 50 A-Weighted decibels (dBA) setback from all residences.

### 1.1.4 COUNTY SITING REQUIREMENTS

The Project is located in Rock and Pipestone counties in Southwestern Minnesota. Approximately 30,805 Acres are located in Rock County and 4,530 acres are in Pipestone County. To date, neither county has elected to permit projects in the 5 to 25 MW range under Minnesota Statute 216F. Both counties have ordinances that govern the siting of small wind energy conversion systems (SWECS), or wind energy conversion systems under 5 MW. Prairie Rose is committed to working with the counties to address local concerns and obtain applicable local permits, including, for example, building permits for the O&M building and substation. Because the counties' ordinances do not apply to LWECS, Prairie Rose has followed the state's general siting guidelines in preparing this application.

### 1.1.5 OPERATION AND MAINTENANCE

The proposed 101 MW project will come into operation in first quarter of 2012. Prairie Rose Wind will be responsible for the O&M for the life of the project, which will be approximately 30 years. Prairie Rose Wind plans to construct a regional O&M facility near the project to staff and supply the facility. Although this associated facility is included within the permitted LWECS facilities, any additional required local permits will be acquired from Rock or Pipestone County and/or through the township where the facility is ultimately located. All of the townships within the Project area, and most within Rock and Pipestone counties, require either a building permit through the township, or a signature from the township on any building permits issued by Rock or Pipestone counties.

### 1.1.6 SITE CONTROL

Prairie Rose Wind has approximately 14,000 acres under control via leases and options, or is currently in final negotiations on leases and options for land within the site boundaries. This area is sufficient to support development of the Prairie Rose Wind Farm by accommodating the proposed facilities and required buffers, and flexibility during siting to avoid natural resources, homes, and other sensitive features.

### 1.1.7 PERMITS AND LICENSES

Prairie Rose Wind will obtain all additional permits and approvals necessary and not covered by this LWECS Site Permit. Potential additional permits are identified in Section 6.0.

### 1.1.8 DEVELOPMENT AND CONSTRUCTION

Prairie Rose Wind and Prairie Rose Wind's engineering contractor will perform or manage all development activities. Specifically, Prairie Rose Wind will:

- Perform site resource analysis;
- Undertake environmental review; and
- Obtain specific permits and licenses for the Project.

Under the oversight of Prairie Rose Wind's staff, the engineering and construction contractors will:

- Perform civil engineering for access roads and turbine foundations;
- Construct foundations, towers, and transformers;
- Assemble and install turbines;
- Install the communication system, including telephone and fiber-optic cable, and Supervisory Control and Data Acquisition (SCADA) software and hardware;
- Construct the step-up substation;
- Construct the electrical feeder and collection system; and
- Construct radial interconnection.

## 1.2 COMPLIANCE WITH THE WIND SITING ACT AND MINNESOTA RULES 7854

Minn. Rule 7854 governs the contents and treatment of applications for LWECS site permits under the Wind Siting Act. Prairie Rose Wind has presented information required by Minn. Rule 7854. Additionally, sufficient Project design, wind resource, and technical information have been provided for a thorough evaluation of the reasonableness of the Project Area as a location for the Project.

### 1.2.1 CERTIFICATE OF NEED

A Certificate of Need (CON) is required for a large energy facility. Under Minnesota Statutes §§216B.2421 and 216B.243, subd. 2, and Minnesota Rules Chapter 7849, a CON is required for the Project because it is larger than 50 MW. Prairie Rose Wind plans to follow parallel review paths for its Site Permit and CON applications. Additionally, the project has an associated transmission line

that triggers a CON because it crosses state lines into South Dakota. The CON for the Wind Farm and Transmission Line can be found in Docket IP-6838/CN-10-80.

### 1.2.2 STATE POLICY

The Wind Siting Act requires an application for a site permit for a LWECS to meet the substantive criteria set forth in Minn. Stat. § 216E.03, subd. 7. This application provides information necessary to demonstrate compliance with these criteria and Minn. Rule 7854. The siting of a LWECS is to be made in an orderly manner compatible with environmental preservation, sustainable development, and the efficient use of resources (Minn. Stat. § 216F.03). Prairie Rose Wind is designing the Project to comply with the PUC's wind turbine setback and siting standards.

## 1.3 OWNERSHIP OF THE PROPOSED FACILITY

The Project will be developed by Prairie Rose Wind LLC, a wholly-owned subsidiary of Geronimo Wind Energy. Prairie Rose Wind will construct, own, and operate the Prairie Rose Wind Farm. GWE reserves the right to sell or assign the Project to another qualified entity at any time before, during or after the Project is constructed, pending the appropriate PUC approvals. The GWE subsidiary, Prairie Rose Wind LLC, will construct and own all equipment up to the point where the Prairie Rose Transmission Line connects to the Prairie Rose Wind Substation. Prairie Rose Transmission LLC, a wholly-owned subsidiary of Prairie Rose Wind LLC, will own and construct the transmission line from the Prairie Rose Wind Substation to the point of interconnection at Split Rock Substation near Brandon, South Dakota. GWE or its project-specific subsidiary will obtain an interconnection agreement with the appropriate transmission owners and Midwest Independent System Operator (MISO) to support the Project.

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# 2.0 GENERAL DESCRIPTION OF THE PROPOSED FACILITY

## 2.1 WIND POWER TECHNOLOGY

### 2.1.1 WIND TURBINE DESIGN AND OPERATION

A wind turbine generally consists of a nacelle, hub, blades, tower, and foundation. The nacelle houses the generator, gear boxes, upper controls, generator cabling, hoist, generator cooling, and other miscellaneous equipment. The hub supports the blades and connecting rotor, yaw motors, mechanical braking system, and a power supply for emergency braking. The hub also contains an emergency power supply to allow the mechanical brakes to work if electric power from the grid is lost. Each turbine has three blades composed of carbon fibers, fiberglass, and internal supports to provide a lightweight but strong component. The blades also contain lightning receptors at the tip of each blade.

The tower supports the nacelle, hub, and blades. The tower also houses electrical, control, and communication cables and a control system located at the bottom of the tower. Towers may include lifts for use by Project personnel. Towers are solid tubular in design and are painted a non-glare white. Electrical equipment at the base of the tower conditions the generated electricity to match electric grid requirements. The expected tower foundation will be a spread foundation design. The tower foundation will be located below ground level except for approximately 18 inches that will remain above-ground, allowing the tower to be appropriately bolted to the foundation.

The wind turbine blades convert linear energy from wind into rotational energy. An anemometer and weather vane located on the turbine nacelle continuously senses wind speed and wind direction. The hub and nacelle are constantly being rotated to match wind speed direction. Yaw motors rotate the blades to optimize blade angles in relation to wind speed and direction. The hub transfers mechanical force from the blades to the shaft connecting the hub to the gear box located within the nacelle. The mechanical braking system, located within the hub, locks the blade rotor to prevent the blades from spinning during maintenance periods or other times when the turbine is out of service. The gear box adjusts shaft speeds to match the required generator speed. Electricity is produced by the generator and transmitted through insulated cables to the power conditioning unit known as a pad mount transformer located at the base of the tower.

### 2.1.2 TURBINE MODEL SELECTION AND TYPES

Prairie Rose Wind will finalize a turbine type for the Project as construction time nears in order to ensure the selection of the most cost effective, available, and optimal design for the project site. The range of turbines Prairie Rose Wind is considering for the Project spans the energy production range of 1.5 MW to 2.3 MW. The GE 1.5 MW Turbine is representative of the 1.5 MW class, the Vestas 1.8 MW machine is representative of the 1.8 MW class, and the Siemens 2.3 MW Turbine is representative of the 2.3 MW class. Prairie Rose Wind may select a different turbine model than those specified; these three turbines are only used to represent the spectrum of available designs for the energy production range Prairie Rose Wind has specified. Regardless of the turbine selected, the hub heights would be 80 m (263 ft) and the RD would range from 77 to 101 m (252 to 331 ft). Table

2-1 shows the range of characteristics for the three representative turbines and a diagram of wind turbine features is presented in Figure 2-1.

**Table 2-1. Wind Turbine Characteristics**

| Characteristics | Turbine | | |
|---|---|---|---|
| | GE 1.5 MW | Vestas 1.8 MW | Siemens 2.3 MW |
| Nameplate capacity | 1,500 kW | 1,860 kW | 2,300 kW |
| Hub height | 80 m (263 ft) | 80 m (263 ft) | 80 m (263 ft) |
| Rotor Diameter | 77 m (252 ft) | 90 m (295 ft) | 101 m (331 ft) |
| Total height[1] | 119 m (390 ft) | 124 m (407 ft) | 129 m (423 ft) |
| Cut-in wind speed[2] | 3.5 m per second (m/s) (7.8 mph) | 3.5 m/s (7.8 mph) | 4 m/s (8.9 mph) |
| Rated capacity wind speed[3] | 12 m/s (26.8 mph) | 12 m/s (26.8 mph) | 12-13 m/s (26.8 to 29.1 mph) |
| Cut-out wind speed[4] | 25 m/s (56 mph) | 25 m/s (56 mph) | 25 m/s (56 mph) |
| Maximum sustained wind speed[5] | Over 45 m/s (100 mph) | Over 45 m/s (100 mph) | Over 45 m/s (100 mph) |
| Rotor speed | 10.1 to 20.4 rpm | 9.0 to 14.9 rpm | 6 to 16 rpm |

*1 Total height = the total turbine height from the ground to the tip of the blade in an upright position*
*2 Cut-in wind speed = wind speed at which turbine begins operation*
*3 Rated capacity wind speed = wind speed at which turbine reaches its rated capacity*
*4 Cut-out wind speed = wind speed above which turbine shuts down operation*
*5 Maximum sustained wind speed = wind speed up to which turbine is designed to withstand*
*N/A = information is not available.*

## 2.2 WIND FARM PROJECT LAYOUT

Prairie Rose Wind will create a site layout that maximizes the energy generation of the project while minimizing impact to the land and surrounding community. The Project will consist of between 43 and 67 turbines. Figures 1-3, 1-4, and 1-5 show potential layouts assuming a GE 1.5 MW turbine, a Vestas V90 1.8 MW turbine, and a Siemens 2.3 MW turbine, respectively. The Vestas V90 1.8 MW turbine is the preferred generator.

Wind turbine setbacks are based on siting guidelines from the OES. Prairie Rose Wind incorporates a 1,000-foot setback from occupied residences as well as the distance necessary to meet Minnesota Pollution Control Nighttime Noise Limit of 50 dBA. A 250-foot setback from all public road and trail right-of-way has been incorporated. All turbines will be located 5 RD from the prevailing wind direction (generally the northern and southern edge) of the leased area and 3 RD from the crosswind di9rection (generally the eastern and western edge) of the leased area to accommodate for disruption of the normal wind flow and protect the wind rights of non-participating landowners. Similarly, internal turbine spacing will follow a general rule of 5 RD in the predominant wind direction

(generally north-south) and 3 RD in the crosswind direction (generally east-west) with no more than 20 percent of the project turbines closer than the prescribed setback.

Table 2-2 reflects the differing setbacks based on rotor diameter for the variety of turbines under consideration for the Project. Noise data for each turbine model described in Section 5.3 demonstrates that the voluntary minimum 1,000-foot setback would exceed the distance required to meet the setback from the 50 dBA noise level for all turbine models.

**Table 2-2. Setback Distances for Wind Turbines**

| Turbine Description | N-S Perimeter Setback | E-W Perimeter Setback | Prairie Rose Wind Standard Occupied Residences | Public Roads |
|---|---|---|---|---|
| | 5 RD (ft) | 3 RD (ft) | 1,000 ft minimum | 250 ft minimum |
| 1.5 MW Turbine with 82.5 m RD | 1,353 | 812 | 1,000 | 250 |
| 1.8 MW Turbine with 90 m RD | 1,476 | 886 | 1,000 | 250 |
| 2.3 MW Turbine with 101 m RD | 1,656 | 994 | 1,000 | 250 |

## 2.3 ASSOCIATED FACILITIES

There are a number of facilities that will be constructed to support the operation of the wind turbines and facilitate the delivery of the electricity to consumers. These include access roads, electrical collection system, step-up substation, transmission line, O&M building, and meteorological towers and other weather data collection systems.

Access roads will be approximately 16 ft wide (depending on requirements of the turbine manufacturer) and will provide access to the wind turbines year-round. They will have a low profile design to allow easy access across them with farming equipment. Prairie Rose Wind will work with landowners and agencies to ensure roads are aligned to minimize impacts on current land uses and natural areas.

The electrical collection system will consist of a group of electrical cabling operating at 34.5 kV. The lines will be undergrounded by trenching, plowing or where needed drilling the cables. They may move above ground when shallow bedrock, restrictive environmental conditions, or conflicts with underground utility infrastructure are encountered or continue below ground with above ground junction boxes. The electricity will be delivered to the Prairie Rose substation, where it will be converted to 115 kV and will then be transported via a new 115 kV line to the Split Rock substation near Brandon, South Dakota.

The step-up substation will require less than one acre of land within the project boundary. While the exact location has not been determined, it will be sited such that the length of the 115 kV overhead transmission line be minimized.

An O&M Building will be constructed on or near the site and will provide access and storage for project maintenance and operations. See Section 4.5.4 for a description of this facility. Also included in the site is a permanent meteorological tower with the potential for a SODAR or LIDAR unit. Currently Prairie Rose Wind is operating two temporary meteorological towers within the site.

## 2.4 LAND RIGHTS

Prairie Rose Wind has, or will obtain, land rights necessary to complete the project. Land rights may include and are not limited to wind turbines and project facilities, wind and buffer easements, access roads, transmission feeder lines on public roads, and land to mitigate environmental impacts. Prairie Rose Wind has land and wind rights for over 14,000 acres at the time of submission and may continue to acquire land within the project boundary until construction.

# 3.0 PROPOSED SITE

## 3.1 IDENTIFICATION OF PROJECT AREA

Access to quality wind resources guided the site selection. However, other factors, including environmental concerns, relative interest from communities and landowners, and access to cost effective transmission, played a part in the selection of a site. This process allows Prairie Rose Wind to maximize the use of Minnesota's wind resource in a cost-effective manner. The site boundary encompasses approximately 35,335 acres, but the area occupied by wind farm facilities will be less than one half of one percent, or approximately 50 acres total.

## 3.2 WIND RESOURCE AREAS – GENERAL

The United States Department of Energy and the Minnesota Department of Commerce (DOC) have conducted wind resource assessment studies in Minnesota since 1982. In October 2002, the DOC published the latest "Wind Resource Analysis Program" report that presents wind analysis data from monitoring stations across Minnesota. In the vicinity of the project area, the mean annual wind speed at an elevation of 80 m is mapped as 8.0 m/s to 8.4 m/s, which is among the highest in the state.

## 3.3 WIND CHARACTERISTICS IN PROJECT AREA

Prairie Rose Wind has two temporary meteorological towers in the project area which have been collecting weather data on site since March 2009. Additionally, Prairie Rose Wind has partnered with WindLogics to perform site analysis of the weather regime in the area. The following sections on wind resources are largely based on the analysis conducted by WindLogics and GWE.

### 3.3.1 INTERANNUAL VARIATION

Interannual variation is the expected variation in wind speeds from one year to the next. There is a very strong correlation between the Prairie Rose Wind meteorological towers and the long-term reference data sets available through NOAA's NCEP/NCAR reanalysis program and the weather monitoring stations available at airports in the vicinity. Based on current analysis, the Prairie Rose Meteorological Tower locations are expected to have an average annual wind speed of 8.24 m/s with a potential variation of 4 to 5 percent or +/- 0.329 to 0.412 m/s (WindLogics 2010).

### 3.3.2 SEASONAL VARIATION

Seasonal variation is represented by the shift in wind speeds from one month to the next. Table 3-1 shows the estimated average seasonal variation based on long-term correlations with on-site data. The months of October through January are expected to have the highest wind speeds, while the months of July and August are expected to have the lowest wind speeds.

**Table 3-1. Average Wind Speed**

| Month | Average Wind Speed (M/s) |
|---|---|
| January | 8.5 |
| February | 8.41 |
| March | 8.64 |
| April | 8.77 |
| May | 8.34 |
| June | 7.77 |
| July | 7.3 |
| August | 7.56 |
| September | 8.2 |
| October | 8.53 |
| November | 8.5 |
| December | 8.41 |
| **Annual Average** | **8.24** |

### 3.3.3 DIURNAL CONDITIONS

Diurnal variation occurs through the shift in daytime and nighttime weather patterns. Figure 3-1 shows the expected variation in wind speeds at the site.

### 3.3.4 ATMOSPHERIC STABILITY

The atmospheric stability is defined by lateral fluctuation of the wind, or sigma theta. Stability level is characterized by sigma theta 0 to 2.5 degrees as stable, 2.5 to 7 as moderately stable, 7 to 9 as neutral, 9 to 15 as moderately unstable, and greater than 15 degrees as very unstable (Slade 1968). The atmospheric stability based on the Prairie Rose Meteorological Tower sites at the 60 m level is 5.8 degrees, or moderately stable.

### 3.3.5 HUB HEIGHT TURBULENCE

The Turbulence Intensity (TI) is defined as the measured standard deviation of wind speed over an hour, divided by the mean for the same time period. For wind speeds greater than 5 m/s the expected TI is 0.1 percent. For wind speeds greater than 15 m/s, the expected TI is 0.107 percent.

### 3.3.6 EXTREME WIND CONDITIONS

The maximum hourly wind speed measured at the more centrally located Prairie Rose Meteorological Tower site was 21 m/s. Site extreme wind events for a one year event will likely be 21.2 m/s. Table 3-2 provides the 20- through 100-year maximum means and gusts for the site based on the observed weather patterns from the centrally located Prairie Rose Meteorological tower.

**Table 3-2. Extreme Wind Events**

| Period (yr) | Extreme Wind Speed (m/s) | |
|---|---|---|
| | 10-min means | Gusts |
| 20 | 21.5 | 48.9 |
| 25 | 21.7 | 50.7 |
| 50 | 22.4 | 56.4 |
| 100 | 23 | 62.0 |

### 3.3.7 WIND SPEED FREQUENCY DISTRIBUTION

Figure 3-2 shows the wind speed frequency distribution; a majority of the winds occur between 5 m/s and 8 m/s.

### 3.3.8 WIND VARIATION WITH HEIGHT

Wind shear is the relative change in wind speed as a function of height. Wind shear is calculated using a power function based upon the relative distance from the ground. The general equation used for calculating wind shear is $S/S_o = (H/H_o)^{\alpha}$ where $S_o$ and $H_o$ are the speed and height of the lower level and $\alpha$ is the power coefficient. The power coefficient can vary greatly due to terrain roughness and atmospheric stability. The power coefficient will also change slightly with variation in height. The vertical variation with height or shear coefficient, based on the 40 to 60 m level at Prairie Rose Meteorological Tower site, is 0.23.

### 3.3.9 SPATIAL WIND VARIATION

As noted above in Section 3.2, the DOC's wind resource analysis program estimates that the spatial variation in wind speed across the Project area is between 8.0 and 8.4 m/s. This estimate is confirmed by the onsite data and the analysis performed by GWE and WindLogics.

### 3.3.10 WIND ROSE

A wind rose is a graphical representation of wind speeds based on the direction the wind comes from and the frequency it comes from each direction. Figure 3-3 shows the wind rose at the Prairie Rose Meteorological location.

## 3.4 OTHER METEOROLOGICAL CONDITIONS

### 3.4.1 AVERAGE AND EXTREME WEATHER CONDITIONS

Tables 3-3 and 3-4 show long term averages from the Pipestone airport located approximately 8 miles north of the Project area.

