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# Site Permit Application for a Large Wind Energy Conversion System

## Jeffers Wind Energy Center

*Docket Number: 05-96-LWECS-SW*

June 2005

*Prepared For*
*Wind Energy Developers, LLC*
*Chaska, Minnesota*
*on behalf of Summit Wind, LLC*



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# Wind Energy Developers, LLC

June 17, 2005

Mr. Larry B. Hartman
Minnesota Environmental Quality Board
658 Cedar Street, Room 300 Centennial Building
St. Paul, Minnesota 55155

**Subject: Docket No. 05-96-LWECS-SW - LWECS Permit Application**
**Proposed Jeffers Wind Energy Center - Cottonwood County**

Dear Mr. Hartman:

On behalf of Summit Wind, LLC (Summit), Wind Energy Developers, LLC (WED) is submitting three copies of an application to the Minnesota Environmental Quality Board (MEQB) for a Site Permit to construct and operate a Large Wind Energy Conversion System (LWECS). Summit is a corporation formed by 34 area landowners to facilitate development of the subject property as a wind farm investment. WED, based in Chaska, Minnesota, is the developer for this project, and is functioning as the agent of Summit for the permitting, construction, and operation of the Jeffers Wind Energy Center.

Contact information for WED, and also for RMT, Inc., who prepared the application on behalf of WED/Summit, is summarized on page "v" of the application. Upon approval, please issue the permit to Summit Wind, LLC, in care of Patrick Pelstring of WED, the authorized representative for Summit.

In response to your request, an installment of $5,000 for the MEQB review fee will be sent under separate cover. The balance of the review fee will be paid upon receipt of a forthcoming MEQB invoice.

If you have any questions, please contact me, at 952-361-5445, or Joel Schittone, of RMT, at 608-662-5433.

Sincerely,

Wind Energy Developers, LLC

Patrick W. Pelstring
Partner

Attachment: LWECS Permit Application (3 copies)

cc: Jack Levi – WED
Joel Schittone, Mark Osten – RMT, Inc.

**120 South Sixth Street, Suite 2490, One Financial Plaza, Minneapolis, MN 55402**
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# Section 1
# Introduction

Summit Wind, LLC (Summit), is submitting this application to the Minnesota Environmental Quality Board (MEQB) for a Site Permit to construct and operate a Large Wind Energy Conversion System (LWECS), as defined in the Wind Siting Act, Minnesota Stat. 116C.691. The proposed project, the Jeffers Wind Energy Center, will be 60 (nominal) (MW) in size, located in Cottonwood County (Figure 1-1).

Wind Energy Developers, LLC (WED), based in Chaska, Minnesota, is the developer for this project, and is functioning as the agent of Summit for the permitting, construction, and operation of the Jeffers Wind Energy Center. As the party of ownership, the site permit should be issued to Summit Wind, LLC, in care of Patrick Pelstring of WED, the authorized representative for Summit. His signature attesting to this role is presented on page v of this report and in the cover letter transmitting this report. For ease of review, where appropriate, WED will be referenced as the applicant representing Summit in the remainder of this application.

A third party may be involved in the long-term operation of this facility, although there are no plans for this at this time. WED has no ownership or financial interest in any operating LWECSs in Minnesota.

This development furthers state policy to site such projects in an orderly manner compatible with environmental preservation, sustainable development, and efficient use of resources by:

- conducting a thorough review of the area land practices and community interests to ensure compatibility;
- evaluating wildlife, historic, and archeological information to avoid and minimize potential impacts;
- including area landowners in an offering for participation in the development; and
- verifying that the area wind and electric transmission resources are compatible for generating and delivering large amounts of energy.

The project will be built in two phases, with consideration given to further development in the future. Phase I is anticipated to be fully commercially operational by December 31, 2005. It is WED's intent for Phase II to be fully commercially operational by December 31, 2006.

Phase I will consist of four Clipper 2.5 megawatt (MW) wind turbine generators and an electrical collector system. The turbines will be mounted on 80-meter (262 feet)–high freestanding tubular towers. The rotor diameter of each turbine is 93 meters (305 feet). The electrical collector system will include underground 34.5 kV collection lines and facilities providing step-up transformation. The 10 MW of power generated from Phase I will be delivered to a new switchyard planned adjacent to the Storden Junction Substation with interconnect to the grid at the Storden Junction Substation. The Storden Junction Substation is owned by Interstate Power & Light Company. The 10 MW of power generated from Phase I will be sold to the Central Minnesota Municipal Power Agency (CMMPA) under a Power Purchase Agreement, which has already been negotiated and agreed upon by all parties. The CMMPA provides wholesale power for 16 member municipal electric utilities located mostly in central Minnesota.

Phase II will consist of 28 Vestas 1.8 MW wind turbine generators, or an equivalent turbine model, and an additional 34.5 kV collection system facilities. The turbines will be mounted on 78-meter (256 feet–high) freestanding tubular towers. The rotor diameter of each turbine is 80 meters (262 feet). Grid interconnection will be at the switchyard located adjacent to the nearby Storden Junction Substation. It is anticipated that power will be sold to Xcel Energy under a separate Power Purchase Agreement, which is under negotiation. Xcel Energy is an investor-owned electric utility serving 10 Western and Midwestern states, including Central Minnesota.

A Certificate of Need from the Minnesota Public Utilities Commission (PUC) is not required for either Phase I or Phase II. Phase I is under 50 MW, and is not subject to this approval. Phase II is the result of Xcel Energy's Request for Proposal bid process under the state's Wind Mandate; therefore, per Minnesota Statute 216B, a Certificate of Need will not be required for Phase II.

The land at the site has been leased to Summit, a corporation formed by 34 area landowners to facilitate development of the property as a wind farm investment. As shown on the Site Layout (Figure 1-2) and the Aerial Photograph of the Project Area (Figure 1-3), the proposed project site and additional property under option for potential future development (referred to as the "project area" in whole) is currently under agricultural use, and is outside the boundaries of wetlands and wildlife protection areas. A permit is requested for the geographic area consisting of 13 sections of land under the control of Summit, identified as the "project site" on Figures 1-2 and 1-3.

On the basis of the site inspections and technical reviews conducted to date by the project development team and discussions with local, state, and federal agencies, including the U.S. Fish and Wildlife Service (USFWS), the Minnesota Department of Natural Resources

(MDNR), the MEQB, and Cottonwood County, no local land use, zoning, or environmental barriers to site development were found. Any such issues later identified will be addressed.

There is strong local support for the proposed project as documented by significant landowner participation and resolutions of support from the City of Jeffers and Cottonwood County, copies of which are included in Appendix A. An archaeological and architectural history literature search has been conducted, and is included in Appendix B. On-site wind data continue to be collected to confirm the wind resource.

# Section 2
# Proposed Site

## 2.1 Identification of Project Area

The proposed Jeffers Wind Energy Center is located near Jeffers, south of Highway 30, in Cottonwood County, Minnesota (see Figure 1-2). The MEQB permit is requested for the geographic area under consideration for development (*i.e.*, project site), consisting of the 13 sections of land located in four townships. The land is owned by local farmers who joined to form Summit. WED controls the right to develop wind energy on the properties through an option-to-lease arrangement.

The project site requested for the subject permit consists of the following 13 sections:

- T107N, R37W (township of Storden): Sections 22, 23, 24, 25, 26, 27, 35, and 36
- T106N, R37W (township of Amo): Section 1
- T107N, R36W (township of Amboy): Sections 19, 30, and 31
- T106N, R36W (township of Dale): Section 6

Two parcels within the project site are excluded, those located in the Township of Storden, Sections 25 and 27, as shown on Figure 1-2.

For Phase I, four Clipper 2.5 MW wind turbines are proposed for installation in the northern portion of the township of Storden, Section 36 (Figure 1-2). The Phase I underground electrical collector system will run through portions of Section 36, 25, 26, 27, and 28 (all within the township of Storden), terminating at the existing Storden Junction Substation.

For Phase II, 28 Vestas 1.8 MW (or equivalent) wind turbines and an associated collector system are proposed for installation at locations shown on Figure 1-2. The Phase II turbine locations shown are approximate, and are subject to change pending final design. The electrical collector system for Phase II will be developed during the final design. It is anticipated that a new switchyard will be installed adjacent to the Storden Junction Substation with final grid connection at the Storden Junction Substation.

Phase II also includes an operations and maintenance (O&M) facility.

The remaining properties in the geographic project area under control by WED (*i.e.*, township of Amboy, Sections 21, 22, 27, 28, 29, 32, 33, and 34) will be held for other potential future

development. Although the locations of turbines as shown in Figure 1-2 are preliminary and subject to change, the locations indicated were chosen on the criteria of maximizing the wind resource and wind revenues, setbacks, and landowner preferences.

## 2.2 Wind Characteristics in Project Area

An accurate representation of the site's wind resources is critical to estimating energy production, as there is a third-power relationship between wind speed and energy. That is, if wind speed were to double, the power available is eight times more than previous. The best way to estimate long-term wind resources is to have site-specific wind speed information.

The Jeffers site is fortunate in that several bodies of data are available from which estimates of the average wind speed can be derived. These bodies of data are as follows:

- Eighteen months of monitoring data from the 2002 Minnesota Department of Commerce Wind Resource Analysis Program (WRAP). According to the WRAP report, the Jeffers WRAP tower was located in the township of Storden, Section 36, within the proposed project area (see Figure 1-2). Measurements from this tower were taken at heights of 10, 30, and 40 meters (33, 98, and 131 feet). A summary of these data that were recorded from May 1999 through October 2000 is included in Appendix C-1. This tower has been abandoned.
- WED installed a site meteorological tower in the township of Storden, Section 26 (see Figure 1-2) in the fall of 2004, which is recording wind speed, direction, and temperature at heights of 40, 50, and 60 meters (131, 164, and 197 feet). A summary of these data for the period from the end of August 2004 through the end of May 2005 is included in Appendix C-2.
- A computational study by WindLogics, Inc., that used the WRAP tower location and elevation as its reference point. An analysis was provided for both 65 and 80 meters (213 and 262 feet). Wind data based on the WindLogics report are included in Table 2-1.
- Wind maps produced by the State of Minnesota depicting state wind resources at 50 and 70 meters (164 and 230 feet).
- A recent study sponsored by the Minnesota Department of Commerce, "Characterization of the Wind Resource in the Upper Midwest," which details wind resources in southwestern Minnesota, especially the area known as Buffalo Ridge, which is located in the counties just west, northwest, and southwest of Cottonwood County. In this study, WindLogics provided a map of average wind speed at 80 meters (262 feet) covering the area including the project site.

The general area, including the project area, has steady winds throughout the year. The project area is classified as a Class 4 wind site (roughly equivalent to IEC Class IIB), having average

annual wind speeds in the range of 7.0 to 7.5 meters/second (m/s) (15.7 to 16.8 miles/hour) at a height of 50 meters (164 feet).

The annual average wind speed found in data reported by WRAP for the Jeffers tower is 7.0 m/s (15.7 miles/hour) at 30 meters (98 feet). Extrapolation to 65 meters (213 feet) using average wind shears reported by WRAP gives an average wind speed of 8.2 m/s (18.3 miles/hour). This confirms the normalized average WindLogics wind speed of 8.18 m/s at 65 meters (18.3 miles/hour at 213 feet) for the identical location. The data collected at the site tower are consistent with previous analyses.

### 2.2.1 Interannual Variation

The expected annual average wind speed at the site is 8.5 m/s at an 80-meter hub height (19.0 miles/hour at 262 feet). Computer modeling typically indicates that average wind speed has a 50% probability of occurrence in any given year, and any given year will be within 10% of the expected average wind speed about 90% of the time.

### 2.2.2 Seasonal Variation

Table 2-1 gives predicted monthly average wind speeds for the site at a height of 80 meters (262 feet) (hub height). Wind speeds are highest in the spring, fall, and winter months, and decrease during the summer months.

### 2.2.3 Diurnal Conditions

Figure 2-1(A) shows projected wind speeds throughout the day at a height of 65 meters (213 feet), based on computer modeling. Figure 2-1(B) shows wind speeds throughout the day at a height of 30 meters (98 feet), based on data recorded by the WRAP Jeffers tower.

### 2.2.4 Atmospheric Stability

While current reports from the meteorological tower for the site do not include atmospheric stability, it is expected to be "moderately stable" in the general area, since stability conditions for the open and relatively flat terrain in the Central Minnesota region do not vary significantly. Storm events can occur in the area, although their intensity, frequency, and duration are not unusual, and other similar wind farms have been placed in similar environments.

### 2.2.5 Hub Height Turbulence

The turbulence intensity (TI) is defined as the measured standard deviation of wind speeds, divided by the mean wind speed for the same time period. Turbine manufacturers may request TI for a site, preferably from wind speeds recorded in 10-minute intervals, as a means of predicting the durability of their units. A calculation based on the Jeffers WRAP tower, 10-minute wind speed data at 30 meters (98 feet), yields an expected TI of 0.116 when all wind speeds are included.

### 2.2.6 Extreme Wind Conditions

Extreme wind speeds may occur with winds from any of the prevailing directions and may happen during any season. Wind speeds in the 200+ mph (89 m/s) range can occur in a tornado; tornadoes have occurred in the general region of the site over a 30-year period.

### 2.2.7 Wind Speed Frequency Distribution

Figure 2-2 shows the expected wind frequency distribution at a height of 65 meters (213 feet). About 30 percent of the wind is at speeds between 6 and 9 m/s (13 and 20 miles/hour) at this height.

### 2.2.8 Wind Variation with Height

Wind variation with height can be assessed by observation of the wind shear from the wind power law. The mathematical formula for wind shear ($\alpha$) is as follows:

$$\alpha = \ln(V/V_o) / \ln(H/H_o),$$

where

$V_o$ and $H_o$ are wind speed and height associated with a lower height, and
$V$ and $H$ are wind speed and height at a higher height.

Analyses of the wind shear data have shown significant variation, depending on season, direction, and time of day. Based on the 18 months of WRAP tower data at the site, the average wind shear for the site is 0.20 (Appendix C-1).

### 2.2.9 Spatial Wind Variation

Other than variations due to elevation changes across the site, the Jeffers Wind Energy Center expects little wind variation across the project area due to relatively open terrain.

### 2.2.10 Wind Rose

The primary average wind direction for the site is south by southwest, with a strong secondary component from the north by northwest. Winds are primarily north by northwest in the winter months. Figure 2-3A, obtained from the WRAP report (Minnesota Department of Commerce, 2002) for the Jeffers tower, shows a complete wind distribution rose. A wind rose from the active site meteorological tower is shown on Figure 2-3B.

## 2.3 Other Meteorological Conditions at Proposed Site

### 2.3.1 Average Weather Conditions

Table 2-2 presents average monthly meteorological conditions for the proposed site, based on National Weather Service data recorded at the Cottonwood County Airport.

### 2.3.2 Extreme Weather Conditions

Extreme weather conditions that would affect wind turbine performance at the site include ice storms, tornadoes, and severe thunderstorms. These weather events strike occasionally, but are of short duration. They result in sparse damage in small areas. Wind farms have been located in similar settings in Minnesota.

In the winter, icing events are variable in frequency. Annual energy losses due to icing on the turbine blades are estimated at 2 percent.

The turbines are programmed to shut down when wind speeds exceed 25 m/s (56 miles/hour) to minimize damage to parts during extreme winds.

Hail occasionally falls in scattered small areas during the warmer periods. Hail and lightning from severe storms do not present a problem for operation of the turbines because the units are made with durable materials and have lightning protection.

Energy projections are summarized in Section 10.

## 2.4 Location of Other Wind Turbines in General Area

Appendix D contains an updated listing of existing and planned wind projects in Minnesota, based on information provided by the U.S. Department of Energy. Nearby wind projects are numerous in the adjacent counties of Murray, Pipestone, Jackson, and Lincoln.

# Section 3
# Wind Rights

WED has obtained lease and easement option agreements and/or rights to such agreements with landowners for land within the wind farm site boundary necessary for installation of the turbines. The secured site lease and easement option agreements ensure access to the site for construction and operation of the project and prohibit landowners from any activities that might interfere with the execution of the project.

The Phase I turbine installation will involve two landowners, who are also Summit participants. Development of the entire project area involves 34 landowners, most of which are Summit participants, with the exception of the two excluded parcels identified on Figure 1-2.

# Section 4
# Project Design

## 4.1 Project Layout

Figure 1-2 includes the layout of the proposed wind farm. Turbines will be placed at a minimum spacing of approximately 1,500 feet (457 m); turbine locations shown on Figure 1-2 are approximate, and are subject to change during final design. The proposed electrical collector system will be located on properties optioned by WED and mostly owned by the Summit participants. Transformation of the electricity to high voltage and interconnection to the grid will occur at the Storden Junction Substation, which is owned by Interstate Power & Light Company.

## 4.2 Major Wind Turbine Components

The Phase I facility design includes four Clipper 2.5 MW wind turbine generators mounted on 80-meter steel conical towers. The blades of the Clipper units are 42.5 meters (139 feet) in length, made of fiberglass-reinforced epoxy resin. The corresponding rotor diameter is 93 meters (305 feet).

Phase II will consist of twenty-eight Vestas 1.8 MW wind turbine generators or an equivalent model. The turbines will be mounted on 78-meter (256 feet)–high freestanding tubular towers. The rotor diameter of each turbine is 80 meters (262 feet).

Appendices E-1 and E-2 contain the current general product specifications for the Clipper and Vestas V80 turbines, respectively, describing the following:

- Mechanical design of the technology
- Capabilities
- Electrical grid compatibility

Other system components will be designed and installed in accordance with the standards of high-voltage engineering practice to be compatible with the specified requirements of the interconnecting area transmission system as set forth by the local transmission owners, and the reliability and operating organizations. Alliant Energy WindConnect™ has provided electrical system design and grid interconnection studies for the proposed facility.

## 4.3 Project Electrical System

For Phase I, the proposed four Clipper 2.5 MW wind turbine generators are each rated at a 690 V output. The electric output from each generator will be transformed to 34.5 kV via pad-mounted 690 V/34.5 kV transformers at the base of each turbine. For Phase II, the proposed 28 Vestas 1.8 MW wind turbine generators are each rated at a 690 V output. The V80 power transformer that converts the generator voltage of 690 V to a distribution-level voltage of 34.5 kV is housed in the nacelle of the turbine.

Based on preliminary design plans, power at 34.5 kV will then be collected via an underground system of cables. Power cables and communication lines, if a wireless system is not used, will be buried in trenches adjacent to the project access roads on private property optioned, or under consideration for option, for this service. The cable system will be routed to a nominally rated 60 MVA 34.5 kV/69 kV transformer at a site switchyard located adjacent to the Storden Junction Substation, then to the point of grid interconnection at the Storden Junction Substation, located just west of the project area. About 4 miles of 34.5 kV cable will be installed for Phase I, and an additional 10 miles is anticipated to be installed for Phase II. Any aboveground feeder lines, if used, will be 34.5 kV conductor mounted on wood poles. Details will be developed in the final design.

A proposed location of an electrical collector system for Phase I is shown on Figure 1-2. An electrical collector system for Phase II will be developed after Phase II turbine locations are confirmed during final design.

The final electrical system design and interconnection details will be determined through discussions with Interstate Power & Light Company (the owner of the Storden Junction Substation) and the Midwest Independent System Operator (MISO). The project will meet electrical design requirements, including power factor, voltage control, and grid system protection set forth by the MISO, Interstate Power & Light Company, and the purchasing utilities. Care will be taken to minimize or avoid interferences with telephones and other communication systems.

## 4.4 Associated Facilities

Each of the wind turbines will have a gravel access road that allows for easy accessibility to the wind turbines year round. These roads will be approximately 16 feet wide. The development site will also include an automated Supervisory Control and Data Acquisition (SCADA) system located at the Substation. The site has an associated meteorological tower, which is located approximately ½ mile to the west of the proposed Phase I turbines. A building to house operations and maintenance facilities will be located on the site.

WED has worked closely, and will continue to work closely, with the landowners to reach agreement on the locations of the turbines, access roads, and collector system to minimize land-use disruptions.

# Section 5
# Environmental Analysis

## 5.1 Description of Environmental Setting

### 5.1.1 Project Site

The project site, as shown on Figure 1-2, consists of the following sections under Summit control:

- Township of Storden: Sections 22, 23, 24, 25, 26, 27, 35, and 36
- Township of Amo: Section 1
- Township of Amboy: Sections 19, 30, and 31
- Township of Dale: Section 6

Two parcels within the sections summarized above are currently excluded from the project site. These parcels are also shown on Figure 1-2. Subsection 2.1 details the proposed development of this area in phases.

### 5.1.2 Impacted Area

The permanently impacted area is considered to be only the land that will be disturbed by the exposed portions of the turbine foundations and the permanent access roads. Approximately 16 acres of the project site will be permanently impacted by Phases I and II of the project: 2 acres for Phase I and 14 acres for Phase II; assuming ½-acre disturbance per turbine. The collector system will be underground.

During construction, additional areas will be temporarily impacted. Activities causing temporary disruption include the widening of access roads for equipment transport, installation of turbine foundations, installation of electrical collector and communication cables, and for staging and support purposes. Disrupted soil will be reclaimed, and temporarily disturbed areas will be restored to its previous use (*e.g.*, agricultural use) upon turbine commissioning. Approximately 16 acres of the project site will be temporarily impacted by Phases I and II of the project: 2 acres for Phase I, and 14 acres for Phase II; assuming ½-acre of temporary disturbance per turbine.

## 5.2 Human Settlement

### 5.2.1 Demographics/Homes

*General Description of Resources*

The project site is a located within a sparsely populated rural agricultural area in southeastern Minnesota, near the city of Jeffers in Cottonwood County.

According to the U.S. Census Bureau statistics, the population of Cottonwood County in 2000 was 12,167. The vast majority of residents are white (98.9% of the residents are of one race. Of those, 95.21% are white). The total number of housing units is 5,376, with the average household size of 2.39 persons per household. The median household income was $31,943. In 1999, 7.4 percent of the families in the County had incomes below the poverty level. The most common occupations in the County are management, professional, and related (30.6% of the employed civilian population over age 16); sales and office (21.1%); production, transportation, and material moving occupations (20.6%); and service occupations (17.2%). Other occupations in the county include construction, extraction, and maintenance (8.4%) and farming, fishing, and forestry (2.1%). The largest industries in the area are educational, health and social services (22.9% of the employed civilian population over age 16); manufacturing (18.4%); retail trade (13.1%); and agriculture, forestry, fishing, hunting, and mining (11.6%).

*Impacts*

No impacts to demographics or residences by the proposed construction and operation of the wind farm are expected. Local service-related businesses will likely benefit in the short term as a result of patronage by workers during construction. Additionally, the County should benefit from the construction, operation, and maintenance spending, and the tax revenue generated by the presence of the wind farm.

*Mitigative Measures*

Minimum setbacks from occupied homesteads to turbines will be equal to, or greater than, those required to meet noise standards (Subsection 5.2.2). Minimum setbacks of turbines from roads will be 76 meters (250 feet).

### 5.2.2 Noise

*General Description of Resources*

Existing ambient noise levels in rural settings are typically in the range of low to mid-40 dBA. These levels are generally representative of this site. Higher levels, however, do exist near areas of agricultural activity and near roads. Windy conditions present in this region would tend to increase ambient noise levels in this area relative to other rural areas.

*Impacts*

Wind turbines emit perceptible noise when in motion. The noise level varies with the speed of the turbine and the distance from the turbine to the listener. On relatively windy days, the turbines create higher noise levels; however, the natural wind level during these periods is also higher and tends to overpower the turbine noise as the distance from the turbine increases.

Calculations were performed to determine at what distance turbine noise would not exceed Minnesota Pollution Control Agency (MPCA) noise standards. The lowest MPCA noise standard is the nighttime $L_{50}$ standard of 50 dBA. $L_{50}$ means the sound level in dBA exceeded 50 percent of the time for a 1-hour survey. The equation used for the sound evaluation calculations is Equation 2.9 from the Industrial Noise Control Manual, issued by the U.S. Department of Health, Education, and Welfare (1978), which is applicable to sound from a point source radiating hemispherically:

$$L_p = L_w - 10 \log(2\pi r^2) + 10,$$

where

$L_p$ = projected sound power level at distance r (dBA),

$L_w$ = sound power of source (dBA) (In this case, 104 dBA was used to model the Clipper turbines, and 102.4 dBA was used to model the Vestas turbines. These are the values provided in the manufacturer's specifications [Appendix E-1 for Clipper turbines and Appendix E-2 for Vestas turbines].),

r = distance to location of interest (feet).

Using the preceding equation, if $L_p$ is set equal to 50 dBA (the nighttime $L_{50}$ standard), and $L_w$ is set equal to 104 dBA for the Clipper turbines, and 102.4 dBA for the Vestas turbines, the calculated distance (r) is 632 feet (193 meters) for the Clippers and 526 feet (160 meters) for the Vestas. Therefore, if Clipper turbines proposed for Phase I are located more than 632 feet (193 meters) away from occupied residences, and Vestas turbines proposed for Phase II are sited greater than 526 feet (160 meters) away from occupied residences, exceedence of the MPCA nighttime $L_{50}$ standard should not occur.

#### *Mitigative Measures*

Impacts to nearby residents and other potentially affected parties in terms of noise have been taken into consideration as part of the actual siting of the turbines.

Clipper wind turbines (Phase I) and Vestas wind turbines (Phase II) will be sited more than 632 feet (193 meters), and 526 feet (160 meters) away from occupied residences, respectively; therefore, no significant noise impacts are expected.

### 5.2.3 Visual Impacts

#### *General Description of Resources*

The landscape in the project site is rural open cropland with gently rolling topography. The area is characterized by large open vistas, agricultural fields, and farmsteads. The photo on Figure 5-1 shows the typical landscape in Cottonwood County. The most widely grown crops in the area are corn, oats, and soybeans. Farmsteads are often surrounded by coniferous and deciduous trees planted as windbreaks. Farmsteads and residences are typically situated near roadways to allow for easy access to transportation.

Several other existing and proposed wind farms are present in southwestern Minnesota.

#### *Impacts*

The placement of wind turbines will have a visual effect on the area. However, this visual impact in based on a subjective human response. On the one hand, the proposed development could be perceived as an intrusion on the rural

character of the area. On the other hand, wind farms have a unique visual character, which is not inconsistent with agricultural land use. In general, the residents and local governmental bodies understand the visual impact of these developments, and are receptive to their presence. The project will not generate an increase in traffic volumes, except for a short period of time during construction and occasionally during operation and maintenance activities, or materially increase daily human activity in the area, and thus would retain the rural and remote feeling of the vicinity. Although the turbines have industrial purposes and forms, the act of "farming" the wind for energy has an agricultural character compatible with the rural, agricultural nature of the area.

At a distance, the wind turbines can be distinguished from vertical forms in the landscape, such as overhead transmission lines or trees. Visual impacts will be evident to people visiting the Lake Augusta Waterfowl Protection Area, located immediately southwest of the project site, and the Storden Waterfowl Protection Area and Highwater Wildlife Management Area, both located just west of the project site. While the ability to see turbines may be perceived by some as diminishing the natural experience of visitors to these areas, the same could be said of any human activity in the vicinity. The turbines will also be visible from local township and county roads, and from U.S. Highway 71, located approximately 4 miles east of the eastern edge of the project site.

### *Mitigative Measures*

The following mitigative measures are proposed:

- Turbines will not be located in biologically sensitive areas such as wetlands or relic prairies.
- Turbines will be illuminated only to meet the minimum requirements of Federal Aviation Administration (FAA) regulations.
- Existing roads will be used for construction and maintenance to the extent possible.
- New access roads will be located on gentle grades to minimize visible cuts and fills.
- Areas that are temporarily disturbed during construction will be reseeded to blend in with existing vegetation, or reclaimed into the existing row crops.

### 5.2.4 Public Services/Infrastructure

As previously discussed, the project is located in a lightly populated rural agricultural area in Cottonwood County. Transportation and utility networks have been established to provide services to light industry, towns, homesteads, and farms in the area. Utility and support services in the area are listed below.

*General Description of Resources*

- ***Electrical service*** - Great River Energy provides electrical service in the area. Existing 69 kV transmission lines in the project vicinity are owned by Interstate Power and Light Company and Great River Energy (shown on Figure 1-2).
- ***Traffic routing*** - The major traffic routes to and from the turbine sites include U.S. Highway 71, State Highway 30, and County Highways 4, 13, and 22. In addition, several county and township roads provide access to the turbine sites, including two-lane gravel and paved roads. In the agricultural areas, landowners often use single-lane farm roads and driveways on their land.
- ***Water supply*** - Municipal water supply is not available at the project site. The area has a rural water system, with wells providing water for human consumption, farming, and other uses.
- ***Sanitary sewer*** - Sanitary sewer is not available at the project site. Individual septic systems are used in this rural area to handle sanitary wastes.
- ***Railroad*** - The railroad track shown on USGS topographic map (see Figure 1-2) crossing the northern portion of the project area through the City of Jeffers, is inactive and has been removed.
- ***Telephone*** - Telephone service is provided by several providers in the vicinity of the project site.
- ***Wireless communications*** - Four microwave towers have been identified in the project vicinity, one in the township of Storden, Section 36 (inside the project site); another in the township of Dale, Section 7 (just south of the project site); and two other towers located in the township of Amboy, Section 20 (within the city of Jeffers).

### *Impacts and Mitigative Measures*

The proposed wind farm is expected to have minimal effects on the existing infrastructure and public services. Impacts that may occur during construction, operation, and maintenance are briefly described below.

- ***Electrical service*** - Construction of Phases I and II of the project will add a total of 32 wind turbine generators, with their associated electrical collector system. A total of 60 MW of power (10 MW for Phase I and 50 MW for Phase II) will be generated by the proposed project, which will help support the demand for power in the area.
- ***Traffic routing*** - Constructing the project will require the construction of new gravel roads to provide access to the turbine locations. These roads will be used by crews performing operation, maintenance, and inspection of the turbines during operation of the project. The roads will be approximately 16 feet wide, and will be low-profile to allow cross-traffic by farm equipment. WED will agree with the landowners as to the location of access roads to minimize land-use disruptions to the extent possible. The roads will be maintained by periodic grading. Construction of the wind farm may also require the upgrading of some existing county and township unimproved roads. WED will work with County and local authorities to ensure that improved roads meet local requirements.
- ***Water supply*** - Construction, operation, and maintenance of the wind farm will not have a significant impact on the water supply of the area. No installation or abandonment of wells is planned for the project. However, if abandonment of a well is required, it will be performed in accordance with Minnesota Department of Health requirements.
- ***Septic systems*** - No new septic systems are planned for the project. No existing systems will be impacted.
- ***Telephone*** - Construction and operation of the project is not expected to impact telephone and/or fiber optic service in the project area. Gopher One Call will be contacted prior to construction to locate all underground utilities. The electrical collector system will be located such that it will minimize or avoid disturbance to existing telephone service. If the project facilities cross or otherwise affect existing utility lines or equipment, or if telephone interference occurs due to the project, WED will enter into agreements with service providers to mitigate the problem.
- ***Television reception*** - Operation of the wind farm may or may not impact the quality of television reception in the area. Experience at other wind farms indicates that, in some cases, new antennas or relocating of antennas

has solved the problem. WED will work with the residents in the area (many of whom are Summit participants) to mitigate impacts if they occur.

- ***Wireless communications*** - The project is not expected to cause microwave, radio, telecommunications, internet, or navigation interference contrary to Federal Communications Commission (FCC) regulations or other laws. In the event that the project causes such interference, measures will be taken to correct the problem.

Construction, operation, and maintenance of the wind farm will be in compliance with applicable federal, state, and local permits.

### 5.2.5 Archaeological, Cultural, and Historic Resources

#### *General Description of Resources*

A literature search was done by the 106 Group, Ltd., for WED to obtain information on archaeological, cultural, and historic resources in the project area. This report is presented in Appendix B. The study area for the literature search encompasses both Phase I and Phase II of the project, as well as areas that may be used in potential future phases.

Minnesota State Historic Preservation Office (SHPO) site files indicated that no archaeological surveys and no archaeological sites have been recorded within the study area. The National Register of Historic Places (NRHP) includes the Jeffers Petroglyphs Site, which is located approximately 4½ miles northeast of the project site. The Jeffers Petroglyphs Site is also a Minnesota Historic Site.

No architectural history surveys and no architectural history properties have been previously recorded within the study area. No properties within the study area have previously been determined eligible for listing on the NRHP.