**Table 3-3. Monthly Average Precipitation and Average Extreme Temperatures for Pipestone Airport**

| | Average Mean Temp | Average Max Temp | Average Min Temp | Average Precip |
|---|---|---|---|---|
| January | 11.2 | 20.6 | 1.7 | 0.55 |
| February | 18 | 27.1 | 8.8 | 0.51 |
| March | 30.2 | 39.4 | 21 | 1.72 |
| April | 44.6 | 55.8 | 33.3 | 2.41 |
| May | 57.7 | 69.2 | 46.2 | 3.32 |
| June | 67.1 | 78.5 | 55.7 | 3.93 |
| July | 71.6 | 83.1 | 60.1 | 3.31 |
| August | 69.3 | 80.9 | 57.6 | 3.1 |
| September | 59.3 | 71.8 | 46.7 | 2.76 |
| October | 46.6 | 58.9 | 34.2 | 2.22 |
| November | 30 | 39 | 21 | 1.52 |
| December | 16.5 | 25.5 | 7.4 | 0.6 |
| **Annual** | **43.5** | **54.2** | **32.8** | **25.95** |

*Source: Midwest Regional Climate Center 2010*

**Table 3-4. Monthly Extreme Temperatures and Snowfall for Pipestone Airport**

| | Highest Daily Max Temp. (F) | Highest Daily Min Temp (F) | Lowest Daily Max Temp (F) | Lowest Daily Min Temp (F) | Maximum Observed Snow Depth (in) | Maximum Snow Fall (in) |
|---|---|---|---|---|---|---|
| January | 64 | 35 | -17 | -36 | 24 | 12 |
| February | 67 | 39 | -17 | -36 | 38 | 12 |
| March | 82 | 55 | -3 | -26 | 39 | 12 |
| April | 93 | 61 | 20 | -2 | 21 | 11 |
| May | 99 | 70 | 35 | 15 | 1 | 0.9 |
| June | 106 | 77 | 50 | 31 | 0 | 0 |
| July | 105 | 76 | 53 | 32 | 0 | 0 |
| August | 106 | 75 | 55 | 25 | 0 | 0 |
| September | 102 | 70 | 40 | 15 | 0 | 0.1 |
| October | 92 | 68 | 24 | 6 | 4 | 4 |
| November | 78 | 51 | 2 | -21 | 18 | 15 |
| December | 61 | 43 | -18 | -33 | 22 | 12 |
| **Annual** | **106** | **77** | **-18** | **-36** | **39** | **15** |

*Source: Midwest Regional Climate Center*

**Table 3-5. Extreme Weather Events in Rock County (Recorded in the Period 1953-2009 in Rock County, Minnesota)**

| Event Type | Attributed to Hardwick/Jasper Area | All Rock County | All Pipestone County |
|---|---|---|---|
| Blizzard | 0 | 11 | 13 |
| Blowing Snow & Extreme Wind Chill | 0 | 1 | 1 |
| Drought | 0 | 5 | 6 |
| Extreme Cold | 0 | 1 | 1 |
| Extreme Cold/Wind Chill | 0 | 1 | 1 |
| Extreme Wind Chill | 0 | 1 | 1 |
| Flash Flood | 0 | 9 | 3 |
| Flood | 2 | 5 | 4 |
| Freezing Rain | 0 | 1 | 1 |
| Hail | 14 | 88 | 83 |
| Heat Wave | 0 | 1 | 1 |
| Heavy Snow | 0 | 12 | 16 |
| Heavy Snow And Blowing Snow | 0 | 1 | 1 |
| Heavy Snow/ice | 0 | 1 | 1 |
| High Wind | 0 | 14 | 15 |
| Ice Storm | 0 | 3 | 4 |
| Ice Storm And Snow | 0 | 1 | 1 |
| Lightning | 0 | 1 | 2 |
| Thunderstorm Wind | 3 | 9 | 3 |
| Tornado | 1 | 12 | 10 |
| Tstm Wind | 4 | 60 | 45 |
| Winter Storm | 0 | 16 | 16 |
| Winter Weather | 0 | 8 | 14 |
| Winter Weather/mix | 0 | 8 | 9 |

*Source: NCDC Storm Event Database 2010*

As detailed in Table 3-5, extreme weather events for Rock and Pipestone counties include thunderstorms, tornadoes, hail, heavy snow and ice, extreme cold, heat waves, flash floods/floods, heavy rain, lightning, and drought. Tornadoes, thunderstorms, and extreme winds strike occasionally. The state of Minnesota experiences approximately 15 to 20 tornadoes per year. National Climatic Data Center (NCDC) records include 86 thunderstorms and high wind events and 12 tornadoes in Rock County, and 67 thunderstorms and high wind events and 10 tornadoes in Pipestone County for the period January 1, 1953, to May 31, 2009. Such storms are usually of short duration and localized, leading to damage in small geographic areas. Wind turbines are built to withstand hail and lightning, but are not designed to survive tornado-force winds of 89+ m/s (200+ mph).

Turbines under consideration for this project are capable of withstanding the extreme weather conditions that occur in the area. All turbines being considered have lightning protection systems, their turbine blades "feather" into the prevailing wind direction during high wind events to minimize the risk of damage, and all will shut down when the cut-out wind speed (generally 45 mph) is reached.

During the winter, there is potential for ice to accumulate on turbine blades with variable frequency. Although the turbines are not equipped with specific ice-sensing equipment, they will stop turning if significant ice accumulation causes an imbalance. The mechanical safeguards and turbine setbacks mitigate the potential hazard associated with ice throw, and minimize the potential that ice thrown from turbine blades reaches public roads or residences. Ice throw is not expected to be a hazard for this Project.

## 3.5 ENERGY PROJECTIONS

### 3.5.1 PROPOSED ARRAY SPACING FOR WIND TURBINES

Wind turbines will be placed on lands under lease by Prairie Rose Wind, primarily along the higher elevation features of the site to provide the best exposure to wind. The proposed internal array spacing for Project turbines is a minimum of three RD in an east-west direction (crosswind spacing) and a minimum of five RD in a north-south direction (downwind spacing) with up to 20 percent of the turbines spaced closer. The spacing is dependent upon the selected equipment and the site topography. Prairie Rose Wind will develop the site to minimize array wake losses and to optimize efficient use of wind and land resources.

### 3.5.2 BASE ENERGY PROJECTIONS

The Prairie Rose Wind Project will have a nameplate capacity of up to 101 MW and a net capacity factor of between 40 to 45 percent. Prairie Rose Wind projects an average annual output of between approximately 341,640 MWH and 394,200 MWH. Annual energy production output will depend on final design, site specific features, and the equipment selected. Gross to net calculations take into account, among other factors, energy losses in the gathering system, mechanical availability, array losses, and system losses. An industry-wide estimate of energy losses ranges from 8 to 10 percent of maximum output.

## 3.6 COST ANALYSIS

### 3.6.1 CAPITAL AND OPERATION COSTS

The total Project-installed capital costs are estimated to be between $197 and $205 million, including wind turbines, associated electrical and communication systems, and roads. Ongoing operations and maintenance costs and administrative costs are estimated to be approximately $4.9 to 5.3 million per year, including royalties to landowners for wind easement rights and property taxes.

### 3.6.2 SITE DESIGN DEPENDENT COSTS

The overall cost of developing the Project will depend primarily on site selection and construction timing. Site-dependent costs will include the relative ease of access to the individual wind turbine locations, site-specific subsurface conditions which determine foundation design, site access road design and layout, ease of underground work, and the layout of the turbine arrays, which affects road and electrical cable cost. Both underground and aboveground cable may be employed to connect turbines, transformers, and the interconnect point. Underground placement of cables is preferable.

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# 4.0 ENGINEERING AND OPERATIONAL DESIGN ANALYSIS

This section provides a summary description of the Project, which includes a description of the layout, turbines, electrical system, and associated facilities. Additional information addressed in this section includes Project construction, schedule, operation, and decommissioning of the site. The Applicant wishes to preserve the right to evaluate and select turbine equipment of varying sizes and outputs.

Turbines other than those detailed in Section 2.1.2 are also feasible choices for the Prairie Rose Wind Farm site, are available from various manufacturers, and include turbines up to 2.3 MW in size. Turbine type may affect the number and configuration of the turbine array.

## 4.1 PRAIRIE ROSE WIND PROJECT LAYOUT AND ASSOCIATED FACILITIES

The Project will consist of wind turbines, transformers, access roads, a permanent meteorological tower, an electrical collection system, a new project-specific step-up substation (Prairie Rose Substation), and an O&M building. The turbines will be interconnected by communication and electric power collection cable within the wind farm. In addition, the wind farm facilities will include electrical collection lines and junction boxes to deliver the electricity to Xcel Energy's Split Rock Substation.

Land will be graded on site for the turbine pads. Drainage systems, access roads, storage areas, and shop facilities will be installed as necessary to fully accommodate all aspects of the construction, operation, and maintenance of the wind farm.

The electrical system design and interconnection details will be determined based on the results of studies currently underway. The electrical system will deliver the power to Xcel Energy's Split Rock Substation, as will be detailed in the interconnection agreement. At the Prairie Rose Substation, the voltage of electricity generated by the project will be converted up to 115kV (a transmission level voltage).

The Project includes a computer-controlled communications system that permits automatic, independent operation and remote supervision, thus allowing the simultaneous control of the wind turbines. The Applicant will be responsible for the operation and maintenance of the Project. The Applicant may contract with suppliers of operations and maintenance services at the time of operation. The Applicant will maintain a computer program and database for tracking each wind turbine's operational history.

## 4.2 DESCRIPTION OF WIND TURBINES

The Applicant anticipates using up to 67 1.5 MW turbines, up to 56 1.8 MW turbines, or up to 43 2.3 MW turbines. The Applicant seeks the flexibility to select the most appropriate technology at the time of the Project to ensure optimization of wind and land resources and cost efficiency. The preliminary site layout is 101 MW, based on 67 1.5 MW wind turbines (Figure 1-3), 56 1.8 MW wind turbines (Figure 1-4), or 43 2.3 MW turbines (Figure 1-5). The Applicant will update the site

layout, consistent with the parameters laid out in the LWECS Permit, when equipment is selected and if information regarding the wind resource identifies opportunities to further optimize the site. A comparison of the turbines under consideration, the 1.5 MW turbine, the 1.8 MW turbine, and the 2.3 MW generator, is presented below and in Section 2.1.

### 4.2.1 TURBINE

Table 2-1 provides details on the hub heights, RDs, and wind speed operation parameters for the GE 1.5 MW turbine, the Vestas 1.8 MW turbine, and the Siemens 2.3 MW turbine. All three models have active yaw and pitch regulation and asynchronous generators. The turbines use a bedplate drive train design where all nacelle components are joined on common structures to improve durability.

The 1.5 MW, the 1.8 MW, and 2.3 MW turbines have SCADA communication technology to control and monitor the wind farm. The SCADA communications system permits automatic, independent operation and remote supervision, thus allowing the simultaneous control of the wind turbines.

Operations, maintenance and service arrangements between the turbine manufacturer and the Applicant will be structured to provide for timely and efficient operations. The computerized data network will provide detailed operating and performance information for each wind turbine. The Applicant will maintain a computer program and database for tracking each wind turbine's operational history.

Other specifications of the turbines include:

- Rotor blade pitch regulation;
- Gearbox with three-step planetary spur gear system (1.5 MW, 1.8 MW and 2.3 MW);
- Double fed three-phase asynchronous generator (1.5 MW), a six-pole asynchronous with variable speed generator (1.8 MW) and an asynchronous four-pole generator with a wound rotor (2.3 MW);
- A braking system for each blade and a hydraulic parking brake (disc brake); and
- Yaw systems are electromechanically driven.

Some of the turbines being considered also incorporate new technology compared to turbines currently in the landscape, including:

- Force-flow bedplates (nacelle components joined on a common structure to improve durability); and
- New gearbox bearing designs (improving reliability by reducing bending and thrust).

### 4.2.2 ROTOR

The rotor consists of three blades mounted to a rotor hub. The hub is attached to the nacelle, which houses the gearbox, generator, brake, cooling system, and other electrical and mechanical systems. The preliminary 1.5 MW turbine design identifies a 77 m (252 ft) RD, the 1.8 MW turbine has a 90 m (295 ft) RD, and the 2.3 MW turbine will have a RD of 101 m (331 ft). For the 1.5 MW turbine, the swept area for the 77 m RD would be 4,657 $m^2$ (50,127 $ft^2$). The 1.8 MW turbine with the 90 m RD would have a swept area of 6,362 $m^2$ (68,480 $ft^2$). For the 2.3 MW turbine, with a 101 m RD, the

swept area would be 6,362 $m^2$ (68,480 $ft^2$). As Table 2-1 shows, the rotor speed would be 10.1 to 20.4 rpm for the 1.5 MW turbines, 9.3 to 16.6 rpm for the 1.8 MW turbine, and 6 to 16 rpm for the 2.3 MW turbines.

### 4.2.3 TOWER

The towers are conical tubular steel with a hub height of 80 m (262 ft). The turbine towers, where the nacelle is mounted, consist of three to four sections manufactured from certified steel plates. Welds are made in automatically controlled power welding machines and ultrasonically inspected during manufacturing per American National Standards Institute specifications. All surfaces are sandblasted and multi-layer coated for protection against corrosion. Access to the turbine is through a lockable steel door at the base of the tower. Four platforms are connected with a ladder and a fall arresting safety system for access to the nacelle.

### 4.2.4 LIGHTNING PROTECTION

The entire turbine is equipped with a lightning protection system. The turbine is grounded and shielded to protect against lightning. The grounding system will be installed during foundation work and must be accommodated to local soil conditions. The resistance to neutral earth must be in accordance with local utility or code requirements. Lightning conductors are placed in each rotor blade and in the tower. The electrical components are also protected.

## 4.3 DESCRIPTION OF ELECTRICAL SYSTEM

At the base of each turbine a step-up transformer will be installed to raise the voltage to power collection line voltage of 34.5 kV. Power will be run through an underground and/or aboveground collection system to the Prairie Rose Substation, which will raise the voltage to 115 kV. From the step-up substation the power will then run through an aboveground line to the Split Rock substation near Brandon, South Dakota, where it will be delivered to the electrical grid.

Generally, the electrical lines will be buried in trenches and run to the edge of the farm field. At the public road at the edge of the farm field, the power collection lines will either rise from underground to aboveground lines (if shallow bedrock, sensitive environmental conditions, or conflicts with underground utility infrastructure are encountered) or continue as underground lines. The collection lines will occasionally require an aboveground junction box when the collection lines from separate spools need to be spliced together. The collector lines will deliver 34.5 kV wind-generated energy to the 115 kV step-up Prairie Rose Substation.

The interconnection details will be determined as a result of studies and discussions and agreements with MISO.

## 4.4 PRAIRIE ROSE WIND PROJECT CONSTRUCTION

Several activities must be completed prior to the proposed commercial production date. The majority of the activities relate to equipment ordering lead-time, as well as design and construction of the

facility. Below is a preliminary schedule of activities necessary to develop the Project. Pre-construction, construction, and post-construction activities for the Project include:

- Order all necessary components including towers, nacelles, blades, foundations, transformers, etc;
- Final turbine micro-siting;
- Complete survey to establish locations of structures and roadways;
- Soil borings, testing, and analysis for proper foundation design and materials;
- Complete construction of access roads, to be used for construction and maintenance;
- Construct aboveground or underground feeder lines;
- Design and construct the step-up substation;
- Potential upgrades to the Split Rock Substation
- Install tower foundations;
- Install underground cables;
- Tower placement and wind turbine setting;
- Acceptance testing of facility; and
- Commencement of commercial production date.

Access roads will be built adjacent to the towers, allowing access both during and after construction. The roads will be approximately 4.9 m (16 ft) wide and have gravel as cover, adequate to support the size and weight of maintenance vehicles. These roads will meet state and local requirements. The specific turbine locations will determine the amount of roadway that will be constructed for this Project. In addition, there will be a 30-foot diameter gravel work area centered on the base of each turbine.

Temporary disturbances during construction of the Project include crane pads at each turbine site, temporary travel roads for the cranes, temporary laydown areas around each turbine, trenching in the underground electrical collection system, and storage/stockpile area. Construction of the turbines will include temporary impacts of approximately an additional 12 ft of gravel roadway on either side of the permanent roadway (40 ft total width), a 40-ft-by-120-ft gravel crane pad extending from the roadway to the turbine foundation which will be graded to a minimum of 1 percent, and a component lay down and rotor assembly area centered close to the turbine foundation which will be graded to a minimum of 5 percent. The component lay down area will range from approximately 260 ft by 260 ft to 335 ft by 335 ft, depending on the turbine size selected. In addition to the disturbances associated with the temporary travel roads for the cranes, it is possible that temporary impacts could occur when cranes move cross-country between strings of turbines.

During the construction phase, several types of light, medium, and heavy-duty construction vehicles will travel to and from the site, as well as private vehicles used by the construction personnel. The Applicant estimates that there will be 75 large truck trips per day and up to 175 small-vehicle (pickups and automobiles) trips per day in the area during peak construction periods. That volume will occur during the peak time when the majority of the foundation and tower assembly is taking place. At the completion of each construction phase this equipment will be removed from the site or

reduced in number. Prior to construction, the Applicant will coordinate with local jurisdictions (county and township) in order to obtain the necessary road access and overwidth/overweight permits.

### 4.4.1 CONSTRUCTION MANAGEMENT

The civil contractor will be the lead entity for the construction management of the Project. The primary civil, erection and electrical contractors will use, where possible, the services of local contractors to assist in the construction of the wind farm. The contractors, in coordination with local contractors, will undertake the following activities:

- Securing building, electrical, grading, road, and utility permits;
- Perform detailed civil, structural, and electrical engineering;
- Schedule execution of construction activities;
- Complete surveying and geotechnical investigations; and
- Forecast Project labor requirements and budgeting

The primary contractors also serve as key contacts and interface for subcontractor coordination. The electrical contractor will oversee the installation of communication and power collection lines as well as the step-up substation. The civil contractor will oversee the installation of roads and foundations, as well as the coordination of aggregate and concrete materials receiving, inventory, and distribution. The construction consists of the following tasks:

- Site development, including roads;
- Foundation excavation;
- Concrete foundations;
- Electrical and communications installation;
- Tower assembly and machine erection; and
- System testing

The construction team will be on site to handle materials purchasing, construction, and quality control. The primary contractors will select and manage their local subcontractors to complete all aspects of construction.

Throughout the construction phase, ongoing coordination occurs between the Project development and the construction teams. The civil contractor helps to coordinate all aspects of the Project, including ongoing communication with local officials, citizens groups, and landowners. Even before the Project becomes fully operational, the O&M staff is integrated into the construction phase of the Project. The construction manager and the O&M staff manager work together continuously to ensure a smooth transition from construction through wind farm commissioning and, finally, operations.

### 4.4.2 FOUNDATION DESIGN

The wind turbines' freestanding 80-meter (262-foot) tubular towers will be connected by anchor bolts to a concrete foundation. Geotechnical surveys, turbine tower load specifications, and cost considerations will dictate final design parameters of the foundations. The base portion of the

foundation for turbines under consideration will be an octagon approximately 12 to 24 m (40 to 80 ft) in diameter and approximately 2.5 m (8 ft) thick.

### 4.4.3 CIVIL WORKS

Completion of the Project will require various types of civil works and physical improvements to the land. These civil works include the following:

- Improving existing access roads to the Project area;
- Constructing roads adjacent to the wind turbine strings to allow construction and continued servicing of the wind turbines;
- Clearing and grading for wind turbine tower foundation installations;
- Trenching for underground cabling for connecting the individual wind turbines;
- Installing an on-site feeder system for connecting wind turbine strings for delivery to the electricity collection/metering location;
- Clearing and grading for pad-mount transformers and other installations;
- Clearing and grading for the step-up substation and O&M building; and
- Installing any site fencing and security.

Any improvements to existing access roads will consist of re-grading and filling of the gravel surface to allow access even in inclement weather. No asphalt or other paving is anticipated.

Access roads will be constructed along turbine strings or arrays. These roads will be sited in consultation with local landowners and completed in accordance with state and local requirements. They will be located to facilitate both construction (cranes) and continued operation and maintenance. Siting roads in areas with unstable soil will be avoided wherever possible. All roads will include appropriate drainage and culverts while still allowing for the crossing of farm equipment. The roads will be approximately 4.9 m (16 ft) wide and will be covered with road base designed to allow passage under inclement weather conditions.

The roads will consist of graded dirt, overlaid with geotechnical fabric (if needed) and covered with gravel. To facilitate crane movement and equipment delivery, an additional 3.5 to 12 ft of gravel roadway will be temporarily installed on either side of the permanent roadway (40 ft total width).