The planned location of the turbines in Phase I will avoid areas having a high potential for containing intact precontact archaeological sites, and a Phase I archeological survey is therefore not recommended. The collection system line for Phase I will pass through approximately 3,800 feet of the area that was identified in the 106 Group report as having some potential to contain precontact archaeological sites (See Figure 4 in Appendix B). This potential is based on topography, and proximity to the wetlands/water bodies to the southwest. There is no evidence that any sites exist along the line location proposed for this facility. The path of the line placement through already

disturbed agricultural lands, and the minimal intrusive installation technique, make the probability of impact extremely unlikely.

Areas proposed for Phase II wind turbines, and potentially later phases, include a significant area of the zones identified as having the potential to contain precontact archaeological sites (see Figure 4 in Appendix B). A Phase I archeological survey will likely be performed prior to development of these areas with wind turbines.

#### *Impacts*

The proposed construction activities could minimally impact archaeological sites if they exist. The project will not impact viewshed integrity from any historic structures, as none have been identified in the area.

#### *Mitigative Measures*

Caution will be taken in areas identified as having potential for archaeological sites. Any unrecorded cultural resources that are found during construction will be evaluated for integrity and potential listing on the National Register of Historic Places (NRHP). Undocumented resources that are confirmed and eligible for listing on the NRHP will be avoided. If archaeological sites are found during construction, the site will be marked and preserved, and the MEQB and SHPO will be notified. A Phase I archaeological survey will likely be performed prior to development of Phase II and possible later phases, if wind turbines are proposed in areas identified as having the potential to contain precontact archaeological sites.

### 5.2.6 Recreational Resources

#### *General Description of Resources*

Recreational activities in Cottonwood County include hunting, fishing, snowmobiling, and hiking.

Locations of recreational resources, including Wildlife Management Areas (WMAs) and Waterfowl Protection Areas (WPAs), were obtained from the United States Fish and Wildlife Service (USFWS). WMAs are owned by the State of Minnesota and managed by the Minnesota Department of Natural Resources (MDNR), and WPAs are federally owned and managed. WPAs are a combination of wetland and grasslands managed for breeding and migrating

avian species. WMAs are managed to provide wildlife habitat, improve wildlife production, and provide public hunting opportunities. WMAs are closed to all-terrain vehicles and horses because of potential detrimental effects on habitat.

Two WPAs and one WMA are located near the project site, as shown on Figure 1-2. The Lake Augusta WPA is located immediately southwest of the project site, and the Storden WPA and Highwater WMA are located just west of the project site.

The Jeffers Petroglyphs site is located approximately 4½ miles northeast of the project. The petroglyphs at the site, which date from 3,000 B.C. up to the 1700s include more than 2000 rock carvings of human figures and animals done by Native Americans. The site is open to the public.

No state parks are located in Cottonwood County. There are two county parks in Cottonwood County: Red Rock Park in the northeastern part of the County, and Dutch Charley and Highwater Creek Parks north of Storden.

#### *Impacts*

Impacts to recreational resources will be primarily visual. Visual impacts are likely to be more evident for the WPAs and WMA near the site. The Jeffers Petroglyph site and the county parks may also be visually impacted by the project, depending on the final turbine layout for Phase II and any future phases.

#### *Mitigative Measures*

Wind turbines will not be located within County Parks, WMAs, or WPAs.

## 5.3 Effects on Public Health and Safety

### 5.3.1 General Description

#### *Air Traffic*

No public-use airports are located within the proposed project area. The nearest public airports are the Windom Municipal Airport, located 7 ½ miles to the southeast , and the Springfield Municipal Airport, located approximately 10 miles to the northeast. However, because there is agricultural land use

within the project site, overhead spraying or crop dusting may occur periodically. Crop dusting is typically done during the day by highly maneuverable helicopters or airplanes.

The USGS topographic map depicting the site shows two private rural airstrips located in the project area, in the township of Amboy, Section 32 (see Figure 1-2). According to a recent communication with landowner Elton Goeman (2005), who is a Summit participant, the east-west–oriented landing strip shown on the topographic map has been plowed under, and the north-south–oriented strip is rarely used. Mr. Goeman and his brother Larry Goeman are the only users of the strip. According to a recent communication with Larry Myking (2005) with the Office of Aeronautics of the Minnesota Department of Transportation, the landing strip is not licensed. Licensing of personal-use airports is optional for those personal-use airports further than 5 miles away from public airports.

### *Electromagnetic Fields*

Electromagnetic fields (EMFs) are invisible lines of force that occur where an electric conductor is present with an electrical current flowing through it. Man-made examples of such conditions include high-voltage transmission lines, distribution (feeder) lines, substation transformers, house wiring, and electrical appliances. EMFs also occur in nature, in the form of the earth's magnetic field, and in electric and magnetic fields generated during lightning storms.

In recent decades, there has been concern about potential health effects caused by EMFs. In September 2002, the Minnesota State Interagency Working Group (MSIWG) on EMF Issues released a white paper on EMF policy and mitigation options (MSIWG, 2002), in which they conclude the following:

> "The Minnesota Department of Health concludes that the current body of evidence is insufficient to establish a cause and effect relationship between EMF and adverse health effects. However, as with many other environmental health issues, the possibility of a health risk from EMF cannot be dismissed."

The MSIWG also points out that scientific panels convened by national and international health agencies and the U.S. Congress have reviewed the research carried out to date, and have typically drawn a similar conclusion.

### *Security*

The proposed project is located in an area that has a low population density. Construction and operation of the project will have minimal impact on the security and safety of the local populace.

### *Road Traffic*

The existing traffic levels for the state and county roads in the project vicinity are shown in Table 5-1. Traffic counts are not available for township roads.

### *Hazardous Materials*

Three types of fluids will be used for wind turbine operation that are required for operation. These are gear box oil (synthetic or mineral depending on application), hydraulic fluid, and gear grease.

Used oil generated will be collected at each turbine location during maintenance procedures, and taken to the O&M facility, where it will be temporarily stored. Any used oil generated by the project will be transported, stored, and disposed of in accordance with Minnesota Rules Chapter 7045. Any hazardous wastes generated at the project site will be hauled off-site and disposed of appropriately under a Small Quantity Generator Hazardous Waste license, if required.

## 5.3.2 Potential Impacts

### *Air Traffic*

The installation of the wind turbines in active agricultural areas will create a potential for collisions with crop-dusting aircraft. However, the wind turbines will be visible from a distance, and will have FAA-approved lighting. Guy wires on the meteorological tower can also pose hazards to crop-dusters. Collector system lines will be buried and thus will not cause any safety hazards to aircraft.

Because the private airstrip owned by the Goeman brothers is oriented north-south, and the proposed turbines for Phase I and II are located more than ½ mile to the west, no impacts are expected.

### *Electric and Magnetic Fields*

Regardless of the scientific community's findings regarding EMFs and possible health effects, or lack thereof, the siting of the project in the sparsely populated project area should not substantially increase public exposure to EMFs, and no adverse effects to health and safety are expected.

EMFs will be generated at very low levels by the turbines and around the collection lines. However, since the turbines are high above the ground, the collection lines are buried, and there is essentially no public exposure to this equipment, no EMF impacts are expected.

### *Road Traffic*

No significant permanent changes in road traffic patterns or volume are expected.

During the construction phase of both Phase I and Phase II, there will be a temporary increase in traffic volumes while light, medium, and heavy-duty construction vehicles travel to and from the project site, as well as private vehicles used by construction personnel. Based on experience at other wind turbine sites, the worst-case scenario would be an average of 20 to 30 extra trips per day. This extra traffic volume would not be as apparent on the larger roads in the area, such as U.S. Highway 71 and State Trunk Highway 30, but would be very apparent on the small county and township roads in the vicinity. The greatest increase in traffic would occur when the majority of the foundation work and wind turbine assembly is taking place over about a 30- to 90-day period during construction of Phase I and a similar period during construction of Phase II. Other phases of construction would require less equipment and fewer personnel.

During the operation and maintenance phase of the project, occasional turbine repair and maintenance would result in a slight, occasional increase in traffic.

### *Security*

Project construction and operation are not expected to significantly impact the security and safety of the community. The mitigative measures described below are expected to reduce the chance of personal injury and property damage at the site.

*Hazardous Materials*

During normal operation, all fluids will be contained within the wind turbine structure. Leakage from the structures is not anticipated. Storage of fluids at the maintenance facility will be in compliance with state and federal regulations. Proper maintenance procedures and fluid-handling practices will be followed.

### 5.3.3 Mitigative Measures

The following mitigative measures will be taken to reduce the chance of property damage and personal injury at the site, and to provide for public safety:

- The towers will be lighted to comply with FAA requirements. The FAA will be notified of the construction and operation of the wind turbines.
- Safety shields will be placed on the guy wires of the meteorological tower to enhance visibility of the wires for small aircraft.
- WED will work with State, County, and local authorities to ensure that, during construction, roads will be used in accordance with applicable requirements. As required, WED will make satisfactory arrangements with State, County, and local authorities as appropriate for maintenance and repair of roads that are subject to extra wear and tear owing to the transportation of equipment.
- The wind turbines will be located a minimum of 76 m (250 feet) from the edge of the nearest public road right-of-way and greater than the minimum setbacks from occupied homesteads needed to comply with applicable MPCA noise standards (Refer to Subsection 5.2.2). These distances are consistent with prior MEQB permits for LWECSs, and are considered to be safe based on developer experience.
- Security measures will be taken during construction and operation, including temporary and permanent fencing, warning signs, and locks on equipment and power facilities.
- ID numbers will be posted on each turbine, and maps with turbine locations, including ID numbers, will be provided to the local fire department and other local authorities as applicable for fire protection and other planning.
- Turbines will be constructed on solid-steel enclosed tubular towers in which electrical equipment will be located, except for the pad-mounted transformer. Access to the turbine will only be through a locked solid-steel door.
- A Small Quantity Generator Hazardous Waste license will be obtained, if required.

## 5.4 Effects on Land-based Economics

### 5.4.1 Agriculture/Farming/Forestry/Mining

*General Description of Resources*

- ***Agriculture/Farming*** - Agriculture is the primary land use in Cottonwood County. According to the United States Department of Agriculture 2002 Census of Agriculture, 374,717 acres, or approximately 90 percent, of the county land is used for farming. The acreage used for farming decreased by 2 percent between 1997 and 2002. The main crops grown are corn, oats, and soybeans. The main livestock raised are turkeys and hogs. The total market value of production was approximately $147 million in 2002, down 8 percent from 1997. Approximately half of this market value was due to crop sales, with the remainder being due to livestock sales.
- ***Forestry*** - As part of the western plains region of Minnesota, Cottonwood County is in an area that was once prairie grasslands. Economically important forest areas are not found in this region. Forested areas are typically associated with homes and farms in the form of wind breaks and woodlots along streams.
- ***Mining*** - Mineral deposits in southwestern Minnesota consist of sand and gravel from unconsolidated surficial deposits, building stone from quartzite rock units, and scattered clay/shale deposits. According to the USGS 7.5-Minute Topographic Map for the site (Jeffers Quadrangle), gravel pits in the area are located along the lower-lying area to the southwest and west of the project area. This lower-lying area includes Augusta Lake and the small streams and wetlands draining toward Augusta Lake and toward Highwater Creek to the north. There are no gravel pits within the project area.

*Impacts*

The proposed wind farm is compatible with existing land use. Approximately 16 acres of the project site (2 acres for Phase I and 14 acres for Phase II) will be permanently removed from their current use for development of the wind turbines and access roads. Agricultural activity will continue between the wind turbines.

During construction, additional areas will be temporarily impacted. Activities causing temporary disruption include the widening of access roads for equipment transport, installation of turbine foundations, installation of

electrical collector and communication cables, and for staging and support purposes. Disrupted soil will be reclaimed, and temporarily disturbed areas will be restored to its previous use (*e.g.*, agricultural use) upon turbine commissioning. Approximately 16 acres of the project site will be temporarily impacted by Phases I and II of the project: 2 acres for Phase I and 14 acres for Phase II; assuming ½-acre of temporary disturbance per turbine.

No impacts to sand and gravel mining or forestry are anticipated.

### *Mitigative Measures*

- ***Agriculture/Farming*** - The wind turbines and access roads will be located so that the most productive farmland (prime farmland) will be avoided as much as possible. Turbine siting will be confirmed through discussions with property owners to identify features on their property, including drain tile, which should be avoided if possible. Electrical collector lines are planned to be installed below drain tiles so that property owners can maintain access to their drain tiles in the future. Drain tile that is damaged during construction will be repaired as necessary, and if surface water ponding is noted after construction due to damage of drain tile, repairs will be made in accordance with the agreement between WED and the affected landowner(s).

## 5.4.2 Community Benefits

### *General Description of Resources*

Tourism in Cottonwood County is mainly related to game, wildlife, and agriculture. Another attraction is the Jeffers Petroglyph site, a cultural and historical site featuring rock carvings done by Native Americans. Recreational outdoor activities such as hunting and hiking also occur in the County.

### *Impacts*

No negative impacts are anticipated to tourism resources.

Positive impacts to the community include production taxes, which will benefit city and county taxpayers, and revenue to local residents (many of the Summit participants) through their investment in the project.

## 5.5 Effects on the Natural Environment

### 5.5.1 Topography

#### *General Description of Resources*

Topographic information was obtained from the USGS 7.5-Minute Topographic Map of the Jeffers Quadrangle (Figure 1-2).

Most of Cottonwood County, including the project area, lies on a ridge known as the "Coteau des Prairies" ("hill of grasses") that extends northwest-southeast across Minnesota from South Dakota to Iowa. This ridge consists of a bedrock core overlain by glacial sediment. On top of the ridge is a plateau composed of nearly level to gently sloping ground moraines, glacial lake plains, glacial river terraces, and lateral moraines. The central part of the county is drained by branches of the Watonwon River, the Des Moines River, the Little Cottonwood River, and Highwater Creek.

The proposed turbine locations are on relatively high ground, with ground elevations for the Phase I turbines on the order of 1,510 feet above mean sea level (M.S.L.). The Phase II turbines and turbines from any later phases generally will be sited in areas with ground elevations greater than 1,450 feet above M.S.L. The proposed turbine locations are on relatively flat ground. To the west/southwest of the project area is lower-lying area including Augusta Lake and the small streams and wetlands draining toward Augusta Lake and toward Highwater Creek to the north. The elevation of the water surface of Lake Augusta is approximately 1,400 feet above mean sea level.

#### *Impacts*

No significant impacts to topography are anticipated. Access roads, wind turbine locations, and the proposed collector system route will not require significant cut or fill.

#### *Mitigation*

No impacts are anticipated.

### 5.5.2 Soil

*General Description of Resources*

The USDA's General Soil Map for Cottonwood County shows three general soil associations in the project area. The soils map is reproduced in Appendix F. A soil association is a mapping unit used to delineate a landscape with a distinctive pattern of soils. It is composed of one or more major soils and some minor soils. It is named for the major soil. The soils making up one association can occur in another, but in a different pattern. A soil association map is useful in providing a general idea of the types of soil in a large tract of land.

The three soil associations in the vicinity of the project are described below.

- ***Glencoe-Jeffers*** - The Glencoe-Jeffers map unit falls within an area dominated by soils that are underlain by firm glacial till. The Glenco-Jeffers unit is generally described as very level, very poorly drained and poorly drained calcareous soils that formed in clay loam and silty clay loam glacial till. This map unit consists of low-gradient drainage ways and depressions. Because of the poor drainage of these soils, runoff water ponds, and in many places, is drained with tile drainage. Slopes are 0 to 3 percent. Most of the soils in this unit are farmed. Undrained areas are suitable for pasture and wildlife habitat, and crops, including corn, soybeans, small grain, forage grasses, and legumes. Tile drainage removes excessive subsurface water, and makes these soils easier to manage and more suitable for crops.
- ***Clarion-Swanlake*** - The Clarion-Swanlake map unit falls within an area dominated by soils that formed in friable glacial till. This unit is generally described as undulating and rolling, well drained soils that formed in loamy glacial till. This map unit consists of knolls, hills, and intermingling swales and draws. Low-gradient drainage ways drain surface runoff. Slopes range from 0 to 12 percent. Areas of this map unit have fair to good potential yields for cultivated crops, small grain, forage grasses, and legumes. Terracing and contour farming on the more sloping areas help to control runoff and conserve moisture. Tile drainage is desirable on the more poorly drained soils.
- ***Estherville-Dickman*** – This map unit falls within an area dominated by soils that formed in glacial outwash, and are generally described as nearly level to steep, well drained soils that formed in loamy and sandy sediments over sandy and gravelly materials. The Estherville-Dickman unit consists of glacial river terraces and glacial outwash plains, with drainage ways

intermingling with sloped areas. Slopes range from 0 to 25 percent. Most of the soils in this unit are farmed, with fair to low potential yields for cultivated crops. The steeply sloping areas are used mostly for pasture. Drought-resistant crops or early-maturing crops are desirable for economical yields. Irrigation is desirable, and mulch tillage or other minimum tillage practices help to conserve soil moisture and control erosion. This map unit is a good source of sand and gravel.

#### *Impacts*

Construction of the wind turbines and access roads will only slightly increase the potential for erosion during a short period of construction, and will take only a limited amount of farmland out of production.

#### *Mitigative Measures*

A National Pollutant Discharge Elimination System (NPDES) construction permit will be acquired by WED or the site contractor from the MPCA. Industry standard best management practices will be used during construction and operation of the project to protect topsoil and to minimize soil erosion. Practices may include installing silt fencing, stockpiling topsoil for later use, containing excavated material, protecting exposed soil, and stabilizing restored areas.

### 5.5.3 Geologic and Groundwater Resources

#### *General Description of Resources*

Information on County geology is summarized from USDA, 1979, and Morey and Meints, 2000. The Coteau des Prairies ridge that extends across the County consists of a bedrock core that is overlain by glacial sediment.

Sioux Quartzite is the oldest bedrock unit found in the County. It is of Pre-Cambrian age, and underlies most of the County. The depth to bedrock throughout the County is variable. In the western part of the County, the Sioux Quartzite underlies sandstone and shale of Cretaceous age. This sandstone and shale bedrock are overlain by thick deposits of glacial sediment except in river bottom lands, where the glacial sediment is thinner. In the central part of the County, the Sioux Quartzite is at a shallower depth, and in the northeastern part of the County, there are bedrock outcrops. The Sioux Quartzite is very hard, is interbedded with thin layers of Catlinite Shale, and does not fracture

along planes. Weathered Sioux Quartzite and Catlinite shale have a dull red color and are known as "red rock." Catlinite shale is softer, and is also known as "Pipestone."

Loamy glacial till, sandy and gravely to clayey glacial outwash, and lacustrine sediment cover most of the County. The glacial till is calcareous and of Wisconsinin age. It is a gently sloping to nearly level ground moraine in most of the County. Undulating lateral moraines formed along the main axis of glacial ice flow. Pre-glacial river channels formed along these lateral moraines. The channels entered the County on the west-central side, and ran in a southeasterly direction. Glacial action was not enough to entirely cover these channels, and the glacial meltwaters reopened some channels. Most of the lakes in the County formed in these channels.

Glacial meltwaters sorted material from the glacial till. Silty and clayey sediments were deposited in glacial lakes in southwestern and south-central parts of the County. Glacial outwash of sand and gravel was deposited at glacial river terraces in the south-central and north-central parts of the County.

Geologic resources in the County include sand and gravel deposits.

The types of aquifers in the County are varied. The unconsolidated glacial deposits yield water from the coarse-textured strata, which are generally sand and gravel lenses in glacial till. Sioux Quartzite also yields water obtained from the fissures of interbedded shale or fractures in the quartzite. Water yield from the quartzite is generally low. The best aquifer in the county is the sandstone, which yields large volumes of water.

Glacial sediments may yield water, especially in lowlands where surface water bodies are present. These are typically low yield, and are not used as potable sources.

The County Well Index was reviewed for the project area (Minnesota Department of Health, 2005). Eight registered wells are present in the project area, but water level data and boring logs are available for only two of the wells. These two wells are located in the township of Storden, Section 23 and the township of Amboy, Section 28, and indicate depth to bedrock of 72 feet (Sioux Quartzite) and greater than 233 feet, respectively. Water levels in the wells were recorded at 45 feet below the ground surface (bgs) and 97 feet bgs, respectively. Other available logs from wells near the project area included

logs from the township of Storden, Sections 34 and 28, and indicated depths to bedrock (Sioux Quartzite) of 255 feet and 83 feet, respectively, and depths to water of 90 feet bgs and 150 feet bgs, respectively. According to a surficial hydrogeology map available from the MDNR (MDNR, 1997), in the vicinity of the project area, the elevation of the water table within the Sioux Quartzite aquifer is approximately 1,450 feet above mean sea level. For reference, the ground surface elevation near the proposed turbine locations for Phase I is around 1,510 feet above mean sea level.

#### *Impacts*

Impacts to geologic and groundwater resources are not anticipated. Water supply needs during construction will be quite limited, and local supplies are adequate. No water will be needed for operations.

#### *Mitigative Measures*

Wind turbine locations will not impact the water supply or the use of existing water wells.

### 5.5.4 Surface Water and Floodplain Resources

#### *General Description of Resources*

Surface water and floodplain resources for the proposed project area were identified by reviewing the USGS 7.5 Minute Topographic Map of the Jeffers Quadrangle (Figure 1-2) and the Flood Insurance Rate Maps (FIRMs) produced by the Federal Emergency Management Agency (FEMA, 1981a and b). According to the FIRM maps for the site, the entire project area is located outside established floodplains, within Zone C, which corresponds to areas of minimal flooding.

For Phase I, the proposed turbine site location generally drains toward the north, toward the flat plateau to the northeast. The proposed collection system route generally drains toward the southwest, with the watershed ultimately draining to Augusta Lake. The USGS quadrangle map for the site (Figure 1-2) shows four small intermittent streams along the proposed collection/transport system. These intermittent streams are not shown on the FIRM map for the site.

The remainder of the project area generally drains ultimately to the Little Cottonwood River to the northeast, the Watonwan River to the southeast, or toward the Lake Augusta area to the southwest. The MDNR-issued Public Waters Inventory (PWI) map for Cottonwood County (MDNR, 1996) shows three protected waters within the project area. The first, classified as a "public ditch" is the headwaters of the Little Cottonwood River running through Sections 27, 28, 33, and 34 (township of Amboy), and the second, also classified as a public ditch, is the headwaters of the Watonwan River running through Section 32 (township of Amboy). The third protected water body is a small basin, which is located inside the Lake Augusta WPA (township of Amo, Section 1). Protected waters are subject to Minnesota Statues, Section 105.42, which requires that a permit be obtained before making any alteration in the course, current, or cross-section of these waters. For public ditches, MDNR waters jurisdiction is subject to public ditch law procedures (MDNR, 2005a).

### *Impacts*

Construction of wind turbines, the electrical collection lines, and access roads will only minimally disturb land within the project site. The turbines will be built on uplands, which will avoid intermittent streams and other surface water features. Access roads will be constructed so as not to significantly impede natural drainage patterns. Electrical collector lines will be buried using trenching or horizontal drilling techniques to prevent impacts to surface water features. The public ditch-type protected waters identified in the project area will be avoided. If it is not possible to avoid these waterways, the MDNR will be consulted, and a permit to cross the waterway will be secured if needed. The only basin-type public water is located within the Lake Augusta WPA and this will be avoided.

### *Mitigative Measures*

If construction is required across streams or drainage ways, it will be conducted in a manner such that they will not be impacted. The electrical collector system lines will be installed underground, and will not alter drainage patterns. An NPDES construction permit will be secured by WED or the contractor prior to construction of the wind turbines and access roads. Erosion control measures and best management practices will be used throughout construction until disturbed areas have been revegetated.

### 5.5.5 Wetlands

#### *General Description of Resources*

Delineated wetlands for the proposed project site were identified from reviewing the National Wetland Inventory (NWI) Maps developed by the United States Department of the Interior and the USFWS, and the MDNR-issued Public Waters Inventory (PWI) map for Cottonwood County (MDNR, 1996), which shows Type 3,4, and 5 state-protected wetlands. There are no Type 3, 4, or 5 state-protected wetlands in the project area. Delineated NWI wetlands in the project area are shown on Figure 1-2. There are a few very small wetland areas within the project area.

#### *Impacts*

The wind turbines will be built on ridges to capture windy conditions. This will avoid the wetlands shown on Figure 1-2, as well as unmapped wetlands, as they would be situated in lowland areas. Access roads and supporting facilities will be located to avoid delineated wetlands.

#### *Mitigative Measures*

The project is not anticipated to impact wetland areas. Access roads and the electrical collector systems will be designed to avoid wetlands. In the event that a small wetland area cannot be avoided and must be crossed by the collector system, horizontal drilling or similar techniques will be used to maintain the integrity of the wetland, and no draining or filling of the wetland area will occur.

### 5.5.6 Vegetation

#### *General Description of Resources*

Before settlement, southwestern Minnesota, including the project site, was part of the Tallgrass Prairie Biome (Coffin and Pfannmuller, 1988). This vast tallgrass prairie that once covered one third of the state has been reduced from millions to thousands of acres. The tallgrass prairie was dominated by a few major prairie grasses, including prairie cordgrass and bluejoint in the wet lowlands, big bluestem and Indian grass in the moist upland soils, and little bluestem and side-oats grama on the thin soils of dry uplands. Throughout the

prairie biome, wetland communities dominated by sedges and reeds were interspersed with upland prairie.

Large-scale habitat destruction and alteration in the prairie biome have been more complete than in any other biome in the state. Shortly after 1850, the entire native prairie landscape had all but disappeared as a result of the conversion of land to agricultural use. Now, less than 1 percent of the original prairie survives. The isolated remnants of native prairie are the last stronghold for a number of species. Native prairie is identified as lands that have never been plowed, with less than 10 percent tree cover, and the presence of native prairie vegetation.

Based on a review of aerial photographs (Figure 1-3), nearly the entire project site has been plowed under for agricultural use, with the exception the homesteads and some areas along drainage ways. Remnant prairie areas and wetlands do not appear to be present. Trees are typically not present in the area, except a few along drainage ways, and those surrounding homesteads.

Some area landowners have maintained prairie-like areas for wildlife habitat. These set-aside areas have been planted with native vegetation and typically have relief that makes farming difficult. These properties are managed under the Federal Conservation Reserve Program (CRP). A small number of these tracts of land are in the project area.

### *Impacts*

Because the project area has already been disturbed by agricultural use, no impacts to native vegetation or native prairie areas are anticipated. A small amount of farmland will be taken out of production. Impacts to agricultural use are discussed in Subsection 5.4.1.

If the electrical collector system lines must cross set-aside areas managed under the CRP, the area will be revegetated with native prairie species. WED's intent is to preserve CRP areas if possible. If any of the CRP areas must be taken out of service by wind turbine or road construction, the landowner(s) will be adequately compensated and appropriate permits will be secured.

### *Mitigative Measures*

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

- Conduct a preconstruction walk-over to ensure that disturbance to remnant prairies and wetlands will be minimized or avoided by the project.
- Exclude established wildlife management, recreation, and scientific natural areas from consideration for wind turbine locations, access roads, or electrical collector line placement.
- Minimize impacts to existing trees and shrubs.
- Use best management practices during construction and operation of the project to protect topsoil and minimize soil erosion.
- Revegetate noncropland and range areas with wildlife conservation species, and if possible, plant native tallgrass prairie species in cooperation with landowners.

### 5.5.7 Wildlife

The following sections discuss general wildlife in the site area, and do not include discussions on wildlife species considered by Minnesota to be threatened or endangered. Refer to Subsection 5.6 for a discussion of these resources.

#### *General Description of Resources*

Wildlife within the vicinity of the project consists of birds, mammals, reptiles, amphibians, and insects. Resident and migratory species use the project site area for forage, breeding, and shelter. The vegetation in the vicinity of the project is mainly agricultural crops. Trees are mainly in windbreak areas near homes and farms. Species present in the vicinity of the project are associated with agricultural fields, prairie grasslands, and minor wetland and forested areas.

Various migratory and resident bird species use the area in the vicinity of the project during their lifecycle. Migratory birds are those that may use the area for nesting, foraging, or breeding for only a portion of the year. Resident bird species are those that occupy the area throughout the year. Some common songbirds in the area include western meadowlark, song sparrow, American robin, red-winged blackbird, and killdeer. Some of the waterfowl species typically found in southwestern Minnesota include Canada geese, mallards, blue-winged teal, and wood ducks. Some of the upland game birds found in southwestern Minnesota are ring-necked pheasants and gray partridges. Common raptors in the area include red-tailed hawk, American kestrels,

northern harriers, and Swainson's hawks. There are two WPAs located to the west and southwest of the project area (Figure 1-2). These areas are a combination of wetland and grassland managed for breeding and migrating avian species.

Mammal populations in the area include white-tailed deer, rabbit, red fox, badger, skunk, squirrel, and others. These species use the food and cover from agricultural fields, grasslands, farm woodlots, wetlands, and other wooded areas. Small mammals typical of the area include house and deer mice, weasels, and prairie and meadow voles. White-tailed deer have an affinity for agricultural crops, and use farm woodlots, wooded ravines, and intermittent stream bottoms for shelter.

Bat species present in southwestern Minnesota include the hoary bat, the eastern red bat, the big brown bat, the silver-haired bat, and the little brown bat.

Reptiles and amphibians present in southwestern Minnesota include garter snakes, western hognose snakes, snapping turtles, western painted turtles, American toads, northern leopard frogs, and western chorus frogs.

Numerous insect species are also present in southwestern Minnesota. While many insect species are important to the native vegetation and wildlife, the only economically important species in the vicinity of the project is expected to be honey bees. The only registered apiary in Cottonwood County is located in Bingham Lake, over 8 miles away.

### *Impacts*

Development of the proposed wind farm is expected to only minimally impact wildlife. A small reduction in the available habitat that some of the resident wildlife uses for forage or cover will occur. Based on studies of existing wind power projects in Europe and the United States, impacts to wildlife primarily occur to avian and bat species. Extensive studies on the impacts of wind turbines to avian populations were conducted at the Buffalo Ridge Wind Resource Area in Lincoln and Pipestone Counties in southwestern Minnesota. The final report on avian monitoring studies at Buffalo Ridge (WEST, 2000) concluded the following:

- Following construction of the turbines, there was a reduction in use of the area within approximately 100 meters of the turbines by seven of 22 species

of grassland breeding birds. The authors hypothesized that lower avian use may be associated with avoidance of turbine noise and maintenance activities, and less available habitat. The authors stated "on a large scale basis, …reduced use by bird 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 at Buffalo Ridge compared with other wind facilities in the United States, and appears to be primarily related to nocturnal migrants. Resident bird mortality is low, and involves primarily common species. The authors stated "based on the estimated number of birds that migrate though Buffalo Ridge each year, the number of wind plat related avian fatalities at Buffalo Ridge is likely inconsequential from a population standpoint."

A study of bat interaction with wind turbines at Buffalo Ridge concluded the following:

- The wind plant probably does not impact bat breeding populations in the project area.
- Available evidence indicates that most of the mortality involves migrant or dispersing bats in the fall.
- Preliminary data suggest that the population of bats susceptible to turbine collisions is large enough that observed mortality is not sufficient to cause population declines.

A discussion with the USFWS (Fairchild, 2005) indicated that mortality to bats due to collisions with wind turbines should not be a significant problem in the proposed project area.

### *Mitigative Measures*

The USFWS has been contacted regarding this proposed project. Correspondence from this agency is contained in Appendix A. In order to minimize potential impacts to migratory birds and other wildlife resources, the USFWS has recommended that wind turbines be located as far as possible from WPAs and WMAs in the area. The USFWS also recommended that no turbines be sited in several sections (township of Dale, Section 6; township of Storden, Sections 26-28 and Section 35). During a subsequent discussion with the Ms. Laurie Fairchild of USFWS (Fairchild, 2005), she mentioned that, because she did not have the proposed turbine locations available to review, she

recommended that "entire" sections be avoided. WED proposes placement of wind turbines within these Sections, but only at strategic locations to maximize use of wind resources while minimizing potential risk to migrating water fowl.

WED will continue to work with the USFWS to finalize turbine locations that reduce potential risk to migrating waterfowl.

Additionally, the USFWS recommends the following mitigative measures:

- Since the project will be constructed in phases, a monitoring plan is recommended following each phase of operation to determine site-specific impacts, so that adjustments can be made in future phases, as needed, to reduce adverse impacts to local wildlife.
- Owners of existing communication towers in the area should be contacted to determine if they have conducted any monitoring at these sites; and, if collected and made available to WED, bird strike data will be used to aid in the assessment of potential effects to wildlife.