In addition, turbine assembly will require a 40-ft-by-120-ft gravel crane pad extending from the access road to the turbine foundation which will be graded to a minimum of one percent, and an approximate 260-ft-by-260-ft to 335-ft-by-335-ft area for component lay down and rotor assembly centered close to the turbine foundation which will be graded to a minimum of five percent.

After construction, the temporary construction areas adjacent to the turbine pad and access road will be restored. The site will be graded to natural contours, soil will be loosened if needed, and the site will be seeded if needed. Once construction is completed, the access roads will be regraded, filled, and dressed as needed.

### 4.4.4 COMMISSIONING

The Project will be commissioned after completion of the construction phase. The Project will undergo detailed inspection and testing procedures. Inspection and testing occurs for each component of the wind turbines, as well as the communication system, meteorological system, high-voltage collection and feeder system, and the SCADA system. Once the interconnection is established, the Applicant will commission each turbine to generate electricity after completion of inspection and testing.

## 4.5 PROJECT OPERATION AND MAINTENANCE

Each wind turbine in the Project will communicate directly with the SCADA system for the purposes of performance monitoring, energy reporting, and trouble-shooting. The SCADA system also provides the overall control of the wind farm.

The Applicant will augment its O&M staff as needed with appropriate contractors to service and maintain the Project.

### 4.5.1 PROJECT CONTROL, MANAGEMENT, AND SERVICE

In addition to providing wind farm control, the SCADA system offers access to wind turbine generation or production data, availability, meteorological, and communications data, as well as alarms and communication error information. Performance data and parameters for each machine (generator speed, wind speed, power output, etc.) can also be viewed, and machine status can be changed. There is also a snapshot facility that collects frames of operating data to aid in diagnostics and troubleshooting of problems.

The primary functions of the SCADA are to:

- Control and monitor the wind farm;
- Alert operations personnel to wind farm conditions requiring resolution;
- Provide a user/operator interface for controlling and monitoring wind turbines;
- Collect performance data from turbines;
- Monitor field communications;
- Provide information on wind turbine performance for operators and maintenance personnel;
- Collect data on wind turbine and wind farm maintenance;
- Serve as an information archive;
- Provide spare parts inventory control; and
- Generate operations and maintenance reports.

### 4.5.2 MAINTENANCE SCHEDULE

Equipment will be monitored by local O&M staff and remotely by the Applicant’s operations and power scheduling desk, which is staffed 24 hours a day. When needed during off hours, local personnel will be dispatched to the site by the remote monitoring staff. Performance testing is done

during the early months of operation to see that the wind farm is operating within expected parameters.

Project inspection and maintenance is performed on the following intervals:

A) First Service Inspection. The first service inspection will take place one to three months after the turbines have been commissioned. At this inspection, particular attention is paid to tower bolt tensioning and equipment lubrication.

B) Semi-Annual Service Inspection. Regular service inspections commence six months after the first inspection. The semi-annual inspection consists of lubrication and a test of the turbine trip system.

C) Annual Service Inspection. The yearly service inspection consists of a semi-annual inspection plus a full component check. Bolts are checked with a torque wrench. The check covers 10 percent of the bolts. If any bolts are found to be loose, all bolts in that assembly are tightened and the event is logged.

D) Two Years Service Inspection. The two years service inspection consists of the annual inspection, plus checking and tightening of electrical terminal connectors.

E) Five Years Service Inspection. The five years inspection consists of the annual inspection, an extensive inspection of the wind braking system, checking and testing of oil and grease, balance check, and tightness of terminal connectors.

### 4.5.3 GENERAL MAINTENANCE DUTIES

The O&M field duties include performing all scheduled and unscheduled maintenance including periodic operational checks and tests, regular preventive maintenance on all turbines, related plant facilities and equipment, safety systems, controls, instruments, and machinery, including:

- Maintenance on the wind turbines and on the mechanical, electrical power, and communications system;
- Performance of all routine inspections;
- Maintenance of all oil levels and changing oil filters;
- Maintenance of the control systems, all structures associated with the wind farm, access roads, drainage systems, and other facilities necessary for the operation of the wind farm;
- Maintenance of all O&M field maintenance manuals, service bulletins, revisions, and documentation for the wind farm;
- Maintenance of all parts, price lists, and computer software;
- Maintenance and operation of interconnection facilities;
- Provide all labor, services, consumables, and parts required to perform scheduled and unscheduled maintenance on the wind farm, including repairs and replacement of parts and removal of failed parts;
- Assist as needed with avian and other wildlife studies;

- Management of lubricants, solvents, and other hazardous materials as required by local and/or state regulations;
- Maintenance of all appropriate levels of spare parts in order to service equipment;
- Obtain all necessary equipment including the rental of industrial cranes for removal and reinstallation of turbine components;
- Hire, train, and supervise a work force necessary to meet the general maintenance requirements; and
- Maintenance of site security.

### 4.5.4 OPERATIONS AND MAINTENANCE FACILITY

The location of the O&M facility at the Project has not been determined at this time, but will be located central to future potential Geronimo projects, and will be permitted through Rock County and/or the township where the facility is ultimately located. The buildings typically used for this purpose are 3,000 to 5,000 square ft and house the equipment to operate and maintain the wind farm. The parking lot adjacent to the building is typically 3,000 square ft.

## 4.6 PROJECT SCHEDULE

### 4.6.1 LAND ACQUISITION

The Applicant will be responsible for all land acquisition and will obtain the necessary easements from landowners.

### 4.6.2 PERMITS

The Applicant will be responsible for undertaking all required environmental review and will obtain all permits and licenses that are required following issuance of the LWECS Site Permit.

### 4.6.3 EQUIPMENT PROCUREMENT, MANUFACTURE AND DELIVERY

Prairie Rose Wind is in the process of procuring turbines for the Project and its other wind farm sites. Turbines will be allocated to the Project after meteorological and economic studies are completed to achieve the best match of turbines and sites. Turbines could arrive on site in first quarter, 2011.

### 4.6.4 CONSTRUCTION

Geronimo personnel will oversee the primary contractors performing Project construction, including roads, wind turbine assembly, electrical, and communications work. The construction may take approximately 12 months to complete, however, depending upon seasonal or weather-related constraints (i.e. minimal work would occur during winter months) it may take less time.

### 4.6.5 CONSTRUCTION FINANCING

The Applicant will be responsible for financing all pre-development, development, and construction activities. The Applicant anticipates financing the cost of all pre-development activities through

internal funds. Construction will be financed with internal funds or a combination of internal funds and third-party sources of debt and equity capital.

### 4.6.6 PERMANENT FINANCING

Permanent financing will be provided with the Applicant's internal funds or a combination of internal funds and third-party sources of debt and equity capital. GWE typically retains a long-term interest in its wind projects.

### 4.6.7 EXPECTED COMMERCIAL OPERATION DATE

The Applicant anticipates that the Project would begin commercial operation between the third calendar quarter of 2011 and the first calendar quarter of 2012. The commercial operation date is dependent on the completion of the interconnection, permitting, and other development activities. The Applicant hopes to enter into a PPA no later than the end of 2010 to support commencement of construction of the project in late 2010 or early 2011.

## 4.7 DECOMMISSIONING AND RESTORATION

The Project decommissioning and restoration plan is in accordance with the requirements of Minn. Rules part 7836.0500, subp. 13. At the end of commercial operation, the Project owners will be responsible for removing wind facilities, and removing the turbine foundations to a depth of 48 inches. Project owners reserve the right to extend options instead of decommissioning at the end of the site permit term. These options may include applying for an extension of the site permit, if necessary, and continuing operation of the Project. In this case, a decision may be made on whether to continue operation with existing equipment or to retrofit the turbines and power system with upgrades based on newer technologies.

### 4.7.1 ANTICIPATED LIFE OF THE PROJECT

The anticipated Project life is approximately 30 years beyond the date of first commercial operation.

### 4.7.2 DECOMMISSIONING

The owner will be responsible for costs to decommission the Project and associated facilities. In the event any wind turbine has exhausted its useful life and is decommissioned, the site will be excavated back to 4 feet below grade.

### 4.7.3 LIST OF DECOMMISSIONING ACTIVITIES

In addition to any requirements under the site permit, each individual land lease requires proper decommissioning of turbines. Decommissioning of the site would include removal of turbines and related facilities. Removal of related facilities would include access roads, equipment, towers, buildings, transformers, and cables or wires. Foundations will be removed to a depth of four ft below grade and buried back to grade. Additionally, any disturbed surface would be graded, reseeded, and restored as nearly as possible to its preconstruction condition.

### 4.7.4 COST TO DECOMMISSION

The estimated decommissioning cost in current dollars is expected to be $58,000 per turbine, including associated facilities. Geronimo's current estimates for the salvage value of the turbines and associated facilities show that the cost to decommission would be fully covered by the sale of scrap from the Project. Prairie Rose Wind will be responsible for all costs to decommission the Project and associated facilities. Based on estimated costs of decommissioning and the salvage value of decommissioned equipment, the salvage value of the wind farm is expected to exceed the costs of decommissioning, but this will depend upon the prevailing rates for salvage value of the equipment and labor costs. This methodology provides a conservative estimate of the Project's residual value because:

- Long-term average scrap metal prices were used instead of recent years' scrap metal values that are much higher, and
- During the majority of the wind farm's life, the components would be sold as used equipment at significantly higher prices than their underlying scrap metal value.

The salvage value of the turbines and other components ensures that sufficient funds will be available to cover decommissioning and restoration costs. Because the uncertainty surrounding future decommissioning cost and salvage value increases with time, Prairie Rose Wind will review and update the cost estimate of decommissioning and restoration for the Project 15 years after Project commissioning. This revised cost estimate of decommissioning and salvage value will then be submitted to the PUC for review and comment. Beginning in year 15 of the Project's operational life, the Applicant will either create a reserve fund or enter into a surety bond agreement and create an escrow account, or provide for a combination of both a reserve and surety bond, that will ultimately fund decommissioning and site restoration costs after Project operations cease, to the extent that the salvage value does not cover decommissioning costs. The exact amount to be allocated for decommissioning will be determined by a third party study in year 14 that will assess the difference between estimated decommissioning costs and the salvage value.

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# 5.0 ENVIRONMENTAL ANALYSIS

This section provides a description of the environmental conditions that exist within the Project. Consistent with PUC procedures on siting LWECS and applicable portions of the Power Plant Siting Act, various exclusion and avoidance criteria were considered in the selection of the Project area.

## 5.1 DESCRIPTION OF ENVIRONMENTAL SETTING (INTRODUCTION)

The Project is located in an area that is entirely rural with an agricultural-based economy. Corn and soybeans are the predominant crops in Pipestone and Rock counties. Rock and Pipestone counties are also producers of livestock, mostly hogs and feeder cattle (Minnesota Planning State Demographic Center 1999). The landscape in the Project area is relatively flat with gently rolling hills. The proposed Project area is approximately 35,335 acres. Elevations in the Project area range from 1,615 to 1,791 ft above sea level.

## 5.2 DEMOGRAPHICS

### 5.2.1 DESCRIPTION OF RESOURCES

The Project is located within a lightly populated rural area in southwestern Minnesota, on the border of Rock and Pipestone counties, with densities ranging from 8 (Rose Dell, Denver, and Springwater Townships) to 13 people per square mile in Eden and Elmer townships, which is slightly lower than Rock and Pipestone County average densities (Table 5-1). The following information on demographics and housing was taken from the U.S. Census.

The majority of the project is located within Rock County. The U.S. Census Bureau (USCB) estimates that both Rock and Pipestone counties experienced slight population declines from 2000 to 2008 compared to a moderate statewide increase. Household income is about 15 to 30 percent less than the statewide average, but poverty levels are similar. Table 5-1 provides a summary of these demographics.

**Table 5-1. Population and Economic Characteristics of Rock and Pipestone Counties, Minnesota**

| Description | Rock County | Pipestone County | Minnesota |
|---|---|---|---|
| Population, 2000 | 9,721 | 9,895 | 4,919,492 |
| Population, 2008 | 9,476 | 9,395 | 5,220,393 |
| Percent Population Change, 2000-2008 | -2.5 | -5.1 | 6.9 |
| Persons per Square Mile, 2000 | 20.1 | 21.2 | 61.8 |
| Median Household Income (dollars), 2008 | 48,104 | 41,421 | 57,318 |
| Percentage of Persons Below Poverty Level, 2008 | 9.0 | 10.6 | 9.6 |

*Source: (USCB 2009)*

The Project is located in parts of Rose Dell, Denver, and Spring Water townships in Rock County, and parts of Eden and Elmer townships in Pipestone County. There are no municipalities within the project area. Most residences within the project area are rural farmsteads. Typical densities in the Project area are about two to four farmsteads per section of land. There are two communities adjacent to the project area, and an additional four communities within five miles of the project area. Table 5-2 provides a summary of these nearby communities.

**Table 5-2. Population Characteristics within 5 Miles of Project Area**

| Municipality | Distance From Project Area (mi) | Population (2000) | Total Housing Units (2000) |
|---|---|---|---|
| Trosky | Adjacent | 110 | 48 |
| Hardwick | Adjacent | 205 | 104 |
| Jasper | 3.0 | 564 | 308 |
| Edgerton | 3.0 | 1,033 | 477 |
| Ihlen | 3.0 | 107 | 44 |
| Hatfield | 5.0 | 47 | 25 |

*Source: (USCB 2010)*

The largest industries employing residents of Rock and Pipestone counties are educational, health and social services, and agriculture.

### 5.2.2 IMPACTS

Short-term impacts to socioeconomic resources will be relatively minor. Roughly 29 to 42 acres of agricultural land will be permanently removed from production. Landowner compensation will be established by their lease, and the areas surrounding each turbine may still be farmed. Project construction will not cause additional impacts to leading industries within the Project area. There is no indication that any minority or low-income population is concentrated in any one area of the Project, or that the wind turbines will be placed in an area occupied primarily by any minority group.

Local contractors and suppliers will be used for portions of the construction. Total wages and salaries paid to contractors and workers in Pipestone and Rock counties will contribute to the total personal income of the region. Additional personal income will be generated for residents in the county and state by circulation and recirculation of dollars paid out by the Applicant for business expenditures and for state and local taxes. Expenditures made for equipment, fuel, operating supplies, and other products and services benefit businesses in the county and the state. Landowners having turbines or other Project facilities on their land will receive a royalty or lease payment annually for the life of the Project. This payment diversifies and strengthens the local economy as discussed below.

Long-term beneficial impacts to the counties' tax base as a result of the construction and operation of the wind farm will contribute to improving the local economy in this area of Minnesota. The development of wind energy in this region has been important in diversifying and strengthening the economic base of southwestern Minnesota. Northwest Economic Associates prepared a report, "Assessing the Economic Development Impacts of Wind Power," that includes a case study of the

Lake Benton I Wind Project in Lincoln County, Minnesota (Northwest Economic Associates 2003). In addition to the creation of jobs and personal income, the Project will pay a Wind Energy Production Tax to the local units of government of $0.0012 per kWh of electricity produced, resulting in an annual Wind Energy Production tax ranging from approximately $409,968 to $473,040.

### 5.2.3 MITIGATIVE MEASURES

Socioeconomic impacts associated with the Project will be primarily positive with an influx of wages and expenditures made at local businesses during Project construction and an increase in the counties' tax bases from the construction and operation of the wind turbines.

The Applicant proposes minimum setbacks for turbines from occupied residences to comply with Minnesota noise standards. The Applicant will adhere to a minimum setback of 250 feet from public roads.

## 5.3 NOISE

### 5.3.1 DESCRIPTION OF RESOURCES

The ambient acoustic environment refers to the outdoor noise levels within a given community. Based on HDR's review of ambient noise levels measured in rural settings with high quality wind resources, typical noise levels range from 30 dBA to 60 dBA on an hourly equivalent sound pressure level (Leq) basis. Typical existing ambient noise levels in rural areas are dominated by agriculture-related activities, existing wind conditions, local fauna, and proximity to other noise sources.

There can be a wide variation in the spectral content of community noise, dependant on the variety of noise sources in the area. The May 22, 2009, Minnesota Department of Health (MDH) white paper (Public Health Effects of Wind Turbines) asserts that dBA is the worst predictor of annoyance of available acoustical weighting scales (MDH 2009). MDH notes that the difference between C- and A-weighted is used by many as an indication of the relative contribution of low-frequency noise (the C-weighting scale does not remove as much low-frequency content as the A-weighting scale does). On this basis, MDH claims that the dBC scale is purportedly better able to deal with the annoying low frequency wind turbine noise, and a difference between C- and A-weighted greater than 10 dB is an indicator of the likelihood of annoyance from low frequency noise emitted by wind turbines.

HDR's review of 24-hour noise monitoring data collected from other wind farm projects demonstrates that the difference between outdoor, ambient C-weighted and A-weighted noise levels exceeds 10 dB for an average of 15 hours per day in rural communities where the wind resource is suitable for wind energy development. Higher noise levels exist near roads and other areas of human activity, and when the wind is blowing. The windy conditions in this region tend to increase ambient noise levels compared to other rural areas that do not have the same high quality wind resources as this project area has.

For the noise evaluation, the Applicant obtained representative sound power levels (Lw) of the Siemens SWT 101 2.3 MW, Vestas V90 1.8 MW, and GE 1.5sle MW wind turbines that were provided by the manufacturers.

### 5.3.2 IMPACTS

When in motion, the wind turbines emit a perceptible sound. The level of this sound varies with the speed of the turbine and the distance of the listener from the turbine. Sound is generated from the wind turbine at points near the hub or nacelle, 80 meters (262.5 feet) to 105 meters (344.5 feet) in the air, from the blade tips as they rotate. The analysis accounted for all sound generating elements associated with wind turbines.

The wind turbine manufacturers provide turbine noise emission data in terms of sound power levels or sound pressure levels, as shown in Table 5-3 below.

**Table 5-3. Noise Emissions Data Provided by Turbine Manufacturers**

| Turbine Make and Model | Sound Power Level (dBA) |
|---|---|
| Siemens 101 SWT 2.3 MW | 107.0 |
| GE 1.5sle | 104.0 |
| Vestas V90 1.8 MW | 103.5 |

Cadna-A, an acoustical analysis software designed for evaluating environmental noise from stationary and mobile sources, was used to calculate the Leq for all three turbine models. Cadna-A is a three-dimensional noise model based on ISO 9613, “Attenuation of Sound during Propagation Outdoors,” adopted by the International Standards Organization (ISO) in 1996. This standard provides a widely-accepted engineering method for the calculation of outdoor environmental noise levels from sources of known sound emission (ISO 1996).

In order to provide cumulative noise analysis results, Cadna-A calculated noise emissions from all proposed turbines. The Cadna-A modeling done for this project did not utilize project-specific terrain. By eliminating terrain, the Cadna-A model assumes flat ground and reduces the opportunity for terrain to potentially block the line-of-sight between turbines and receptors.

In lieu of specific state and county specifications for ground absorption, a ground absorption factor of 0.7 was used as suggested in the “Noise Guidelines for Wind Farms” document published by the Ontario Ministry of the Environment. This ground absorption factor takes into account the majority of cultivated terrain in the project area; in effect it assumes 70 percent of the ground cover is acoustically absorptive (Ministry of Ontario 2008). Additionally, by eliminating wind rose data from the Cadna-A model, Cadna-A conservatively calculates noise levels at all receptors by assuming that each receptor is downwind from every turbine at once, regardless of actual turbine directions, with favorable sound propagation conditions. Because of the described assumptions and the analysis utilized the loudest sound power level provided by the manufacturers; the analysis provides a conservative prediction of noise levels.

By assuming that wind speeds are constant for an entire one-hour period, the Leq calculated by Cadna-A can be compared to the Minnesota Pollution Control Agency's (MPCA) L50 standard (the Leq is an energy-based time-averaged noise level and the L50 is the statistical median noise level, the noise level exceeded 50 percent of the time). The recent MDH white paper indicates a 5 dBA buffer provides an adequate surrogate for low-frequency noise. The nighttime L50 standard is the most stringent noise limit in the MPCA standards; therefore, when combined with the 5 dBA buffer suggested by the MDH white paper, analysis results are appropriate and conservative for evaluating the acceptability of calculated wind turbine noise levels.