These recommendations will be followed by WED.

Other measures that will be used to help avoid potential impacts to wildlife in the project area are as follows:

- Exclude established wildlife management, recreation, and scientific natural areas from consideration for wind turbine locations, access roads, or collection line placement.
- Avoid disturbance of individual wetlands or drainage systems during construction of the project.
- Protect existing tress and shrubs, which are important to the wildlife present in the area.
- Maintain soil conservation practices during construction, operation, and maintenance phases. Protect topsoil and minimize erosion.
- Revegetate noncropland and pasture areas with wildlife conservation species where possible.

## 5.6 Rare and Unique Natural Features

### 5.6.1 General Description of Resources

The Endangered Species Act of 1973, as amended, requires that the USFWS be consulted pursuant to Section 7 to ensure that a proposed project will not affect the continued

existence of any endangered or threatened species or adversely affect their habitats, and that corrective action be taken if adverse impacts occur.

The USFWS has reviewed the project site (see correspondence in Appendix A), and determined that there are no known federally-listed or proposed threatened or endangered species, candidate species, or designated critical habitat within the proposed action area, and that no further action is required under Section 7 of the Endangered Species Act.

The MDNR maintains a Natural Heritage Database through their Natural Heritage Program and Nongame Research Program, which is the most comprehensive source of data on Minnesota's rare, endangered, or otherwise significant plant and animal species, plant communities, and other natural features. A request was submitted to query this database for the proposed project area. There are four known occurrences of rare species or native plant communities just outside the project area (within an approximate 1-mile radius), as described in the MDNR correspondence in Appendix A. None are within the project area. The rare species and native plant communities near the project area are as follows:

- A Dry Hill Prairie native plant community in the NW ¼ of Section 28, township of Storden. This prairie remnant along with another nearby remnant were enrolled in Minnesota's Native Prairie Bank Program in 2001. This program protects prairie through conservation easements, which prohibit construction or placement of structures or devices whether permanent or temporary on the premises without written authorization from the DNR Commissioner. Additionally, no conveyance of any other easement for any other purpose, including, but not limited to, road or utility is permitted upon or within the premises without authorization.
- Two special concern butterfly species, the Powesheik Skipper and the Regal Frittilary. These species were observed in the Dry Hill Prairie described above (NW ¼ of Section 28, in the township of Storden) in 1994.
- A Mesic Prairie native plant community in Section 12, in the township of Amo, south of the Lake Augusta WPA.

According to the MDNR, the Minnesota County Biological Survey has just begun working in Cottonwood County, so more information on the presence of native plant communities and rare plant species should be available for the area by the end of summer 2005. MDNR suspects that additional prairie remnants may be present along the Highwater Creek drainage in the township of Storden, Sections 28, 33, and 34 (outside the project area).

### 5.6.2 Impacts

Impacts to rare and unique resources are not anticipated. The rare and unique resources described above are all outside the project area.

### 5.6.3 Mitigative Measures

The proposed site layout does not conflict with the recommendations stated in the MDNR correspondence contained in Appendix A. The electrical collector system will not be routed through the Native Prairie Bank area in NW ¼ of Section 28 in the township of Storden.

As requested by MDNR, WED will contact MDNR later in the 2005 field season to obtain the results of the Minnesota County Biological Survey's evaluation of Cottonwood County, to be completed in the summer of 2005. WED will work with MDNR to finalize turbine locations that minimize impacts to rare and unique resources.

## 5.7 Adverse Human and Natural Environmental Effects That Cannot Be Avoided

### 5.7.1 Visual Impacts

The proposed wind turbines will be prominent features of the landscape. By design, these structures must be placed in open areas of high elevation. Some mitigative measures as described in Subsection 5.2.3 can be implemented to somewhat limit visual impacts; however, it is not possible to make these structures unnoticeable. The degree to which the visual impacts are considered to be negative is subjective, and tends to vary, depending, for example, on how often the viewer sees the turbines.

### 5.7.2 Commitment of Land

Assuming approximately 0.5 acre of disturbance per turbine, approximately 16 acres (2 acres for Phase I and 14 acres for Phase II) will be converted from agricultural use to wind turbines, access roads, and transformer pads, and an O&M facility during Phases I and II of the project. However, existing land use can continue on the remainder of the land.

### 5.7.3 Turbine and Substation Noise

When in motion, the wind turbines emit perceptible noise. The noise level 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 noise due to the wind

tends to override the turbine noise as distance from the turbines increases. Setbacks from occupied residences should be adequate to prevent problems with noise.

The project will connect to an existing substation. Power transformation at the substation, from the new generation, will add minimally to the substation noise levels. Since the substation is in a rural setting, no impact is expected.

### 5.7.4 Avian Impacts

Birds and bats occasionally collide with wind turbines. The mortality associated with these collisions has, in many cases, been concluded to be inconsequential from a population standpoint. Also, turbines may result in reduced use of habitat by wetland and/or grassland bird species within 100 meters of the turbines. None of these impacts are expected to be significant to migrating birds at the site. A discussion with the USFWS (Fairchild, 2005) indicated that mortality to bats due to collisions with wind turbines should not be a significant problem in the proposed project area.

## 5.8 Description of Environmental Setting

### 5.8.1 Project Site

The project site consists of the following sections under Summit control:

- Township of Storden: Sections 22, 23, 24, 25, 26, 27, 35, and 36
- Township of Amo: Section 1
- Township of Amboy: Sections 19, 30, and 31
- Township of Dale: Section 6

# Section 6
# Project Construction

A schedule of preconstruction, construction, and post-construction activities involved in the development of a wind energy project would list hundreds of individual tasks. In order to efficiently work through these processes, WED has retained the engineering, permitting, and construction professionals at Alliant Energy affiliate organizations RMT, Inc., and WindConnect™ for preconstruction activities.

Preconstruction, construction, and post-construction activities for the project are as follows:

- Ordering of components, including towers, nacelles, blades, foundations, and transformers
- Land surveys to establish locations of structures and roadways
- Soil borings, testing, and analysis for proper foundation design and materials, and collector cable design
- Foundation excavation and construction
- Tower assembly and placement
- Wind turbine assembly and setting
- Complete construction of access roads to be used for construction and maintenance
- Installation of underground collector cable system
- Installation of underground communication lines
- Construction of new switchyard and upgrades to the existing Storden Junction Substation
- Acceptance testing of facility
- Commencement of commercial operation

## 6.1 Construction Management

An Engineering/Procurement/Construction (EPC) contractor will be hired for the construction management of the project. Other contractors may be hired for individual areas of expertise, such as civil work, electrical work, and turbine erection. The services of local contractors to assist in project construction will be secured where possible.

The EPC contractor will also oversee the installation of roads, concrete foundations, towers, turbines and blades, electrical infrastructure, as well as the coordination of materials receiving, inventory, and distribution.

The construction team will be on-site to handle materials purchasing, construction, and quality control. An on-site project manager will coordinate all aspects of the work, including ongoing communication with local officials, citizens groups, and landowners.

## 6.2 Civil Works

Completion of the project will require various types of civil works and physical improvements to the land. These civil works may include improvement of existing roads; construction of access roads adjacent to the wind turbines; clearing and grading of land; trenching for, and installation of, underground electric cables and communication wires, and foundation work.

Improvements to existing access roads will typically consist of regrading and filling of the gravel surface to allow access even in inclement weather. Access roads will be built adjacent to the towers, allowing access both during and after construction. The final roads will be approximately 16 feet wide with gravel cover. During construction only, those roads will be temporarily widened by an additional 16 feet of compacted soil, covered with geotextile/gravel, if required, to support the size and weight of heavy-duty cranes and turbine delivery vehicles. The final road design will be dependant on geotechnical information obtained during the engineering phase.

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 busiest traffic will occur when the majority of the foundation and tower assembly is taking place.

The specific turbine placement will determine the amount of roadway that will be constructed for this project. These roads will be sited in consultation with local landowners and completed in accordance with specified design requirements and 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. Roads may include appropriate drainage and culverts while still allowing for the crossing of farm equipment. The roads will consist of graded soil, overlain with geotextile and covered with gravel. Once construction is completed, the roads will be regraded, filled, and dressed as needed. Local requirements will be followed wherever access roads join state or local roadways.

Underground concrete foundations will be constructed to support the steel tubular towers of the turbines. Geotechnical surveys, turbine tower load specifications, and cost considerations will dictate final design parameters of the foundations.

## 6.3 Commissioning

The project will be commissioned after completion of the construction and testing phases. Inspection and testing occurs for each component of the wind turbines, as well as the communication system, meteorological system, the low- and high-voltage collector system, and the SCADA system. These commissioning procedures ensure that the generation units are performing to guaranteed levels and that the project meets electrical system requirements.

# Section 7
# Project Operations and Maintenance

## 7.1 Project Operations

Each wind turbine is programmed to operate autonomously, and will make its own control "decisions" under normal conditions. The turbines continuously communicate with a SCADA system that monitors operation and energy production. The 32-turbine project will be monitored and operated remotely. WED will enter into contractual agreements with a third party(ies) to provide off-site operations, and on-site service and maintenance for the project.

The SCADA system monitors the wind farm status and alerts operations personnel to operational conditions that require attention. The SCADA system collects data on wind turbine generation, availability, alarms and communication error information, and meteorological and communications data. Performance data and parameters for each machine can also be viewed in real time, and machine status can be changed. The SCADA system also reports and archives generation data. Design of the SCADA system is not finalized.

On-site service and maintenance activities include routine inspections, regular preventive maintenance on all turbines and related facilities, and unscheduled maintenance and repair. Routine minor maintenance on the wind turbines, electrical power system, and communications system may include maintenance of oil levels and filters, tightening of bolts, minor electrical repairs, upgrading of computer software, and system testing. Civil maintenance includes maintaining project structures, access roads, drainage systems, and other facilities. The third party may also provide labor, services, consumables, and parts required to perform scheduled and unscheduled major maintenance on the wind farm, including repairs and replacement of parts and removal of failed parts.

Other maintenance activities include cooperation with wildlife studies as may be required; management of lubricants, solvents, and other hazardous materials; the hiring, training, and supervision of personnel; and the implementation of appropriate security methods.

An operations and maintenance building will be built to house consumables, spare parts, and some control functions.

## 7.2 Maintenance Schedule

During turbine commissioning and initial commercial operation, the project will be inspected on-site daily to see that it is operating within expected parameters. Following the "break-in" period, the turbines will be remotely monitored on a daily basis with planned service and maintenance at the following intervals:

1. ***First service inspection.*** The first service inspection will take place 1 to 3 months after the turbines have been commissioned. Activities include tightening bolts, greasing bearings, and filtering gear oil.
2. ***Semiannual service inspection.*** Routine service inspections commence 6 months after the first inspection. The semiannual inspection consists of lubrication and a safety test of the turbine.
3. ***Annual service inspection.*** The annual service inspection consists of a semiannual inspection plus a full component check.
4. ***Two-year service inspection.*** The 2-year service inspection consists of the annual inspection, plus the checking and tightening of terminal connectors.
5. ***Five-year service inspection.*** The 5-year inspection consists of the annual inspection, an extensive inspection of the wind braking system, the checking and testing of oil and grease, a balance check, and the tightening of terminal connectors.

# Section 8
# Costs

Specific cost information is confidential to the business of WED. Final costs for the project have not yet been confirmed. Based on previous experience, WED estimates that the installed capital cost for wind farm design and construction will be approximately $1,400 per kilowatt. Operating costs are expected to be about 2 percent of the capital costs per year.

The actual cost of the project will not be known until final design, procurement, construction, and contractual arrangements are complete. Power Purchase Agreements are in place or under way with both CMMPA and Xcel Energy.

# Section 9
# Project Schedule

## 9.1 Land Acquisition

The Summit participants are responsible for land acquisition. All but two excluded parcels (Figure 1-2) of the 21–square mile geographic project area (including the 13–square mile project site) are owned by individuals who are Summit participants. WED has the option to develop the wind energy on these properties.

## 9.2 Permits

WED is responsible for undertaking required environmental and energy reviews, and will obtain the permits and licenses for Summit that are required for construction and operation of the facility. Because this project will be built in phases, Summit requests that the MEQB issue its site Permit for the project so that construction can commence within 3 years of the issuance of the Permit without revocation.

## 9.3 Equipment Procurement, Manufacture, and Delivery

WED will order the wind turbine components as soon as practicable. Delivery of the turbines is anticipated within 4 months of the order. The transformer for the substation will arrive within approximately 6 months after ordering. Collector system cable will arrive approximately 4 months after ordering.

## 9.4 Construction

The EPC contractor is responsible for completing project construction, including roads, wind turbine assembly, electrical, and communications work. The construction of Phase I is anticipated to take approximately 2 months to complete. Construction of Phase I is anticipated to commence in late 2005. The construction of Phase II is anticipated to take 3 to 4 months to complete. Construction of Phase II is anticipated to be conducted during the 2006 construction season.

## 9.5 Financing

WED is responsible for financing predevelopment, development, and construction activities. WED is financing the cost of predevelopment activities through internal funds. Permanent

financing is being arranged with partner investors and will be completed prior to commercial operation.

## 9.6 Expected Commercial Operation Date

WED anticipates that Phase I will be available to begin commercial operation no later than December 31, 2005. Phase II is anticipated to begin commercial operation by December 31, 2006.

# Section 10
# Energy Projections

A site-specific wind analysis was conducted, which found the proposed site to have a wind resource in excess of U.S. Class 4 (greater than 7 m/s [16 miles/hour] at a height of 50 meters [164 feet]). The analysis used both 18 months of measured wind speed data from the WRAP meteorological tower that had been located near the proposed site and computer modeled projections of expected wind speeds for the site. Computer modeling of wind speed was performed by WindLogics, Inc., of St. Paul, Minnesota. On-site wind tower data collected to date (Appendix C-2) are consistent with the WRAP (Appendix C-1) and WindLogics (Table 2-1) information.

The normalized wind data were imported into the power curve for the selected wind turbines to calculate gross energy production. Appropriate loss factors were then applied to calculate net energy production. Loss factors reflect uncertainties in the wind speed data, topographic losses, production losses, and electrical system losses. Production loss considerations include blade soiling and icing, wake effect for multiple turbines, other mechanical losses, and unavailability of the generators due to outages. The calculated compounded loss factor applied to gross generation is about 12% for Phase I and about 14% for Phase II. Differences in assumed losses between the two Phases are due to topography and turbine wake. Compounded losses were assumed to be multiplicative and not additive.

Based on professional judgment, wake losses for the turbines were assumed to average 4 percent for the four Phase I turbines, which are somewhat isolated from the Phase II turbines. For Phase II, some turbines are isolated from the turbine clusters. Wake losses for the 28 Phase II turbines were assumed to average 5 percent.

A preliminary analysis of the net energy output based on turbine types and locations indicates that approximately 34,768 MWh will be delivered annually to the point of interconnection from Phase I, and approximately 172,533 MWh will be delivered from Phase II. Monthly projections of net energy production as delivered to the interconnection are provided in Table 10-1. Final energy estimates will be developed once the wind farm final design is complete.

# Section 11
# Decommissioning and Restoration

At the end of commercial operation, the Jeffers Wind Energy Center owner will be responsible for removing wind facilities, and either removing or sufficiently burying the turbine foundations. WED reserves 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.

## 11.1 Anticipated Life of the Project

The anticipated project life is 25 years beyond the date of first commercial operation for each respective phase.

## 11.2 Estimated Decommissioning Costs in Current Dollars

The owner would be responsible for costs to decommission the project and associated facilities. The estimated cost of decommissioning the 32 turbines of both Phase I and Phase II of the project is $500,000 (2005 dollars).

## 11.3 Updating of Decommissioning Costs

No updating of decommissioning costs is required for this project. The set-aside funds will be adequate to complete the task.

## 11.4 Ensurance of Decommissioning Funds

Decommissioning funds will be set aside as a specific budget item. A set-aside will be included as part of the operating reserves for the project.

## 11.5 List of Decommissioning and Restoration 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 4 feet 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.

# Section 12
# Identification of Required Permits/Approvals

A preliminary list of required permits and approvals identified for the project are shown in Table 12-1.

# Section 13
# Select References


Xcel Energy and the Minnesota Department of Commerce. 2004. Characterization of the wind resource in the upper Midwest: Wind integration study - Task 1." September 10, 2004.

City Data, Jeffers, Minnesota: http://www.city-data.com/city/Jeffers-Minnesota.html. Visited on April 28, 2005.

Coffin, B. and L. Pfannmuller, eds. 1988. Minnesota's endangered flora and fauna. Minneapolis: University of Minnesota Press. 1988.

Fedstats. The gateway to statistics from over 100 U.S. federal agencies, data set for Cottonwood County, Minnesota. http://www.fedstats.gov/mapstats/more.data/27033.html.

Fairchild, Laurie, United States Fish and Wildlife Service. 2005. Telephone conversation with Alyssa Sellwood and Joel Schittone of RMT, Inc. February 3, 2005.

Federal Emergency Management Agency. 1981a. National flood insurance program, FIRM flood insurance rate map Cottonwood County, Community Panel No. 2706620100B. January 2, 1981.

Federal Emergency Management Agency. 1981b. National flood insurance program, FIRM flood insurance rate map Cottonwood County, Community Panel No. 2706620125B. January 2, 1981.

Goeman, Elton. 2005. Telephone conversation with Mark Osten of RMT, Inc. May 9, 2005.

Explore Minnesota tourism. 2005. http://www.exploreminnesota.com/destinations/region.cfm?oid=4672. Visited on April 27, 2005.

Minnesota Department of Agriculture. 2005. License search for honey bees in Cottonwood County. http://www2.mda.state.mn.us/webapp/lis/apiaryloc_results.jsp. Visited on April 27, 2005.

Minnesota Department of Commerce. 2002. 14th Wind resource analysis program report, Jeffers Tower (pages 145- 147). October 2002.

Minnesota Department of Health. 2005. County well index online. http://mdh-agua.health.state.mn.us/cwi/cwiViewer.htm. Visited on April 27, 2005.

Minnesota Department of Transportation. 2004. Traffic volumes general highway map, Cottonwood County, Minnesota. http://www.dot.state.mn.us/tda/maps/trafficvolume/2000/counties/cottonwo.pdf

Minnesota Department of Natural Resources (MDNR). 1996. Protected waters and wetlands map, Cottonwood County, Minnesota. Issued 1984, revised 1996. http://files.dnr.state.mn.us/waters/watermgmt_section/pwi/COTT1OF1.pdf.

Minnesota Department of Natural Resources (MDNR). 1997. Regional hydrogeological assessment, southwestern Minnesota. Regional hydrogeologic assessment service. RHA-2, Part B maps. St. Paul. 1997.

Minnesota Department of Natural Resources (MDNR). 2005a. Public Waters Inventory Maps and Lists. http://ww.dnr.state.mn.us/waters/watermgmt_section/pwi/maps.html. Visited on May 26, 2005.

Minnesota Department of Natural Resources. 2005b. Recreation compass. http://www.dnr.state.mn.us/maps/compass.html. Visited on April 27, 2005.

Minnesota State Interagency Working Group (MSIWG) on EMF Issues. 2002. A white paper on electric and magnetic field (EMF) policy and mitigation options. September 2002. at http://www.health.state.mn.us/divs/eh/radiation/emf/emfrept.pdf.

Morey, G.B. and J. Meints. 2000. Geologic map of Minnesota bedrock geology (Map: Scale 1:1,000,000). University of Minnesota and Minnesota Geological Survey, State Map Series S-20, 3rd Edition, Minnesota Bedrock Geology. 2000.

Myking, Larry, Minnesota Department of Transportation Office of Aeronautics. 2005. Telephone conversation with Lisa Coleman of RMT, Inc. May 24, 2005.

U.S. Census Bureau. 2000. Profile of general demographic, social, economic, and housing characteristics: 2000, Geographic Area: Cottonwood County, Minnesota. http://censtats.census.gov/data/MN/05027033.pdf. 2000.

U.S. Census Bureau. 2005. American factfinder. http://factfinder.census.gov/home/saff/. Visited on April 25, 2005.

United States Department of Agriculture Soil Conservation Service. 1979. Soil survey of Cottonwood County, Minnesota. November 1979.

United States Department of Agriculture, Minnesota Agricultural Statistics Service. 2002. Census of agriculture, county profile, Cottonwood County, Minnesota. http://www.nass.usda.gov/census/census02/profiles/mn/cp27033.PDF. Site visited on April 27, 2005.

United Stated Department of Energy. Energy efficiency and renewable energy Web site. 2005. http://www.eere.energy.gov/state_energy/opfacbytech.cfm?state=MN - content. Visited on April 26, 2005.

United States Department of Health, Education and Welfare. 1978. NIOSH technical report, industrial noise control manual (Revised Edition). 1978.

Western Ecosystems Technology (WEST), Inc. 2000. Final report – Avian monitoring studies at Buffalo Ridge, Minnesota, wind resource area: results of a four-year study. Prepared for Northern States Power Company. Cheyenne, Wyoming. 262 pp. http://www.eqb.state.mn.us/pdf/Wind/NSP99RPT.pdf.

Western Ecosystems Technology (WEST), Inc. 2002. Interim report – Bat interactions with wind turbines at Buffalo Ridge, Minnesota Wind Resource Area: 2001 Field Season. Prepared for Electric Power Research Institute and Xcel Energy. Cheyenne, Wyoming. 66 pp.

**Table 2-1**
**Monthly Average Wind Speeds at 80 Meters for the Proposed Site**

| MONTH | AVERAGE WIND SPEED (m/s) | AVERAGE WIND SPEED (miles/hour) |
|---|---|---|
| January | 9.1 | 20.4 |
| February | 9.7 | 21.7 |
| March | 9.5 | 21.3 |
| April | 9.0 | 20.1 |
| May | 8.9 | 19.9 |
| June | 8.0 | 17.9 |
| July | 6.8 | 15.2 |
| August | 6.4 | 14.3 |
| September | 8.1 | 18.1 |
| October | 8.6 | 19.2 |
| November | 9.1 | 20.4 |
| December | 9.2 | 20.6 |
| **Average** | **8.5** | **19.1** |

Note:
Averages based on hourly wind speeds calculated from datasets provided by WindLogics, Inc., to Wind Energy Developers.

Prepared by: DLR, 5/05
Checked by: JVS, 6/05

**Table 2-2**
**Average Monthly Meteorological Conditions for the Proposed Site**

| | JAN | FEB | MAR | APR | MAY | JUN | JUL | AUG | SEP | OCT | NOV | DEC |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Average temperature (°F) | 12.3 | 18.9 | 30.9 | 44.8 | 58.5 | 68.2 | 71.8 | 69.1 | 60.1 | 47.8 | 31.1 | 17.3 |
| High temperature (°F) | 21.8 | 28.3 | 39.8 | 55.8 | 70.5 | 79.8 | 83 | 80.5 | 72.6 | 59.9 | 40.1 | 26 |
| Low temperature (°F) | 2.7 | 9.6 | 22 | 33.8 | 46.4 | 56.6 | 60.6 | 57.7 | 47.6 | 35.7 | 22.1 | 8.4 |
| Precipitation (in) | 0.7 | 0.6 | 1.9 | 2.8 | 3.4 | 4.1 | 3.7 | 3.4 | 2.5 | 2 | 1.6 | 0.7 |
| Days with precipitation | 7 | 7 | 9 | 10 | 11 | 11 | 10 | 9 | 9 | 7 | 7 | 7 |
| Ground wind speed (mph) | 10.4 | 10.5 | 11.5 | 12.2 | 11.2 | 10.2 | 9.3 | 9.1 | 9.7 | 10.3 | 10.8 | 10.2 |
| Morning humidity (%) | 78 | 79 | 81 | 79 | 80 | 81 | 84 | 86 | 86 | 81 | 82 | 80 |
| Afternoon humidity (%) | 71 | 70 | 66 | 57 | 57 | 59 | 60 | 62 | 62 | 60 | 69 | 73 |
| Sunshine (%) | 55 | 58 | 57 | 59 | 62 | 67 | 73 | 70 | 64 | 59 | 44 | 45 |
| Days clear of clouds | 8 | 7 | 6 | 7 | 7 | 8 | 11 | 11 | 11 | 11 | 6 | 7 |
| Partly cloudy days | 8 | 7 | 8 | 8 | 10 | 11 | 12 | 11 | 8 | 8 | 7 | 7 |
| Cloudy days | 15 | 14 | 17 | 15 | 14 | 11 | 8 | 9 | 11 | 13 | 17 | 17 |
| Snowfall (in) | 8.1 | 7.9 | 9.6 | 2.8 | 0 | 0 | 0 | 0 | 0 | 0.8 | 6.7 | 7.7 |

Note:
Based on National Weather Service Data Recorded at the Cottonwood County Airport, Windom, Minnesota, www.city-data.com/city/Jeffers-Minnesota.html

Prepared by: DLR, 5/05
Checked by: LRC, 5/05

**Table 5-1**
**2004 Traffic Volumes for Roads in Project Vicinity**

| ROAD | AVERAGE DAILY TRAFFIC VOLUME |
|---|---|
| US Hwy. 71 | 2,100 |
| State Trunk Hwy. 30 | 940-1,250 |
| County State Aid Hwy 5 | 640-800 |
| County State Aid Hwy. 13 | 580 |
| County State Aid Hwy. 4 | 360-490 |
| County State Aid Hwy. 3 | 65-190 |
| County State Aid Hwy. 22 | 115 |
| County Road 52 | 55 |
| County State Aid Hwy. 21 | 50-105 |
| County Road 51 | 20 |

Source: Minnesota Department of Transportation, 2004 Traffic Volumes General Highway Map, 2004.

Prepared b: LRC, 5/05
Checked by: DLR, 5/05

**Table 10-1**
**Net Energy Projections for the Proposed Site**

| MONTH | Phase I<br>NET ENERGY<br>(MWh) | Phase II<br>NET ENERGY<br>(MWh) |
|---|---|---|
| January | 3,252 | 16,154 |
| February | 3,347 | 16,600 |
| March | 3,612 | 17,823 |
| April | 3,154 | 15,637 |
| May | 2,791 | 13,918 |
| June | 2,559 | 12,655 |
| July | 1,929 | 9,611 |
| August | 1,642 | 8,170 |
| September | 2,707 | 13,445 |
| October | 3,129 | 15,430 |
| November | 3,198 | 15,925 |
| December | 3,449 | 17,164 |
| **Annual** | **34,768** | **172,533** |

Note:
Projections based on calculated hourly wind speed data using WindLogics dataset and C93 wind generator production curve, obtained from Clipper Windpower Technology, Inc. (Phase I) or Vestas (Phase II).

Prepared by: DLR, 5/05
Checked by: JVS, 5/05

**Table 12-1**
**Potential Permits and Approvals Required for Construction and Operation of the Proposed Site (both Phase I and Phase II)**

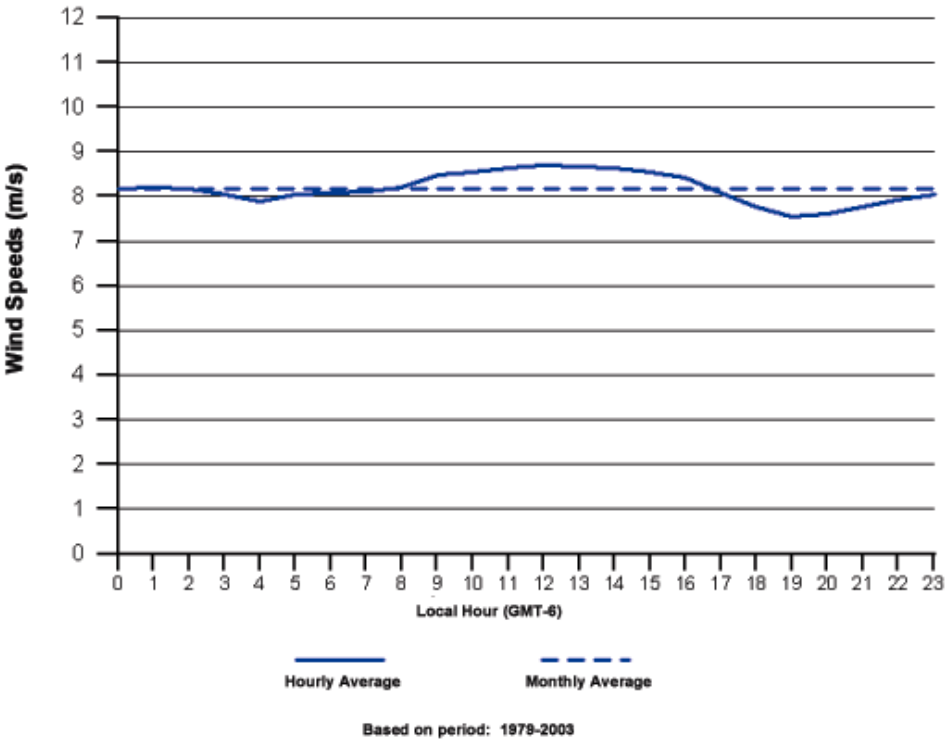
| AGENCY | TYPE OF APPROVAL | PHASE I LIKELIHOOD | PHASE II LIKELIHOOD |
|---|---|---|---|
| ***Federal*** | | | |
| Federal Aviation Administration | Permit for structures over 200 feet | Yes | Yes |
| U.S. Army Corps of Engineers | Section 404 Permit | No | No |
| ***State of Minnesota*** | | | |
| Environmental Quality Board/ Public Utility Commission (after July 1, 2005) | Environmental Impact Assessment | Yes | Yes |
| Minnesota Department of Natural Resources | License to cross public lands and waters | No | No |
| Minnesota Board of Water and Soil Resources | Wetland Conservation Act approval | No | No |
| **Minnesota Pollution Control Agency** | NPDES Permit: Construction license | Yes | Yes |
| | License for Very Small Quantity Generator of Hazardous Waste | Yes | Possible amendment |
| **Minnesota Department of Health** | Plumbing plan review | No | No |
| | Water well permit | No | No |
| Public Utilities Commission | None identified at this time | No | No |
| Department of Transportation | Heavy equipment transport | Possible | Possible |
| ***Local*** | | | |
| Cottonwood County | Conditional use | No | No |
| | Foundations and buildings | Possible | Possible |
| | Access roads construction | Yes | Yes |
| | County road use | Possible | Possible |
| Town of Jeffers | Land use, zoning vari1ances, construction permits, including roads and buildings | No | Possible |

**Figure 1-1**
**Project Vicinity Map**

**Figure 1-2**
**Project Layout**

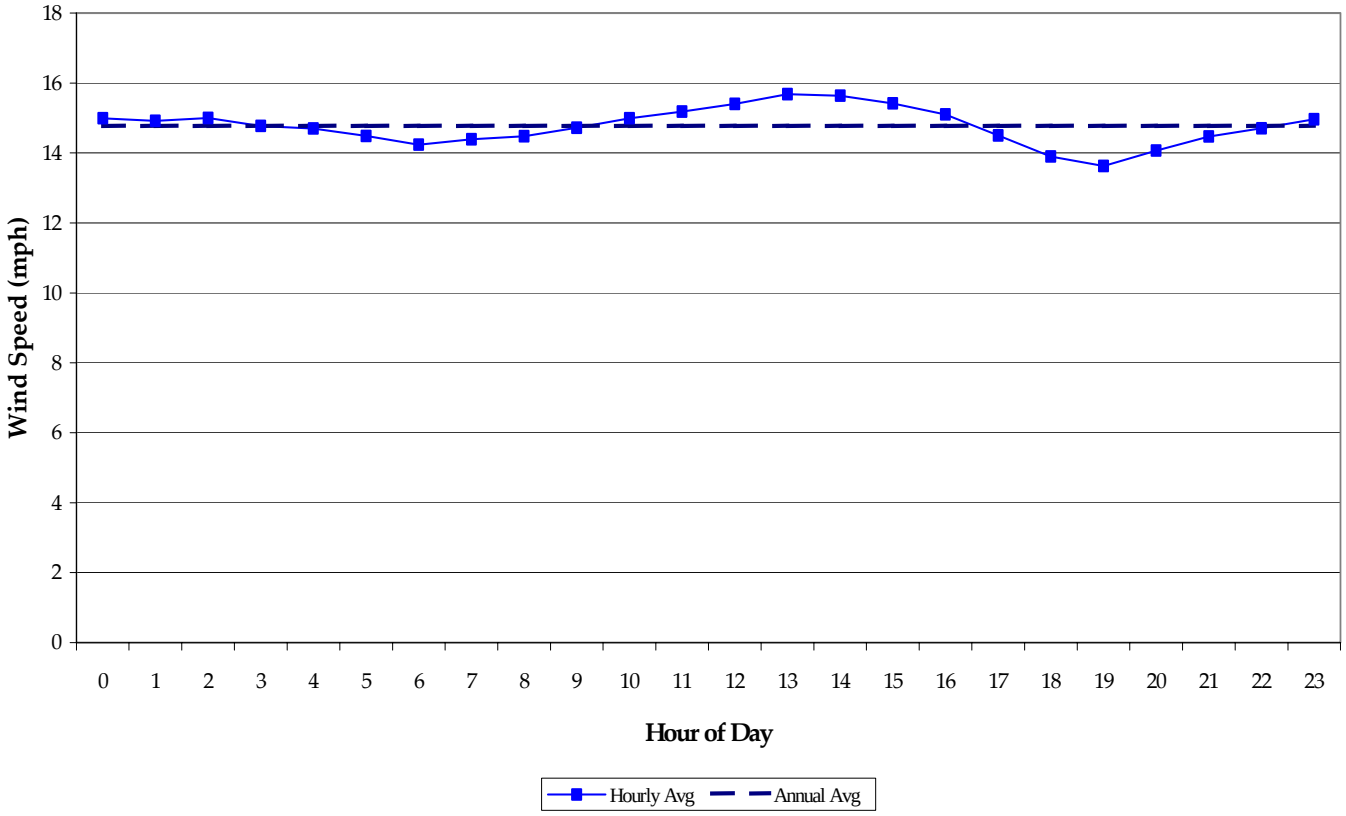
**Figure 1-3**
**Aerial Photograph of the Project Site**

**Figure 2-1(A)**
**Normalized Wind Speed Diurnal Distribution Shown in Local Time - Summit Development Project - 65 m Annual**



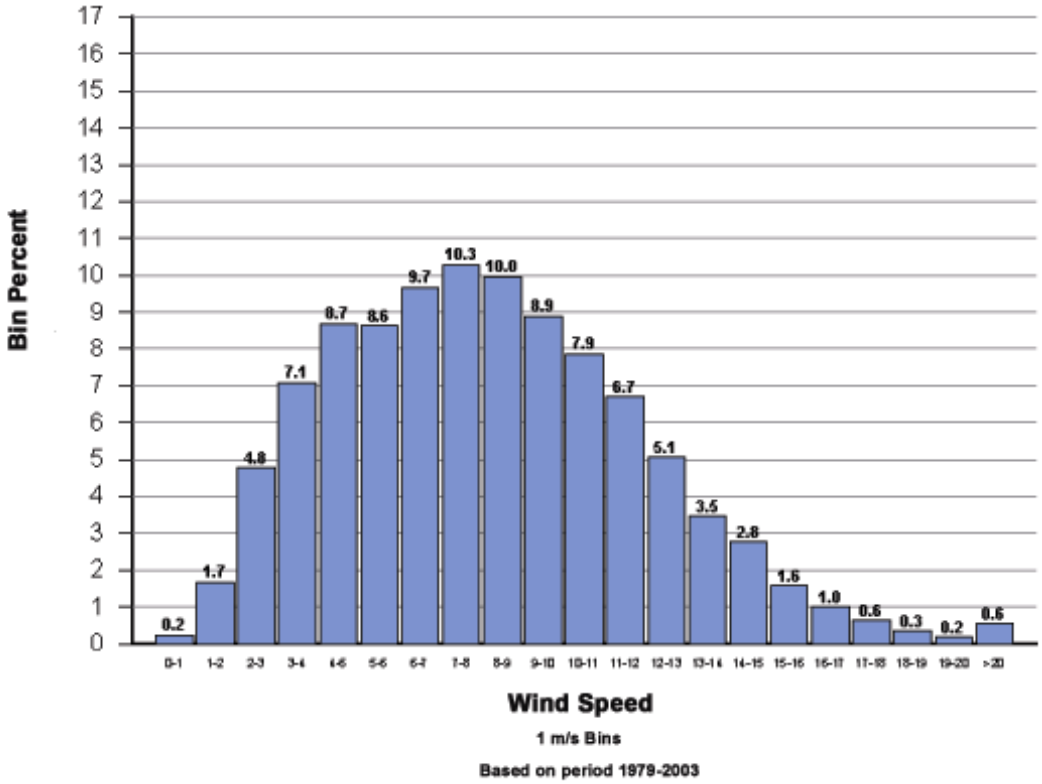

Source: "Summit Development Project, Site Assessment," report by WindLogics, Inc., St. Paul, Minnesota, for Wind Energy Developers, LLC, April 21, 2004.

**Figure 2-1(B)**
**MN WRAP Jeffers Tower Wind Speed Diurnal Distribution 30 m Annual**




Source: Calculated from 10-minute data recorded by the MN WRAP Jeffers tower over the period from January 1, 2000, through October 26, 2000.

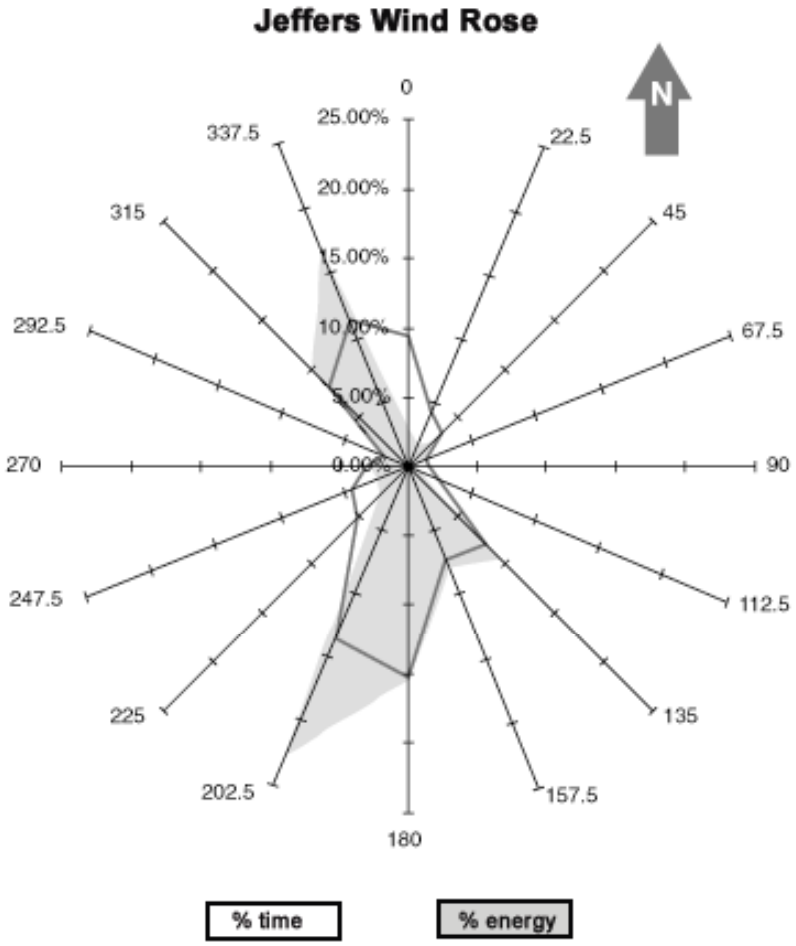
**Figure 2-2**
**Normalized Average Wind Speed Frequency Distribution Histogram**
**(in 1 m/s bins) - Summit Development Project - 65 m Annual**




Source: "Summit Development Project, Site Assessment," report by WindLogics, Inc., St. Paul, Minnesota, for Wind Energy Developers, LLC, April 21, 2004.

**Figure 2-3(A)**
**WRAP Study Wind Distribution Rose**

**Period: May 1999 to October 2000**




Source: "14th Wind Resource Analysis Program Report," Minnesota Department of Commerce, October 2002.

**Figure 2-3(B)**
**Summit Site Met Tower Wind Distribution Rose**

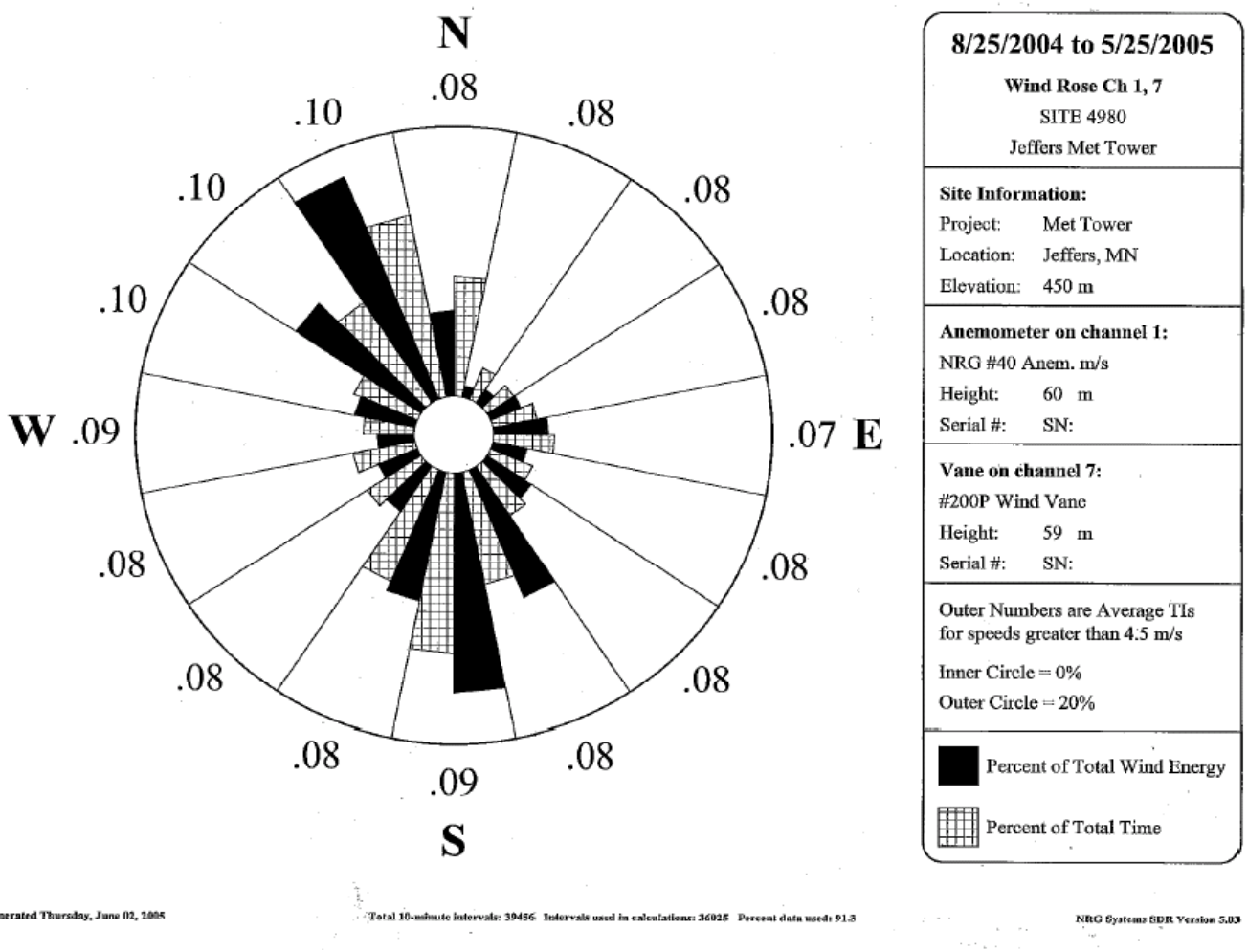


**Figure 5-1**
**Photograph of Proposed Site Landscape in Cottonwood County**

# Appendix A
# Correspondence

# RESOLUTION
# CITY OF JEFFERS

| | |
|---|---|
| **INTRODUCED:** | DORR |
| **SECONDED:** | WILL |
| **VOTED: Aye:** | DORR; WILL; DUROE; JOHNSON; PRINS |
| **Nay:** | NONE |
| **Absent:** | NONE |

**A RESOLUTION SUPPORTING THE SUMMIT WIND, LLC PROJECT AND STRONGLY ENDORSING THE SELECTION OF THIS PROJECT BY GREAT RIVER ENERGY IN ITS "REQUEST FOR PROPOSAL" FOR THE PURCHASE OF ENERGY FROM RENEWABLE ENERGY PROJECTS.**

---

WHEREAS, Summit Wind, LLC has been formed by certain landowners in Cottonwood County, Minnesota, in and around the City of Jeffers with the goal of developing a wind energy generation project that would have a name-plate rating of approximately 50 megawatts near the City of Jeffers, Minnesota (the "Project"); and

WHEREAS, Summit Wind is currently in the process of preparing its submission to Great River Energy's request for proposal and desires to attract support from area landowners and units of government for the purpose of constructing, installing, operating and maintaining wind energy conversion turbines, and related facilities and equipment ("Wind Facilities") for the Project; and

WHEREAS, This project is intended to be owned substantially by landowners and residents of the area, thereby deriving the financial benefits of the project, to the greatest extent, to the residents of the area; and

WHEREAS, Great River Energy places a high emphasis for its selection of projects based upon providing local ownership and support from the various local units of government.

NOW THEREFORE BE IT RESOLVED, That the City Council of the City of Jeffers, Minnesota, proclaims its support for the Summit Wind, LLC project and strongly endorses the selection of this project by Great River Energy in its "Request for Proposal" for the purchase of energy from renewable energy projects.

The City Council's endorsement of this project is based on the following findings:

1. Local Ownership. The project contemplates that the applicant will be an LLC predominately owned by area landowners and residents. Further, the new

LLC is intended to be the long term beneficiary owner of the project. The local ownership will result in a strong local economic benefit as the revenues and profits from the project will be incorporated into our local economy with a substantial reinvestment for the benefit of our residents.

2. Local Economic Development. The project will result in an estimated $50-55M capital investment in the area near the City of Jeffers, utilizing local subcontractors, whenever possible. Further the project is projected to create 20-25 construction jobs and 3-5 permanent full time jobs in the immediate area.

3. Increase in City/County Taxes. The project is projected to generate an estimated $210,000 per year of production tax credits, for the benefit of City and County Taxpayers.

4. Environmental Benefits. The construction of a 50 MW wind project will be a clean, non-polluting renewable energy project. The environmental attributes and approximate air emissions savings benefits are as follows: (1) equivalent reduced natural gas consumption of 420 million cubic feet per year; or (2) reduces equivalent coal consumption and mining of over 17,000 tons per year; or (3) reduces equivalent savings of imported oil consumption of 74,000 barrels per year; and (4) water pollution/consumption savings of over 31 million gallons per year. In addition, this project will reduce air emissions, as compared with a new gas-fired plant, equivalent to over 134 million pounds of $CO_2$ per year, thereby reducing the impacts of global warming.

Adopted by the Council this 26th day of April, 2004.

Brad Prins

Brad Prins, Mayor

CERTIFICATE OF RECORDING OFFICER:

The undersigned duly qualified and acting Clerk of the City of Jeffers does hereby certify that the above resolution is a true and correct copy of the resolution SUPPORTING THE SUMMIT WIND, LLC PROJECT AND STRONGLY ENDORSING THE SELECTION OF THIS PROJECT BY GREAT RIVER ENERGY IN ITS "REQUEST FOR PROPOSAL" FOR THE PURCHASE OF ENERGY FROM RENEWABLE ENERGY PROJECTS.

Janet M Prins

Janet M Prins, City Clerk

# Board of County Commissioners
# Cottonwood County

900 Third Avenue
Windom, Minnesota 56101
Phone: 507.831.5669 FAX: 507.831.3675
E- mail: cottonwood.commissioners@co.cottonwood.mn.us

**Chairperson:**

Gary Sorenson
First District
4016 United States Ave.
Steiden, MN 56174
507-445-3224

**Vice-Chairperson:**

Charlen Severson
Third District
1605 Sixth Avenue
Windom, MN 56101
507-831-2503

**Members:**

Ron Kuecker
Second District
850 21st Street
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Norman Holman
Fourth District
23606 County Road 1
Comfrey, MN 56019
507-877-3213

John Ostjenbruns
Fifth District
PO Box 684
Mt. Lake, MN 56159
507-427-2191

**Administrative Assistant**
Kelly Thongvivong
900 Third Ave.
Windom, MN 56101
507-831-5669

**Resolution 04-04-27A**

**WHEREAS:** Summit Wind, LLC has been formed by certain landowners in Cottonwood County, Minnesota and other investors with the goal of developing a wind energy generation project that would have a name-plate rating of approximately 30 megawatts in Cottonwood County, Minnesota (the "Project").

**WHEREAS:** Summit Wind is currently in the process of preparing its submission to Great River Energy's request for proposal and desires to obtain support from area landowners and units of government for the purpose of constructing, installing, operating and maintaining wind energy conversion turbines, and related facilities and equipment ("Wind Facilities") for the Project.

**WHEREAS:** This project is intended to be owned substantially by landowners and residents of Cottonwood County, thereby deriving the financial benefits of the project, to the greatest extent, to the residents of Cottonwood County.

**WHEREAS:** Great River Energy places a high emphasis for its selection of projects based upon providing local ownership and support from the various local units of government.

**NOW, THEREFORE, BE IT RESOLVED**, that the Cottonwood County Board of Commissioners proclaim its support for the Summit Wind, LLC project and strongly endorse the selection of this project by Great River Energy in its "Request for Proposal" for the purchase of energy from renewable energy projects.

The County Board's endorsement of this project is based on the following findings:

1) Local Ownership. The project contemplates that the applicant will be an LLC predominantly owned by Cottonwood County landowners and residents. Further, the new LLC is intended to be the long-term beneficiary owner of the project. The local ownership will result in a strong local economic benefit as the revenues and profits from the project will be incorporated into our local economy with a substantial reinvestment for the benefit of our residents.

2) Local Economic Development. The project will result in an estimated $50-55M capital investment in Cottonwood County, utilizing local subcontractors, whenever possible. Further the project is projected to create 20-25 construction jobs and 3-5 permanent full time jobs in Cottonwood County.

3) Increase in County Taxes. The project is projected to generate an estimated $210,00 per year of production tax credits, for the benefit of County Taxpayers.

4) Environmental Benefits. The construction of a 50 MW wind project will be a clean, non-polluting renewable energy project. The environmental attributes and approximate air emissions savings benefits are as follows: (1) equivalent reduced natural gas consumption of 420 million cubic feet per year; or (2) reduces equivalent coal consumption and mining of over 17,000 tons per year; or (3) reduces equivalent savings of imported oil consumption of 74,000 barrels per year; and (4) water pollution/consumption savings of over 31 million gallons per year. In addition, this project will reduce air emissions, as compared with a new gas-fired plant, equivalent to over 134 million pounds of $CO_2$ per year, thereby reducing the impacts of global warming.

A motion made by Oelkenbruns, seconded by Severson and approved by the County Board on the 27th day of April 2004.

ATTEST:

Jan Johnson, Auditor/Treasurer

Gary Sorenson, Board Chairman

# United States Department of the Interior

FISH AND WILDLIFE SERVICE
Twin Cities Field Office
4101 East 80th Street
Bloomington, Minnesota 55425-1665


JAN 21 2005

Ms. Alyssa Sellwood
744 Heartland Trail
Madison, Wisconsin 53717

Dear Ms. Sellwood:

This responds to your December 22, 2004, letter requesting information on threatened and endangered species in the area of a number of proposed wind turbines (33) located in Sections 20 through 29, 35 and 36, Township 107N, Range 37W and Sections 19, 21, 22, and 27 through 34, Township 107N, Range 36W. Two additional sections, Section 1, Township 107N Range 37W and Section 6, Township 107N, Range 36W, have been added as potential turbine sites per your January 18, 2004, telephone conversation with our project biologist. The proposed project area is east of the city of Storden and extends west and south of the city of Jeffers, in Cottonwood County, Minnesota. These wind turbines will be 400 feet tall, including the blade length, and will be located with a minimum of 800 to 1500 feet between towers.

The U.S. Fish and Wildlife Service (Service) is responsible for recommending measures to minimize project impacts to migratory birds and other wildlife resources according to various federal laws such as the Migratory Bird Treaty Act. In 2003, the Department of Interior developed *Interim Guidelines to Avoid and Minimize Wildlife Impacts from Wind Turbines*. These guidelines can be found on the Internet at www.fws.gov/r9dhcbfa/wind.pdf. We recommend that you use these guidelines in developing your project.

We have enclosed a map depicting the extent of public lands within and adjacent to the proposed project area. Waterfowl Production Areas (WPA's) are federally owned and managed and questions regarding these properties or easements should be directed to this office. The Wildlife Management Areas (WMA's) shown on the map are owned by the state of Minnesota and managed by the Minnesota Department of Natural Resources; questions regarding these properties should be directed to their regional wildlife managers.

Specific Comments/Recommendations:

1. The Service has several properties within or adjacent to the proposed action area. Because these areas are a combination of wetland and grassland managed for breeding and migrating avian species, we request that turbines be located as far as

possible away from these areas (see enclosed map). In particular, we recommend that no turbines be sited in Section 6, T107N, R36W, or Sections 26 through 28 and Section 35 in T107N, Range 37W.

2. If the project is to be constructed in phases, we recommend that a monitoring plan be included in each phase of the operation to determine the site specific impacts of the turbines so adjustments can be made in future phases, as needed, to reduce adverse impacts to local wildlife.

3. We recommend that Wind Energy Developers, LLC, contact the owners of the existing communication towers in the area to determine whether they have conducted any monitoring at these sites and if so, obtain any bird strike data they may have collected to aid in your assessment of the potential project affects on migrating and breeding birds.

To provide an in-depth review of site-specific concerns, it is necessary to have a thorough understanding of the expected duration of operation (e.g. 24 hour continuous, 7 days/week), expected life of the project, and other siting, construction and operation issues that may have an influence on wildlife use of the area. We request that you provide us details as they become available so adverse impacts to migratory birds and their habitats are avoided and minimized to the extent possible.

There are no known federally listed or proposed threatened or endangered species, candidate species, or designated critical habitat within the proposed action area. Therefore, no further action on this project is required under section 7 of the Endangered Species Act of 1973, as amended. However, if the project is modified or new information becomes available which indicates that listed species may occur in the affected area, consultation with this office should be reinitiated.

We appreciate the opportunity to provide preliminary comments and look forward to providing additional technical assistance for the proposed project. If you have questions regarding our comments, please contact Ms. Laurie Fairchild of my staff at (612) 725-3548, extension 214.

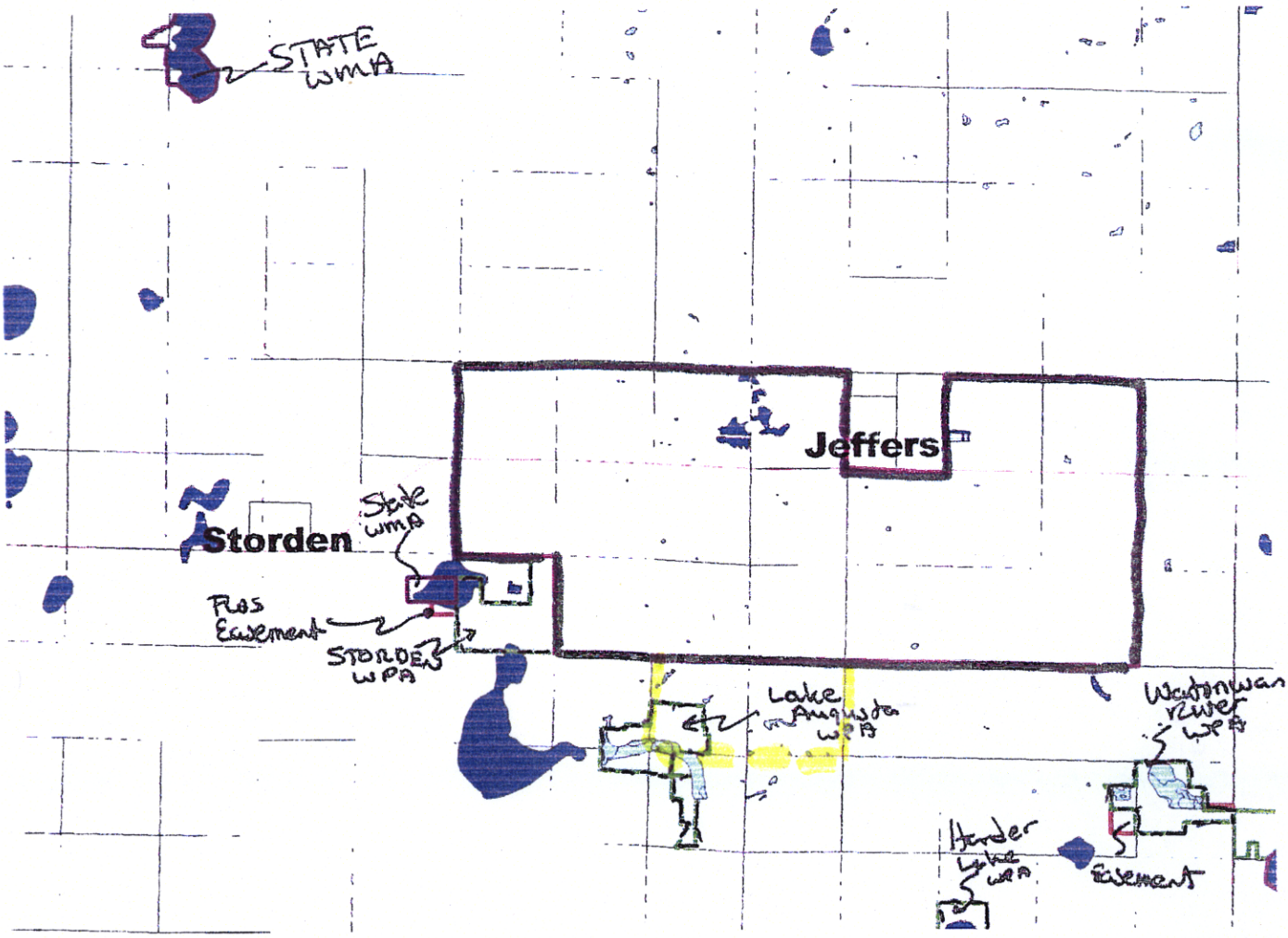
Sincerely,

Annette Trowbridge

Acting for Dan P. Stinnett
Field Supervisor

cc: Mark Vaniman, Windom Wetland Management District

# Windom WMD Base Map




3 0 3 6 Miles

- Private Lands
- Jeffers NWI

Roads
- Interstate Hwy
- US Trunk Hwy
- MN Trunk Hwy
- County State Aid Hwy
- County Rd
- Township Rd
- City Street
- Ramp
- Windom WMA
- Slayton WMA
- WPA Boundary
- Easement Boundary
- Lakes
- PLSS - Sections
- Municipal Boundaries
- County Boundaries

N
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# Minnesota Department of Natural Resources

Natural Heritage and Nongame Research Program, Box 25
500 Lafayette Road
St. Paul, Minnesota 55155-40__

Phone: (651) 296-7863 Fax: (651) 296-1811 E-mail: sarah.hoffmann@dnr.state.mn.us


June 1, 2005

Ms. Lisa Coleman
RMT, Inc.
744 Heartland Trail
Madison, WI 53717

Re: Request for Natural Heritage information for vicinity of proposed Jeffers Wind Energy Project; T106N R36W Section 6; T106N R37W Section 1; T107N R36W Sections 19, 21, 22, 27-34; T107N R37W Sections 22-28, 35, 36; Cottonwood County
NHNRP Contact #: ERDB 20050821

Dear Ms. Coleman,

The Minnesota Natural Heritage database has been reviewed to determine if any rare plant or animal species or other significant natural features are known to occur within an approximate one-mile radius of the area indicated on the map enclosed with your information request. Based on this review, there are 4 known occurrences of rare species or native plant communities in the area searched (for details, see enclosed database printout and explanation of selected fields). Following are specific comments for **only those elements that *may* be impacted** by the proposed project. Rare feature occurrences not listed below are not anticipated to be affected by the proposed project.

- A Dry Hill Prairie native plant community was documented above Highwater Creek, just outside the northwestern edge of the project study area, in 1989. Two special concern butterfly species, the Powesheik Skipper and the Regal Frittilary, were later observed in this prairie in 1994. In 2001, this prairie remnant along with another remnant in the NW ¼ of Section 28 T107N R37W were enrolled in Minnesota's Native Prairie Bank Program. This program protects prairie through conservation easements, which prohibit the construction or placement of structures or devices whether permanent or temporary on the premises without written authorization from the DNR Commissioner. In addition, no conveyance of any other easement for any other purpose including, but not limited to, road or utility is permitted upon or within the premises without authorization.

  We suspect that additional prairie remnants may also be present along the Highwater Creek drainage in T107N R37W Section 28, 33, & 34. The Minnesota County Biological Survey has just begun working in Cottonwood County, so we expect to have more information on the presence of native plant communities and rare plant species in this area by the end of the summer. Please contact me later in the field season to obtain the results of this survey work.

  In the mid-1800s, eighteen million acres of prairie covered Minnesota. More than 99% of this native prairie has since been converted into agricultural land. Most of the remaining prairie includes fragmented remnants in areas unsuitable for cultivation. Because of the loss of once widespread prairie habitat, more than one-third of Minnesota's endangered, threatened, and special concern species are now dependent on the remaining small fragments of Minnesota's prairie ecosystem. Therefore, we feel that all prairie remnants merit protection. In addition, there is some evidence to suggest that grassland birds are deterred from nesting in otherwise appropriate

habitat by the presence of tall structures in the vicinity. As such, we request that wind turbines not be placed on or within at least ¼ mile, and preferably ½ mile, of prairie remnants. Please see the enclosed map for the locations of known prairie remnants and contact me later in the field season to see if any additional prairie remnants were discovered during the course of the County Biological Survey.

- As you may be aware, the Storden Waterfowl Production Area (WPA) is located just outside the project study area in T107N R7W Section 34 and the Lake Augusta WPA is located within the study area in the southwest quarter T106N R37W Section 1. If you have not already done so, I recommend that you contact U.S. Fish & Wildlife Service to determine if they have any information or concerns about the project as it relates to the WPAs.

The Natural Heritage database is maintained by the Natural Heritage and Nongame Research Program, a unit within the Division of Ecological Services, Department of Natural Resources. It is continually updated as new information becomes available, and is the most complete source of data on Minnesota's rare or otherwise significant species, native plant communities, and other natural features. Its purpose is to foster better understanding and protection of these features.

Because our information is not based on a comprehensive inventory, there may be rare or otherwise significant natural features in the state that are not represented in the database. A county-by-county survey of rare natural features is now underway, but has not been completed for Cottonwood County. Therefore ecologically significant features for which we have no records may exist on the project area.

The enclosed results of the database search are provided in two formats: index and full record. To control the release of locational information, which might result in the damage or destruction of a rare element, both printout formats are copyrighted.

The index provides rare feature locations only to the nearest section, and may be reprinted, unaltered, in an Environmental Assessment Worksheet, municipal natural resource plan, or report compiled by your company for the project listed above. If you wish to reproduce the index for any other purpose, please contact me to request written permission. **The full-record printout includes more detailed locational information, and is for your personal use only. If you wish to reprint the full-record printouts for any purpose, please contact me to request written permission.**

Please be aware that review by the Natural Heritage and Nongame Research Program focuses only on *rare natural features*. It does not constitute review or approval by the Department of Natural Resources as a whole. If you require further information on the environmental review process for other natural resource-related issues, you may contact your Regional Environmental Assessment Ecologist, Mike North, at (218) 828-2433.

An invoice in the amount of $98.72 will be mailed to you under separate cover within two weeks of the date of this letter. You are being billed for map and database search and staff scientist review. Thank you for consulting us on this matter, and for your interest in preserving Minnesota's rare natural resources.