All proposed wind turbines (noise sources) were modeled in Cadna-A and project-related noise levels were calculated at 204 noise-sensitive receptors within the study area. Table 5-4 presents a summary of the noise analysis results.

**Table 5-4. Summary of Noise Analysis**

| Turbine Make and Model | Maximum Project-Related Leq, dBA | Average Project-Related Leq, dBA |
|---|---|---|
| Siemens 101 SWT 2.3 MW | 45 | 28 |
| GE 1.5sle | 45 | 29 |
| Vestas V90 1.8 MW | 43 | 24 |

The maximum calculated noise level, based on assumptions incorporated into the Cadna-A model and the most current turbine layout, results in a 45 dBA Leq at the nearest noise-sensitive receptor. Average project-related noise levels for all turbine models range from 24 – 29 dBA, on an hourly Leq basis.

Noise isopleths are depicted in Figures 5-1 through 5-3.

As depicted in the multi-turbine constraint maps all proposed turbine layouts comply with MPCA noise guidelines. Maximum calculated noise levels for all turbine models are at least 5 dB below the nighttime L50 noise limit of 50 dBA.

The MDH white paper also recommended an evaluation of the low-frequency component of turbine noise, as a possible additional cause of irritation. Sound levels from modern wind turbines pose no risk of hearing loss or any other nonauditory effect. (Ising and Kruppa 2004) While subaudible, low frequency sound and infrasound are most commonly associated with noise complaints about wind turbines, there is a consensus among acoustic experts that these frequencies are of no consequence to health. (Colby *et al.* 2009) Although some people may be annoyed at the presence of sound from wind turbines, annoyance is a highly-individualized phenomenon, and is not an identified medical condition (Colby *et al.* 2009). The primary concern about wind turbine sound is its fluctuating nature, which can occur under certain circumstances such as turbulent wind conditions. A small number of individuals with particular sensitivities may find this sound annoying, but the reaction depends primarily on the personal characteristics, as opposed to the intensity of the sound level (Colby *et al.* 2009). The substantial body of peer-reviewed literature on the subject of wind turbine noise indicates that there is

nothing unique about the sounds and vibrations emitted by wind turbines, and that there is no evidence that the audible or subaudible sounds emitted by wind turbines have any direct adverse physiological effects (Colby *et al.* 2009).

Geoff Levanthall, an acoustic and vibration expert from the UK who was cited in the MDH white paper for two of his earlier works on low frequency sound, conducted a study in 2006 on infrasound from wind turbines. According to Leventhall, there is now agreement among peer-reviewed acousticians that infrasound from wind turbines is not a public health issue (Colby et al. 2009).

When studying 1.5 MW wind turbines from a distance of 65 meters (213 feet), Levanthall found that modern upwind turbines produce pulses which are considered infrasound, but only at low levels, typically 50 to 70 dB, which are well below the hearing threshold. Based on his study, Levanthall further concludes that infrasound is inaudible at frequencies below 16 Hz. The threshold which is audible varies by individuals, but Levanthall states that "…it is most unlikely that an individual will be able to hear sound at any frequency which is more than 20 dB below the median threshold for hearing." (Colby, et al. 2009)

Project-specific field studies conducted by Epsilon Associates, Inc. and previously submitted to the PUC in document 20099-41923-01 of docket 09-845 reached similar conclusions (O'Neal, et al, 2009). Epsilon studied the two turbine models most frequently installed – the GE 1.5sle (1.5 MW) and Siemens SWT-2.3-93 (2.3 MW). These field studies consisted of outdoor measurements at various reference distances, and concurrent indoor/outdoor measurements at residences within the wind farm. Epsilon determined all means, methods, and the testing protocol without interference or direction from wind energy industry participants.

Based on field measurements and an extensive literature review, Epsilon concluded that wind farms consisting of GE 1.5sle and Siemens SWT 2.3-93 wind turbines (similar to those proposed at the Paynesville Wind Farm) sited at distances beyond 1,000 feet from residences (i) meet the American National Standards Institute (ANSI) standard for low frequency sound in bedrooms, classrooms, and hospitals, (ii) meet the ANSI standard for thresholds of annoyance from low frequency sound, and (iii) caused no window rattles or perceptible vibration of light weight walls or ceilings within homes (O'Neal *et al.* 2009). In homes, there may be slightly audible low frequency sound (depending on other sources of low frequency sound); however, the levels are below criteria and recommendations for low frequency sound within homes (O'Neal et al, 2009). There is no audible infrasound either outside or inside the homes at any of the measurement sites. (O'Neal et al, 2009) Epsilon concluded there should be no adverse public health effects from low frequency sound or infrasound at distances greater than 1,000 feet (O'Neal et al, 2009).

### 5.3.3 MITIGATIVE MEASURES

Impacts to nearby residents and other potentially affected parties in terms of noise will be taken into consideration as part of the siting of the turbines. The Applicant proposes minimum setbacks for turbines from occupied residences of 1,000 ft (unless other arrangements have been made with the landowner), plus any additional distance necessary to achieve the setback for the 50 dBA nighttime L50 standard. To the extent that the sound characteristics of the selected turbine vary, the Applicant

will ensure compliance with MPCA noise standards. Per the guidance from the MDH whitepaper, the preliminary layout has been modeled to consider cumulative impacts from all wind turbines, and maximum calculated noise levels for all turbine models are at least 5 dB below the MPCA's nighttime L50 noise limit of 50 dBA, which the MDH suggested as a surrogate for low-frequency noise.

## 5.4 VISUAL IMPACTS

### 5.4.1 DESCRIPTION OF RESOURCES

**Existing Aesthetics**

The topography of the Project area is relatively flat with gently rolling hills and ridges with elevations that range from 1,615 ft to 1,791 ft above sea level. Agricultural fields, farmsteads, and gently rolling topography visually dominate the Project area. The landscape can be classified as rural open space. The photos in Figure 5-4 show typical landscapes within the Project area.

Vegetation is predominantly agricultural crops and pasture within the Project boundary. Crops include corn, soybeans, small grains, and forage crops, which visually create a low uniform cover. A mix of deciduous and coniferous trees planted for windbreaks typically surrounds farmsteads. Generally, these forested areas are isolated groves or windrows established by the landowner/farmers to prevent wind erosion and shelter dwellings. Bedrock outcrops (exposed bedrock) are present within the Project area. In the wet swales, there are occasional patches of native willows, cattails, sedges, and rushes.

The settlements in Pipestone and Rock counties are residences and farm buildings (inhabited and uninhabited) scattered along rural county roads. These structures are focal points in the dominant open space character of the vicinity.

There are many existing wind farms, located to the north, south, and east of the Project area (Figure 5-5). Many of these wind farms are visible from County State Aid Highways (CSAHs) and County Roads (CRs) in the vicinity of these projects, some of which are visible from roads within the proposed Project area.

**Shadow Flicker**

Like any tall structure, wind turbines will cast a shadow when the sun is visible. As wind turbine blades rotate, they can cast a shadow upon the ground and objects below. A flickering or flashing effect may occur where the shadows of the rotating blades cause rapid changes in light intensity. This change in light intensity is sometimes referred to as shadow flicker.

Generally, no shadow flicker occurs on completely overcast days, or when the wind turbine rotor and blades are not rotating, such as when winds are calm. Because the turbine is designed to turn and face into the wind, shadow flicker is most pronounced when the turbine is between the sun and a receptor directly downwind from the wind turbine.

When turbines are not properly sited, shadow flicker has been reported by some nearby residents as a visual irritant, or annoyance issue. A particular concern that has been voiced is that shadow flicker

can induce seizures. Wind turbines in the Project will rotate at a rate less than 0.33 Hz, making them too slow to trigger an epileptic response (Epilepsy Foundation 2010).

### 5.4.2 IMPACTS

The placement of turbines will have an effect on the visual quality of the site and in nearby areas. However, discussion of the aesthetics of the proposed wind farm is based on subjective human responses. For some viewers, the Project could be perceived as a visual intrusion, characterized as "industrial" metal structures, 80 m (262 ft) high at hub height for the range of turbines considered, intruding on the natural aesthetic value of the landscape.

For other viewers, wind projects have their own positive aesthetic qualities, distinguishing them from other non-agricultural land uses. Operation of the wind farm will not generate much traffic or significantly increase day-to-day human activity in the area. Therefore, the Project area will retain a rural sense and remote character. Also, although "industrial" in form and purpose, turbines are essentially "farming" the wind for energy. Although the turbines are high-tech in appearance, they are compatible with the rural and agricultural heritage of the area.

Essentially, the installation of the Project will alter the land use and visual quality of the site. The topography in the vicinity is generally flat and the vegetation cover is uniformly low, making the high topography vulnerable to visual disruptions. Visual impacts will be most evident to people traveling north and south along U.S. Highway 75, CR 66 and CSAH 11, and east and west along CSAH 12 and CSAH 7. These impacts will affect the rural visual quality of the landscape and the experience of the persons utilizing those areas. With wind resources present in southwestern Minnesota, wind development has increased and is likely to continue.

The Federal Aviation Administration (FAA) requires obstruction lighting or marking of structures over 200 ft above ground to provide safe air navigation. GWE will apply to the FAA for approval of a lighting plan that is compliant with FAA requirements. It is anticipated that approximately 50 percent of the turbines will be lit. FAA requires synchronized flashing of red lights for wind turbines within a Project. Geronimo will also apply for tall structure permits from the Minnesota Department of Transportation (MnDOT).

It has been noted that the presence of turbines within the viewshed of Minnesota Department of Natural Resources (DNR)-managed Wildlife Management Areas (WMAs), or other natural areas may diminish the natural quality of those areas and the experience of the persons utilizing those areas. Figure 5-6 identifies recreation and wildlife areas within the Project's vicinity. Users of these areas may experience visual impacts due to the presence of turbines nearby. Further information regarding recreational lands in relation to the Project area is found in Section 5.7.

While it may be true to some extent that the ability to see turbines in the background intrudes upon the purity of that experience, the same could be said of any human habitation or activity in the vicinity, and the presence of turbines may be less intrusive than many such activities. Nonetheless, persons within the vicinity of the Project may perceive the Project to have negative effects.

The visual difference between the 1.5 MW, 1.8 MW, and 2.3 MW turbines will be primarily in the RD and in the number of turbines used. The 1.5 MW turbine design will have a 77 m (252 ft) RD, whereas the 1.8 MW turbine will have a RD of 90 m (295 ft) and the 2.3 MW turbine will have a RD of 101 m (331 ft). The difference in visual impacts between the 1.5 and 1.8 MW turbines' RD will be difficult to ascertain, but the 2.3 MW turbine's RD would be noticeably larger than the 1.5 MW turbine's RD. The major difference will be in the number of turbines associated with the wind farm. The visual impact on the landscape will be reduced if the Project is built using 2.3 MW versus 1.5 MW turbines (43 versus 67 turbines).

Areas most likely to experience shadow flicker would occur to the east and west of the wind turbine locations. However, the number of hours per year during which shadow flicker could occur lessens as distance from the wind turbine increases, even for residences that are located to the east and west of the wind turbine locations. There are three reasons why this is so:

- As the sun passes from winter to summer, the shadow angles at sunrise and sunset move from north to south. Since this angle changes, a residence further from the wind turbine would most likely experience shadow flicker only during a few days per year.
- As the sun rises or sets, the wind turbine shadow length changes rapidly, so that a residence further away from the wind turbine location would experience shadow flicker for only a short time during the day.
- A discernable shadow forms or dissipates 15 to 45 minutes of sunrise or sunset, depending on sky conditions.

### 5.4.3 MITIGATIVE MEASURES

The following are proposed mitigative measures:

- Turbines will be uniform in color;
- Turbines will not be located in biologically sensitive areas such as parks, WMAs, or wetlands;
- Turbines will be illuminated to meet the minimum requirements of FAA regulations;
- Existing roads will be used for construction and maintenance where possible to minimize the amount of new roads constructed; and
- Access roads created for the wind farm facility will be located on gentle grades to minimize erosion, visible cuts, and fills.

To attain maximum efficiency, wind power technology requires as much exposure to the wind as possible. As a result, the turbines are located on the hilltops in the area, which makes them highly visible to a wide range of surrounding areas. Shorter towers or placement of the turbines at alternate locations off the ridgelines are not feasible as visual mitigation measures because these measures would result in less efficiency per unit and adversely impact the economic viability of the Project.

Computer models can accurately predict the expected amount of shadow flicker at locations within or around a wind farm. The Applicant will conduct a shadow flicker analysis to help guide the final

selection of turbine locations by identifying places for turbines that minimize shadow flicker on residences. The shadow flicker analysis will be provided to the PUC prior to construction. While turbine siting will be the primary means to minimize shadow flicker, the Applicant will consider additional mitigative measures to further reduce flicker on a case-by-case basis.

## 5.5 PUBLIC SERVICES AND INFRASTRUCTURE

### 5.5.1 DESCRIPTION OF RESOURCES

The Project is located in a lightly populated, rural area in southwestern Minnesota. There is an established transportation and utility network that provides access and necessary services to the light industry, small cities, homesteads, and farms existing near the Project area. The communities of Hardwick and Trosky are located adjacent to the Project area. These communities provide sanitary sewer and water. The townships have limited public infrastructure services. Homes typically utilize septic systems for household needs.

The closest hospital services are in Luverne and Pipestone. The nearest fire departments are within the cities of Pipestone, Luverne, Edgerton, and Jasper. Law enforcement is serviced by the Pipestone and Rock County Sheriff's departments, which are based out of the cities of Pipestone and Luverne, respectively.

In general, the existing roadway infrastructure in and around the Project area is characterized by county and township roads that generally follow section lines. Various CSAHs, CRs, and township roads provide access to the proposed site. Access to the Project area also includes two-lane paved and gravel roads. In the agricultural areas, many landowners use private single-lane farm roads and driveways on their property.

U.S. Highway 75 borders the eastern edge of the Project boundary and crosses the northeast corner of the Project area. There are five CSAHs within the Project area. CSAHs 6 and 11 run north to south, and CSAHs 7 and 12 run east to west through the Project area.

The existing traffic volumes on the area's county highways are documented in Figure 5-7. For purposes of comparison, the functional capacity of a two-lane paved rural highway is in excess of 5,000 vehicles per day, or Annual Average Daily Traffic (AADT). The highest existing AADT in or near the Project area is 3,000 vehicles per day along U.S. Highway 75 south of CSAH 7. Along the county highways, the AADTs are generally below 500 vehicles per day (MnDOT 2006).

There are no active railroad lines in the Project area. No interstate pipelines have been identified within the Project area.

There is currently one major utility corridor in the Project area. The L and O Power Cooperative has a 115 kV transmission line running north to south along State Highway 75 along the east side of the Project area, and two small distribution substations in the northeast and southeast portions of the Project area. Distribution lines are infrequent within the Project area. Telephone service is provided by local telephone companies to the homes and businesses in the area.

### 5.5.2 IMPACTS

The Project is expected to have a minimal effect on the existing infrastructure. The following is a brief description of the impacts that may occur during the construction and operation of the Project at the proposed site.

- Electrical Service: Construction of the Project will include up to 67 wind turbines, a pad-mounted transformer at the base of each turbine, an underground and aboveground electrical collection system, including an occasional aboveground junction box that will deliver power to the Project substation. The power will then be transmitted to the point of interconnection at Xcel's Split Rock Substation where it will enter the grid.
- Roads: Constructing the Project will require approximately 10 to 17 miles of gravel access roads, depending on the size of turbine selected and final design. In addition, during operation of the Project, the access roads will be used by operation and maintenance crews while inspecting and servicing the wind turbines. The access roads will be between towers and one road will be required for each string. The roads will be approximately 16 to 33 ft wide and low profile to allow cross-travel by farm equipment. The Applicant will work closely with the landowners to locate these access roads to minimize land-use disruptions. Construction traffic will use the existing county and state roadway system to access the Project area and deliver construction materials and personnel. During the peak of construction, it is anticipated that there will be an additional 250 vehicle trips per day. Since the current traffic levels on the roadways in the Project area are well below roadway capacities, construction traffic will be perceptible but similar to seasonal variations in traffic, such as autumn harvest. Construction is not anticipated to result in adverse traffic impacts. Operation and maintenance activities will not noticeably increase traffic in the Project area.
- Railroads: The Project will not affect any railroads.
- Water Supply: Construction and operation of the proposed Project will not significantly impact the water supply. No installation or abandonment of any wells is anticipated for the Project. However, in the event wells are abandoned, they will be capped as required by Minnesota law. The Project will not require the appropriation of surface water or permanent dewatering. Temporary dewatering may be required during construction for specific turbine foundations and/or electrical trenches. A water supply will be necessary for the operations and maintenance facility, which is anticipated to require a new private well. Water usage during the operating period will be similar to household volume; less then five gallons per minute. Water use during construction will occur at a higher rate to provide dust control and water for concrete mixes.
- Telephone: Construction and operation of the proposed wind farm will not impact the telephone service to the Project area. Gopher One Call will be contacted prior to construction to located and avoid all underground facilities. To the extent Project facilities cross or otherwise affect existing telephone lines or equipment, the Applicant will enter into agreements with service providers to avoid interference with their facilities.

- Federal Communications Commission (FCC)-Registered Towers: The Applicant has conducted a microwave beam path analysis, and one microwave beam path was identified within the Project area (Figures 1-6, 1-7, and 1-8). The Applicant will not operate the wind farm so as to cause microwave, radio, telephone, or navigation interference contrary to FCC regulations or other law. In the event the wind farm or its operation causes such interference, the Applicant will take the steps necessary to correct the problem.
- Television Reception: The Applicant will conduct an off-air television reception analysis of the Project. The Applicant will not operate the wind farm so it causes television interference contrary to FCC regulations or other law. In the event of a problem after construction, the Applicant will work with affected residents to determine the cause of interference and, where necessary, reestablish acceptable reception in a timely fashion.
- Next Generation (NEXRAD) Radar: The Applicant contacted the U.S. Department of Commerce National Telecommunications and Information Administration (NTIA) regarding potential interference with weather radars. The NTIA (Appendix A), commented that the proposed Project will impact the Weather Surveillance Radar-1988 Doppler (WSR-88D) located northeast of Sioux Falls, South Dakota. The applicant will continue coordination with NTIA and NEXRAD to minimize impacts to weather radars.

### 5.5.3 MITIGATIVE MEASURES

Construction and operation of the proposed wind Project will be in accordance with all associated federal and state permits and laws, as well as industry construction and operation standards. Due to the minor impacts expected on the existing infrastructure during the Project construction and operation, extensive mitigation measures are not anticipated.

## 5.6 CULTURAL AND ARCHAEOLOGICAL RESOURCES

### 5.6.1 DESCRIPTION OF RESOURCES

The proposed Project area lies completely within the Southwest Riverine Archaeological Region (Anfinson 1990 also found as a part of the Minnesota Archaeological Predictive Model). The Southwest Riverine Archaeological Region is located in southwestern corner of Minnesota and includes all of Rock, the majority of Pipestone, and parts of Nobles, Murray, and Lincoln counties. Archaeological resource sites are small and in general widely scattered. However, it is suspected that archaeological site concentrations can be found near prominent land forms and near larger permanent water sources.

HDR collected data from the State Historic Preservation Office (SHPO) in St. Paul on known cultural resources information that was derived from previous professional cultural resources surveys and to inquire about any possible leads regarding previously unknown archaeological resources. Data collection includes gathering information within the Project area and a two-mile search area outside the Project area. Usually, only a one mile search area buffer is used to understand the context of the Project area; in this case a two mile search area buffer was used because the Project boundary was not completely defined at the time the search was completed. The two-mile search area was used to

gather valuable information regarding the location of previously identified cultural resources and cultural resources surveys. This information is then used to identify resource types that may be encountered and landforms that correspond to those resources or areas that correspond to those resources that have a higher potential for containing significant cultural resources. Collected data includes archaeological resource files, historic facility resource files, and previous cultural resources studies and reports.

In addition, HDR reviewed 19th Century Public Land Survey (PLS) maps to identify potential historic-period facility features that may exist in the Project area. Based on this information HDR prepared a Phase Ia Inventory (Appendix B) which reports on the results of the literature review described above and recommends a course of action for further analysis. The Phase Ia Inventory documented 6 previous cultural resources reports, 12 historic facility resources, and seven archaeological resources within or near the Project area.