Sincerely,

Sarah Hoffmann

Sarah D. Hoffmann
Endangered Species Environmental Review Coordinator

encl: Database search results
Rare Feature Database Print-Outs: An Explanation of Fields
Map

cc: Mike North
Lisa Gelvin-Innvaer
John Schladweiler

Minnesota Natural Heritage Database
Element Occurrence Records
Copyright 2005 State of Minnesota DNR

| TWP | RNG | PRIMARY SECTION | FED STATUS | MN STATUS | S RANK | ELEMENT and OCCURRENCE NUMBER | MANAGED AREA |
|---|---|---|---|---|---|---|---|
| T106N | R37W | 12 | | | S2 | MESIC PRAIRIE (SOUTHWEST) #225 | LAKE AUGUSTA WPA |
| T107N | R37W | 21 | | | S3 | DRY PRAIRIE (SOUTHWEST) HILL SUBTYPE #132 | STORDEN 28 NATIVE PRAIRIE BANK |
| T107N | R37W | 21 | | SPC | | OARISMA POWESHEIK (POWESHEIK SKIPPER) #103 | |
| T107N | R37W | 21 | | SPC | | SPEYERIA IDALIA (REGAL FRITTILARY) #167 | |

RECORDS PRINTED = 4

# Appendix B
# Archaeological and Cultural Literature Search

# LITERATURE SEARCH FOR THE JEFFERS WIND FARM PROJECT, AMBOY, AMO, DALE, AND STORDEN TOWNSHIPS, COTTONWOOD COUNTY, MINNESOTA

Submitted to:
Wind Energy Developers, Inc.

Submitted by:
The 106 Group Ltd.

February 2005

# LITERATURE SEARCH FOR THE JEFFERS WIND FARM PROJECT, AMBOY, AMO, DALE, AND STORDEN TOWNSHIPS, COTTONWOOD COUNTY, MINNESOTA

**SHPO File No. pending**
**The 106 Group Project No. 05-03**

**Submitted to:**
**Wind Energy Developers, Inc.**
**207 Chestnut Street North**
**Suite 200**
**Chaska, MN 55318**

**Submitted by:**
**The 106 Group Ltd.**
**The Dacotah Building**
**370 Selby Avenue**
**St. Paul, MN 55102**

**Report Author:**
**Andrea Vermeer, M.A., RPA**

**February 2005**

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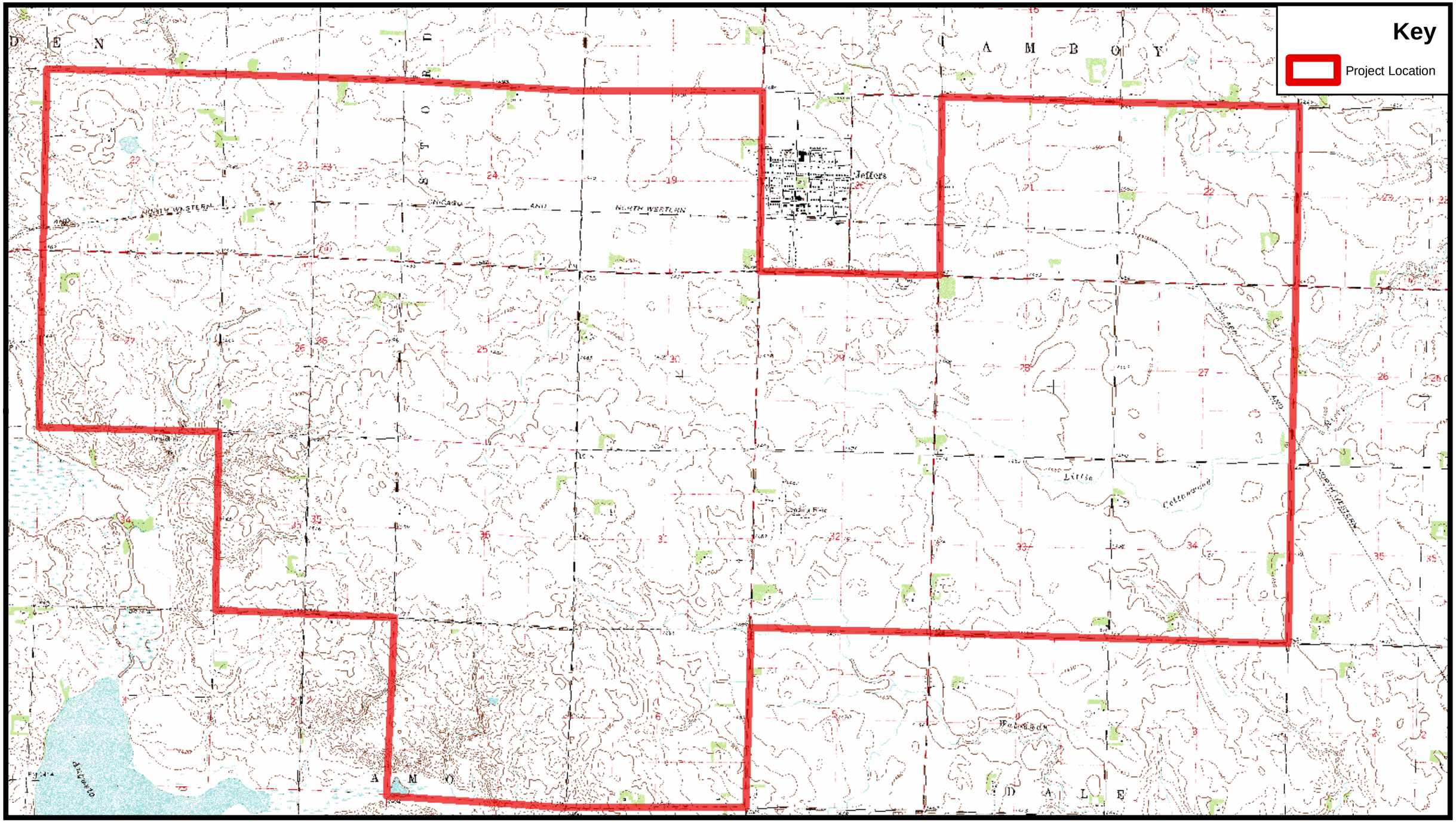
# 1.0 INTRODUCTION

In January of 2005, The 106 Group Ltd. (The 106 Group) conducted a literature search for the Jeffers Wind Farm project. The literature search was conducted under contract with Wind Energy Developers, Inc. The project area is located in Section 6, T106N, R36W, Dale Township; Section 1, T106N, R37W, Amo Township; Sections 19, 21, 22, and 27 through 34, T107N, R36W, Amboy Township; and Sections 22 through 27, 35, and 36, T107N, R37W, Storden Township, Cottonwood County, Minnesota (Figure 1). The project requires a site permit from the Minnesota Environmental Quality Board (EQB), and it is anticipated that a federal permit from the Federal Aviation Administration (FAA) will be required. Federal involvement in this project would require compliance with Section 106 of the National Historic Preservation Act of 1966, as amended (NHPA), as well as state laws, namely the Minnesota Field Archaeology Act (M.S. 138). This report is intended to provide preliminary archaeological, historical, and cultural resources information for completion of the EQB site permit and to assist in future compliance requirements under federal and state law.

The study area for this literature search is the same as the project area, and includes 13,440 acres (5,439 hectares). The purpose of the literature search was to identify any archaeological sites previously recorded within the study area; to identify any architectural history properties within the study area that have been listed on or determined eligible for listing on the National Register of Historic Places; and to assess the study area's potential for containing previously unidentified archaeological resources. Should the Jeffers Wind Farm project be altered from the present proposal, the study area for architectural history and archaeological resources will need to be adjusted as appropriate.

The literature search for this project included background research to identify any archaeological sites or architectural history properties previously recorded, and any cultural resources studies previously conducted, within the study area. In addition, research was conducted using historical and current documents relevant to the study area to assess archaeological potential.




Source: USGS Quadrangles. 7.5 Minute Series. Jeffers, MN 1980; Storden, MN 1980.

**Jeffers Wind Farm**
**Literature Search**
**Cottonwood County, Minnesota**

**Project Location**

0 0.25 0.5 0.75 1 1.25 1.5 1.75 2 Miles

**Figure 1**

# 2.0 METHODS

## 2.1 BACKGROUND RESEARCH

On January 27, 2005, background research was conducted using the Minnesota State Historic Preservation Office (SHPO) site files for information on previously identified archaeological sites and architectural history properties and on cultural resources surveys previously conducted within the study area.

## 2.2 ARCHAEOLOGY

### *2.2.1 Study Area*

The study area included all areas where construction or other ground-disturbing activities related to the project might take place. The precise locations of turbines, transmission lines and access roads, etc., have not yet been determined. Based on plans available in January of 2005, the study area for the Jeffers Wind Farm project is 13,440 acres (5,439 hectares).

### *2.2.2 Methods*

USGS topographic quadrangles, aerial photographs, historical plat maps, and data on project soils were examined in order to identify the portions of the project area that possess a higher potential for containing archaeological sites. Such areas are generally defined as the undisturbed portions of a given area:

- within 500 ft. (150 m) of an existing or former water source of 40 acres (19 hectares) or greater in extent, or within 500 ft. (150 m) of a former or existing perennial stream;
- located on topographically prominent landscape features;
- located within 300 ft. (100 m) of a previously reported site; or
- located within 300 ft. (100 m) of a former or existing historic structure or feature (such as a building foundation or cellar depression).

Areas defined as having a relatively low potential for containing intact archaeological resources, based on their unsuitability for occupation, included inundated areas, former and existing wetland areas, poorly drained areas, and areas with a 20 percent or greater slope. Low potential areas and areas in which Holocene (less than 10,000 years old) deposits have been significantly disturbed are defined as having little or no potential for containing intact archaeological resources.

## 2.3 ARCHITECTURAL HISTORY

### *2.3.1 Study Area*

A study area for architectural history is usually based upon an analysis of the factors considered when recommending an area of potential effect (APE), such as land acquisition, changes in access to properties, alterations in traffic patterns, noticeable noise increases, visual effects, increase in vibration, change in air quality, and impacts to land use and a property's setting.

Because an analysis of these factors has not been provided and a field survey was not conducted for the current study, the study area for architectural history was limited to the project area.

### *2.3.2 Methods*

The literature search for architectural history was limited to background research at the SHPO (see Section 2.1).

If, in the future, there is federal involvement (e.g., through an FAA permit) in this project, the project must comply with Section 106 of the National Historic Preservation Act of 1966, as amended, which could involve the completion of a field survey to identify any architectural history properties that are potentially eligible for listing on the NRHP.

# 3.0 PREVIOUS INVESTIGATIONS

## 3.1 ARCHAEOLOGY

Research indicated that no archaeological surveys have been conducted, and no archaeological sites have been recorded within the study area. Two archaeological sites, 21CO7 and 21CO19, have been recorded within one mile of the project area (Table 1). Site 21CO7 was recorded on ridges near Lake Augusta in 1969. The site consists of an artifact scatter containing projectile points, a round milling stone, and pottery sherds (University of Minnesota, Department of Anthropology, Archaeological Site Survey, 21CO7, on file at the SHPO). Site 21CO19 was recorded in an agricultural field near a large wetland just south of the Jeffers Wind Farm study area. It consists of a lithic scatter containing debitage and non-diagnostic bifaces (Johnson 1992).

The NRHP-listed Jeffers Petroglyphs Site (21CO3), which is also designated a Minnesota Historic Site, is located approximately 4.6 miles northeast of the Jeffers Wind Farm study area in Section 9, T107N, R35W. Given this distance, it is not likely that the Jeffers Wind Farm project will have an effect on the historic site.

**TABLE 1. ARCHAEOLOGICAL SITES RECORDED NEAR THE PROJECT AREA**

| Site No. | Site Name | T | R | S | ¼ Section | Description |
|---|---|---|---|---|---|---|
| 21CO7 | Lake Augusta Site | 106 | 37 | 3 | NW-SE | Artifact Scatter |
| 21CO19 | | 107 | 37 | 34 | NE-NW-SW | Lithic Scatter |

## 3.2 ARCHITECTURAL HISTORY

No architectural history surveys have been conducted, and no architectural history properties have been previously recorded within the study area. Based on the results of the SHPO query submitted in January of 2005, no architectural history properties within the Jeffers Wind Farm study area have been previously determined eligible for listing or listed on the NRHP. The SHPO query also indicated that there are no architectural history properties that have been previously determined eligible for listing or listed in the NRHP within the town of Jeffers, which is located adjacent to the study area.

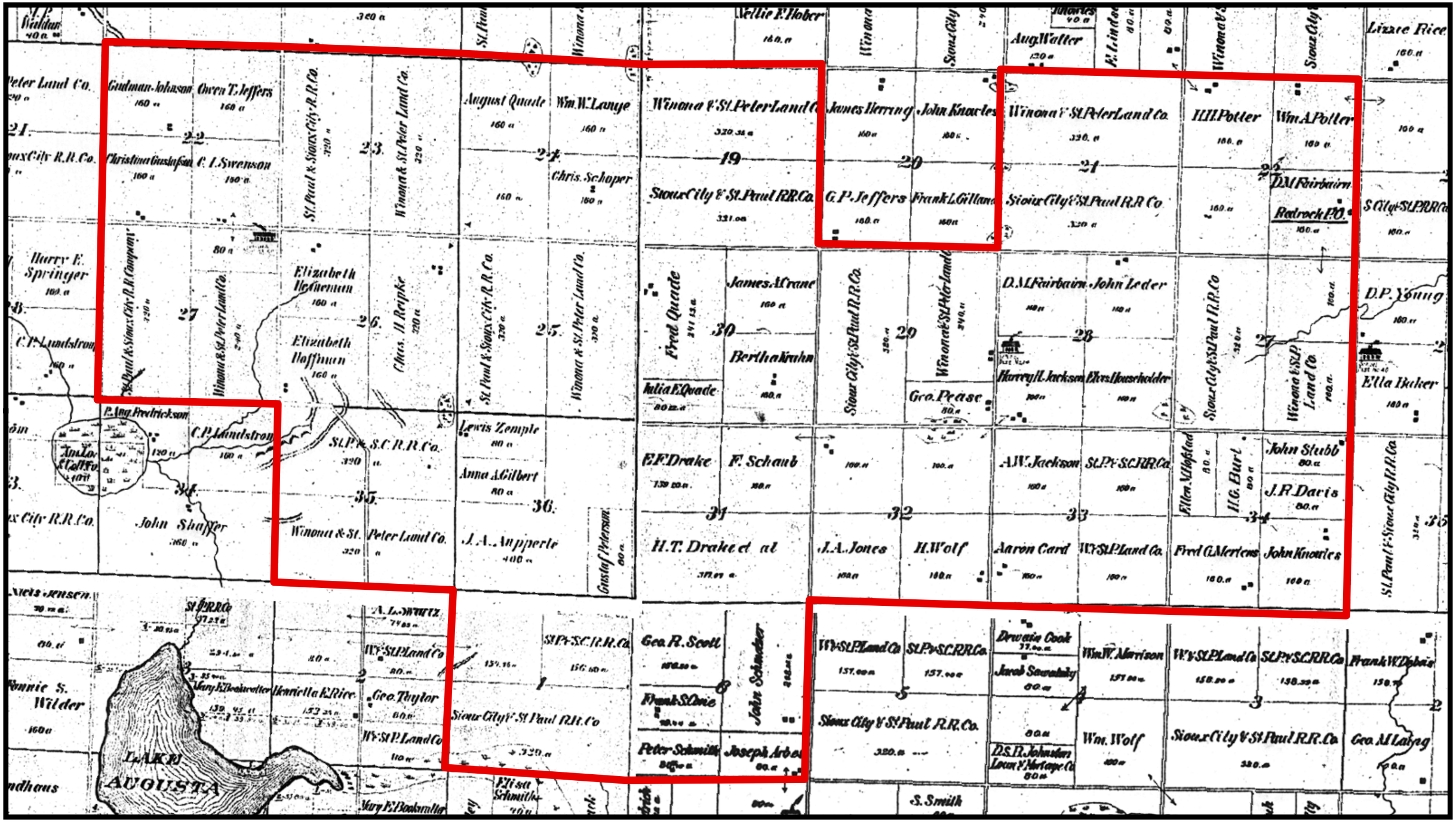
# 4.0 RESULTS

## 4.1 ARCHAEOLOGY

A 2003 aerial view and 1980 USGS topographic maps of the study area show that it is almost entirely comprised of lightly rolling farmland and farmsteads, with the exception of a small airstrip located in the NW ¼ of Section 32, and a cemetery located in the NE ¼ of Section 29, T107N, R36W. At the time that the USGS map was created, a gravel pit was located along the southern edge of the SW ¼ of the SE ¼ of the SE ¼, Section 27, T107N, R37W. Within the southwestern portion of the study area are a few ravines containing creeks that trend into Lake Augusta, south of the study area. These creeks represent the ends of a tributary of the Big Cottonwood River, located north of the study area. Though no longer visible, during the mid to late nineteenth century, the Little Cottonwood River ran within the study area in Section 27, T107N, R36W (Trygg 1966; Gibson 1896) (Figure 2). It was subsequently diverted or altered, probably for the railroad, to run additionally in Sections 28, 29, 33, and 34, T107N, R36W, as indicated on a 1909 plat of Amboy Township (Figure 3) and the USGS topographic map of the area. It does not appear on the 2003 aerial view of the area.

A mid to late nineteenth-century map (Trygg 1964) of the area indicates that it was historically comprised of prairie lands. The 1896 plat maps of the area (Gibson 1896) show the presence of several structures, many of which are clustered in groups of two or three buildings and are likely farmsteads. In addition to these farmsteads, two schools, one in the SW ¼ of Section 28, T107N, R36W, and one in Section 27, T107N, R37W (see Figure 2), and the Redrock Post Office, in Section 22, T107N, R36W, were located in the study area. In 1899, the Des Moines Valley Railway Company of Minnesota (DMVR) constructed a spur line from Bingham Lake to Jeffers. The following year, the DMVR was sold to the Chicago St. Paul Minneapolis & Omaha Railway Company (the Omaha), who extended the spur from Jeffers to Currie (Prosser 1966). It is this spur line that is illustrated on plat maps of the area dating to 1909 (Ogle 1909) (see Figure 3). The school in Section 28, T107N, R36W, was gone by that year, as was the post office, but the school in Section 27, T107N, R37W, remained (Ogle 1909).

Aerial views from 1938 and 1993 show that the study area retained its rural character throughout the twentieth century and into the present. The school in Section 27, T107N, R37W, was gone by 1938. While, based on the USGS topographic map of the area, the Omaha spur line was present until at least 1980, it has since been removed and its grade demolished through plowing. Farmsteads are still present in a few of the locations depicted on the 1896 plat maps, indicating that some early farmsteads may remain intact.



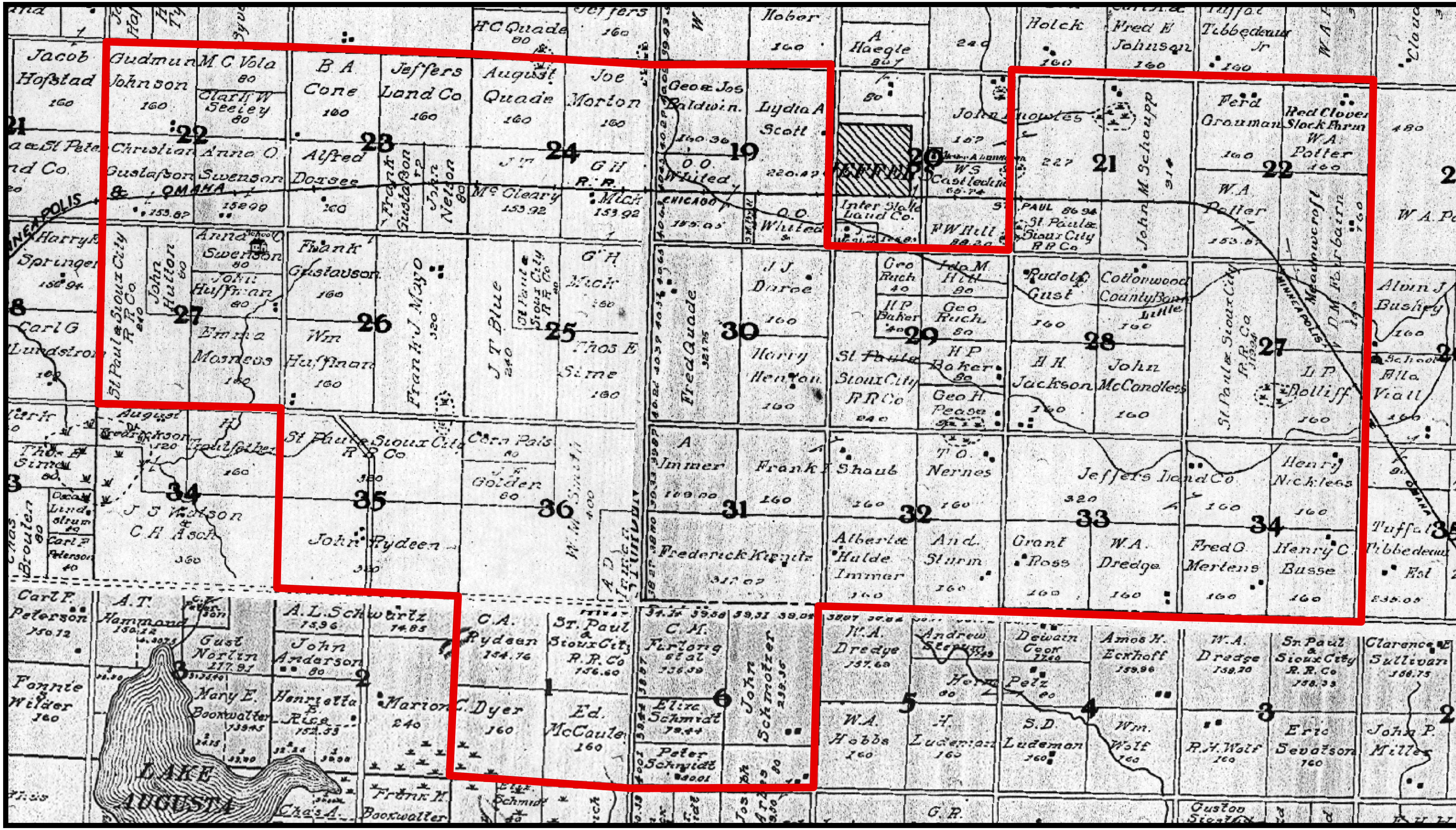

Source: Gibson 1896

**Jeffers Wind Farm**
**Literature Search**
**Cottonwood County, Minnesota**

**1896 Plat Maps of Study Area /**
**Post-Contact Archaeology Assessment Results**

0 0.25 0.5 0.75 1 1.25 1.5 1.75 2 Miles

**Figure 2**




Source: Ogle 1909

**Jeffers Wind Farm**
**Literature Search**
**Cottonwood County, Minnesota**

**1909 Plat Maps of Study Area**

0 0.25 0.5 0.75 1 1.25 1.5 1.75 2 Miles

**Figure 3**

### *4.1.1 Precontact Archaeology*

The construction of the former rail line, the creation of the airstrip, and building construction would have caused heavy disturbance to those portions of the study area formerly or currently occupied by buildings, the railroad, and the airstrip. The location of the gravel pit indicated on the USGS topographic map of the area would also have been heavily disturbed. These portions of the study area are therefore considered to have low potential for containing intact precontact archaeological resources.

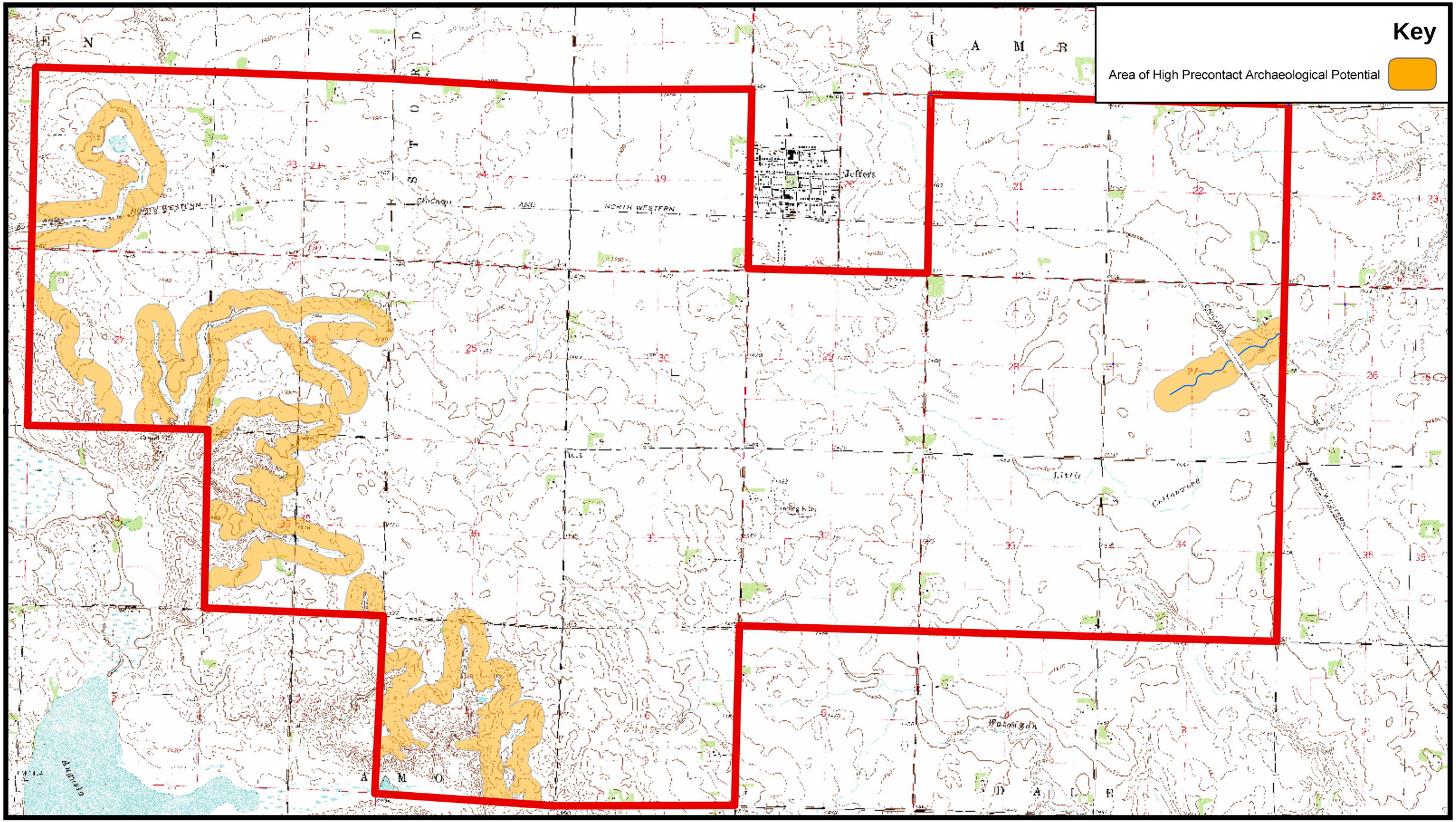
The remainder of the study area has undergone little disturbance that would negate the intactness of archaeological resources. While cultivation can impact archaeological resources, intact soil horizons containing such resources are frequently preserved below the plow zone. Much of the study area, however, is not topographically prominent or in proximity to bodies of water or archaeological sites. The majority of the study area, therefore, is considered to have low potential for containing intact precontact archaeological sites.

A few areas within the study area are considered to have high potential for containing intact precontact archaeological sites. Based on its proximity to the former Little Cottonwood River, the area within 500 ft. of the Little Cottonwood River as it appeared historically (see Figure 2), within Section 27, T107N, R36W, except where it was crossed by the former railroad, is considered to have high potential for containing intact precontact archaeological resources (Figure 4). In addition, those areas on uplands within 500 ft. of the creeks that represent tributaries of the Big Cottonwood River and are in proximity to the wetlands surrounding Lake Augusta are considered to have high potential for containing intact precontact archaeological resources (see Figure 4).

#### *4.1.1.1 Recommendations*

The 106 Group recommends that a Phase I archaeological survey be conducted of those areas considered to have high precontact archaeological potential to identify the presence of any previously unidentified precontact archaeological sites.

If the survey is conducted when the agricultural fields are plowed, either prior to or after the presence of crops (typically May to June and September to October, respectively), surface visibility would allow for pedestrian reconnaissance (walkover) to be employed for survey in those areas containing agricultural fields. If the survey is conducted when crops are present and therefore visibility is poor, per SHPO guidelines, it will require shovel testing in 15-meter (m) intervals along transects spaced 15 m apart throughout those areas designated as high potential. Any high-potential areas outside of the agricultural fields in which visibility is poor also would be subject to shovel testing at 15-m intervals along transects spaced 15 m apart.




Source: USGS Quadrangles. 7.5 Minute Series. Jeffers, MN 1980; Storden, MN 1980.

**Jeffers Wind Farm**
**Literature Search**
**Cottonwood County, Minnesota**

**Precontact Archaeology Assessment Results**

0 0.25 0.5 0.75 1 1.25 1.5 1.75 2 Miles

**Figure 4**

### *4.1.2 Post-Contact Archaeology*

The construction of the former rail line, the creation of the airstrip, and the former gravel pit in the study area would have caused disturbance to those portions of the study area, which are therefore considered to have low potential for containing intact post-contact archaeological sites.

The 1896 plat map, which is the earliest available from the Minnesota Historical Society for the study area, depicts several farmsteads, two schools, and a post office within the study area. The locations surrounding these early structures within the study area, which is largely undisturbed, are considered to have high potential for containing intact post-contact archaeological sites (see Figure 2).

The potential significance of any post-contact archaeological resources that might exist within the study area is not known at this stage.

#### *4.1.2.1 Recommendations*

The 106 Group recommends that deed research, subsequent census review, and other documentary research be conducted at the Phase I level to identify whether any of the potential post-contact archaeological sites associated with the former structures in the proposed plant site are potentially eligible for listing on the NRHP.

A visual assessment should be conducted of the survey area to determine whether any of the farmsteads that date to or predate 1896 are extant. Extant historical farmsteads would instead be subject to an architectural history investigation under Section 106 of the NHPA, if there is future federal involvement in this project.

## 4.2 ARCHITECTURAL HISTORY

Based on the results of the SHPO query submitted in January of 2005, no architectural history properties within the Jeffers Wind Farm study area have been previously determined eligible for listing or listed on the NRHP.

# 5.0 RECOMMENDATIONS

## 5.1 ARCHAEOLOGY

### *5.1.1 Precontact Archaeology*

The 106 Group recommends that a Phase I archaeological survey be conducted of those areas considered to have high precontact archaeological potential to identify the presence of any previously unidentified precontact archaeological sites.

If the survey is conducted when the agricultural fields are plowed, either prior to or after the presence of crops (typically May to June and September to October, respectively), surface visibility would allow for pedestrian reconnaissance (walkover) to be employed for survey in those areas containing agricultural fields. If the survey is conducted when crops are present and therefore visibility is poor, per SHPO guidelines, it will require shovel testing in 15-meter (m) intervals along transects spaced 15 m apart throughout those areas designated as high potential. Any high-potential areas outside of the agricultural fields in which visibility is poor would be subject to shovel testing at 15-m intervals along transects spaced 15 m apart.

### *5.1.2 Post-Contact Archaeology*

The 106 Group recommends that deed research, subsequent census review, and other documentary research be conducted at the Phase I level to identify whether any of the potential post-contact archaeological sites associated with the former structures in the proposed plant site are potentially eligible for listing on the NRHP.

A visual assessment should be conducted of the survey area to determine whether any of the farmsteads that date to or predate 1896 are extant. Extant historical farmsteads would instead be subject to an architectural history investigation under Section 106 of the NHPA, if there is future federal involvement in this project.

## 5.2 ARCHITECTURAL HISTORY

If, in the future, there is federal involvement (e.g., through an FAA permit) in this project, the project must comply with Section 106 of the National Historic Preservation Act of 1966, as amended, which could involve the completion of a field survey to identify any architectural history properties that are potentially eligible for listing on the NRHP.

## 5.3 POTENTIAL FUTURE LEGISLATIVE REQUIREMENTS

If there is any public involvement in a future development of the Jeffers Wind Farm project, several pieces of state and federal law would apply. A summary of these applicable laws is presented in Appendix A.

## REFERENCES CITED

Gibson, Arthur
1896 *Plat Book of Cottonwood County, Minnesota*. Arthur Gibson, M & C. E., Windom.

Johnson, Craig M.
1992 *Phase I and II Archaeological Investigations of Sixteen Project Areas in Minnesota*. Institute for Minnesota Archaeology. Submitted to Department of the Interior, U.S. Fish and Wildlife Service.

Ogle, Geo. A. & Co.
1909 *Standard Atlas of Cottonwood County Minnesota*. Geo A. Ogle & Co., Chicago.

Prosser, Richard S.
1966 *Rails to the North Star: One Hundred Years of Railroad Evolution in Minnesota*. Dillon Press, Minneapolis.

Trygg, J. W.
1966 *Composite Map of U.S. Land Surveyors' Original Plats and Field Notes*. Trygg Land Office, Ely, Minnesota.

# APPENDIX A: SUMMARY OF POTENTIAL FUTURE LEGISLATIVE REQUIREMENTS

# SUMMARY OF POTENTIAL FUTURE LEGISLATIVE REQUIREMENTS

## STATE LEGISLATION

### Minnesota Field Archaeology Act, 1963 (M.S. 138.31 – 138.42)

This Act established the Office of State Archaeologist (OSA) and directs the OSA and the Minnesota Historical Society (MHS) to make recommendations for the preservation of archaeological sites endangered by construction or development on all public lands. The OSA issues licenses, with the concurrence of the Minnesota Indian Affairs Council, for all archaeological investigations associated with public funding or on public land.

- Licensure through the OSA is required for field archaeology undertaken on all lands or waters owned, leased by or subject to the paramount right of the state or its subdivisions, as well as on lands impacted by publicly-funded development projects (http://www.admin.state.mn.us/osa/)
- Only professional archaeologists meeting the Secretary of the Interior's Standards for Archaeology (36 CFR Part 61) may be licensed to conduct such investigations in the state of Minnesota.
- When a state archaeological site is known or suspected to exist, the controlling agency must submit development plans to the MHS and OSA for review.
- The controlling agency (regulatory governmental unit [RGU]), in consultation with the MHS and OSA, is directed to preserve such sites and is authorized to use its funds for such activities.
- If a site is related to American Indian history or religion, the OSA must coordinate with the Minnesota Indian Affairs Council (MIAC) for review and comment.

For more information see http://www.mnhs.org/preserve/shpo/index.html

### Minnesota Private Cemeteries Act, 1975 (M.S. 307.08)

This act provides protection for marked and unmarked human burials and remains older than 50 years, and located outside of platted, recorded or identified cemeteries, protection from unauthorized disturbance. This statute applies to burials on either public or private lands or waters. Highlights include:

- It is a crime to intentionally destroy or remove human skeletal remains or burials.
- The Act directs the OSA to authenticate all burial sites.
- When human remains or burials are American Indian, the OSA and MIAC must attempt to identify their tribal identity.
- No authenticated American Indian burial may be relocated without approval of the MIAC.
- When American Indian burials are known or suspected to exist on public lands, the political subdivision controlling the land must submit development plans to the state archaeologist and the MIAC for review prior to advertising bids.

For further information see http://www.admin.state.mn.us/osa/

**Minnesota Historic Sites Act, 1965 (M.S. 138.661 - 138.6691)**

This Act creates a state register of properties "possessing historical, architectural, archaeological, and aesthetic values" for which adverse effects resulting from state funded or licensed projects must be mitigated. . Important points:

- Historic sites are defined as properties named in the Act or listed on the National Register of Historic Places.
- Similar to federal regulations, any undertaking receiving funding or licensing by any political subdivision is covered by the Act.
- If the undertaking affects historic sites, the agency must consult with the MHS to avoid or mitigate adverse effects.
- If the parties agree in writing to an appropriate course of action, the undertaking may proceed.
- If the parties cannot reach agreement, any of the parties may request that the governor appoint a mediation task force.

For more information see http://www.mnhs.org/preserve/shpo/index.html

## FEDERAL LEGISLATION

If there is any federal involvement in a proposed future development, through funding, permitting, loans or other federal action a number of federal laws apply, of which the National Historic Preservation Act is the most significant.

**National Historic Preservation Act of 1966**

Section 106 of the National Historic Preservation Act requires Federal agencies to take into account the effects of their undertakings on historic properties and afford the Advisory Council on Historic Preservation a reasonable opportunity to comment on such undertakings. The SHPO acts on behalf of the Advisory Council in each state. The Section 106 process seeks to accommodate historic preservation concerns with the needs of Federal undertakings through consultation among the agency officials and other parties with an interest in the effects of the undertaking on historic properties, commencing at the early stages of project planning. The goal of consultation is to identify historic properties potentially affected by the undertaking, assess its effects and seek ways to avoid, minimize or mitigate any adverse effects on historic properties. A Federal undertaking includes such activities as transfer of funds, issuing of permits, providing loans etc.

For further information see http://www.achp.gov/regs.html

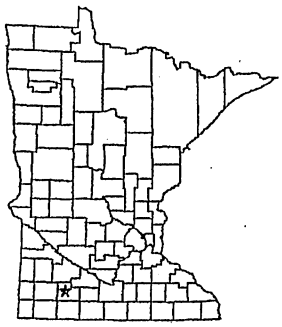
# APPENDIX B: LIST OF PERSONNEL

# LIST OF PERSONNEL

| | |
|---|---|
| Project Manager | Anne Ketz, M.A., RPA |
| Archival Research | Andrea Vermeer, M.A., RPA |
| Graphics and GIS | Matthew Schillerberg |

# Appendix C-1
# MN WRAP Wind Data Report for Jeffers Tower

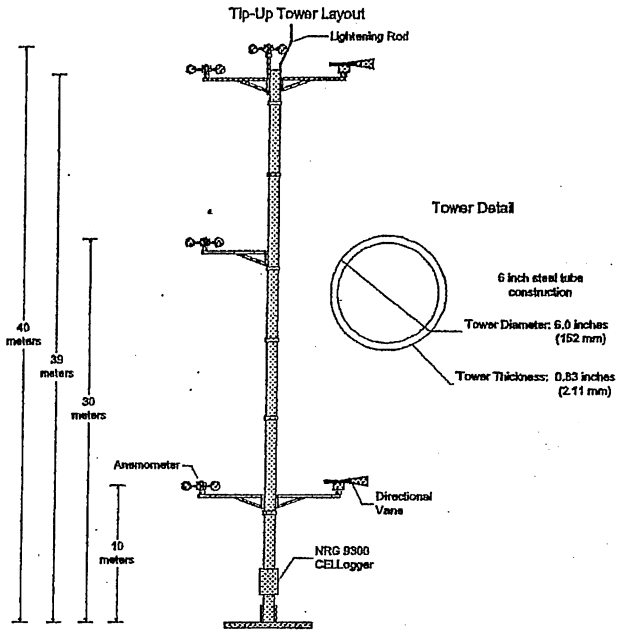
## Jeffers

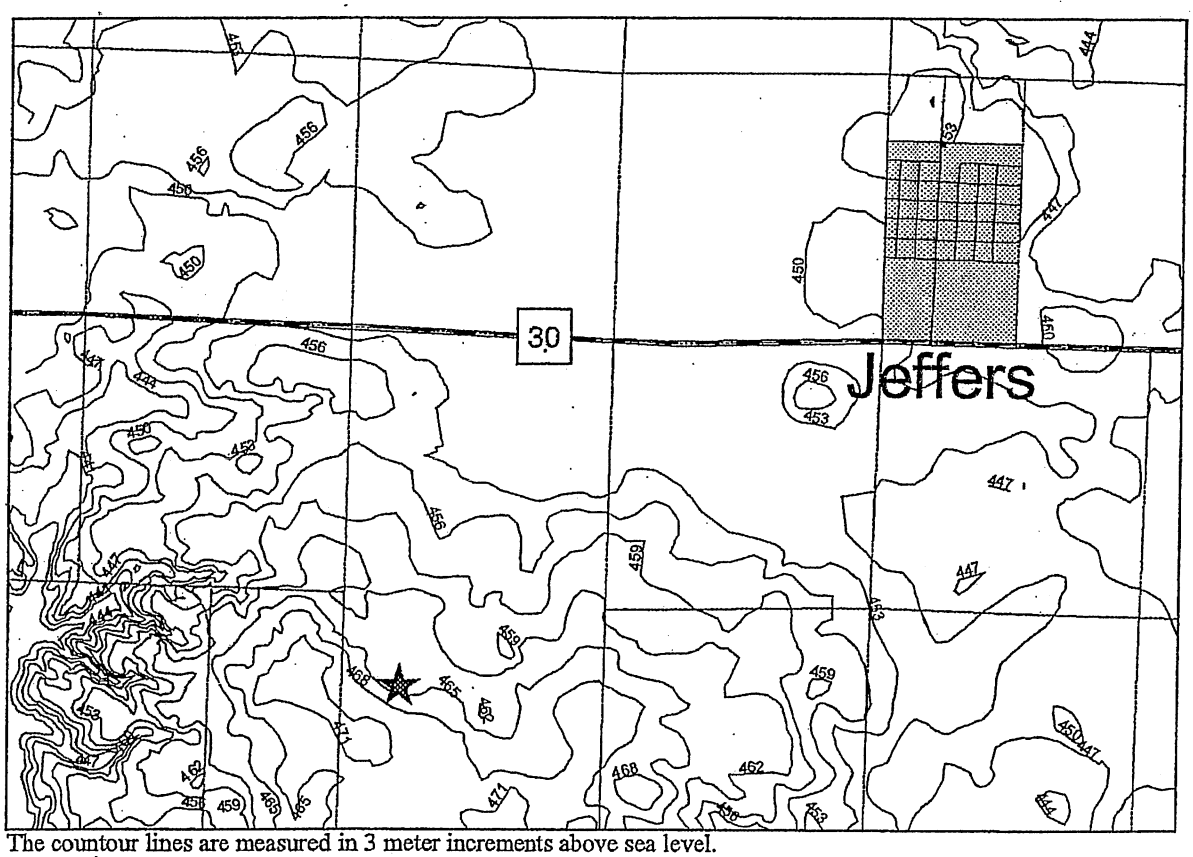


Coordinates

| Long/Lat | UTM |
|---|---|
| N 44.0211 | E 322048 |
| W 95.2203 | N 4876616 |

Elevation: 1551 feet




The countour lines are measured in 3 meter increments above sea level.
County roads are approximately 1 mile apart.

## Jeffers

### Wind Speed (Meters per Second)

| | | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | Avg |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1999 | 10m | | | | | 6.4 | 5.7 | 4.8 | 4.5 | 5.2 | 6.1 | 6.3 | 6.4 | 5.7 |
| | 30m | | | | | 7.3 | 6.7 | 5.9 | 5.8 | 6.7 | 7.5 | 7.5 | 7.5 | 6.9 |
| | 40m | | | | | 7.6 | 7.2 | * | * | * | * | * | * | 7.4 |
| 2000 | 10m | 6.3 | 6.3 | 5.8 | 6.5 | 6.4 | 6.1 | 3.8 | 4.0 | 4.6 | 5.0 | | | 5.5 |
| | 30m | 7.4 | 7.3 | 6.8 | 7.4 | 7.3 | 7.2 | 5.0 | 5.5 | 6.3 | 6.7 | | | 6.7 |
| | 40m | * | * | * | * | * | * | * | * | * | * | | | * |
| Average | 10m | 6.3 | 6.3 | 5.8 | 6.5 | 6.4 | 5.9 | 4.3 | 4.3 | 4.9 | 5.5 | 6.3 | 6.4 | 5.6 |
| | 30m | 7.4 | 7.3 | 6.8 | 7.4 | 7.3 | 6.9 | 5.4 | 5.7 | 6.5 | 7.1 | 7.5 | 7.5 | 6.8 |
| | 40m | * | * | * | * | 7.6 | 7.2 | * | * | * | * | * | * | 7.4 |

### Wind Power (Watts per Square Meter)

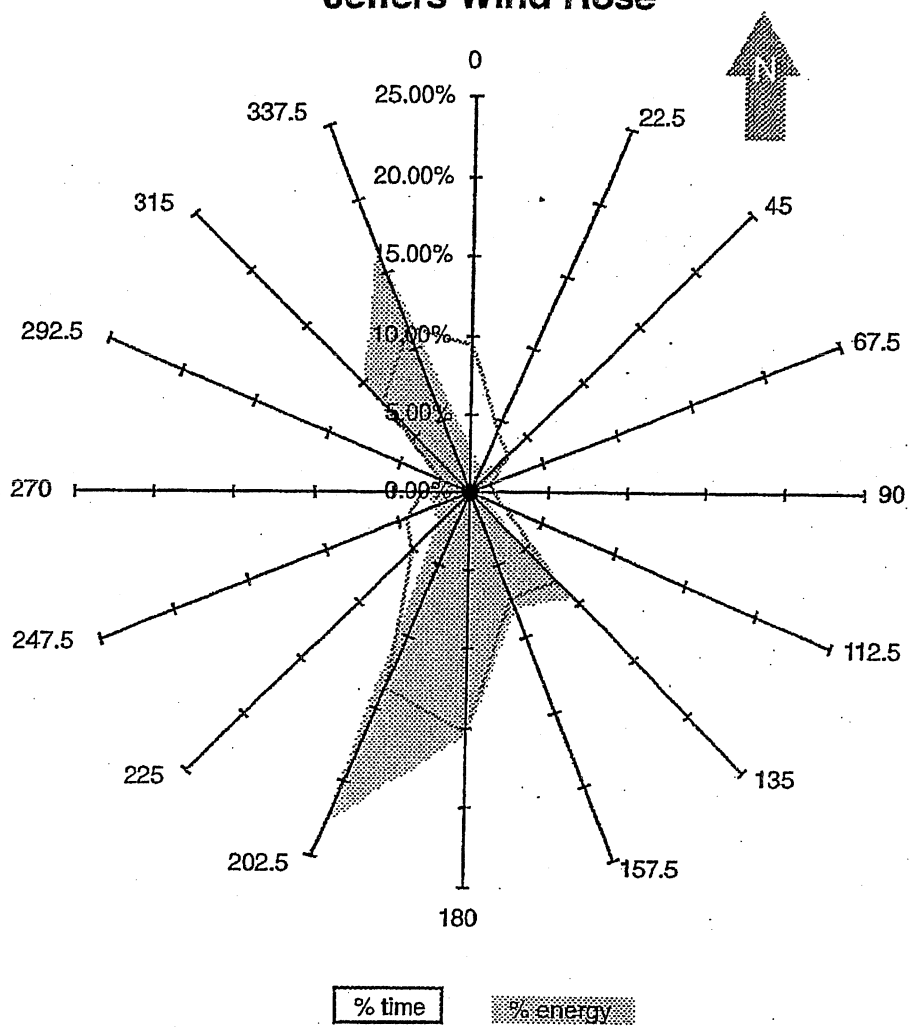
| | | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | Avg |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1999 | 10m | | | | | 255 | 184 | 123 | 88 | 122 | 237 | 247 | 293 | 194 |
| | 30m | | | | | 352 | 275 | 214 | 171 | 232 | 372 | 384 | 421 | 303 |
| | 40m | | | | | 388 | 325 | * | * | * | * | * | * | 356 |
| 2000 | 10m | 271 | 276 | 253 | 281 | 277 | 221 | 57 | 56 | 93 | 88 | | | 187 |
| | 30m | 395 | 393 | 351 | 391 | 369 | 333 | 115 | 139 | 221 | 204 | | | 291 |
| | 40m | * | * | * | * | * | * | * | * | * | * | | | * |
| Average | 10m | 271 | 276 | 253 | 281 | 266 | 203 | 90 | 72 | 107 | 163 | 247 | 293 | 198 |
| | 30m | 395 | 393 | 351 | 391 | 360 | 304 | 165 | 155 | 226 | 288 | 384 | 421 | 303 |
| | 40m | * | * | * | * | 388 | 325 | * | * | * | * | * | * | 356 |

### Wind Shear Exponent (Alpha)

| | | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | Average |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1999 | 10m-30m | | | | | 0.14 | 0.16 | 0.20 | 0.23 | 0.24 | 0.19 | 0.18 | 0.17 | 0.19 |
| | 30m-40m | | | | | 0.18 | 0.21 | * | * | * | * | * | * | 0.20 |
| 2000 | 10m-30m | 0.16 | 0.15 | 0.17 | 0.15 | 0.14 | 0.17 | 0.23 | 0.29 | 0.30 | 0.28 | | | 0.20 |
| | 30m-40m | * | * | * | * | * | * | * | * | * | * | | | * |
| Average | 10m-30m | 0.16 | 0.15 | 0.17 | 0.15 | 0.14 | 0.16 | 0.22 | 0.26 | 0.27 | 0.23 | 0.18 | 0.17 | 0.19 |
| | 30m-40m | * | * | * | * | 0.18 | 0.21 | * | * | * | * | * | * | 0.20 |

* Equipment was damaged during this period.

## Jeffers Wind Rose



**Site Information:**

Project: Met Tower

Location: Jeffers, MN

Elevation: 450 m

**Sensor Information:**

1 NRG #40 Anem. m/s
2 NRG #40 Anem. m/s
3 NRG #40 Anem. m/s
4 NRG #40 Anem. m/s
5 No SCM Installed
6 No SCM Installed
7 #200P Wind Vane
8 #200P Wind Vane
9 NRG #110S Temp C
10 No SCM Installed
11 No SCM Installed
12 No SCM Installed

# 8/25/2004 to 5/1/2005

## Summary Report

SITE 4980

Jeffers Met Tower

| Channel | 1 | 2 | 3 | 4 | | | 7 | 8 | 9 | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Height | 60 m | 60 m | 50 m | 40 m | ------ | ------ | 59 m | 48 m | 3 m | ------ | ------ | ------ |
| Units | m/s | m/s | m/s | m/s | ------ | ------ | deg | deg | C | ------ | ------ | ------ |
| Intervals with Valid Data | 33435 | 33423 | 33591 | 33483 | | | 34033 | 33828 | 35493 | | | |
| Average Filtered Data | 7.99 | 8.16 | 7.72 | 7.36 | | | 253 | 235.7 | 3.82 | | | |
| Average for All Data | 7.72 | 7.91 | 7.5 | 7.18 | | | 244.53 | 226.3 | 3.83 | | | |
| Min Interval Average | 0.4 | 0.4 | 0.4 | 0.4 | | | | | -27.3 | | | |
| Date of Min Interval | 8/31/2004 | 8/31/2004 | 8/31/2004 | 8/26/2004 | | | | | 1/14/2005 | | | |
| Time of Min Interval | 4:40:00 AM | 4:30:00 AM | 4:40:00 AM | 10:10:00 PM | | | | | 7:30:00 AM | | | |
| Max Interval Average | 22.5 | 23 | 22.4 | 21.4 | | | | | 32.8 | | | |
| Date of Max Interval | 12/12/2004 | 12/12/2004 | 12/12/2004 | 12/12/2004 | | | | | 9/1/2004 | | | |
| Time of Max Interval | 7:40:00 AM | 7:40:00 AM | 7:40:00 AM | 7:40:00 AM | | | | | 3:00:00 PM | | | |
| Average Interval SD | 0.71 | 0.71 | 0.72 | 0.75 | | | 5.2 | 5.54 | 0.04 | | | |
| Min Sample | 0.4 | 0.4 | 0.4 | 0.4 | | | | | -27.4 | | | |
| Date of Min Sample | 8/25/2004 | 8/25/2004 | 8/25/2004 | 8/26/2004 | | | | | 1/14/2005 | | | |
| Time of Min Sample | 3:50:00 AM | 3:50:00 AM | 3:50:00 AM | 10:00:00 PM | | | | | 7:30:00 AM | | | |
| Max Sample | 28.7 | 29.4 | 29.1 | 28.3 | | | | | 33.1 | | | |
| Date of Max Sample | 12/12/2004 | 12/12/2004 | 12/12/2004 | 3/30/2005 | | | | | 9/1/2004 | | | |
| Time of Max Sample | 11:40:00 AM | 11:40:00 AM | 11:40:00 AM | 8:20:00 AM | | | | | 3:00:00 PM | | | |
| Average Interval TI | 0.1 | 0.1 | 0.1 | 0.11 | | | | | | | | |
| Wind Speed Direction | | | | | | | S | S | | | | |

Generated Wednesday, May 11, 2005

NRG Systems SDR Version 5.02

# Appendix C-2
# Summit Site Meteorological Data

**Site Information:**

Project: Met Tower

Location: Jeffers, MN

Elevation: 450 m

**Sensor Information:**

1 NRG #40 Anem. m/s
2 NRG #40 Anem. m/s
3 NRG #40 Anem. m/s
4 NRG #40 Anem. m/s
5 No SCM Installed
6 No SCM Installed
7 #200P Wind Vane
8 #200P Wind Vane
9 NRG #110S Temp C
10 No SCM Installed
11 No SCM Installed
12 No SCM Installed

# 8/25/2004 to 5/25/2005

## Summary Report

SITE 4980

Jeffers Met Tower

| Channel | 1 | 2 | 3 | 4 | | | 7 | 8 | 9 | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Height | 60 m | 60 m | 50 m | 40 m | ------ | ------ | 59 m | 48 m | 3 m | ------ | ------ | ------ |
| Units | m/s | m/s | m/s | m/s | ----- | ----- | deg | deg | C | ----- | ----- | ----- |
| Intervals with Valid Data | 36891 | 36879 | 37047 | 36939 | | | 37489 | 37284 | 38949 | | | |
| Average Filtered Data | 8.12 | 8.29 | 7.85 | 7.48 | | | 248.25 | 231.21 | 4.73 | | | |
| Average for All Data | 7.86 | 8.06 | 7.65 | 7.31 | | | 239.4 | 221.88 | 4.74 | | | |
| Min Interval Average | 0.4 | 0.4 | 0.4 | 0.4 | | | | | -27.3 | | | |
| Date of Min Interval | 8/31/2004 | 8/31/2004 | 8/31/2004 | 8/26/2004 | | | | | 1/14/2005 | | | |
| Time of Min Interval | 4:40:00 AM | 4:30:00 AM | 4:40:00 AM | 10:10:00 PM | | | | | 7:30:00 AM | | | |
| Max Interval Average | 22.5 | 23 | 22.4 | 21.4 | | | | | 32.8 | | | |
| Date of Max Interval | 12/12/2004 | 12/12/2004 | 12/12/2004 | 12/12/2004 | | | | | 9/1/2004 | | | |
| Time of Max Interval | 7:40:00 AM | 7:40:00 AM | 7:40:00 AM | 7:40:00 AM | | | | | 3:00:00 PM | | | |
| Average Interval SD | 0.73 | 0.73 | 0.73 | 0.76 | | | 5.29 | 5.62 | 0.04 | | | |
| Min Sample | 0.4 | 0.4 | 0.4 | 0.4 | | | | | -27.4 | | | |
| Date of Min Sample | 8/25/2004 | 8/25/2004 | 8/25/2004 | 8/26/2004 | | | | | 1/14/2005 | | | |
| Time of Min Sample | 3:50:00 AM | 3:50:00 AM | 3:50:00 AM | 10:00:00 PM | | | | | 7:30:00 AM | | | |
| Max Sample | 28.7 | 29.4 | 29.1 | 28.3 | | | | | 33.1 | | | |
| Date of Max Sample | 12/12/2004 | 12/12/2004 | 12/12/2004 | 3/30/2005 | | | | | 9/1/2004 | | | |
| Time of Max Sample | 11:40:00 AM | 11:40:00 AM | 11:40:00 AM | 8:20:00 AM | | | | | 3:00:00 PM | | | |
| Average Interval TI | 0.1 | 0.1 | 0.1 | 0.11 | | | | | | | | |
| Wind Speed Direction | | | | | | | S | S | | | | |

# Appendix D
# Operating Wind Facilities in the State of Minnesota

# Operating Wind Facilities in the State of Minnesota

This table provides data of all currently tracked renewable energy facilities in the state. Data are derived from the Renewable Plant Information System, developed at the National Renewable Energy Laboratory.

| LOCATION | OWNER | PLANT NAME | CAPACITY (kW) |
|---|---|---|---|
| Hendricks | -- Left Empty -- | -- Left Empty -- | 900.0 |
| Worthington | -- Left Empty -- | -- Left Empty -- | 1,800.0 |
| Wilmont | -- Left Empty -- | -- Left Empty -- | 900.0 |
| Averill | -- Left Empty -- | -- Left Empty -- | 1,980.0 |
| Wilmont | -- Left Empty -- | -- Left Empty -- | 1,500.0 |
| Pipestone | -- Left Empty -- | -- Left Empty -- | 3,000.0 |
| Dodge Center | -- Left Empty -- | -- Left Empty -- | 9,000.0 |
| | Abraham, Darlene | Abraham, Darlene | 35.0 |
| Maple Grove | Aerogenerator | Aerogenerator | 2.0 |
| | Chi Energy, Inc. | Agassiz Beach Wind Farm | 1,980.0 |
| Delano | Ahlstrom | Ahlstrom | 2.5 |
| Taylor Falls | Moss, Alan | Alan Moss | 10.0 |
| Elk River | Alfords, John | Alfords, John | 10.0 |
| | ANDERSON, WAYNE | ANDERSON, WAYNE | 35.0 |
| Albany | Arceneau, Elmer | Arceneau, Elmer | 20.0 |
| Pipestone | Baartman, Michael | Baartman, Michael | 35.0 |
| Zumbrota | Bach, John | Bach, John | 10.0 |
| Long Lake | Lfc Power Systems | Boisclair, L.F. | 10.0 |
| Northfield | Briebell, Lloyd | Briebel, Lloyd | 10.0 |
| Brooten | Brooten Electric | Brooten Electric | 8.0 |
| Tyler | Kenetech Windpower | Buffalo Ridge | 21,900.0 |
| Eagan | Buick Dealership | Buick | 10.0 |
| | BUYSSEE, MARK | BUYSSEE, MARK | 35.0 |
| Chandler | Great River Energy | Chandler Hills - I | 1,980.0 |
| Chandler | Great River Energy | Chandler Hills - II | 3,960.0 |

| LOCATION | OWNER | PLANT NAME | CAPACITY (kW) |
|---|---|---|---|
| Elk River | Cota, Bob | Cota, Bob | 10.0 |
| Crookston | Crookston Welding | Crookston Welding | 25.0 |
| | D & G EXCAVATING | D & G EXCAVATING | 35.0 |
| | MCFARLAND, D.C. | D.C. MCFARLAND | 35.0 |
| Green Isle | Dacey, John | Dacey, John | 18.0 |
| | DANEBAD VILLAGE | DANEBAD VILLAGE | 35.0 |
| Lake Benton | Danielson, Curt | Danielson, Curt | 10.0 |
| Pelican Rapids | Ellison, Dave | Dave Ellison | 20.0 |
| Cloquet | Douglas, David | David Douglas | 10.0 |
| Dayton | Jones, David | David Jones | 20.0 |
| Duluth | Davis, David | Davis, David | 4.0 |
| Waseca | Jones, Doug | Doug Jones | 10.0 |
| Big Lake | Koelfgen, Douglas | Douglas Koelfgen | 10.0 |
| Kennedy | Dzingle, Rodger | Dzingle, Rodger | 25.0 |
| | Maroney, Ed | Ed Maroney | 35.0 |
| | Bendel, Jeff | Environmental Energy Systems | 40.0 |
| Crookston | Fert-L-Flow | Fert-L-Flow | 30.0 |
| Inver Grove Heights | Fischer, Don | Fischer, Don | 10.0 |
| Arlington | Bigaouette, Francis | Francis Bigaouette | 10.0 |
| Elko | G&T Trucking | G&T Trucking | 18.0 |
| Mable | Swenson, Garry | Garry Swenson | 38.0 |
| | -- Left Empty -- | Garwin Mcneilus Windfarm | 1,800.0 |
| Fairbault | Wunderlich, Gary | Gary Wunderlich | 35.0 |
| Silver Lake | Bebo, Gerald | Gerald Bebo | 75.0 |
| St. Francis | Gertvig, Ronald | Gjervig, Ronald | 10.0 |
| Battle Lake | Kern, Glaydon | Glaydon Kern | 4.0 |
| Fulda | Goedtke, Rickey | Goedike, Dell | 10.0 |
| Brainerd | Gull Lake Motel | Gull Lake Motel | 10.0 |

| LOCATION | OWNER | PLANT NAME | CAPACITY (kW) |
|---|---|---|---|
| Spring Valley | Gunderson, Dennis | Gunderson, Dennis | 10.0 |
| Byron | Harrison | Harrison | 10.0 |
| Rechall | Maciej, Harvey | Harvey Maciej | 4.0 |
| | Hesse, Wayne | HESSE, WAYNE | 40.0 |
| | Hindal, Dale | Hindal, Dale | 10.0 |
| Fulda | Holinka, Chuck | Holinka, Chuck | 10.0 |
| Calumet | Irrb Mineland Reclamation | Irrb Mineland Reclamation | 18.0 |
| | IVERSON, GLEN | IVERSON, GLEN | 10.0 |
| | HAUGEN, JAMES | JAMES HAUGEN | 10.0 |
| Zimmerman | Muchow, James | James Muchow | 17.5 |
| Mankato | Tachney, James | James Tachney | 20.0 |
| Taylor | Jessen, Alfred | Jessen, Alfred | 35.0 |
| Cakato | Nelson, Jim | Jim Nelson | 10.0 |
| Green Isle | Youngdahl, John | John Youngdahl | 10.0 |
| Grand Dmarais | Routh, Joseph | Joseph Routh | 10.0 |
| | K&R FARM | K&R FARM | 10.0 |
| Sabin | Kakac, Dan | Kakac, Dan | 4.0 |
| | Kas Brothers | Kas Brothers Wind Farm, LLC | 1,500.0 |
| Frazee | Kercher, Les | Kercher, Les | 40.0 |
| Baudette | Brederson, Kim | Kim Brederson | 4.0 |
| Foxhome | Knapp Seed Farm | Knapp Seed Farm | 40.0 |
| Kennedy | Knuson, Neil | Knuson, Neil | 2.0 |
| | KONTZ, JOE | KONTZ, JOE | 35.0 |
| Lac Qui Parle | Lac Qui Parle Schools | Lac Qui Parle Schools | 225.0 |
| Lake Benton | Enron Wind Corp. | Lake Benton I | 107,250.0 |
| Lake Benton | Fpl Energy | Lake Benton Ii | 103,500.0 |
| Ivanhoe | Northern Alternative Energy | Lakota Ridge | 11,250.0 |
| Zumbrota | Olson, Larry | Larry Olson | 10.0 |

| LOCATION | OWNER | PLANT NAME | CAPACITY (kW) |
|---|---|---|---|
| Hill City | Nelson, Lawarance | Lawarance Nelson | 37.0 |
| Loman | Hervey, Leroy | Leroy Hervey | 4.0 |
| Crookston | Vanderber, Lester | Lester Vanderber | 17.0 |
| Fulda | Griebel, Lloyd | Lloyd Griebel | 10.0 |
| Crookston | Wagner, Lloyd | Lloyd Wagner | 25.0 |
| Fairfax | Lund, Larry | Lund, Larry | 10.0 |
| Felton | Lundblom, Harold | Lundblom, Harold | 4.0 |
| Breckenridge | M&M Construction | M&M Construction | 40.0 |
| Fairmont | Central Minnesota Municipal Power Agency (CMMPA) | Mark Kotewa Family - "Century Farm" | 1,900.0 |
| Marshall | Minnesota Windpower | Marshall (City Of) | 600.0 |
| Elk River | Moritz, Martin | Martin Moritz | 10.0 |
| Preston | Maust, Robert | Maust, Robert | 10.0 |
| Lakeville | Maxa, Ken | Maxa, Ken | 10.0 |
| Lakeville | Maxa, Robert | Maxa, Robert | 10.0 |
| Minneota | Mbb Farms (Mike Bakker) | Mbb Farms (Mike Bakker) | 35.0 |
| Breckenridge | Miranowski, Merrill | Merrill Miranowski | 40.0 |
| Elk River | Chi Energy, Inc. | Metro Wind Farm | 650.0 |
| Elk River | Hendrickx, Mildrid | Mildrid Hendrickx | 10.0 |
| Moorhead | Moorhead Public Service | Moorhead | 1,500.0 |
| Elk River | Berthold Moritz | Moritz, Berthold | 10.0 |
| Crookston | Napa Auto | Napa Auto | 30.0 |
| Audubon | Nelson, Daryl | Nelson, Daryl | 10.0 |
| | NELSON, STAN | NELSON, STAN | 35.0 |
| Hancock | Nohl, Ray | Nohl, Ray | 40.0 |
| | -- Left Empty -- | Nshuokaton Hills Wind Farm | 1,980.0 |
| Edgerton | Nykamp, Henry | Nykamp, Henry | 18.0 |
| Pipestone | Olsen Farm | Olsen Wind Farm, LLC | 1,500.0 |

| LOCATION | OWNER | PLANT NAME | CAPACITY (kW) |
|---|---|---|---|
| Taylor Falls | Our Lady Laurdes Church | Our Lady Laurdes Church | 10.0 |
| Lonsdale | Knapper, Paul | Paul Knapper | 17.5 |
| Blooming Prarire | Vogt, Peter | Peter Vogt | 35.0 |
| Fertile | Petry, Leroy | Petry, Leroy | 4.0 |
| Crookston | Phoenix Industries | Phoenix Industries | 75.0 |
| | PINE CITY DISTRICT | PINE CITY DISTRICT | 10.0 |
| Prior Lake | Prior Lake Machine Shop | Prior Lake Machine Shop | 25.0 |
| Bellingham | Rademacher, Ed | Rademacher, Ed | 35.0 |
| Bellingham | Rademacher, Gerard | Rademacher, Gerard | 35.0 |
| Dodge Center | Nash, Randy | Randy Nash | 25.0 |
| Crookston | Red River Distributing | Red River Distributing | 25.0 |
| Red Wing | Red Wing Energy Center | Red Wing Hi 61 @ 19 | 2.0 |
| Corcoran | Reiss, William | Reiss, William | 10.0 |
| Buffalo | Rentz | Rentz | 10.0 |
| Frontenac | Hedlin, Robert | Robert Hedlin | 10.0 |
| Littlefork | Murry, Robert | Robert Murry | 4.0 |
| Duluth | Roningen, Robert | Robert Roningen | 5.0 |
| Inver Grove Heights | Kerkvliet, Ronald | Ronald Kerkvliet | 6.0 |
| Sabin | Rosenfeldt, Loren | Rosenfeldt, Loren | 4.0 |
| | Chi Energy, Inc. | Ruthton Ridge Wind Farm | 1,980.0 |
| Dilworth | Sabo, Jerry | Sabo, Jerry | 2.0 |
| Elbow Lake | Sanford Irrigation | Sanford Irrigation | 20.0 |
| Pine Island | Sanford, Don | Sanford, Don | 10.0 |
| | Schjeldrup, Arnold | Schjeldrup, Arnold | 4.0 |
| Buffalo | Schmidt | Schmidt | 10.0 |
| Breckenridge | Schuler, Bob | Schuler, Bob | 40.0 |
| Northfield | -- Left Empty -- | Scotia Wind Farm | 20.0 |

| LOCATION | OWNER | PLANT NAME | CAPACITY (kW) |
|---|---|---|---|
| Ivanhoe | Northern Alternative Energy | Shaokatan Hills | 11,880.0 |
| St Croix | Otto, Shawn | Shawn Otto | 10.0 |
| Dundas | Sherman, Lloyd | Sherman, Lloyd | 18.0 |
| Crookston | Sisters Of St. Joseph | Sisters Of St. Joseph | 25.0 |
| Rochester | Northern Alternative Energy | CMMPA Turbine | 900.0 |
| Montgomery | Stangler, William | Stangler, William | 10.0 |
| Lake City | Schwen, Steve | Steve Schwen | 10.0 |
| Silver Bay | Stewart, Richard | Stewart, Richard | 10.0 |
| Silver Bay | Tate, Merle | Tate, Merle | 12.0 |
| | Taveirne, Greg | Taveirne, Greg | 35.0 |
| | Taveirne, Louis | Taveirne, Louis | 70.0 |
| Crookston | Terra | Terra | 25.0 |
| Maple Grove | Coss, Terry | Terry Coss | 10.0 |
| Lakeville | Zwiers, Thomas | Thomas Zwiers | 10.0 |
| Hallock | Valley Motel | Valley Motel | 12.0 |
| Edgerton | Lester Vandenberg | Vanderberg, Lester | 18.0 |
| | Verly, Roger | Verly, Roger | 35.0 |
| Arlington | Danielson, Vince | Vince Danielson | 10.0 |
| Princeton | Walker, Gary | Walker, Gary | 10.0 |
| Lake Henry | Honnarding, Wally | Wally Honnarding | 18.0 |
| | Anderson, Wesley | Wesley Anderson | 10.0 |
| Duluth | Whirlwind Company | Whirlwind I | 10.0 |
| Duluth | Whirlwind Company | Whirlwind Ii | 10.0 |
| | Wild, Floyd | Wild, Floyd | 35.0 |
| Woodstock | Woodstock Wind Farms | Woodstock | 10,250.0 |

http://www.eere.energy.gov/state_energy/opfacbytech.cfm?state=MN - content

Updated: 07 February 2005

# Appendix E-1
# Clipper Turbine Product Specification

# 2.5 MW Wind Turbine

for IEC class I, II & III wind conditions

## Specifications

Clipper
WINDPOWER

# 2.5 MW Wind Turbine

CERTIFICATION: Germanischer Lloyd
State of Compliance for Design Assessment
#WT00-006A-2005