Two historic facility resources (RK-DNT-001 and PP-ELM-001), both bridges, were identified within the Project boundary and 10 historic facility resources (PP-EDN-002, RK-HAC-001, RK-HAC-002, RK-HAC-003, RK-HAC-004, RK-RSD-001, RK-RSD-003, RK-RSD-004, RK-SPG-001, and RK-SPG-003) were identified within the 2-mile search area. The 10 historic facilities within the 2-mile search area are:

- PP-EDN-002, a Norwegian Lutheran Church
- RK-HAC-001, a Pool Hall
- RK-HAC-002, the Old Hardwick State Bank
- RK-HAC-003, a Recreation Hall
- RK-HAC-004, the New Hardwick State Bank
- RK-RSD-001, School District No. 41
- RK-RSD-003, the Boettcher Farm
- RK-RSD-004, a bridge
- RK-SPG-001, a bridge
- RK-SPG-003, a bridge

During the SHPO background check, all site forms were available with the exception of PP-ELM-001and RK-SPG-003. Both sites have not been evaluated for inclusion in the National Register of Historic Places (NRHP), and no additional information was available on these sites. The other ten historic facility resources have not been evaluated for inclusion in the NRHP.

No archaeological sites were identified within the Project boundary and seven archaeological sites (21PP003, 32PP0011, 21PP0012, 21PP0014, 21PP0015, 21PP0046, and 21RK0054) were identified within the 2-mile search area. During the background check, all site forms were available, and all sites were found to be lithic and artifact scatters. None of the archaeological sites have been evaluated for inclusion in the NRHP.

The PLS maps for the Project area illustrate the environmental conditions, including elevation variations across the landscape and watercourses, that were present in the mid 1880s. The maps indicate no historic-period land use within the Project area. However, topography within the Project

area does show the presence of what is believed to be an ancient lake. In addition, in the township south of the project area, historic period land use is present and represented by roads, trails, farmsteads, and fields. While these historic facility resources do not coincide directly with the Project area or 2-mile search area, they suggest the possibility that additional resources of this type and age are present within the Project area.

### 5.6.2 IMPACTS

Archaeological resources could be impacted directly during the construction of a wind energy facility. Construction within the turbine footprint, cable trenching, access roads, and borrow areas could impact archaeological resources. In addition, construction of turbines or other structures that project dramatically from the landscape may visually impact the viewshed of existing historic facilities.

A letter was sent to the Minnesota SHPO, OSA, and DOC on August 5, 2009, requesting a review of the proposed Project area and potential impacts to archaeological and historic facility resources. A second letter was sent to SHPO, OSA, and the DOC on March 22, 2010 to notify them of the updated project boundary. To date HDR has received two responses from SHPO (SHPO Number 2009-3187), dated September 9, 2009 and April 12, 2010, both stating that it is recommended that an archaeological resources survey be completed prior to project construction (Appendix A).

### 5.6.3 MITIGATIVE MEASURES

The recorded archaeological site information and the information in previous survey reports suggest that the Project area has potential for containing archaeological resources on or near elevated landforms and in areas within close proximity of permanent water sources. In addition, the proximity of recorded historic facilities to the Project area and the presence of known historic facilities within the Project area and adjacent two-mile search area imply that additional resources from the historic period may also be present within the Project area.

In concurrence with the SHPO recommendation, GWE will conduct a Phase I archaeological resources inventory. The archaeological resource inventory will focus on areas proposed for project construction, including wind turbine locations, associated access roads, electrical cables and other construction elements. These investigations will be conducted by professionals who meet the Secretary of the Interior's Standards for Archaeology as published in Title 36 Code of Federal Regulations Part 6. Survey strategies for the archaeological resource inventory will depend on surface exposure and the characteristics of the landforms proposed for development. After receiving the proposed turbine, access road, and electrical cable layouts, archaeologists will design an appropriate survey strategy for archaeological resources. Higher potential areas for archaeological resources will most likely include portions of the Project area within close proximity of a permanent water source and areas of higher elevation.

If archaeological or historic facility resources are identified during the survey, an archaeologist and/or architectural historian will identify the location and record UTM coordinates so that project construction layout can be adjusted to avoid the location. If project construction plans can not be

adjusted, further investigation of the resource may be needed. This additional investigation would be described and documented on an individual basis.

## 5.7 RECREATIONAL RESOURCES

### 5.7.1 DESCRIPTION OF RESOURCES

Recreational opportunities in Rock and Pipestone counties include hiking, biking, boating, fishing, camping, swimming, horseback riding, cross country skiing, snowmobiling, hunting, and nature viewing. Figure 5-6 depicts the locations of state and county parks, DNR WMAs and U.S. Fish and Wildlife Service (USFWS) lands near the proposed Project area.

Minnesota WMAs are managed to provide wildlife habitat, improve wildlife production, and provide public hunting and trapping opportunities. These DNR lands were acquired and developed primarily with hunting license fees. WMAs are closed to all-terrain vehicles and horses because of potential detrimental effects on wildlife habitat. There are no WMAs within the Project area. WMAs located within five miles of the Project include:

- Poplar Creek WMA located 1.0 mile northeast of the Project area;
- Jasper WMA located 2.0 miles northwest of the Project are;
- Eden WMA located 2.5 miles north of the Project area;
- Little Beaver Creek WMA located 2.5 miles south of the Project area;
- Springwater WMA located 3.5 miles south of the Project area; and,
- Ringneck Ridge WMA located 4.5 miles northwest of the Project area.

Scientific and Natural Areas (SNAs) are areas designated to protect rare and endangered species habitat, unique plant communities, and significant geologic features that possess exceptional scientific or educational values. There are no SNAs within the Project area.

USFWS Waterfowl Production Areas (WPAs) are managed to protect breeding, forage, shelter, and migratory habitat for waterfowl or wading birds, such as ducks, geese, herons, and egrets. WPAs provide opportunities for viewing wildlife and intact ecosystems. There are no WPAs in the Project area. USFWS administers a program by which the USFWS holds easements on private lands that have wetlands and/or grassland habitat. Development may be restricted on lands held in a USFWS easement. No easements are known to exist within the Project Area; the USFWS has been contacted to verify the presence or lack of easements.

No National Wildlife Refuges (NWRs) were identified within the Project area. The Touch the Sky Unit of the Northern Tallgrass Prairie NWR is located within about 0.5 mile of the southern Project area boundary (Figure 5-6). It is managed through the USFWS' Windom Wetland Management District (WMD).

Two state parks are located less than 5 miles from the Project area. Split Rock Creek State Park is located about 2.5 miles northwest of the Project area. This Park is about 1,300 acres and is located on Split Rock Lake in Pipestone County. Split Rock Creek hosts about 57,000 visitors each year (DNR, 2009). Blue Mounds State Park is located about 2.5 miles southeast of the Project area. This park is

about 1,800 acres and is known for its unique rock outcrops and relatively tall cliffs. Blue Mounds hosts about 80,000 visitors each year (DNR, 2009).

In Rock County, an approximately 7-mile segment of the Buffalo Ridge snowmobile trail crosses the Project area. This trail follows U.S. Highway 75 for most of this alignment. The snowmobile trail alignment continues along U.S. Highway 75 into Pipestone County, where it is managed as the Hiawatha Sno Blazers Trail. About 3.0 miles of the Hiawatha Sno Blazers Trail crosses the Project area.

### 5.7.2 IMPACTS

The Project will avoid all WMAs, USFWS lands, and public parks. In general, recreational impacts will be visual in nature affecting individuals using public land near the Project area for recreation. See Section 5.4 for additional discussion of visual impacts and proposed mitigative measures. Visual impacts will be most evident to visitors using the WMAs, NWR, state parks, and snowmobile trails within a one- to four-mile radius of the site. No significant impacts to recreational resources are anticipated.

### 5.7.3 MITIGATIVE MEASURES

Project turbines and facilities will not be located within public parks, WMAs or in USFWS lands. Prairie Rose Wind will coordinate with the DNR to avoid limiting access to public snowmobile trails.

## 5.8 HUMAN HEALTH AND SAFETY

### 5.8.1 AIR TRAFFIC

#### 5.8.1.1 Description of Resources

Within 20 miles of the Project boundary, there are two airports located in Rock County, Minnesota, two airports located in Pipestone County, Minnesota, two airports located in Moody County, South Dakota, and one airport in Minnehaha County, South Dakota (Table 5-4). The nearest airport is Dykstra Acreage Airport located less than a half mile from the eastern Project boundary. It is a private airport with a turf runway 2,200 ft in length.

**Table 5-5. Airports within 20 Miles of the Project Site**

| Airport Name | City | County | Distance[a] | Runway Information[b] | Ownership Type | Runway Elevation (ft)[c] |
|---|---|---|---|---|---|---|
| Dykstra Acreage | Trosky, MN | Pipestone, MN | <0.5 | Turf | Private | 1,690 |
| Luverne Community Hospital Heliport | Luverne, MN | Rock, MN | 6.5 | Concrete | Private | 1,427 |
| Pipestone Municipal | Pipestone, MN | Pipestone, MN | 8 | Turf<br>Asphalt | Public | 1,736 |
| Quentin Aanenson Field | Luverne, MN | Rock, MN | 9 | Asphalt | Public | 1,431 |
| Flandreau Municipal | Flandreau, SD | Moody, SD | 17.5 | Concrete | Public | 1,645 |
| Weelborg | Dell Rapids, SD | Minnehaha, SD | 17.9 | Asphalt | Private | 1,553 |
| Flandreau Medical Center Heliport | Flandreau, SD | Moody, SD | 20.0 | Asphalt | Private | 1,570 |

*a Distance in miles from the nearest portion of the Prairie Rose Wind Farm boundary.*
*b Runway surface type and condition.*
*c Elevation in feet at the highest point on the centerline of the useable landing surface. Measured to the nearest foot with respect to mean sea level (MSL).*
*Source: FAA 2009*

Air traffic may be present near the Project for crop dusting of agricultural fields. Crop dusting is typically carried out during the day by highly maneuverable airplanes or helicopters. The installation of wind turbine towers in active croplands and installation of overhead collection lines, if needed, will create a potential for collisions with crop-dusting aircraft. However, overhead collection lines are expected to be similar to existing transmission and distribution lines (located along the edges of fields and roadways) and the turbines themselves would be visible from a distance and lighted according to FAA guidelines.

### 5.8.1.2 Impacts

Because the proposed turbine structures will exceed 200 ft above ground level, FAA notification is required, and an aeronautical study must be completed. The Project will be reviewed by the FAA, and a “No Hazard” issuance determination is expected for the Project. The FAA review will be for turbines with total height of up to 423 ft. The wind and meteorological towers will have lighting to comply with FAA requirements. The Applicant will notify local airports about the Project including locations of new towers in the area to minimize impacts and reduce potential risks to crop dusters.

### 5.8.1.3 Mitigative Measures

The Applicant will mark and light the turbines to comply with FAA requirements. The Applicant will paint meteorological towers red at the top to improve visibility and will notify local airports about the Project and new towers in the area to reduce the risk to crop dusters. Permanent meteorological

towers will be free-standing with no guy wires. Temporary meteorological towers will have supporting guy wires which will be marked with safety shields (colored balls) for increased visibility.

## 5.8.2 ELECTROMAGNETIC FIELDS

### 5.8.2.1 Description of Resources

The term electromagnetic fields (EMF) refers to electric and magnetic fields that are present around any electrical device. Electric fields arise from the voltage or electrical charges and magnetic fields arise from the flow of electricity or current that travels along transmission lines, power collection (feeder) lines, substation transformers, house wiring, and electrical appliances. The intensity of the electric field is related to the voltage of the line and the intensity of the magnetic field is related to the current flow through the conductors (wire). EMF can occur indoors and outdoors. However, there are no discernible health impacts from power lines.

EMF from underground electrical collection lines dissipates very close to the line because they are installed below ground within insulated shielding. The electrical fields are negligible, and there is a small magnetic field directly above the lines that, based on engineering analysis, dissipates within 20 feet on either side of the installed cable. EMF associated with the transformers at the base of each turbine completely dissipates within 500 feet from the transformer, so the 1,000-foot turbine setback from residences will be adequate to avoid any EMF exposure to homes.

### 5.8.2.2 Impacts

While the general consensus is that electric fields pose no risk to humans, the question of whether exposure to magnetic fields potentially can cause biological responses or even health effects continues to be the subject of research and debate. Based on the most current research on electromagnetic fields, and the distance between any turbines or collector lines and houses, the Project will have no impact to public health and safety due to EMF.

Stray voltage is a natural phenomenon that is the result of low levels of electrical current flowing between two points that are not directly connected. Electrical systems, including farm systems and utility distribution systems, must be adequately grounded to the earth to ensure continuous safety and reliability, and to minimize this current flow. Potential effects from stray voltage can result from a person or animal coming in contact with neutral-to-earth voltage. Stray voltage does not cause electrocution and is not related to ground currents, EMF or earth currents. Stray voltage is a particular concern for dairy farms because it can impact operations and milk production. Problems are usually related to the distribution and service lines directly serving the farm or the wiring on a farm affecting confined farm animals. In those instances where distribution lines have been shown to contribute to stray voltage, the electric distribution system directly serving the farm or the wiring on a farm was directly under and parallel to the transmission line. These circumstances are considered in installing transmission lines and can be readily mitigated. Problems related to distribution lines are also readily managed by correctly connecting and grounding electrical equipment.

#### 5.8.2.3 Mitigative Measures

No impacts due to electromagnetic fields or stray voltage are anticipated and no mitigation is necessary.

### 5.8.3 SECURITY

#### 5.8.3.1 Description of Resources

The proposed wind farm site is located in an area that has a low population density. Construction and operation of the Project will have minimal impacts on the security and safety of the local populace.

#### 5.8.3.2 Impacts

Project construction and operation will have no significant impact to security and safety of the local residents. In some past wind farm projects, wind turbines have posed hazards to human safety from tower collapse and blade throw, typically as a result of seismic events. The Project area is within a region considered to have low seismic activity (Gomberg 2007). Furthermore, modern turbine technology, in addition to proactive maintenance and inspections, has reduced these risks to insignificant rates. No safety issues have been reported for other Geronimo-associated wind projects in Minnesota; therefore safety issues including blade throw are not considered likely for the proposed Project.

#### 5.8.3.3 Mitigative Measures

The following security measures will be taken to reduce the chance of physical and property damage, as well as personal injury, at the site:

- The towers will be placed according to State and County noise standards from occupied homesteads. These distances are considered to be safe based on developer experience, and are consistent with prior LWECS site permits;
- Security measures will be taken during the construction and operation of the Project including temporary (safety) and permanent fencing, warning signs, and locks on equipment and wind power facilities;
- Regular maintenance and inspections will address potential blade failures, minimizing the potential for blade throw;
- Turbines will sit on solid steel enclosed tubular towers in which all electrical equipment will be located, except for the pad-mounted transformer. Access to the tower is only through a solid steel door that will be locked when not in use;
- Permanent meteorological towers will be free-standing. The guy wires on temporary meteorological towers will have color sleeves at ground level to increase visibility to people at ground level; and
- Where necessary or requested by landowners, the Applicant will construct gates or fences.

### 5.8.4 TRAFFIC

#### 5.8.4.1 Description of Resources

The existing traffic levels for the U.S. Highways, state Trunk Highways, CSAHs, and CRs in the Project area are shown in Figure 5-7.

#### 5.8.4.2 Impacts

The maximum construction workforce is expected to generate approximately 20-30 additional vehicle trips per day. The functional capacity of a two-lane paved rural highway is in excess of 5,000 vehicles per day. Currently, the heaviest traffic is on U.S. Highway 75 along the eastern border of the Project area, south of CSAH 7, at 3,000 AADT (MnDOT 2006). Most of the CRs in and near the Project area have AADTs between 95 and 550. Since many of the area roadways have AADTs currently well below capacity, the addition of 20-30 vehicle trips would be perceptible, but similar to seasonal variations such as autumn harvest.

Truck access to the Project area is generally served by U.S. Highway 75 and CSAH 12. Specific additional truck routes will be dictated by the location required for delivery. Additional operating permits will be obtained for over-sized truck movements.

The operations phase of the new Project will require a small maintenance crew driving through the area to monitor and maintain the wind turbines. The maintenance crew will monitor the wind turbines as needed. There would be a slight increase in traffic for occasional turbine and substation repair, but no impacts to traffic function would result from this small increase.

#### 5.8.4.3 Mitigative Measures

No impacts to traffic are anticipated. No mitigation will be necessary.

## 5.9 HAZARDOUS MATERIALS

### 5.9.1 DESCRIPTION OF RESOURCES

The land within the Project area is primarily rural and used for agriculture. Potential hazardous materials within the Project area would be associated with agricultural activities, and include petroleum products (fuel and lubricants), pesticides, and herbicides. Older farmsteads may also have lead-base paint, asbestos shingles, and polychlorinated biphenyls (PCBs) in transformers. Trash and farm equipment dumps are common in rural settings.

There will be three types of fluids used in the operation of the wind turbines that are petroleum products. These fluids are necessary for the operation of each turbine and include:

- Gear box oil – synthetic or mineral depending on application (approximately 300 liters)
- Hydraulic fluid
- Gear grease

These wastes will be managed and, if disposal is necessary, disposed of in compliance with the requirements of applicable laws and regulations.

### 5.9.2 IMPACTS

The Applicant will conduct a Phase I Environmental Site Assessment prior to construction to locate and avoid hazardous waste sites.

Turbine hydraulic oils and lubricants will be contained within the wind turbine nacelle, or in the case of car, truck and equipment fuel and lubricants, within the vehicle. Transformer oil will be contained within the transformer. Fluids will be monitored during maintenance at each turbine and transformer. A small amount of hydraulic oil, lube oil, grease, and cleaning solvent will be stored in the O&M building. When fluids are replaced, the waste products will be handled according to regulations and disposed of through an approved waste disposal firm.

### 5.9.3 MITIGATIVE MEASURES

Because there are no proposed impacts to hazardous waste sites, no mitigative measures are necessary. If any wastes, fluids, or pollutants are generated during any phase of the operation of the Project, they will be handled, processed, treated, stored, and disposed of in accordance with Minnesota Rules Chapter 7045.

## 5.10 EFFECTS ON LAND-BASED ECONOMIES

### 5.10.1 AGRICULTURE/FARMING/FORESTRY/MINING

#### 5.10.1.1 Description of Resources

**Agriculture/Farming**

The majority of the Project area is farmland and grassland, as shown in the Land Cover Map, Figure 5-8. Cultivated land comprises approximately 27,553 acres (78 percent) of the Project area. Grasslands comprise approximately 7,700 acres (22 percent) of the site. Essentially the whole Project area is used for agricultural purposes. Corn, soybeans, small grains, and forage crops are grown throughout Rock and Pipestone counties. Feeding cattle and hogs, raising livestock, and dairy farming are major sources of income in the Project area. Within the area of the Project, the trend is toward fewer and larger farms. Converting cropland to the Conservation Reserve Program (CRP) and the Reinvest in Minnesota (RIM) program is another source of farm income. CRP and RIM lands are cropland planted to conservation grasses and legumes to protect and improve the soil and cannot be harvested or pastured. Under the CRP, landowners are compensated for taking agricultural land out of production for a set contract period, and payments are made on a per-acre basis. While wind development is allowed within CRP parcels, coordination with landowners and the Natural Resources Conservation Service (NRCS) is necessary to withdraw the impacted areas from the CRP contract, and to compensate the NRCS for any payments already distributed for those areas. CRP is enrolled for 10-year periods, whereas RIM easements are permanent conservation easements.

Based on 2007 data, the majority of croplands are planted in corn and soybeans in Rock County and Pipestone County. Forage, corn for silage, and oats, and barley are also crops grown in these counties (USDA 2009).

Large-scale animal production has been a growing component of the agricultural industry in recent years. Feedlots used for the confined feeding, breeding, or holding of animals are a common practice for animal production. The Minnesota Pollution Control Agency records 617 registered feedlots in Rock County and 604 in Pipestone County (MPCA 2009). The 2007 Agricultural Census indicates that both Rock and Pipestone counties are relatively large producers of hogs and cattle (USDA, 2009).

Most of the soil within the Project area is prime farmland. The U.S. Department of Agriculture (USDA) NRCS identifies prime farmland as the land that has the best combination of physical and chemical characteristics for producing food, feed, forage, fiber, and oilseed crops and is available for these uses. It could be cultivated land, pasture land, forestland, or other land. Important farmlands consist of prime farmland, unique farmland, and farmland of statewide or local importance.

**Forestry**

Rock and Pipestone counties are in a region of Minnesota historically known for its prairie grasslands. Economically important forestry resources are not found in this region of Minnesota. Forested areas are primarily associated with homes in the form of woodlots and along creeks within the Project area.

**Mining**

Mineral deposits in southern Minnesota consist of sand and gravel from unconsolidated surficial deposits, building stone from quartzite rock units, and scattered clay/shale deposits for brick making. One active quartzite quarry, Jasper Stone Company, is located in the town of Jasper, approximately 3 miles west of the Project area.

Sand and gravel resources occur in glacial till and outwash deposits; 10 active gravel mines are present within 5 miles of the Project area (MnDOT 2003), but no active mines are present within the Project area.

## 5.10.2 IMPACTS

### 5.10.2.1 Agriculture/Farming

Specific impacts to agricultural lands (approximately 29 to 42 acres) will be determined once turbine and road placement and substation/O&M facility locations have been finalized. Most of the soil within the Project area is considered prime farmland. The loss of agricultural land to the construction of the wind farm will reduce the amount of land that can be cultivated. Less than one half of one percent of the Project area will be converted to non-agricultural land use. This will not significantly alter crop production in the Project area or Rock or Pipestone counties.

Turbine and facility siting will include discussions with property owners to identify features on their property, including drain tile, which should be avoided. Impacts to drain tile due to Project construction and operation are not anticipated. However, in the event that there is damage to drain tile as a result of construction activities or operation of the LWECS, the tile will be repaired according to the agreement between the Applicant and the owner of any damaged tile.

The Applicant will avoid all impacts to RIM land, and will minimize impacts to CRP land.

#### 5.10.2.2 Forestry

No impacts are anticipated to forestry resources. Since a majority of the woodlots are associated with homesteads, no impacts are anticipated to woodlots.

#### 5.10.2.3 Mining

Impacts to mining are not anticipated. Sand and gravel operations tend to be small and other occurrences of these materials are likely to be present in nearby areas, including large commercial operations in the general area. Quartzite is not currently being quarried within the Project area.

### 5.10.3 MITIGATIVE MEASURES

#### 5.10.3.1 Agriculture/Farming

Only land for the turbine, certain electrical equipment, and access roads will be taken out of crop production. Once the wind turbines are constructed, all land surrounding the turbines and access roads may still be farmed.

In the event that there is damage to drain tile as a result of construction activities or operation of the LWECS, the Applicant will work with affected property owners to repair the damaged drain tile in accordance with the agreement between the Project Owner and the owner of any damaged tile.

If CRP land is impacted, the Applicant will work with the landowner to remove the impacted portion of the parcel from the CRP program. There will be no impacts to RIM land; therefore no mitigation will be necessary.

#### 5.10.3.2 Forestry

No impacts are anticipated. No mitigation will be necessary.

#### 5.10.3.3 Mining

Towers will not be located within sand and gravel operations or quarries.

## 5.11 TOURISM AND COMMUNITY BENEFITS

### 5.11.1 DESCRIPTION OF RESOURCES

Tourism in southwestern Minnesota and Rock and Pipestone counties focuses on promoting the area's game and wildlife, lakes, farms, and villages. Also publicized are culture (museums, art, and antiques) and recreation activities such as parks, hiking trails, camping, canoeing, horseback riding, fishing, wildlife refuges, snowmobiling, golf courses, swimming pools, and cross country skiing. A variety of festivities and cultural events are hosted throughout the year.

As noted in Section 5.7 Split Rock Creek State Park and Blue Mound State Park are both located about 2.5 miles from the Project area. Split Rock Creek hosts about 57,000 visitors each year and

Blue Mound hosts about 80,000 visitors each year (DNR 2009). Pipestone National Monument, located about 10 miles north of the Project area, is near the city of Pipestone.

### 5.11.2 IMPACTS

No impacts are anticipated to local tourism.

### 5.11.3 MITIGATIVE MEASURES

No impacts are anticipated, as such, no mitigation is necessary.

## 5.12 TOPOGRAPHY

### 5.12.1 DESCRIPTION OF RESOURCES

The Project is located in the Inner Coteau subsection of the Ecological Classification System (DNR ECS 2009). Subsection boundaries delineate a significant regional change in geology, topography, and vegetation. The Inner Coteau subsection consists of highly dissected moraines of pre-Wisconsin drift. Bedrock is overlain with glacial till and capped with wind-blown silt (loess) deposits. The Project vicinity has broad, undulating to rolling ridge tops and hilly to steep valley sides that are generally narrow (MLRA 2006).

The topography of the Project area is relatively flat with gently rolling hills and ridges with elevations that range from 1,615 to 1,791 ft above sea level. An elevation map of the Project area is shown in Figure 5-10. Agricultural fields, farmsteads, and gently rolling topography visually dominate the Project area. The landscape can be classified as rural open space.

### 5.12.2 IMPACTS

No impacts to topography are anticipated. Wind turbines and access roads will not require significant excavation or fill.

### 5.12.3 MITIGATIVE MEASURES

No impacts are anticipated; as such, no mitigative measures are necessary.

## 5.13 SOILS

### 5.13.1 DESCRIPTION OF RESOURCES

Mollisols are dominant in this area. Bedrock is covered by glacially deposited till. Portions of bedrock are exposed throughout the counties, and within the Project boundary. Soils tend to be loamy, well-drained, and have thick dark surface horizons that formed under centuries of prairie vegetation (Inner Coteau 2009).

Six soil associations are found within the Project area (Table 5-6). Soil associations are mapped in Figure 5-9. A soil association has a distinctive pattern of soils, relief, and drainage. Each is a unique natural landscape consisting of one or more major soils and other minor soils. The association is named after its major soils.

**Table 5-6. Soil Associations in Project Area**

| Soil Association | Area (acres) |
|---|---|
| Moody-Trent-Marcus (MN 477) | 9,222 |
| Sac-Trent-Whitewood (MN 126) | 11,478 |
| Marcus Variant – Spicer (MN 129) | 2,497 |
| Kranzburg –Vienna-Hidewood (MN 122) | 5,608 |
| Ihlen-Rock Outcrop-Moody (MN 128) | 4,273 |
| Spillco-Millington-Calco (MN 451) | 1,322 |
| Estelline-Lamoure-Trosky (MN 123) | 911 |
| Everly-Flandreau-Dickman (MN 133) | 1 |

The Moody-Trent-Marcus soil complex is a combination of the following three soil types: Moody soils are silty clay loams found on northwest-facing convex slopes of two percent. Moody soils are well drained with moderate to moderately slow permeability and a range in surface runoff speed. The Trent series is a silty clay loam on one percent slopes, and is well to moderately well-drained with moderate permeability. These soils receive runoff from adjoining higher areas; however, surface runoff is low. The Marcus series is a silty clay loam with a slope of about one percent in cultivated fields. It is very poorly to poorly drained soil with moderately slow permeability and low to negligible surface runoff.

The Sac-Trent-Whitewood soil complex is a combination of the following three soil types. Sac soils are silty clay loams on a convex slope of three percent in a cultivated field. It is moderately well drained. The Trent series is a silty clay loam on a west-facing slope of one percent in a cultivated field. It is well to moderately well-drained with moderate permeability. These soils receive runoff from adjoining higher areas however surface runoff is low. The Whitewood series is a silty clay loam on a south-facing concave slope of one percent in a cultivated field. It is somewhat poorly drained to poorly drained soil with slow permeability and low surface runoff.

The Marcus Variant – Spicer soil complex is a combination of the following two soil types. The Spicer series is a silty clay loam with a plane slope of about ½ percent on a glacial lake plain in a cultivated field. It is poorly and very poorly drained with low surface runoff and moderate permeability. The Marcus series is a poorly drained silty clay loam that typically formed on loess uplands.

The Kranzburg-Vienna-Hidewood soil complex is a combination of three types of soils with the following characteristics. The Kranzburg series is a silty clay loam, on south-facing slopes of two percent, and is well drained, with low to medium surface runoff. The Vienna series is a silt loam on one percent slopes in a cultivated field. It is well drained with low-high surface runoff and moderately slow permeability. The hidewood series is a silty clay loam with a slightly concave slope of one percent in a cultivated field. It is poorly drained with slow surface runoff and moderate to moderately slow permeability.

The Ihlen-Rock Outcrop-Moody soil complex is a combination of two major soil types that exhibit the following characteristics. Ihlen soils are silty clay loams found on west-facing slightly convex slopes of three percent or less. Usually on loess mantled bedrock high in a pasture field. This soil is well-drained with slow to rapid surface runoff and has moderate permeability.

The Spillco-Millington-Calco soil complex is a combination of the following three soil types. Spillco soil is a loam with a slope of about one percent in a cultivated field. It is somewhat poorly drained to moderately well-drained with slow runoff and moderate permeability. Millington soils are silt loams on a slope of less than one percent, and are poorly drained with low surface runoff and moderate permeability. Calco soils are silty clay loams with a one percent slope on a floodplain, in a cultivated field at an elevation of about 322 m (1056 ft) above sea level. These soils are poorly drained to very poorly drained with negligible to low surface runoff potential. These soils are frequently saturated at the soil surface. (NRCS 2009)

The Estelline-Lamoure-Trosky soil complex is a combination of the following three soil types. Estelline soil is a fine silty or sandy skeletal mix with a slope of zero to nine. It is well drained and runoff is low to medium. Lamoure soil is a silty clay loam with a slope of one percent in a cultivated field. It is moist throughout and poorly drained. Trosky soil is a silty clay loam on a one percent slope in a cropped field. It is poorly drained and surface runoff is slow.

The Everly-Flandreau-Dickman soil complex is a combination of the following three soil types. Everly soil is clay loam and has a slope of three in a cultivated field. It is moderately well drained. Flandreau soil is a fine loam with a slope of three percent in a cultivated field. It is well drained and surface runoff is low on level areas and medium to high on the sloping areas. Dickman soil is a sandy loam with a slope of one percent on a glacial outwash plain in a cultivated field. It is excessively drained.

### 5.13.2 IMPACTS

Construction of the wind turbines and access roads will increase the potential for soil erosion during construction and convert prime farmland from agricultural uses to industrial uses. The amount of land that will be converted to wind turbines, transformer pads, and access roads will be determined once the site layout has been finalized. See Section 5.10.3 for a discussion of impacts to prime farmland.

### 5.13.3 MITIGATIVE MEASURES

A National Pollutant Discharge Elimination System (NPDES) permit application to discharge storm water from construction activities will be acquired by the Applicant from the MPCA. Best Management Practices (BMP) will be used during construction and operation of the Project to protect topsoil and adjacent resources and to minimize soil erosion. Practices may include containing excavated material, protecting exposed soil, and stabilizing restored material. In addition, the placement of wind turbines and access roads will be planned so that the conversion of prime farmland will be minimized.

# 5.14 GEOLOGIC AND GROUNDWATER RESOURCES

## 5.14.1 DESCRIPTION OF RESOURCES

Surficial geology within the Project area consists of mainly old loess-covered glacial till from the Verdi position of the Des Moines Lobe. This is described as clay-rich, calcareous, shale-poor till, and deeply weathered boulder gravel and coarse sand. This till is overlain by a layer of loess. Meltwater stream sediments from this period are also incorporated in the Project area. Thin bands representing old channels consists of sand and gravel with silty stream and wind blown sediments. These stream deposits are dendritic and well integrated (DNR, 1997)[1]. Surficial geology in northern Rock County and southern Pipestone County is relatively shallow, ranging from a depth of 0 to 100 ft (Anderson 1976).

Bedrock in the Project area is Sioux Quartzite. Quartzite is red and purple to light gray and may be interbedded with hard red claystone (pipestone). The thickness of this bedrock may be more than 1,000 ft (Anderson, 1976). Bedrock outcrops were noted in areas throughout the Project area. The surface of the bedrock appears to be highly fractured and eroded.

Ten active gravel mines are present within 5 miles of the Project area. (MnDOT 2001).

Jasper Stone Company actively mines Sioux quartzite approximately 3 miles west of the Project area.

Groundwater in the region is mainly supplied by surficial sand and gravel deposits and fractures within the Sioux quartizite. Generally the Project area lies atop materials that generally do not yield significant amounts of water. Sand and gravel deposits are scattered throughout in thin bands. The Project Area lies along a groundwater divide in the Sioux quartzite, where groundwater flows to the west, south, and east away from the center of the Project area. Water table elevations range from 1650 to 1700 ft AMSL. The sensitivity of these units to pollution is very high (hours to months) in the sand and gravel aquifers and moderate (year to decades) in the Sioux quartzite (DNR 1997)..

## 5.14.2 IMPACTS

Impacts to geologic and groundwater resources are not anticipated. Water supply needs will be quite limited. It is probable that operations and maintenance water requirements will be satisfied with either a well or rural water service.

Siting of turbines in areas of shallow bedrock may encounter issues relating to the construction of foundations. It appears that most of the bedrock found at the surface is highly eroded and fractured and would not require blasting to remove.

## 5.14.3 MITIGATIVE MEASURES

Wind turbine locations will not impact the use of existing water wells because the turbines will be sited according to State and County standards from occupied structures.

Measures will be taken to identify any nearby wells that could be impacted if blasting is required for the construction of turbine foundations. Local agencies such as the DNR, MPCA, and MDH will also

be contacted as necessary to determine what appropriate actions are needed to be protective of local groundwater resources.

## 5.15 SURFACE WATER AND FLOODPLAIN RESOURCES

### 5.15.1 DESCRIPTION OF RESOURCES

Surface water and floodplain resources for the Project area were identified by reviewing U.S. Geological Survey topographic maps and Minnesota Public Waters Inventory (PWI) map. There are no PWI lakes or PWI wetlands within the Project area. The Project area is located in the Big Sioux-Pipestone Watershed and the Rock River Watershed. All streams within the Project area are mapped as intermittent or perennial in nature. Many of these streams function as drainage swales within agricultural fields. There are four PWI streams located within the Project area (Beaver Creek, Poplar Creek, Mound Creek and an unnamed stream. Figure 5-11 shows the locations of surface waters and PWIs within the site. Federal Emergency Management Agency (FEMA) Flood Insurance Rate Maps (FIRM) have not been created within the Project area (FEMA, 2009). However, because the site drains toward the margins of the Project area and has extensive tile and surface drainage, floodplains within the Project area are likely limited to the margins of intermittent streams (FEMA 2009) .

### 5.15.2 IMPACTS

Construction of the wind turbines, transformer pads, and access roads will disturb land within the Project area. The wind turbines will be built on ridges and this will avoid lakes and streams located in the lower positions in the landscape. Access roads will be designed to minimize impacts to streams.

### 5.15.3 MITIGATIVE MEASURES

If the Project will impact waters of the U.S. or Minnesota PWIs, the Applicant will apply for the necessary permits prior to construction. Access roads constructed adjacent to streams and drainageways will be designed in a manner so runoff from the upper portions of the watershed can flow unrestricted to the lower portion of the watershed. A Storm Water Pollution Prevention Plan will be prepared and an NPDES permit will be obtained prior to the construction of the Project. Without FIRM maps of the Project area, it is unknown if the Project area is located within a 100-year floodplain. If the Project is determined to be located within a 100-year floodplain, the Applicant will work with local officials to minimize impacts.

## 5.16 WETLANDS

### 5.16.1 DESCRIPTION OF RESOURCES

National Wetland Inventory (NWI) data indicates that wetlands within the Project area are few, scattered, and relatively small (typically less than one acre in size). On-site review noted that some of these mapped NWI areas are in active cultivation and are not functioning as wetlands. Soils, topographic, and aerial photo data indicate that a several thousand-acre lake or wetland historically occupied the center of the Project area. This area is currently drained and in agricultural production.

Wetlands near the Project area were identified by reviewing NWI Maps and Minnesota PWI Maps. Some of the wetlands are associated with creeks and unnamed intermittent streams within the site and some of the wetlands are isolated basins. The NWI wetland types and their acreage within the Project boundary are presented in Table 5-7.

**Table 5-7. NWI Wetland Type and Acreage**

| NWI Type | Acreage |
|---|---|
| **Freshwater Emergent Wetland** | |
| PEM/FO1C | 0.7 |
| PEMA | 26.3 |
| PEMAd | 5.9 |
| PEMC | 77.0 |
| PEMCd | 20.3 |
| PEMF | 12.0 |
| **Freshwater Pond** | |
| PUBF | 1.2 |
| PUBFx | 0.3 |
| PUBGx | 21.4 |
| **Riverine** | |
| R2UBGx | 7.5 |
| Total | 172.6 |

[1] *Wetland acreage is calculated using USFWS NWI data.*

There is a total of 172.6 acres of NWI wetlands in the Project area: 142.2 acres of freshwater emergent wetlands, 22.9 acres of freshwater pond wetlands, and 7.5 acres of riverine wetlands. See Figure 5-12 for locations of NWI wetlands within the site.

### 5.16.2 IMPACTS

Wind turbines will be built on high elevations and this will avoid wetlands on the lower positions in the landscape. Access roads will be designed to minimize impacts on the wetlands.

### 5.16.3 MITIGATIVE MEASURES

Formal wetland delineations of the Project area will be completed prior to construction, and the layout will be designed to avoid and minimize wetland impacts. Wetlands will be avoided to the extent possible during the construction phase of the Project. If wetland impacts cannot be avoided, the Applicant will submit Section 404 and Minnesota Wetland Conservation Act permit applications to the U.S. Army Corps of Engineers and the state prior to construction.

# 5.17 VEGETATION

## 5.17.1 DESCRIPTION OF RESOURCES

According to The Ecological Classification System of Minnesota, areas of Rock and Pipestone counties are identified as historically tallgrass prairie or Prairie Coteau (DNR 2008). Typical tallgrass prairie vegetation includes bluestems (*Andropogon* spp), Indian grass (*Sorghastrum nutans*), Switchgrass (*Panicum virgatum*), Side Oats Grama (*Bouteloua curtipendula*), composites, and other forbs.

As a result of settlement in the mid-1800s, the area was converted into farmland. During this process, wetland and prairie areas were frequently cropped, ditched, and drained. Only a small fraction of the original prairie and wetlands remain as relic habitats. With the settlement of the area, periodic burning of the land halted as settlers did not want to endanger their property (homes, crops, livestock, etc.). Periodic burning recycled nutrients and decreased invasive plant competition. Trees were planted by landowners for shelter belts (windrows and homestead groves) or were established by natural means – transported to the area by animals, birds, or winds.

Based on review of aerial photographs, land use database information, and a visit to the Project area, it was determined that the majority of the land area at the site is cultivated. The grassland and wetland areas at the site may contain potential remnant native prairie areas. Native prairie is identified as lands that have never been plowed, with less than ten percent tree cover, and presence of native prairie vegetation. A list of prairie indicator species can be found in Appendix 3 and Supplement to Appendix 3 in Minnesota's Native Vegetation: A Key to Natural Communities, Minnesota Department of Natural Resources Natural Heritage Program, 1993.

The relative abundance of the major habitats in the Project area is shown in Table 5-8 (USGS 2009).

**Table 5-8. Major Habitats and their Relative Abundance in the Project Area**

| Habitat | Area (acres)* | Percent of Project Area |
|---|---|---|
| Aquatic | 1 | 0.01 |
| Cropland | 27,553 | 77.9 |
| Grassland | 7,700 | 21.8 |
| Marsh | 2 | 0.01 |
| Deciduous Forest | 76 | 0.21 |
| **Total** | **35,332** | **100** |

** approximations*

Crops include corn, soybeans, alfalfa, clover, wheat, oats, and hay. Range and pasture lands are used to graze cattle and horses. Heavily grazed range/pasture lands contain Kentucky bluegrass (*Poa pratensis*), quack grass (*Elytrigia repens*), and brome grasses (*Bromus spp*). Lightly grazed or undisturbed range land may contain native grass species including big blue stem, needle grass (*Stipa spp*), and gramma grass (*Bouteloua spp*).