## General

| | |
|---|---|
| Type | Horizontal axis, 3 blades, upwind |
| Power output | 2500 kW System power output |
| Components | Purpose designed by Clipper |
| Primary brake | Blade pitch (aerodynamic) |
| Operation | Variable speed 9.7 to 15.5 rpm |
| Yaw | Electromechanical |
| Hub height | 80m (standard) |

## Rotor

| Wind Class | Class I | Class II | Class III |
|---|---|---|---|
| Diameter | 89m | 93m | 99m |
| Swept area | 6221m$^2$ | 6793m$^2$ | 7698m$^2$ |

| | |
|---|---|
| Blades | Clipper 43.2m, 45.2m, 48.2m |
| Tilt | 5.5° |
| Tip speed @ rated output | 75 m/s |
| Rotor lock | Integrated into base, hydraulic |
| Rotor turning gear | Manual, high torque |

## Pitch system

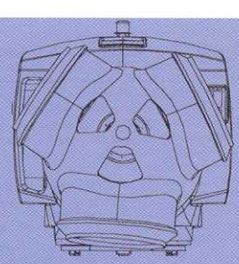
| | |
|---|---|
| Type | Individual blade pitch |
| Drive | DC electric servo-drive |
| Failsafe braking | Battery banks |
| Blade bearings | Internal gear, dual row ball-bearing |

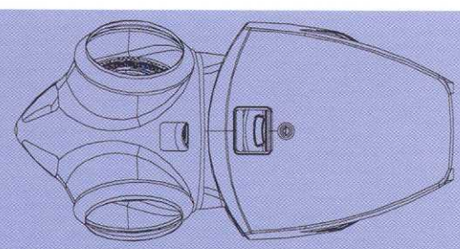
## Hub

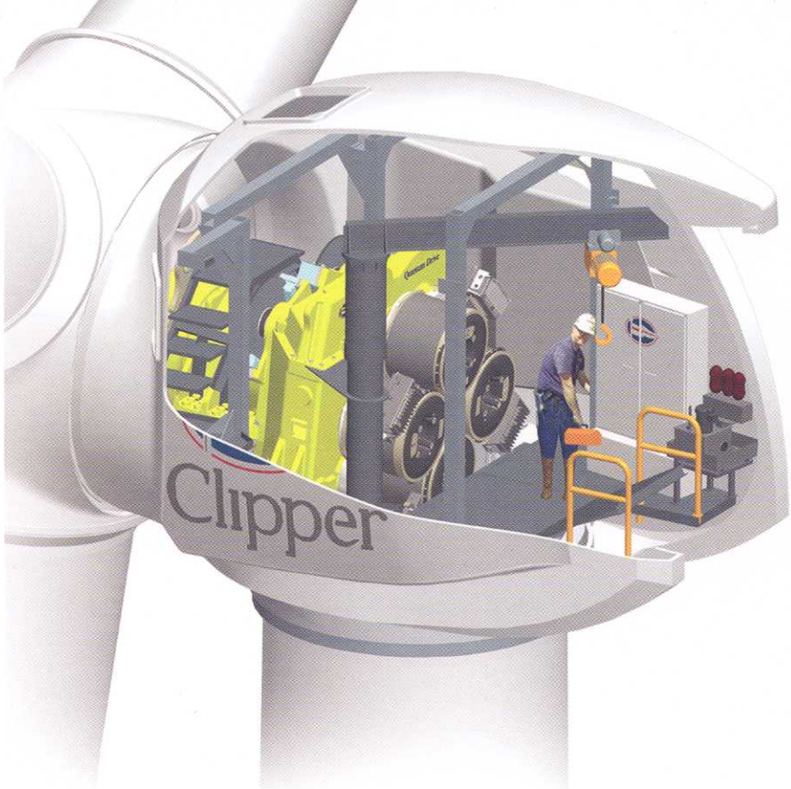
| | |
|---|---|
| Type | Spherical |
| Material | Ductile cast iron |

## Parking brake

| | |
|---|---|
| Type | Twin discs, active hydraulic |
| Location | Intermediate stage of gearbox |








## Power Train

| | |
|---|---|
| Generator Type | Clipper D-GEN, Quantum, Distributed generation |
| Rated power | 2735 kW |
| Gear arrangement | 2-stage, high-contact ratio |
| Mainshaft | Forged steel, integrated with gear housing |
| Lubrication | Forced, mechanical pump |
| Filtration | Multi-element; inline coarse/fine and offline filter system |
| Cooling | Radiator, external to nacelle |
| Gearbox mounting | Stable, non-floating |

## Controller

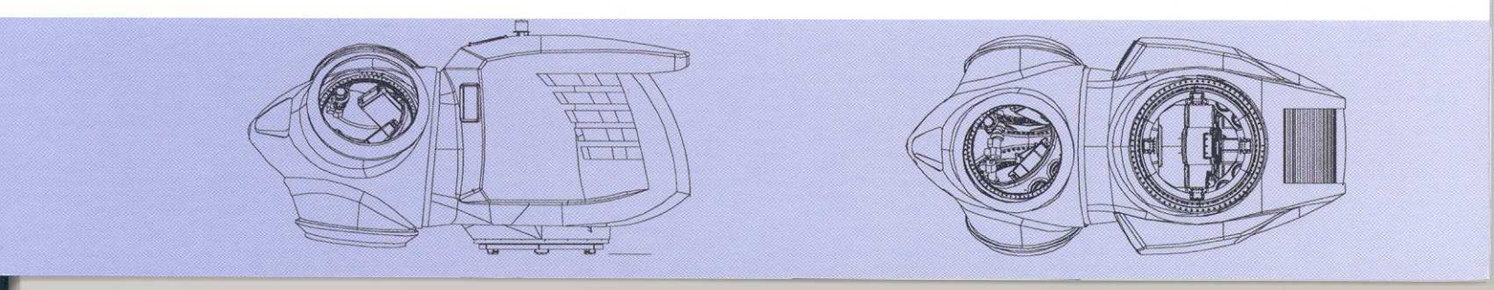
| | |
|---|---|
| Voltage-3 phase | 690 VAC, 480 VAC, 240 VAC |
| Voltage-single phase | 120 VAC |
| Computer | Embedded power PC |
| Operator interface | Palm Top or laptop PC |
| SCADA | Fiber optic connections, serial interface |

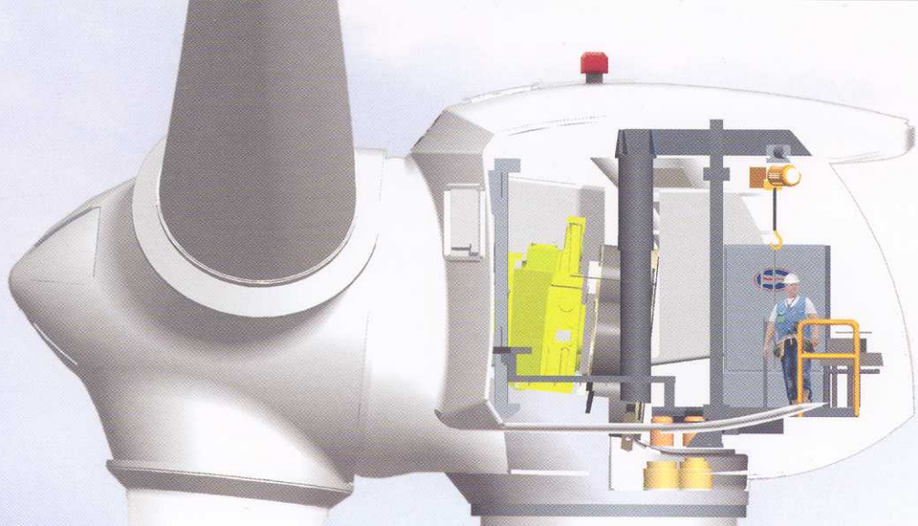
## Generators

| | |
|---|---|
| Type | Clipper Permanent Magnet (Synchronous) |
| Number of units | 4 |
| Rated power (each) | 656 kW |
| Voltage | 1000-1350 VDC |
| Enclosure | IP54 |
| Cooling | TEWAC (IP54) enclosed water/air-cooled external radiator |
| Windings | Form-wound, insulation Class H |
| Operation | Continued operation with one generator outage |

## Power Converter

| | |
|---|---|
| Type | IGBT, 4 modules rectifier/converter |
| Voltage | 690 VAC |
| Frequency | 50 ± 3Hz, 60 ± 3Hz |





## Grid Compatibility

| | | | |
|---|---|---|---|
| Frequency-continuous | 50 Hz or 60 Hz ± 3Hz | | |
| Line voltage 690 VAC | Continuous | 5 sec | 500ms |
| | ± 10% | ± 20% | ± 30% |
| Line fault ride-thru | -90% of nominal line for 150 ms | | |
| Line phase imbalance | rated power | cut-in | |
| | ± 5% | ± 10% | |

## Machine Base

| | |
|---|---|
| Material | Ductile cast iron, single piece, no welds |

## Yaw system

| | |
|---|---|
| Drives | 4 Electric motors with planetary drives |
| Brake | 4 Active hydraulic disc brakes |
| Yaw bearing | Internal gear, ball bearing |

## Parking brake

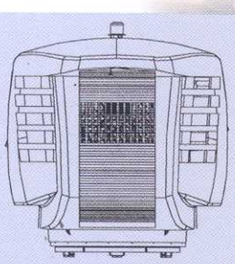
| | |
|---|---|
| Type | 2 discs, active hydraulic |
| Location | Intermediate stage of gearbox |

## Service crane

| | |
|---|---|
| On-board convenience | 2-ton jib crane, brakes, yaw motors, gears, pinion cartridges, generators |

## Maintenance interval

| | |
|---|---|
| Post commissioning | Once at 500 hours, every 6 months periodic, optional periodic at 12 months. |



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## Condition-based monitoring

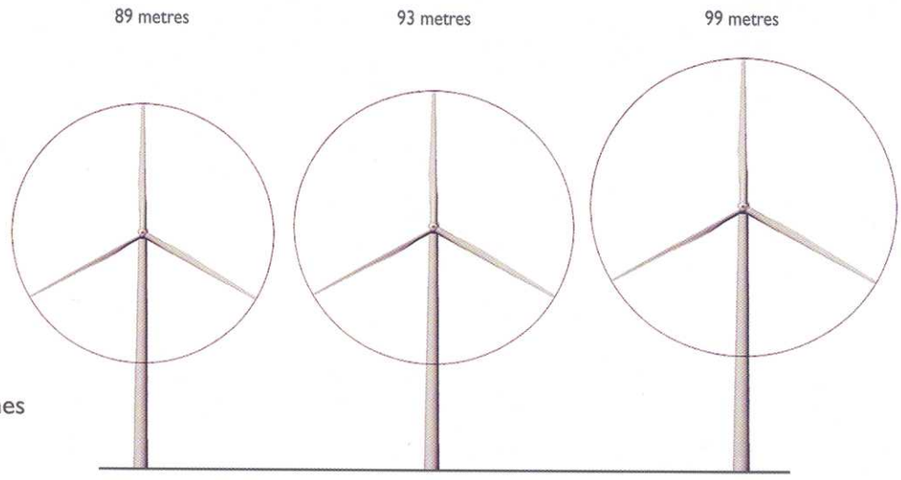
Blade strain measurement

Real time gearbox oil analysis

Bearing temperatures

Vibration monitoring

Hydraulic system pressures




## Access

Nacelle top-hatch, nacelle aft roll-down door, hub entry from nacelle interior, spinner hatches

## Lightning protection

| | |
|---|---|
| Blade | Tip + 2 receptors, internal ground conductor |
| Nacelle | Air termination, full shielded, (Faraday cage) |
| Electrical | IEC 61400-24 level III |

## Noise performance

| | |
|---|---|
| SPL @8 m/s | 104 db(A), according to IEC 61400-11 (very quiet) |

## Environmental limits

| | | | |
|---|---|---|---|
| Survival wind velocity | Based on IEC IA, IIA, IIIA | | |
| Ambient temperature | Standard | Cold | Survival |
| | -20° to +40°C | -40° to +40°C | -40° to +50°C |

## Tower

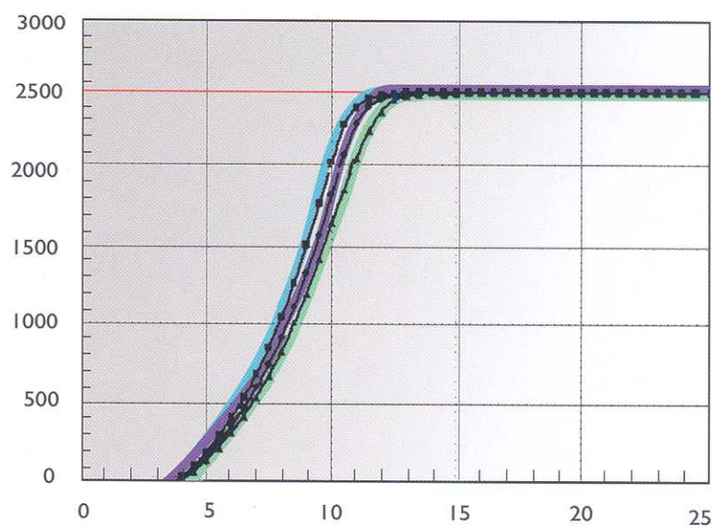
80m hub height, optional to height available

| | |
|---|---|
| Type | Tubular |
| Material | Steel plate |
| Sections | 4 (80m hub height) |

## Lifting requirements

| | |
|---|---|
| 80m hub height | same crane size as most 1.5 MW turbines. |

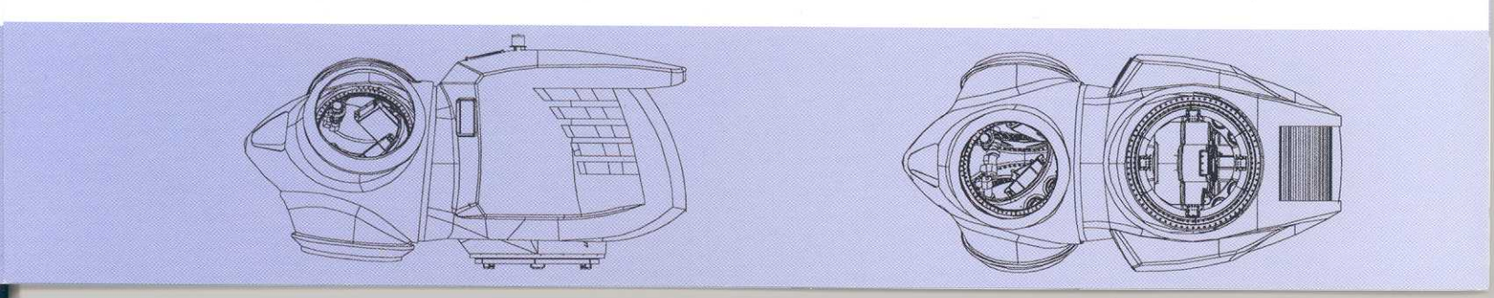
Power curve / kW




Hub height wind speed (m/s)

C99 ( class III ) C93 ( class II ) C89 ( class I )

| Cut-in wind velocity | Cut-out wind velocity | Cut-out wind gust |
|---|---|---|
| 4 m/s - 10 mi. avg. | 25 m/s - 10 min. avg. | 29 m/s - 5 sec. avg. |



For more than 20 years, Clipper WindPower's management and engineering team has been at the forefront of the wind power industry, both in turbine design and project development. This Clipper 2.5 MW turbine is the fourth generation of commercial turbines designed by Clipper's engineers.

Clipper's goal is to provide the most cost competitive wind turbine, with extended operating life, and reduced operating costs.
This goal is achieved with the 2.5 MW Liberty turbine.

Clipper
WINDPOWER

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# Appendix E-2
# Vestas V-80 General Specification

Item no. 944411.R5

# General Specification

## V80 – 1.80 MW

60 Hz, OptiSlip® - Wind Turbine

Vestas

(6a)

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# 1. Introduction

The Vestas V80 - 1.8 MW wind turbine is based on experience gained from several generations of Vestas Wind Turbines. It is designed around a platform closely resembling the Vestas V66 - 1.65 MW Wind Turbine

The Vestas 1.8 MW, with a rotor diameter of 80 m (264 ft.), utilises the Vestas OptiSlip® concept. When compared to regular pitch or stall regulated wind turbines, OptiSlip® technology produces a smoother power output and significant load reductions.

The Vestas OptiTip® feature is also standard on the Vestas V80 - 1.8 MW turbine. OptiTip® continuously optimises the blade tip angle for improved power performance and reduced sound emission.

# 2. Wind Climate

Turbulence describes short-term wind variations or fluctuations. The conditions for which the VESTAS V80-1.8 MW wind turbine was designed are listed below.

| IEC Class | Tower height [m] | A-parameter [m/s] | C-parameter [-] | Turbulence at 15 m/s [%] | Reference wind[1)] [m/s] | Reference wind[2)] [m/s] |
|---|---|---|---|---|---|---|
| I | 60 – 78 | 11.3 | 2.0 | 18.0 | 50.0 | 70.0 |
| II | 60 – 78 | 9.59 | 2.0 | 18.0 | 42.5 | 59.5 |

1) 10 min., 50 year wind
2) 5 sec., 50 year wind gust
Wind speed and turbulence are referenced at hub height.

The maximum wind speeds at which the turbine may be operated are listed below.

| **Model** | **Wind gust Max. Acc. [m/s$^2$]** | **Stop Wind Speed/ Restart Wind Speed [m/s]** |
|---|---|---|
| V80-1.8 MW | 10 | 25/20 |

# 3. Wind Turbine Description

The Vestas V80 - 1.8 MW is a pitch-regulated, upwind wind turbine with active yaw and a three - blade rotor.

The blades are made of glass fibre reinforced epoxy. Each blade consists of two shells, bonded to a supporting beam. Special steel root inserts connect the blade to the blade bearing. The blade bearing is a 4-point contact ball bearing bolted to the blade hub.

The main shaft transmits the power to the generator through a combined planetary-helical gearbox. Power is transmitted from the gearbox to the generator via a maintenance-free composite coupling.

The generator is an asynchronous (induction) 4-pole generator with wound rotor and Vestas OptiSlip® technology. Grid connection is accomplished through thyristors that are by-passed after generator cut-in.

The pitch system together with the unique Vestas OptiSlip® generator combine to maintain smooth, nominal power output at higher wind speeds. This power output is hence independent of air temperature and air density. At lower wind speeds, the pitch system and OptiTip® technology optimise the power through the calculated blade pitch angle.

Turbine braking is accomplished by full blade feathering. A secondary fail-safe mechanical brake system is mounted on the High- Speed shaft connecting the gearbox to the generator.

All turbine functions are monitored and controlled by microprocessor-based control units in the nacelle. Blade pitch changes are activated by hydraulics that also supply mechanical brake-system pressure. Each blade is equipped with a hydraulic cylinder enabling the blade to rotate 95°.

Four (4) electrical yaw gear-motors perform nacelle yawing. The yaw bearing system is a plain bearing system with built-in friction and self-locking mechanisms.

The power transformer, which converts generator voltages to distribution-level voltages of up to 34.5 kV, is housed in the nacelle.

The glass fibre reinforced nacelle cover provides protection for the components in it. A central opening provides access to the nacelle from the tower. The nacelle houses the internal 800-kg (1760-lb.) service crane. As an option, this can be enlarged for the hoisting of main components (SWL = 7500 kg, (16534 lbs.)).

The steel tower is supplied with the standard Vestas American Wind Technology coating system as specified in Section 7. The customer may choose to use an optional system based upon specific environmental conditions of the proposed site.

# 4. General Overview

| Model | Rotor Diameter | Nominal RPM | Hub Height |
|---|---|---|---|
| **V80 - 1.8** | 80 m [264 ft.] | 15.5/16.8 | 60/67/78 m. [198/221/257 ft.] |

# 5. OptiSlip® Description

Asynchronous (induction) generator slip is defined as the difference between the synchronous speed and the actual generator speed. The standard slip for big, non-regulated asynchronous generators is about 1%, such that the rpm value is 1% higher when the generator is completely loaded, than without the load. Thus, speed and load changes are interdependent.

The Vestas OptiSlip® allows the generator slip to vary from 1% to 10%, reducing speed and load interdependency. Through OptiSlip® technology, the excess power of a sudden wind gust is not sent directly to the electrical grid. As a further advantage, the resulting mechanical loads on the wind turbine are also reduced.

Nevertheless, wind power during a wind gust is not lost, but briefly stored in a fly-wheel consisting of blades, gear and generator. The power during a wind gust leads to a short acceleration condition. The Vestas OptiSlip® with the Vestas pitch regulation system then reduces the rpm to a constant speed. At that time the stored power is released and sent to the electrical grid.

Vestas OptiSlip® provides the benefit of smooth electrical grid power quality, while minimising wind turbine loads.

Vestas OptiSlip® was introduced in 1994 and is operating successfully on thousands of Vestas wind turbines around the world.

# 6. Power Curves and Sound Levels

## 6.1 Power Curve for Vestas V80 1.8 MW, IEC class I

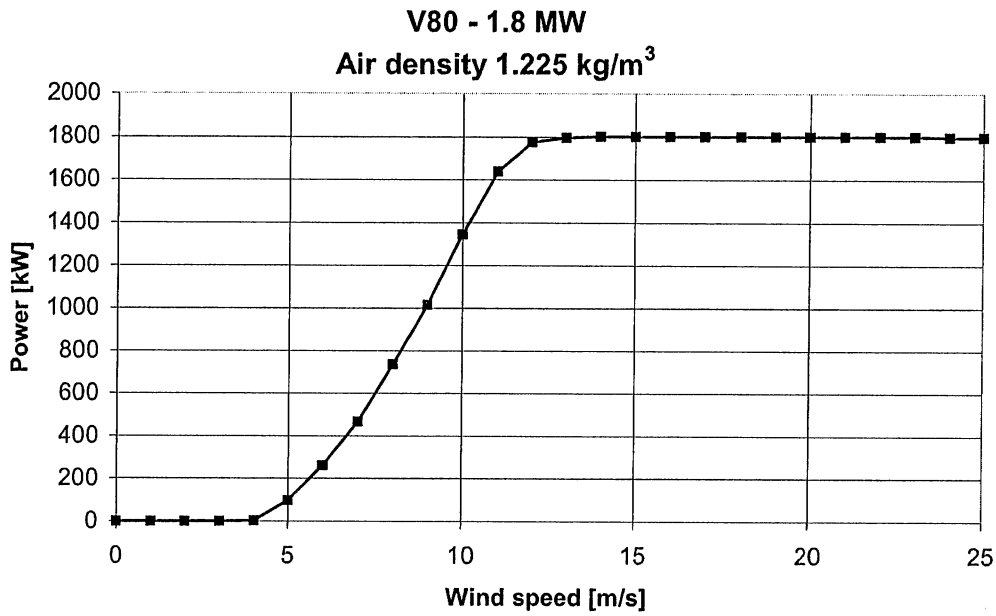
### 6.1.1 Power Curve for Vestas V80 1.8 MW, IEC class I

The parameters for the curves are:

| | |
|---|---|
| Frequency: | 60 Hz. |
| Rotor diameter: | 80 meters [264 ft.] |
| Nominal Rotor speed: | 16.8 rpm. |
| Tip angle: | Pitch regulated |
| Turbulence: | 10 % |

The power curve is measured on the low-voltage side of the transformer. Transformer and high-voltage cable losses are not accounted for.

| Electrical-power [kW] as a function of wind speed [m/s] at hub height and density [kg/m$^3$] | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| $V_{10}$ [m/s] | 1.225 | 1.06 | 1.09 | 1.12 | 1.15 | 1.18 | 1.21 | 1.24 | 1.27 |
| 4 | 3 | -7 | -6 | -4 | -2 | 0 | 2 | 4 | 5 |
| 5 | 99 | 74 | 79 | 84 | 89 | 93 | 97 | 101 | 105 |
| 6 | 260 | 203 | 212 | 223 | 233 | 244 | 255 | 265 | 276 |
| 7 | 465 | 393 | 405 | 417 | 431 | 445 | 459 | 472 | 485 |
| 8 | 735 | 630 | 650 | 670 | 689 | 708 | 726 | 744 | 762 |
| 9 | 1015 | 892 | 913 | 935 | 959 | 982 | 1004 | 1026 | 1048 |
| 10 | 1345 | 1182 | 1210 | 1239 | 1270 | 1300 | 1330 | 1359 | 1388 |
| 11 | 1639 | 1498 | 1527 | 1555 | 1579 | 1603 | 1627 | 1651 | 1672 |
| 12 | 1775 | 1722 | 1740 | 1753 | 1759 | 1766 | 1772 | 1779 | 1783 |
| 13 | 1797 | 1789 | 1792 | 1794 | 1795 | 1796 | 1797 | 1798 | 1799 |
| 14 | 1802 | 1800 | 1800 | 1801 | 1801 | 1802 | 1802 | 1802 | 1802 |
| 15 | 1802 | 1802 | 1802 | 1802 | 1802 | 1802 | 1802 | 1802 | 1802 |
| 16 | 1802 | 1802 | 1802 | 1802 | 1802 | 1802 | 1802 | 1802 | 1802 |
| 17 | 1802 | 1802 | 1802 | 1802 | 1802 | 1802 | 1802 | 1802 | 1802 |
| 18 | 1802 | 1802 | 1802 | 1802 | 1802 | 1802 | 1802 | 1802 | 1802 |
| 19 | 1802 | 1802 | 1802 | 1802 | 1802 | 1802 | 1802 | 1802 | 1802 |
| 20 | 1802 | 1802 | 1802 | 1802 | 1802 | 1803 | 1802 | 1802 | 1802 |
| 21 | 1802 | 1802 | 1802 | 1802 | 1802 | 1802 | 1802 | 1802 | 1802 |
| 22 | 1802 | 1802 | 1802 | 1802 | 1802 | 1802 | 1802 | 1802 | 1802 |
| 23 | 1802 | 1802 | 1802 | 1802 | 1802 | 1802 | 1802 | 1802 | 1800 |
| 24 | 1800 | 1802 | 1802 | 1800 | 1800 | 1800 | 1800 | 1800 | 1800 |
| 25 | 1800 | 1800 | 1800 | 1800 | 1800 | 1800 | 1800 | 1800 | 1800 |




Wind speed is represented as a 10-minute average value with a reference point at the hub height and perpendicular to the rotor plane.