CRP land is discussed in Section 5.10 and may be present within the Project area. CRP land is typically covered by brome grasses, orchard grass, and alfalfa. Land is typically put into CRP for 10-year cycles.

Approximately 78 acres of the site is wooded, according to U.S. Geological Survey (USGS) GAP land cover data. Generally, the wooded areas are isolated groves or windrows established by the landowner/farmers to prevent wind erosion and shelter dwellings. Typical tree species include white and bur oak (*Quarcus spp*), cottonwood (*Populus deltoids*), American elm (*Ulmus americana*), silver maple (*Acer saccharinum*), poplar (*Populus spp*), and willow (*Salix spp*).

Bedrock outcrop vegetation varies by regions in Minnesota. According to the DNR Native Plant Community Types, Crystalline Bedrock Outcrop typically is the vegetation type within the Project area. This is a rare bedrock outcrop that is generally covered with vascular species including brittle prickly pear (*Opuntia fragilis*), rock spikemoss (*Selaginella* P. Beauv.), rusty woodsia (*Woodsia ilvensis*), false pennyroyal (*Hedeoma Pers.),* devil's tongue (*Opuntia humifusa*), desert Parsley (*Lomatium orientale*), and little barley (*Hordeum pusillum*). Along with vascular plants, lichens including *Aspicilia cinerea* and *Rhizocarpon* are present. There is a potential for rainwater to pool in bedrock outcrops which creates a habitat for aquatic plants including water hyssop mousetail (*Myosurus minimus*), spring forget-me-not (*Myosotis verna*), and Caroline foxtail (*Alopecurus carolinianus*) (DNR 2010).

### 5.17.2 IMPACTS

The amount of vegetation that will be removed as a result of the Project will be determined once a site layout is finalized. Vegetation will be permanently removed and replaced by wind turbines, access roads, and substation components. The Project will likely also involve building a new O&M facility. Additional areas may also be temporarily disturbed for the installation of underground power lines during construction. Approximately three acres of land will be temporarily impacted for contractor staging and lay down areas. Temporarily disturbed areas will be reseeded to blend in with existing vegetation. The turbines will avoid forests and groves to maximize turbine output and reduce tree removal. Avoidance and minimization of impacts to wetlands and native prairies will reduce impacts to those vegetated areas.

### 5.17.3 MITIGATIVE MEASURES

The following measures will be used to avoid and minimize potential impacts to the vegetation of the Project area during siting, construction, and operation:

- Conduct a pre-construction inventory of the Project area for existing WMAs, recreation areas, wetlands, native prairie, and forests. The preconstruction inventories will have varying levels of detail with the most specific detail in the vicinity of construction;
- Exclude established WMAs and recreation areas from consideration for wind turbine, access road, or electrical line placement;

- Avoid disturbance of wetlands during construction and operation of the Project. If jurisdictional wetland impacts are proposed, then the Applicant will apply for wetland permits;
- Minimize the need to clear existing trees and shrubs;
- Use Best Management Practices (BMPs) during construction and operation of the Project to protect topsoil and adjacent resources and to minimize soil erosion. Practices may include containing excavated material, protecting exposed soil and stabilizing restored material, revegetating non-cropland and range areas with wildlife conservation species and, wherever feasible, planting native tall grass prairie species in cooperation with landowners;
- Completely avoid areas of exposed bedrock and associated plant communities; and
- Initial surveys will identify native prairie remnants in the vicinity of Project facilities. The Project will be designed to avoid impacts to prairie whenever feasible. If native prairie impacts are anticipated, the Applicant shall, with the advice of the DNR, and any others selected by the Applicant, prepare a prairie protection and management plan. The plan will be submitted to the PUC and DNR after issuance of the site permit and prior to construction. The plan shall address steps to be taken to identify native prairie within the Project area, measures to avoid impacts to native prairie, and measures to minimize and mitigate for impacts if unavoidable. Wind turbines and all associated facilities, including foundations, access roads, underground cable, and transformers, shall not be placed in native prairie unless addressed in the prairie management plan. Measures to be taken to mitigate unavoidable impacts to native prairie will be agreed to by the Applicant and DNR.

## 5.18 WILDLIFE

### 5.18.1 DESCRIPTION OF RESOURCES

The USFWS and the DNR were contacted to review the Project for wildlife species and avian issues, and a second letter requesting comments was sent to these agencies on March 12, 2010, after the Project boundary was expanded. Response letters dated August 3, 2009, and April 30, 2010, from the DNR, and responses from the USFWS dated October 2, 2009, and April 21, 2010, are included in Appendix A.

Information on the existing wildlife in the proposed wind farm area was obtained from a variety of sources including DNR, USFWS, Minnesota Ornithologist's Union County Checklists, and bat monitoring studies at Buffalo Ridge prepared for Xcel Energy. The following sections include a discussion of general wildlife that occurs in the Project area. Section 5.19 includes a discussion of wildlife that are considered by the state to be threatened or endangered (T&E) or of special concern.

Wildlife in the Project area consists of birds, mammals, fish, reptiles, amphibians, and insects, both resident and migratory, which utilize the habitat in the Project area for forage, breeding, and/or shelter. The resident species are representative of Minnesota game and non-game fauna that are associated with upland grass and farmlands with wetland and forested areas. The majority of the migratory wildlife species are birds including waterfowl, raptors, and songbirds.

WPAs are managed by the USFWS to protect breeding, forage, shelter, and migratory habitat for waterfowl or wading birds, such as ducks, geese, herons, and egrets. (USFWS 2009) WPAs provide opportunities for viewing wildlife and intact ecosystems. No WPAs were identified in the Project area. USFWS also administers a program by which the USFWS holds easements on private lands that have wetlands and/or grassland habitat. Development may be restricted on lands held in a USFWS easement. No easements are known to exist within the Project area; the USFWS has been contacted to verify the presence or lack of easements. The Touch the Sky Unit of the Northern Tallgrass Prairie National Wildlife Refuge (NWR) is located approximately 0.5 mile south of the Project area.

While there are no WMAs within the Project boundary, six WMAs totaling 434 acres are located within five miles of the Project area (Figure 5-6). These lands include the Ringneck Ridge, Elden, Jasper, Poplar Creek, Little Beaver Creek, and Springwater WMAs. WMAs provide habitat, breeding area, and food supply for many types of wildlife (DNR 2009). WMAs are state-owned and managed by the DNR to protect and enhance wildlife habitat. Animal populations are expected to be denser in these areas, including bird and bat populations, than in adjacent crop fields. Please see Section 5.7 for further discussion of WMAs near the Project area.

SNAs are areas designated to protect rare and endangered species habitat, unique plant communities, and significant geologic features that possess exceptional scientific or educational values (DNR 2009). There are no SNAs within 5 miles of the Project area.

Two state parks and two recreational trails are located within 5 miles of the Project Area. Split Rock Creek State Park is 1,300 acres located approximately three miles northwest of the Project area on Split Rock Lake in Pipestone County. Split Rock Creek State Park is home to common lake, prairie, and woodland wildlife. Blue Mounds State Park is 1,800 acres located approximately three miles southeast of the Project area (DNR 2009). Blue Mounds State Park houses many of the same species as well as a herd of bison and small population of coyotes and is known for unique rock outcroppings and tall cliffs.

RIM land involves the acquisition and enhancement of critical habitat, which may provide habitat for wildlife found in the Project area. DNR data indicates there are no RIM lands in or within two miles of the Project area. CRP may also be located within or in the vicinity of the Project and may provide habitat for local wildlife.

Included below is a discussion of migratory and resident birds, mammals, reptiles, amphibians and insects that are expected to exist in the Project area.

#### 5.18.1.1 Birds

Various migratory and resident bird species utilize the Project area as a part of their life cycle. (DNR 2009) Migratory bird species are those that may use the Project area for resting, foraging, or breeding activities for only a portion of the year. Resident bird species occupy the proposed wind farm site throughout the year. A list of migratory and resident bird species documented in the vicinity of the Project area is presented in Appendix C.

Upland game birds in the region include ring-necked pheasant (*Phasianus colchicus*) and mourning dove (*Zenaida macroura*). Common raptors in the region include red-tailed hawk (*Buteo jamaicensis*), American kestrel (*Falco sparverius*), and northern harrier (*Circus cyaneus*).

#### 5.18.1.2 Mammals

There are many different species of non-game mammals known to reside in the southwest region of Minnesota (Henderson *et al.* 1979). They include one marsupial (i.e. opossum), three insectivores (e.g. shrew), four bats, seven carnivores, six squirrels, and eleven other rodents (e.g. mouse). Rabbits and deer are also known to occur in this region. See Appendix C for a list of these species. These species use the food and cover available from agricultural fields, grasslands, farm woodlots, wetland areas, and wooded ravines. Grassland areas and woody vegetation are also habitat for a variety of small mammals. White-tailed deer (*Odocoileus virginianus)*, an economically important species, have a strong affinity for agricultural crops and use farm woodlots, wooded ravines, and intermittent stream bottoms for shelter.

Bat species present in Minnesota include the hoary bat (*Lasiurus cinereus)*, eastern red bat (*Lasiurus borealis)*, big brown bat (*Eptesicus fuscus*), silver-haired bat (*Lasionycteris noctivagans)*, northern myotis (*Myotis septentrionalis*), eastern pipistrelle (*Pipistrellus subflavus*) and little brown bat (*Myotis lucifiugus)*.

#### 5.18.1.3 Reptiles and Amphibians

Reptile and amphibian species that may be present in the Project vicinity include many snakes, frogs and turtles. A list of reptile and amphibian species, which may use the grassland, wetland and forested areas, is presented in Appendix C.

#### 5.18.1.4 Insects

While many insect species are important to the indigenous vegetation and wildlife, honeybees are the only species economically important in the Project area. Honeybees are considered a small but important part of southwest Minnesota's economy. Statewide, production from 130,000 colonies was valued around $9 million (USD) in 2007 (NASS 2009). Butterfly species are associated with native prairie plants.

### 5.18.2 IMPACTS

Development of the wind farm, including the construction and operation of the Project, is expected to produce a minimal impact to wildlife. Based on studies of existing wind power projects in the United States and Europe, the impact to wildlife would primarily occur to avian and bat populations. The final report (WEST 2000) on avian monitoring studies at Buffalo Ridge Wind Resource Area (WRA), Minnesota, which is the nearest and most relevant study to the Project area, identified the following impacts:

- Following construction of the wind turbines there is a reduction in use of the area within 100 m of the turbines by about 32 percent of species of grassland breeding birds. It was hypothesized that lower avian use may be associated with avoidance of turbine noise,

maintenance activities, and less available habitat. The researchers stated "on a large scale basis, reduced use by birds associated with wind power development appears to be relatively minor and would not likely have any population consequences on a regional level."

- Avian mortality appears to be low in the vicinity of the Project area at nearby Buffalo Ridge WRA compared to other wind facilities in the United States (WEST 2002). They found an overall avian mortality of 0.98 birds per turbine per year. Avian mortality is primarily related to nocturnal migrants. Resident bird mortality is very low and involves common species. The researchers stated that "based on the estimated number of birds that migrate through Buffalo Ridge each year, the number of wind plant related avian fatalities at Buffalo Ridge is likely inconsequential from a population standpoint."
- Bat mortality was studied at the Buffalo Ridge WRA in 2001 and 2002 by WEST. They found an overall mortality average of 2.16 bats/turbine/year. Approximately 82 percent of the bat mortality occurred from mid-July to the end of August. WEST found that "both the bat detector and mist net data indicate there are relatively large breeding populations of bats in close proximity to the wind plant that experienced little to no wind plant related collision mortality." It appears that most bat mortality at Buffalo Ridge involves migrating bats. Researchers highlighted that bat mortality increased with reduced distance between turbines and wetlands or woodlands. Turbines in this study were 750 KW turbines with a 50 m tower and rotor diameter 46 m or 48 m depending on blade length. The proposed turbines for the Prairie Rose Wind Project will be of a higher MW-age and larger rotor diameter.

The impact of the proposed Project on wildlife is expected to be minimal. There is potential for avian and bat collisions with facility turbines or meteorological towers. Additional impacts may include a small reduction in the available habitat that some of the wildlife uses for forage or cover. Operation of the wind farm will not change the existing land use.

### 5.18.3 MITIGATIVE MEASURES

The Applicant will implement the following measures, to the extent practicable, to help avoid potential impacts to wildlife in the Project area during selection of the turbine locations and subsequent Project development and operation:

- Conduct a pre-construction inventory of existing biological resources, native prairie, and wetlands in the Project area;
- Exclude established WMAs and recreation areas from consideration for wind turbine, access road, or feeder/collector line placement;
- Avoid or minimize disturbance of individual wetlands or drainage systems during construction of the Project;
- Avoid or minimize placement of turbines in high quality native prairie tracts, including complete avoidance of exposed bedrock and associated plant communities;
- Protect existing trees and shrubs that are important to the wildlife present in the area;
- Avoid construction activities within deer-wintering yards during winter;

- Maintain sound water and soil conservation practices during construction and operation of the Project to protect topsoil and adjacent resources and to minimize soil erosion. To minimize erosion during and after construction, BMPs for erosion and sediment control will be utilized. These practices include temporary seeding, permanent seeding, mulching, filter strips, erosion blankets, grassed waterways, and sod stabilization;
- Construct wind turbines using tubular monopole towers;
- Minimally light turbines according to FAA requirements;
- Revegetate non-cropland and pasture areas disturbed during construction or operation with an appropriate native seeding mix, in cooperation/coordination with landowners;
- Inspect and control noxious weeds in areas disturbed by the construction and operation of the Project; and
- Prepare and implement an Avian and Bat Protection Plan during construction and operation of the Project.

The Applicant is committed to minimizing wildlife impacts within the Project area. The Applicant will design their facility to minimize avian impacts by avoiding high use wildlife habitat, using tubular towers to minimize perching, placing electrical collection lines underground as practicable and minimizing infrastructure. In its August 3, 2009 response letter (Appendix A), DNR staff recommended additional setbacks from wetlands, streams, and associated habitat to minimize avian and bat mortality. The DNR also recommended two years of post-construction avian and bat mortality studies. In its October 2, 2009 and April 21, 2010 response letters, the USFWS recommended pre-construction avian surveys to assess bird and bat movement throughout the site. GWE will continue to consult with the USFWS and DNR regarding appropriate mitigation measures for wildlife impacts.

## 5.19 RARE AND UNIQUE NATURAL RESOURCES

### 5.19.1 DESCRIPTION OF RESOURCES

**Agency correspondence**

The USFWS and the DNR were contacted to review the Project for T&E species and unique habitats. Response letters from the DNR and USFWS are included in Appendix A.

A meeting was held with the USFWS on July 21, 2009 and meeting notes are included in Appendix A. The main discussion point from the meeting was the Topeka shiner (*Notropis topeka*) habitat and recommendations from the USFWS to minimize impacts include using BMPs to minimize erosion and sedimentation, address long-term erosion potential from turbine foundations or access roads into streams, and to protect tributaries. The USFWS recommended avoiding the stream in the southeast corner of the Project area.

In an April 30, 2010, response letter, the DNR Natural Heritage Program indicated that several rare features have been documented within a one-mile radius of the Project area. These include the following:

- Blanding's turtles (*Emydoidea blandingii*), a state-listed threatened species, have been reported from the vicinity of the proposed project. There are no records of occurrence within the Project boundary, but turtles have been documented in Poplar Creek, which extends into the project area and may occur in the wetlands and waterways within the project boundary. Blanding's turtles use upland areas up to and over a mile distant from wetlands and streams, and are susceptible to collisions with vehicles.
- Intermittent streams in the project boundary are either federally-designated as critical habitat for the federally listed endangered and state-listed special concern species, the Topeka shiner species, or flow into waterways that are federally designated as such. The plains topminnow (*Fundulus sciadicus*), a state-listed species of special concern, has also been identified in these streams. Decreased water quality or altered stream hydrology could adversely impact the Topeka shiner and the plains topminnow.
- Burrowing owls (*Speotyto cunicularia*), a state-listed endangered species, have nested in pastures within the project boundary in the past, and in 2007 this species successfully nested in a soybean field less than 5 miles from the project boundary. Burrowing owls typically use open, grazed pastures or native prairies populated by burrowing mammals. The DNR recommends a pre-construction survey for burrowing owls be conducted to determine if they are currently using the area and, if so, to assist in the placement of the turbines. The DNR recommends a quarter-mile buffer from burrowing owl territories.
- Several "Sites of Biodiversity Significance," identified by the Minnesota County Biological Survey (MCBS), are located within the project boundary (Figure 5-13). These sites have varying levels of native biodiversity and are ranked from "Below" to "Outstanding" based on the significance of this biodiversity. Ranking factors include the number of rare species documented within the site, the quality of native plant communities, and the size and context of the site within the landscape. Sites within the project boundary contain several state-listed plants and animals, and several rare native plant communities. The rare native plant communities within the project area include Mesic prairie, Crystalline Bedrock Outcrop: Sioux Quartzite Subtype, Basswood-Bur Oak-(Green Ash) Forest and Seepage Meadow/Carr Tussock: Sedge Meadow, which are all vulnerable to extirpation from the state. Avoidance of these areas will alleviate most of the Natural Heritage concerns.
- The Crystalline Bedrock Outcrops within the Project boundary contain several state-listed endangered (wolf's spike-rush, *Eleocharis wolfii*; blackfoot quillwort, *Isoetes melanopoda*; hairy water clover, *Marsilea vestita*) and threatened (pigmyweed, *Crassula aquatic*; short-pointed umbrella-sedge, *Cyperus acuminatus*; mud plantain, *Heteranthera limosa*; slender plantain, *Plantago elongata*) plant species. These rare species exist in bedrock outcrop communities. Outcrop communities are small features that are embedded within prairie, savanna, woodland, and forest and/or marsh vegetation. The outcrops within the project area are a rare subtype of outcrop that occurs in scattered locations throughout Rock, Pipestone and Cottonwood counties. The DNR recommended that any bedrock outcrop communities within the project area will need to be identified and avoided.

- The western fringed prairie orchid (*Platanthera praeclara*), a federally-listed threatened and state-listed endangered species, has been documented within a prairie remnant just outside of the Project area. These orchids usually occur in remnant native prairies and sedge meadows. Two Seepage Meadow/Carr Tussock native plant communities identified by the MCBS within Sites of Biodiversity Significance within the Project boundary may provide habitat for the western fringed prairie orchid. It is recommended that any suitable habitat for this species within the Project area will need to be identified and avoided.
- The Project area contains several prairie remnants which merit protection. Along with conserving these remnants the DNR is concerned with potential impacts to the grassland birds that depend on these prairies. Evidence suggests that grassland birds are deterred to some degree from nesting in these appropriate habitat areas due to the presence of tall structures. Because of the potential for wind turbines to cause avian mortality or displacement due to disturbance, the DNR encourages pre- and post-construction avian monitoring in general.

In an October 2, 2009 response letter, the USFWS discuss federally listed threatened, endangered, and candidate species. Other recommendations to migratory bird concentration areas and conservation lands were also included. The response letter includes the following:

- The Topeka shiner (*Notropis topeka*) – a federally endangered fish species found in Rock County. A designated Topeka shiner Critical Habitat intermittent stream extends into the southeast corner of the project boundary at sections 20 and 29, T104N, R45W. Impacts to this stream channel need to be avoided during project construction and operation. The Service must be notified if any type of preparation, construction, or land clearing work will be completed within 300 ft of all streams (intermittent and permanent) within or adjacent to the project area.
- Touch the Sky Prairie National Wildlife Refuge is located approximately two miles south of the proposed Prairie Rose Wind Farm. At this time, the Service does not have any concerns that the Project will negatively affect the Touch the Sky Prairie National Wildlife Refuge or the wildlife that utilize the refuge.
- The Service also recommends that no turbines be located within ¼ mile of CRP or WRP, or other similar federally- or state-funded restoration project.

Refer to the USFWS reference letter in Appendix A for a list of interim service guidelines and BMPs.

Because the Project boundary has been altered subsequent to the original agency consultation, a second letter was sent to the DNR and USFWS on March 12, 2010. The current Project boundary includes approximately 39 additional Township sections than the boundary did at the time of the original agency consultation. The original boundary was modified eastward at the request of the DNR to exclude some highly-ranked plant communities and known locations of rare species (Appendix A), and the Project boundaries were subsequently expanded to the north, east, and south. A response letter from the USFWS dated April 21, 2010, and a letter from the DNR dated April 30, 2010, are included in Appendix A.