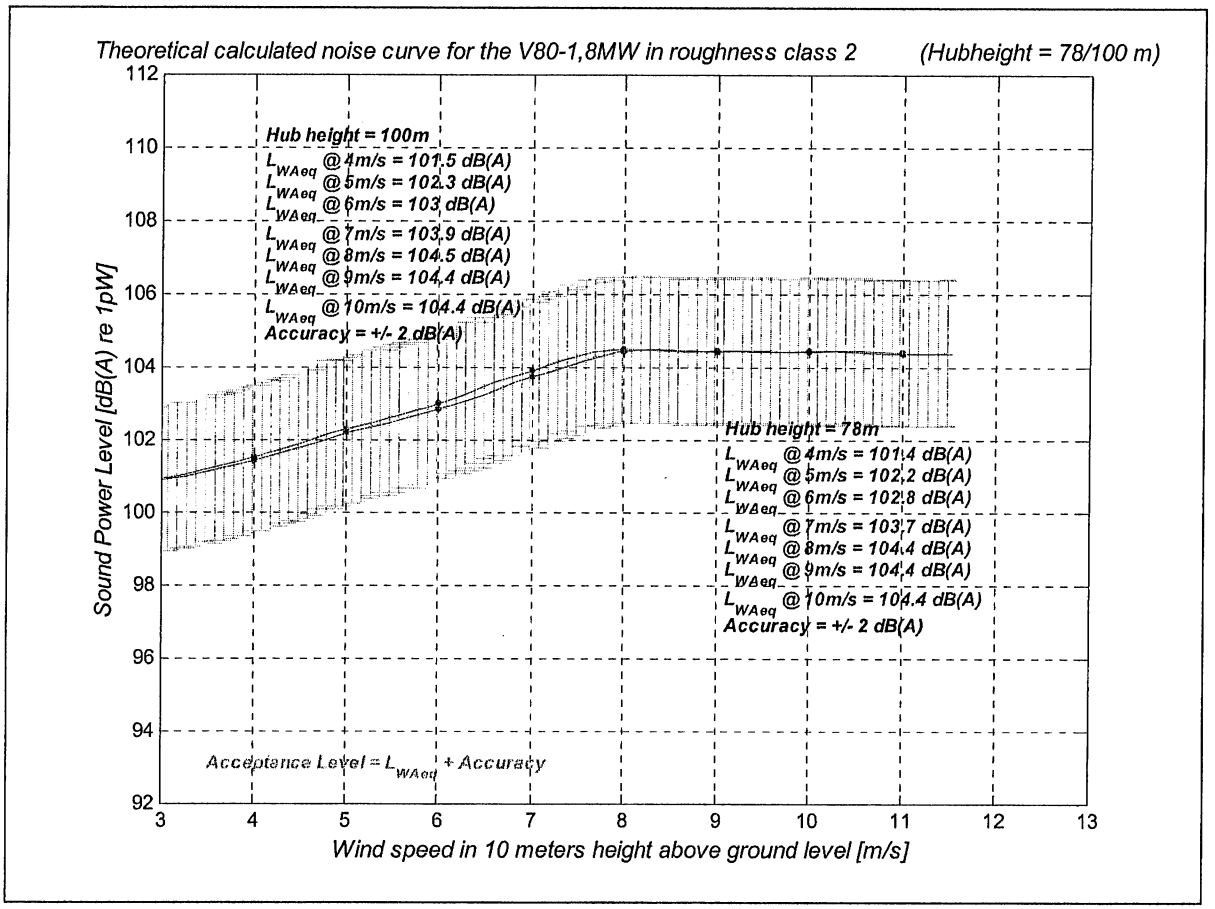
### 6.1.2 Annual Production V80 - 1.8 MW, IEC Class I

The estimated production is corrected to the standard air density of 1.225 kg/m3 and calculated on the assumption that the availability is 100 %, at a hub height of 78 m [257.4 ft.] and with a 25 m/s stop wind speed.

| Annual Production [MWh] | | | |
|---|---|---|---|
| Mean Wind speed [m/s] | **C = 1.5** | **C = 2.0** | **C = 2.5** |
| **5** | 2926 | 2412 | 2016 |
| **6** | 4216 | 3918 | 3600 |
| **7** | 5398 | 5430 | 5323 |
| **8** | 6404 | 6812 | 6964 |
| **9** | 7210 | 8000 | 8408 |
| **10** | 7819 | 8966 | 9615 |

## 6.2 Noise Curves V80 – 1.8MW, IEC Class I

All noise curves are calculated at 8 m/s at a height of 10-m [33 ft.].



# 6.3 Calculated Data for Vestas V80 1.8 MW, IEC Class II

## 6.3.1 Power Curve for Vestas V80 - 1.8 MW, IEC Class II

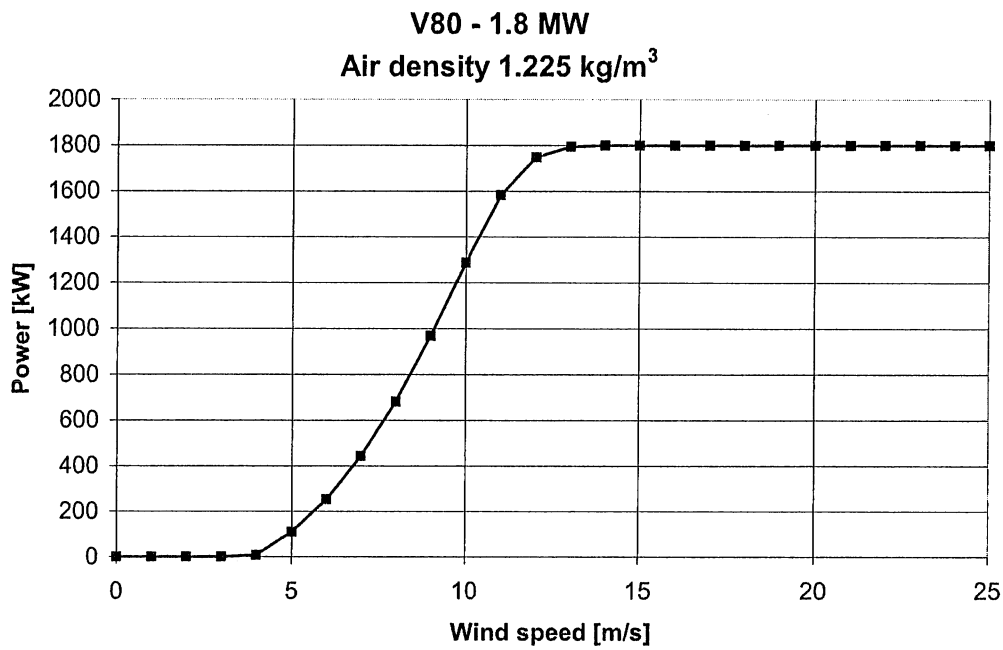
The parameters for the curves are:

| | |
|---|---|
| Frequency: | 60 Hz. |
| Rotor diameter: | 80 meters [264 ft.] |
| Nominal Rotor speed: | 15.5 rpm. |
| Tip angle: | Pitch regulated |
| Turbulence: | 10 % |

The power curve is measured on the low-voltage side of the transformer. Transformer and high-voltage cable losses are not accounted for.

| Electrical-power [kW] as a function of wind speed [m/s] at hub height and density [kg/m$^3$] | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| $V_{10}$ [m/s] | 1.225 | 1.06 | 1.09 | 1.12 | 1.15 | 1.18 | 1.21 | 1.24 | 1.27 |
| 4 | 7 | 1 | 2 | 3 | 4 | 6 | 7 | 8 | 9 |
| 5 | 109 | 89 | 92 | 96 | 100 | 103 | 107 | 111 | 115 |
| 6 | 253 | 213 | 220 | 228 | 235 | 242 | 249 | 256 | 264 |
| 7 | 443 | 379 | 390 | 402 | 414 | 426 | 438 | 449 | 461 |
| 8 | 682 | 586 | 604 | 621 | 638 | 656 | 673 | 690 | 707 |
| 9 | 968 | 835 | 859 | 883 | 907 | 931 | 956 | 980 | 1004 |
| 10 | 1286 | 1110 | 1142 | 1174 | 1206 | 1238 | 1270 | 1302 | 1334 |
| 11 | 1582 | 1387 | 1426 | 1464 | 1500 | 1534 | 1567 | 1596 | 1624 |
| 12 | 1748 | 1624 | 1656 | 1683 | 1706 | 1726 | 1741 | 1754 | 1764 |
| 13 | 1793 | 1754 | 1767 | 1777 | 1783 | 1788 | 1792 | 1794 | 1796 |
| 14 | 1799 | 1793 | 1795 | 1797 | 1798 | 1799 | 1799 | 1800 | 1800 |
| 15 | 1800 | 1799 | 1800 | 1800 | 1800 | 1800 | 1800 | 1800 | 1800 |
| 16 | 1800 | 1800 | 1800 | 1800 | 1800 | 1800 | 1800 | 1800 | 1800 |
| 17 | 1800 | 1800 | 1800 | 1800 | 1800 | 1800 | 1800 | 1800 | 1800 |
| 18 | 1800 | 1800 | 1800 | 1800 | 1800 | 1800 | 1800 | 1800 | 1800 |
| 19 | 1800 | 1800 | 1800 | 1800 | 1800 | 1800 | 1800 | 1800 | 1800 |
| 20 | 1800 | 1800 | 1800 | 1800 | 1800 | 1800 | 1800 | 1800 | 1800 |
| 21 | 1800 | 1800 | 1800 | 1800 | 1800 | 1800 | 1800 | 1800 | 1800 |
| 22 | 1800 | 1800 | 1800 | 1800 | 1800 | 1800 | 1800 | 1800 | 1800 |
| 23 | 1800 | 1800 | 1800 | 1800 | 1800 | 1800 | 1800 | 1800 | 1800 |
| 24 | 1800 | 1800 | 1800 | 1800 | 1800 | 1800 | 1800 | 1800 | 1800 |
| 25 | 1800 | 1800 | 1800 | 1800 | 1800 | 1800 | 1800 | 1800 | 1800 |

Wind speed is represented as a 10-minute average value with a reference point at the hub height and perpendicular to the rotor plane.



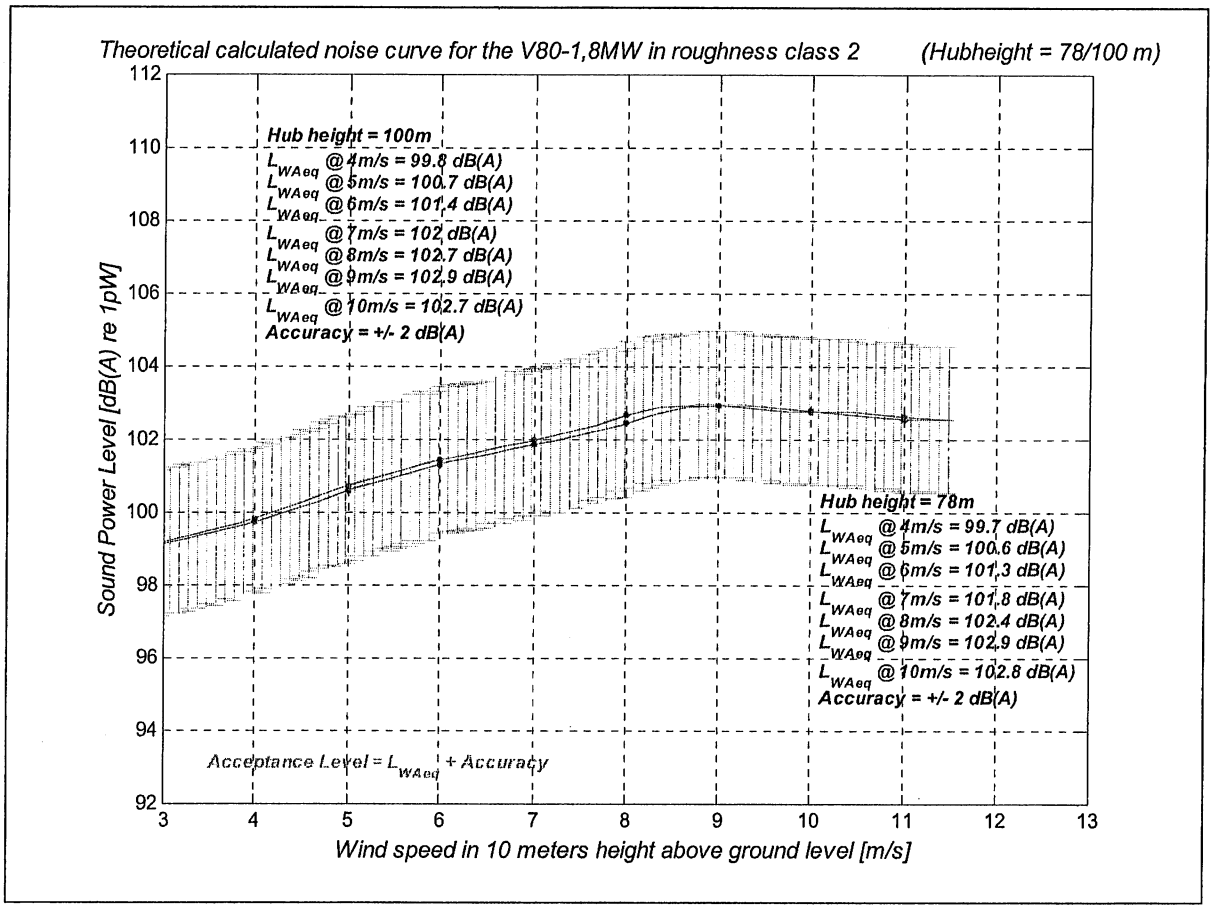

## 6.3.2 Annual Production V80 - 1.8 MW, IEC Class II

The estimated production is corrected to the standard air density of 1.225 kg/m3 and calculated on the assumption that the availability is 100 %, the hub height is 78 m [257.4 ft.] and with a 25 m/s stop wind speed.

| Annual Production [MWh] | | | |
|---|---|---|---|
| Mean Wind speed [m/s] | **C = 1.5** | **C = 2.0** | **C = 2.5** |
| **5** | 2841 | 2331 | 1950 |
| **6** | 4105 | 3789 | 3464 |
| **7** | 5271 | 5271 | 5138 |
| **8** | 6271 | 6640 | 6756 |
| **9** | 7076 | 7826 | 8196 |
| **10** | 7686 | 8797 | 9413 |

## 6.4 Noise Curves V80 – 1.8MW, IEC Class II

All noise curves are calculated at 8 m/s at a height of 10-m [33 ft.].



# 7. Specifications

## 7.1 Rotor

| | |
|---|---|
| Diameter: | 80 m [264 ft.] |
| Swept area: | 5027 $m^2$ [54,114 $ft^2$] |
| Rotational speed static, rotor: | 16.8 RPM (IEC Class I)<br>15.5 RPM (IEC Class II) |
| Rotational direction: | Clockwise (front view) |
| Orientation: | Upwind |
| Tilt: | 6° |
| Blade coning | 2° |
| Number of blades: | 3 |
| Aerodynamic brakes: | Full feathering |

## 7.2 Blades

| | |
|---|---|
| Principle: | Shells bonded to supporting beam |
| Material: | Glass fibre reinforced epoxy |
| Blade connection: | Steel root inserts |
| Air foils: | NACA63 profile series and FFA-W3 |
| Length: | 39 m [129 ft.] |
| Chord (width) (blade root/blade tip): | 3.52 m /0.48 m [11.62 ft/1.6 ft] |
| Twist (blade root/blade tip): | 13°/0° |
| Weight per blade: | Approx. 6,500 kg. (14,300 lbs.) |

## 7.3 Blade Bearing

| | |
|---|---|
| Type: | 4-point contact ball bearing |

## 7.4 Blade Hub

| | |
|---|---|
| Type: | Cast ball hub |
| Material: | EN-GJS-400-18U-LT |

## 7.5 Main Shaft

| | |
|---|---|
| Type: | Forged, hollow shaft |
| Material: | 42CrMo4 V / EN10083 |

## 7.6 Bearing Housing

| | |
|---|---|
| Type: | Cast foot housing with lowered centre |
| Material: | EN-GJS-400-18U-LT |

## 7.7 Main Bearings

| | |
|---|---|
| Type: | Spherical roller bearings from recognised suppliers |

## 7.8 Machine Foundation

| | |
|---|---|
| Type: | Cast EN-GJS-400-18U-LT |

## 7.9 Yaw System

| | |
|---|---|
| Type: | Plain bearing system with built-in friction |
| Material: | Forged yaw ring: heat-treated.<br>Plain bearings: PETP. |
| Yawing speed: | < 0.5°/sec |

## 7.10 Yaw Gears

| | |
|---|---|
| Type: | Planetary-/worm gear combination,<br>2 step planetary/1 step worm gear with torque limiter |
| Motor: | 2.5 kW, 6 pole, asynchronous (induction) |

## 7.11 Steel Tower

| | |
|---|---|
| Type: | Conical tubular |
| Material: | ASTM A709-Grade 36 or 50 |
| Surface treatment: | Painted in accordance with ISO 12944-2 |
| Corrosion class, outside: | C3 |
| Corrosion class, inside | C3 |
| Top diameter for all towers: | 2.3 m (7.6 ft) |
| Bottom diameter for all towers | 4.0 m (13.2 ft) |
| | **Exact Hub Height** |
| 3-section, modular tower (60 m): | 60 m (198 ft) |
| 3-section, modular tower (67 m): | 67 m (221 ft) |
| 4-section, modular tower (78 m): | 78 m (257 ft) |

The exact hub height includes 0.4 m [1.3 ft] distance from the top of the foundation to the top of the foundation insert section flange, and 1.7 m [5.61 ft] distance from the top flange to the centre of the hub.

## 7.12 Gearbox

| | IEC1A | IEC2A |
|---|---|---|
| Type: | 1 planetary stage / 2 helical stages | 1 planetary stage / 2 helical stages |
| Ratio: | 60 Hz: 1:111.0 | 60 Hz: 1:120.6 |
| Cooling: | Oil-pump with oil-cooler | Oil-pump with oil-cooler |
| Oil heater: | 2 kW | 2 kW |
| Oil filtration: | 3 µm off-line filter unit + 25µm inline filter | 3 µm off-line filter unit + 25µm inline filter |

Manufacturer: Vestas has a number of sub-suppliers of gearboxes. All gearboxes are in compliance with Vestas specifications.

## 7.13 Couplings

**Main shaft-gearbox:**

| | |
|---|---|
| Type: | Shrink disc, conical |

**Gearbox:**

| | |
|---|---|
| Type: | Composite shaft |

## 7.14 Generator

| | |
|---|---|
| Type: | Asynchronous [induction] with wound rotor, slip-rings and VRCC (OptiSlip® technology) |
| Rated power: | 1.8 MW |
| Voltage: | 690 VAC |
| Frequency: | 60Hz |
| No. of poles: | 4 |
| Class of insulation: | F or better |
| Class of protection: | IP54 |
| Slip regulation interval: | 1- 10 % |
| Nominal slip: | 4% |
| Nominal speed: | 1872 RPM |
| Power factor, generator: | ≥0.90 |
| Rated current: | ≤1673 |
| Power factor correction: | 864 kVar |
| Resulting power factor 690V: | ≥0.999 |
| Resulting current: | 1507 Amps |

## 7.15 Parking Brake

| | |
|---|---|
| Type: | Disc Brake |
| Diameter: | 600 mm [24 inches] |
| Disc material: | SJV300 |

## 7.16 Hydraulic Unit

| | |
|---|---|
| Pump capacity: | 44 l/min (11.6 gal/min) |
| Max. Pressure: | 200 bar (2900 psi) |
| Brake pressure: | 28 bar (406 psi) |
| Oil quantity: | 300 l (79.3 gal) |
| Motor: | 18.5 kW |

## 7.17 Anemometer and Wind Direction Sensor

| | |
|---|---|
| Type: | 1 ultrasonic sensor |

## 7.18 Lightning Protection

| | |
|---|---|
| Down-conductors in blades | A down-conductor is placed in each rotor blade |
| Equipotential bonding | The machine frames, crane bars, crane pillars and the tower are equipotentially bonded |

## 7.19 Control Unit

| | |
|---|---|
| Power current: | |
| Voltage: | 3 x 690 VAC |
| Frequency | 60 Hz |
| Power supply for light and plugs: | 110 VAC |
| Computer: | |
| Communication: | ARCNET |
| Program memory: | EPROM (flash) |
| Programming language: | Modula-2 |
| Configuration: | Modules |
| Operation: | Numeric keyboard + function keys |
| Display: | 4 x 40 characters |
| Processor Supervision/control: | Yawing<br>Hydraulics<br>Ambient Surroundings (wind, temperature)<br>Rotation<br>Generator<br>Pitch system<br>Grid<br>Power factor correction<br>Thyristors<br>Remote monitoring |
| Information: | Operating data<br>Production<br>Operation log<br>Alarm log |
| Commands: | Run/Pause<br>Man. Yaw start/stop<br>Maintenance routine |
| REMOTE SUPERVISION | Possible serial communication connection. |

## 7.20 Transformer

| | |
|---|---|
| Type: | Cast resin |
| Rated Power: | 1850 kVA |
| High voltage: | 6 – 34,5 kV (36kV equipment voltage) |
| Frequency | 60 Hz |
| Vector group: | Yn/Yn, unless otherwise specified |
| Low voltage: | 690 Vac |
| HV – Tabs: | +/- 2 x 2.5% |
| Impedance voltage: | 6.8% |

## 7.21 Weights

[Weights in tons = 1000 kg]

| | |
|---|---|
| Nacelle: | [70 tons] |
| Rotor: | [37.5 tons] |

# 8. Installation

## 8.1 Terrain

Particular considerations must be taken if the terrain has a slope of more than 10° within a 100-m [330ft.] radius of the turbine. In all cases, it is recommended to consult Vestas prior to final site selection.

## 8.2 Climatic Conditions

The turbine is designed for an ambient temperature range of -20°C [-4°F] to +40°C [+104°F]. At temperatures less than –20°C [-4°F] and greater than +40°C [+104°F] the turbine will not generate power, and special considerations must be undertaken.

The turbine has been designed in accordance with IEC 61400-1 class $I_A$ wind conditions and can be placed in wind farms with a minimum distance of 5 (five) rotor diameters (400 m/1320 ft) between all turbines. If the turbines are placed in a single row, perpendicular to the predominant wind direction, the distance between adjacent turbines must be a minimum of 4 (four) rotor diameters (320 m/1056 ft).

The relatively humidity can be 100 % (max. 10 % of the time).

**Corrosion**
Corrosion protection is in accordance with ISO Standard12944-2.

All Vestas turbines are produced and protected according to the following corrosion classes:

Outside fittings and sensors are corrosion protected to class **C3**.

Inside surfaces, directly exposed to outside air, e.g. inside nose cone and transformer housing are corrosion protected to class **C3**.

Inside surfaces, not directly exposed to outside air, e.g. component inside the nacelle, are corrosion protected to class **C3**.

Towers are deliverable in different corrosion protection classes. Standard towers are protected to class **C3** on outside surfaces and **C3** inside. Foundations are classified according to ISO Standard 12944-2, corrosion class **IM3.**

## 8.3 Grid Connection

The turbine can be connected to a medium-voltage grid at a range of 6-34.5 kV, where 36 kV ($U_m$) is the highest equipment voltage. The electrical grid medium-voltage cable connection is made at the tower base.

The low-voltage/medium-voltage transformer must be special-ordered to correspond to the desired grid voltage. At the turbine ordering stage, Vestas will need precise information about the interconnecting grid voltage so that the low voltage/medium voltage transformer's nominal voltage and winding connection can be correctly specified. Winding connections in both Y-Δ and Y-Y (low voltage/medium voltage) configurations are available. As an option, Vestas can also provide a medium voltage switch gear installation to isolate the turbine from the interconnecting grid.

The medium-voltage grid voltage levels shall be within +5/-5% of nominal levels, with frequency variations of +2/-3Hz permitted.

NOTE: GRID FREQUENCY FLUCTUATIONS OF AN INTERMITTENT OR RAPID NATURE CAN CAUSE SERIOUS TURBINE DAMAGE AND SHOULD BE MINIMIZED.

As an average, grid drop-out (loss of grid power) shall not take place more than once a week over the turbines' lifetime.

The grounding system must be designed (by others) in accordance with the local soil conditions. The resistance to neutral earth must be according to the requirements of the local authorities. Vestas requires that the electrical ground connection has a maximum resistance of 10 Ω.

**Harmonics and Capacitors for Power Factor Correction**
The 5th and 7th harmonics are sinusoidal voltages with frequencies of 300 Hz and 420 Hz, respectively. Harmonics are caused by different equipment (e.g. welding machines, converters and drives) connected to the same power supply systems as the wind turbine. Harmonics in power supply system may cause overload conditions that could lead to a reduction in the lifetime of the power factor correction capacitors.

The turbine is equipped with reactors to reduce the harmonic load at the capacitors. The power factor correction system is designed to operate at a harmonic spectrum according to the following European and American standards:
VDE 0160, IEEE 519, IEC 1000-2-2 and EN 50160.

# 9. General Reservations, Notes and Disclaimers

- All data are valid at sea level ($\rho$=1.225 kg/m$^3$). Machine de-rating may be necessary at other altitudes.
- Periodic operational disturbances and generator power de-rating may be caused by combination of high winds, low voltage or high temperature.
- Vestas recommends that the electrical grid be as close to nominal as possible with little variation in frequency.
- A certain time allowance for turbine warm-up must be expected following grid dropout and/or periods of very low ambient temperature.
- If the wind turbine is sited at elevations greater than 1000 m (3300 ft) above sea level, a higher than usual temperature rise may occur in electrical components. In such cases, a periodic power reduction from rated electrical output may occur. This may occur even when the ambient temperature remains within specified limits.
- Furthermore, sites situated at greater than 1000 m (3300 ft.) above sea level usually experience an increased risk of icing in most climates.
- Because of continuous development and product upgrade, Vestas reserves the right to change or alter these specifications at any time.

# 10. Performance Note

THE PERFORMANCE OF THE VESTAS V80-1.8 MW WIND TURBINES CAN AND WILL VARY DEPENDING ON NUMEROUS VARIABLES, MANY OF WHICH ARE CONSIDERED AS PART OF THE PERFORMANCE MEASUREMENT STANDARD SET FORTH IN THE GENERAL SPECIFICATIONS. MANY OF THESE VARIABLES INCLUDING, BUT NOT LIMITED TO, SITE LOCATION, INSTALLATION, TURBINE CONDITION, TURBINE MAINTENANCE AND ENVIRONMENTAL/CLIMATIC CONDITIONS ARE BEYOND THE CONTROL OF VESTAS. UNLESS OTHERVISE CONTRACTUALLY AGREED IN WRITING, ALL PERFORMANCE SPECIFICATIONS SET FORTH IN THIS GENERAL SPECIFICATION INCLUDING, BUT NOT LIMITED TO, POWER CURVES, ANNUAL PRODUCTIONS AND NOISE EMISSIONS SHOULD BE USED FOR GUIDEANCE ONLY, AND NOT AS A PREDICTOR OR GUARANTEE OF FUTURE PERFORMANCE. FOR ADDITIONAL INFORMATION REGARDING THE INSTALLATION, MAINTENANCE AND PERFORMANCE OF THE VESTAS V80–1.8MW WIND TURBINES, PLEASE CONTACT VESTAS DIRECTLY.

# Appendix F
# Soils Map

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

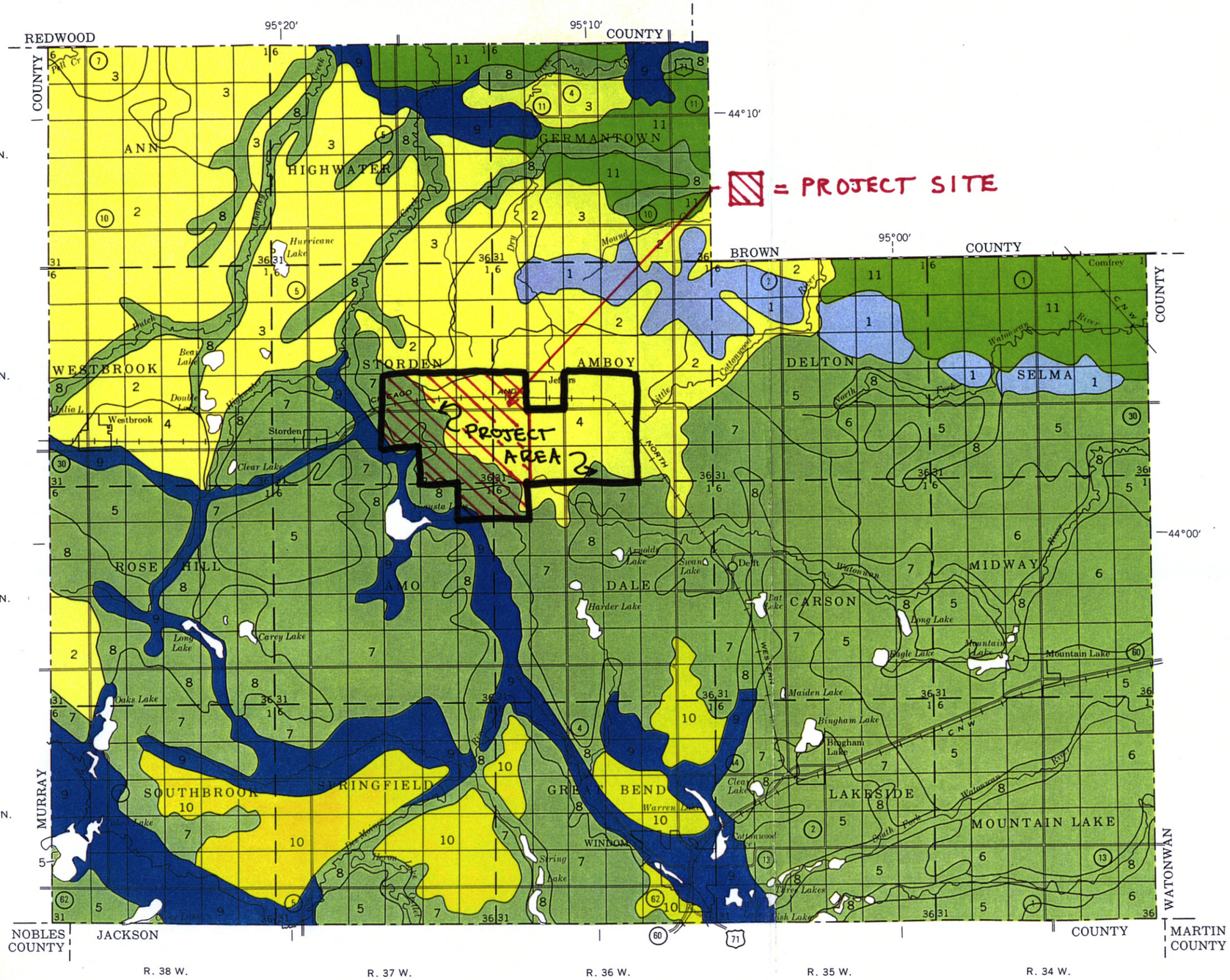
MINNESOTA AGRICULTURAL EXPERIMENT STATION

# GENERAL SOIL MAP

## COTTONWOOD COUNTY, MINNESOTA

Scale 1:190,080

1 0 1 2 3 4 Miles




## SOIL LEGEND

AREAS DOMINATED BY SOILS THAT ARE UNDERLAIN BY BEDROCK

1 — Germantown: Nearly level to gently sloping, well drained soils that formed in clay loam and loam glacial till over bedrock

AREAS DOMINATED BY SOILS THAT ARE UNDERLAIN BY FIRM GLACIAL TILL

2 — Everly–Letri: Gently sloping, well drained soils and nearly level, poorly drained soils that formed in clay loam and loam glacial till

3 — Wilmonton–Letri: Nearly level, moderately well drained to poorly drained soils that formed in clay loam and loam glacial till

4 — Glencoe–Jeffers: Nearly level, very poorly drained soils and poorly drained calcareous soils that formed in clay loam and silty clay loam glacial till

AREAS DOMINATED BY SOILS THAT FORMED IN FRIABLE GLACIAL TILL

5 — Webster–Nicollet: Nearly level, poorly drained soils and very gently sloping, moderately well drained and somewhat poorly drained soils that formed in clay loam and loam glacial till

6 — Webster–Canisteo: Nearly level, poorly drained soils and nearly level, poorly drained calcareous soils that formed in clay loam and loam glacial till

7 — Clarion–Swanlake: Undulating and rolling, well drained soils that formed in loamy glacial till

8 — Swanlake–Storden: Undulating to very steep, well drained soils that formed in loam and clay loam glacial till

AREAS DOMINATED BY SOILS THAT FORMED IN GLACIAL OUTWASH

9 — Estherville–Dickman: Nearly level to steep, well drained soils that formed in loamy and sandy sediments over sandy and gravelly materials

AREAS DOMINATED BY SOILS THAT FORMED IN GLACIAL LACUSTRINE SEDIMENT

10 — Rushmore–Ransom: Nearly level, poorly drained soils and very gently sloping, moderately well drained and somewhat poorly drained soils that formed in silty lacustrine sediment over calcareous loamy glacial till

AREAS DOMINATED BY SOILS THAT FORMED IN SHALY GLACIAL TILL

11 — Ves–Canisteo: Undulating, well drained soils that formed in shaly loam glacial till and nearly level, poorly drained soils that formed in loamy glacial till

Compiled 1978

SECTIONALIZED TOWNSHIP

| | | | | | |
|---|---|---|---|---|---|
| 6 | 5 | 4 | 3 | 2 | 1 |
| 7 | 8 | 9 | 10 | 11 | 12 |
| 18 | 17 | 16 | 15 | 14 | 13 |
| 19 | 20 | 21 | 22 | 23 | 24 |
| 30 | 29 | 28 | 27 | 26 | 25 |
| 31 | 32 | 33 | 34 | 35 | 36 |

*Each area outlined on this map consists of more than one kind of soil. The map is thus meant for general planning rather than a basis for decisions on the use of specific tracts.*

1/1