In its April 21, 2010, response letter, the USFWS discuss federally listed threatened, endangered, and candidate species in the additional sections added since the initial response letter, and further recommendations to migratory bird concentration areas and conservation lands. The response letter includes the following comments in addition to their previous letter:

- A designated Topeka shiner Critical Habitat intermittent/perennial stream (Poplar Creek) also extends into sections 32 and 33, T105N, R45W of Pipestone County. The intermittent stream (Beaver Creek) designated Critical Habitat in the southeast portion of the project boundary also occurs in sections 21, 28 and 32, T104N, R45W of Rock County. An intermittent stream (tributatry to Beaver Creek) designated Critical Habitat, is within section 1, T103N, R46W and section 36, T104N, R46W of Rock County.
- Touch the Sky Prairie National Wildlife Refuge is now located approximately ½ mile from the proposed Project boundary. USFWS strongly recommends additional avian surveys in the vicinity of Touch the Sky Prairie National Wildlife Refuge.

**Natural Heritage Information System Data**

The DNR maintains a Natural Heritage Information System (NHIS) database through their Natural Heritage Program and Nongame Game Wildlife Program, which is the most complete source of data on Minnesota's rare, endangered, or otherwise significant plant and animal species, plant communities, and other rare natural features. NHIS data shows there are 98 recorded occurrences of special status species, plant communities or other unique natural features within a 1–mile radius of the Project area (Figure 5-13). The 98 recorded occurrences include 21 rare species or native plant communities within a one-mile radius of the Project area. The rare species include: blackfoot quillwort, Blanding's turtle, Buffalo grass (*Buchloe dactyloides*), burrowing owl, forget-me-not (*Myosotis verna*), hairy water clover, meadow popcorn-flower (*Plagiobothrys scouleri*), mudplantain, mudwort (*Limosella aquatica*), phlox moth (*Schinia indiana*), pigmyweed, plains topminnow, powesheik skipper (*Oarisma powesheik*), short-pointed umbrella-sedge, slender plantain, three stamened waterwort (*Elatine triandra*), Topeka shiner, tumblegrass (*Schedonnardus paniculatus*), water-hyssop (*Bacopa rotundifolia*), western prairie fringed orchid, and wolf's spike-rush. Native plant communities include the Basswood-Bur Oak-(Green Ash) Forest, Crystalline Bedrock Outcrop (Prairie): Sioux Quartzite Subtype, Dry Hill Prairie (Southern), Mesic Prairie (Southern), Prairie Meadow/Carr, Seepage Meadow/Carr Tussock: Sedge Subtype, and Wet Prairie (Southern).

### 5.19.2 IMPACTS

No impacts are anticipated to Rare and Unique Resources. Based on preliminary site observations, most of these approximately 20-acre prairie remnants are heavily degraded through intensive grazing and invasive vegetation; however, scattered patches of native habitat are present within these areas, particularly surrounding rock outcrops or where grazing has been less intense . The pastured areas are sharply defined by cropped field edges, and thus can be readily identified during micrositing. A pre-construction inventory of existing native prairie, woodlands, and wetlands will be conducted in the Project area. The Applicant will avoid the resources identified to the extent practicable. In

particular, the applicant will avoid all "Sites of Biodiversity Significance" ranked as "Outstanding," "High," or "Medium" and coordinate with the DNR if impacts are proposed to sites ranked as "Low" or "Below."

### 5.19.3 MITIGATIVE MEASURES

The Applicant will implement the following measures to avoid potential impacts to federal and state-listed species and rare or sensitive habitat in the area during selection of the wind turbines and access roads and the subsequent development and operation:

- Conduct a pre-construction inventory of existing biological resources, native prairie, bedrock outcrops, and wetlands in the Project area;
- Avoid or minimize disturbance of individual wetlands or drainage systems during construction of the Project; and
- Avoid or minimize placement of turbines in high quality native prairie or bedrock outcrops, including all MCBS "Sites of Biodiversity Significance" ranked as "Outstanding," "High," or "Medium," and to the extent practicable sites ranked as "Low."
- Avoid impacts to streams with Topeka shiner habitat by directionally boring electrical cabling under the stream channel when crossings are necessary, and using BMPs to minimize erosion or runoff into potential Topeka shiner streams;
- Incorporate the DNR's "Summary of Recommendations for Avoiding and Minimizing Impacts to Blanding's Turtle Populations" to minimize impacts to Blanding's turtles during construction activities. Because permanent access roads will be at-grade with existing cropped areas, they are not anticipated to affect Blanding's turtle movement.
- Continue to coordinate with DNR and USFWS to discuss potential impacts to unique and rare features.

## 5.20 SUMMARY OF IMPACTS

Included below is a summary of the impacts to key resources found within the Project area, including visual resources, land use, noise, and wildlife.

### 5.20.1 VISUAL

The wind turbine arrays will be prominent features in the landscape. By design, these structures are placed in open areas of higher elevations. Some mitigative measures, as described in Section 5.4, can be implemented to somewhat limit visual impacts. However, there is no way to make these structures unnoticeable. The degree to which the visual impacts are considered adverse is subjective, and can be expected to vary depending, for example, on how often the viewer sees the turbines. A shadow flicker analysis will be completed to aid in micrositing, and the final report will be made available to the PUC prior to construction.

### 5.20.2 LAND USE

The Project area includes a total of 35,335 acres of land. Less than one percent will be permanently converted from natural vegetation or agricultural field for siting wind turbines, access roads, and

transformer pads. Approximately 4.02 acres of land will be converted for the 1.5 MW turbines; 3.36 acres of land will be converted for 1.8 MW turbines, and 2.58 acres for 2.3 MW turbines. Approximately 21 to 32 acres of land will be converted for the access roads. An additional 6 acres of land will be used for the O&M facility and substation construction. The existing land use will continue on the remainder of the land.

### 5.20.3 NOISE

When in motion, the wind turbines emit a perceptible sound. The level of this noise varies with the speed of the turbine and the distance of the listener to the turbine. On relatively windy days, the turbines create more noise. However, the ambient or natural noise level from the wind tends to override the turbine noise as distance from the turbines increases. Turbines will be set back from occupied residences based on state noise regulations.

### 5.20.4 WILDLIFE

Birds and bats occasionally collide with wind turbines. The mortality associated with these collisions has been identified as inconsequential from a population standpoint on Buffalo Ridge. In addition, turbines may result in reduced use of habitat by grassland bird species within 100 m (328 ft) of the turbine.

The impact of the proposed Project on wildlife is expected to be minimal. Roughly 29 to 42 acres of crop land will be converted for the access roads, turbine pads, O&M facility, and substation. This will reduce available habitat that some of the wildlife uses for nesting, forage or cover.

## 5.21 SUMMARY OF PRECONSTRUCTION INVENTORIES

The Applicant has already and/or will conduct the following resource inventories for the Project area prior to construction.

- Biological Resources Survey – inventory of existing WMAs, SNAs, recreation areas, wetlands, native prairies, bedrock outcrops, forests, and other biologically sensitive areas within the Project area;
- Wetland Delineations;
- Noise Studies;
- Archaeological Reconnaissance Survey; and
- Electromagnetic Interference Study – inventory of microwave beams and television signal reception within the Project area.
- Shadow Flicker analysis

The Applicant will submit copies of these preconstruction inventories to the PUC at the preconstruction meeting, as well as maps depicting how these resources are being avoided, or if avoidance is not feasible, minimization and mitigation measures that will be taken.

## 5.22 EXCLUSION AND AVOIDANCE CRITERIA AND SITE DESIGNATION SUMMARY

State law governing the siting of traditional electric generating facilities requires that certain environmental features be avoided. These requirements will be applied in determining the location of the proposed wind turbines and related appurtenances on the Prairie Rose site. Table 5-9 identifies these features to be avoided and whether or not such features exist within the Project area. For those categories where these exclusion/avoidance features are present within the site boundaries, the final locations of the turbines will be selected to not interfere with them. Hence, this table reflects the ease, or degree of flexibility, in siting the turbines, for a given type of environmental feature.

**Table 5-9. Exclusion/Avoidance Features Relative to Project Area**

| Exclusion/Avoidance Feature | Presence in Project Area |
|---|---|
| National Parks | None |
| National Historic Sites | None |
| National Historic Districts | None |
| National Wildlife Refuges | None |
| National Monuments | None |
| National Wild, Scenic and Recreational Riverways | None |
| National Wilderness Areas | None |
| State Wild, Scenic and Recreational Rivers | None |
| State Parks | None |
| Nature Conservancy Preserves | None |
| State Scientific and Natural Areas | None |
| State Wilderness Areas | None |
| Registered Historic Sites/Dist. | None |
| Waterfowl Production Areas | None |
| State Wildlife Mgmt. Areas | None |
| County and Municipal Parks | None |
| State and Federal Rec. Trails | Present (Figure 5-6) |
| Designated Trout Streams | None |
| DNR Canoe/Boating Routes | None |
| Prime Farmlands | Present |
| Wetlands | Present (Figure 5-12) |
| Streams Within Site Boundaries | Present (Figure 5-11) |
| Residences | Present |

# 6.0 IDENTIFICATION OF REQUIRED PERMITS/APPROVALS

The potential federal and state permits or approvals that have been identified as being required for the construction and operation of the Project are shown in Table 6-1.

**Table 6-1. Permits and Approvals**

| Regulatory Authority | Statute | Permit/ Approval | Description | Trigger | Fee | Application Timeline | Website |
|---|---|---|---|---|---|---|---|
| **Federal Approvals** | | | | | | | |
| FAA | 49 USC 44718 | Notice of Proposed Construction (Form 7461-1) Hazard Determination | Notifies FAA of proposed structures that might affect navigable airspace. Form requires proposed markings and lighting. FAA must review possible impacts to air safety and navigation, as well as the potential for adverse effects on radar systems. | All turbines/ structures over 200 feet tall; and/or turbines/ structures fewer than 200 feet tall near an airport. | No fee. | One week to prepare application; submit notice at least 30 days prior to anticipated start of construction or before the application for construction permit is filed. | http://www.faa.gov/ |
| USACE | Clean Water Act | Section 404 Permit | Required for the discharge of dredged or fill material into waters of U.S. Minimal levels of file may be covered under existing General Permits/Letters of Permission | Presence of waters of the U.S. | No fee. | Depending on level of fill and type of permit required (individual vs. Letter of Permission) | http://www.usace.army.mil/ |

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| Regulatory Authority | Statute | Permit/ Approval | Description | Trigger | Fee | Application Timeline | Website |
|---|---|---|---|---|---|---|---|
| **State Approvals** | | | | | | | |
| Minnesota Public Utility Commission | Pursuant to Minnesota Statute §216F.08 | LWECS Site Permit | For facilities with greater than 25 MW nameplate capacity. | Generation of power described in previous column. | To be determined by PUC upon receipt of application | 180 days prior to construction (minimum). | https://webrh12.revisor.leg.state.mn.us/statutes/?id=216F |
| Minnesota Public Utilities Commission | Minnesota Statutes §§216B.2421 and 216B.243, subd. 2, and Minnesota Rules Chapter 7849 | Certificate of Need | Needed for a large energy project in Minnesota. Commission determines basic types of facility to be constructed, size of facility, and the time of the facility | Project nameplate is greater than 50 MW | To be determined by PUC. | Notice of intent must be filed 3 months prior to application. Following the filing, application process generally takes one year. | https://webrh12.revisor.leg.state.mn.us/rules/?id=7849 |
| Minnesota Pollution Control Agency | Clean Water Act | Section 401 Certification | Verify that project construction would comply with state water quality standards. | Wetland impacts proposed that do not qualify for Section 404 GP/LOP. | No fee. | Prior to construction activities. | http://www.pca.state.mn.us/water/401.html |
| Minnesota Pollution Control Agency | National Pollutant Discharge Elimination System Act | General Permit (Construction) | For stormwater discharges from construction activities | Grading of more than 1 acre. | $400 | Permit to be filed prior to construction with a SWPPP. Construction Stormwater Permit. | http://www.pca.state.mn.us/publications/wq-strm2-05.pdf |

| Regulatory Authority | Statute | Permit/ Approval | Description | Trigger | Fee | Application Timeline | Website |
|---|---|---|---|---|---|---|---|
| Minnesota Pollution Control Agency | Minnesota Hazardous Waste Rules Chapter 7045 | License for Very Small Quantity Generator of Hazardous Waste | For discharge of hazardous waste. | Generate 220 pounds or less per month hazardous waste | $413 | Apply annually. Permits are issued once per year in June. | http://www.pca.state.mn.us/publications/w-hw7-09.pdf |
| Minnesota Department of Natural Resources | Minnesota Statute Chapter 84.415. | License to Cross Public Land and Water | For projects that affect the course, current, or cross-section of DNR Public Waters, or for utility crossings of Public Lands | DNR Public Waters, Wetlands, or Watercourses, or Public Lands affected. | $2,000 for public waters or $5,000 for public lands | Prior to impact. Process takes 60 to 90 days. | http://www.dnr.state.mn.us/waters/watermgmt_section/pwpermits/applications.html |
| Minnesota Board of Water and Soil Resources | Wetland Conservation Act (WCA) | WCA Approval | For wetland impacts. Ranges from an exemption for small or temporary impacts to a permit and mitigation for greater impacts | Impacts to any wetland in the state. | To be determined by LGU | Permit application process takes up to 60 days. | http://www.bwsr.state.mn.us/wetlands/forms/index.html |
| Minnesota Department of Transportation | Minnesota Statute 505, Minnesota Rules 8810.0050 | Access Driveway Permit | Required to provide driveway access to state owned right of way. | Project requires change in access to or from state right of way or change in use of property. | To be determined by MnDOT | Prior to construction-process takes 30 days. | http://www.dot.state.mn.us/utility/ |

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| Regulatory Authority | Statute | Permit/ Approval | Description | Trigger | Fee | Application Timeline | Website |
|---|---|---|---|---|---|---|---|
| Minnesota Department of Transportation | Minnesota Statute 161.45, Minnesota Rules 8810.3100-8810.3600 | Utility Permit on Trunk Highway Right of Way | Required to install utilities within state owned right of way. | Project requires use of state right of way for utility route or crossing. | To be determined by MNDOT | Prior to construction. Process takes 4 to 6 weeks | http://www.dot.state.mn.us/utility/ |
| Minnesota Department of Transportation | Minnesota Statute 169.862 | Wind Energy Transportation Oversize and/or Overweight Permit | Required to transport oversize loads on state maintained roads. | Project construction requires oversize/ overweight truck loads. | 60-day $36 | Permit required prior to construction. | http://www.dot.state.mn.us/cvo/oversize/Wind%20Energy%20Application%20Form.pdf |
| Minnesota Department of Transportation | Minnesota Statute 360.83 | Tall Structure Permit | Required for wind turbines and other tall structures | Structure more than 200 feet above ground level within 3 miles of an airport and increasing by 100 feet for each additional mile out to 6 miles and 500 feet | None | Review takes approximately 2 weeks; submittal must include FAA Aeronautical Study Determination | http://www.dot.state.mn.us/aero/avoffice/talltowers.html |
| Minnesota Department of Health | Minnesota Statutes, Chapter 103I, Minnesota Rules, Chapter 4725 | Water Supply Well Notification | New water supply well construction. | Construction of new water supply well. | $215 | Prior to well installation. Once fee and notification are received by DOH, well installation can begin. | http://www.health.state.mn.us/divs/eh/wells/construction/construct.html |

| Regulatory Authority | Statute | Permit/ Approval | Description | Trigger | Fee | Application Timeline | Website |
|---|---|---|---|---|---|---|---|
| Minnesota Department of Health | Minnesota Statutes326B.49 Subd. 2. | Plumbing Plan Review | Required to ensure compliance with Minnesota Plumbing Code | New plumbing system in commercial buildings (i.e. O&M Facility) | $150 | Prior to construction of O&M. | http://www.dli.mn.gov/CCLD/PDF/pe_plumbplanrevapp.pdf |
| **Local Regulations** | | | | | | | |
| Rock County | County Regulations | Right-of-way permits, road access permits, driveway permits for access roads and electrical collection system. | N/A | N/A | N/A | N/A | http://www.co.rock.mn.us/ |
| Rock County | Wetland Conservation Act (WCA) | WCA Approval | For wetland impacts. Ranges from an exemption for small or temporary impacts to a permit and mitigation for greater impacts | Impacts to any wetland in the state. | To be determined by LGU | Permit application process takes up to 60 days. | http://www.rockswcd.org/ |
| Pipestone County | Wetland Conservation Act (WCA) | WCA Approval | For wetland impacts. Ranges from an exemption for small or temporary impacts to a permit and mitigation for greater impacts | Impacts to any wetland in the state. | To be determined by LGU | Permit application process takes up to 60 days. | http://www.pipestoneswcd.org/ |

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| Regulatory Authority | Statute | Permit/ Approval | Description | Trigger | Fee | Application Timeline | Website |
|---|---|---|---|---|---|---|---|
| Pipestone County | County Regulations | Right-of-way permits, road access permits, driveway permits for access roads and electrical collection system. | N/A | N/A | N/A | N/A | http://www.co.pipestone.mn.us/ |
| Denver Township | Township Regulations | | N/A | N/A | N/A | N/A | N/A |
| Rose Dell Township | Township Regulations | | N/A | N/A | N/A | N/A | N/A |
| Springwater Township | Township Regulations | | N/A | N/A | N/A | N/A | N/A |
| Eden Township | Township Regulations | | N/A | N/A | N/A | N/A | N/A |
| Elmer Township | Township Regulations | | N/A | N/A | N/A | N/A | N/A |

# 7.0 REFERENCES

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# 8.0 ABBREVIATIONS

| | |
|---|---|
| AADT | Annual Average Daily Traffic |
| BMP | Best Management Practices |
| CON | Certificate of Need |
| CR | County Road |
| CRP | Conservation Reserve Program |
| CSAH | County State Aid Highway |
| dBA | A-Weighted Decibels |
| DNR | Minnesota Department of Natural Resources |
| DOC | Department of Commerce |
| EMF | Electric and Magnetic Field |
| FAA | Federal Aviation Administration |
| FCC | Federal Communications Commission |
| FEMA | Federal Emergency Management Agency |
| FIRM | Flood Insurance Rate Map |
| ft | Feet |
| GE | General Electric |
| kV | Kilovolt |
| kW | Kilowatt |
| LWECS | Large Wind Energy Conversion System |
| m | Meter |
| m/s | M per second |
| MCBS | Minnesota County Biological Survey |
| MDH | Minnesota Department of Health |
| MISO | Midwest Independent System Operator |
| MnDOT | Minnesota Department of Transportation |
| MPCA | Minnesota Pollution Control Agency |
| mph | Miles per hour |
| MW | Megawatt |
| MWh | Megawatt hour |
| NCDC | National Climatic Data Center |
| NPDES | National Pollutant Discharge Elimination System |
| NRCS | Natural Resources Conservation Service |
| NRHP | National Register of Historic Places |
| NWI | National Wetland Inventory |
| O & M | Operations and Management |
| OES | Minnesota Department of Commerce ,Office of Energy Security |
| PCB | Polychlorinated Biphenyls |
| PLS | Public Land Survey |
| PPA | Power Purchase Agreement |

| | |
|---|---|
| PUC | Minnesota Public Utilities Commission |
| PWI | Public Waters and Wetlands Inventory |
| RD | Rotor Diameter |
| RIM | Reinvest in Minnesota |
| SCADA | Supervisory Control and Data Acquisition System |
| SHPO | State Historic Preservation Office |
| SNA | Scientific and Natural Area |
| T&E | Threatened and Endangered |
| TI | Turbulence Intensity |
| USDA | U.S. Department of Agriculture |
| USFWS | U.S. Fish and Wildlife Service |
| USGS | U.S. Geological Survey |
| V | Volts |
| WMA | Wildlife Management Area |
| WPA | Waterfowl Protection Area |
| WRA | Wind Resource Area |

# Figures

# Appendix A

# Agency Correspondence

# Appendix B

# Cultural Resources Memorandum

# Appendix C

# Animals in Project Area