# Appendix A

# Township Zoning Maps

# Ashley Township Official Zoning Map

Zoning Ordinance #439
June 22, 2010

Amended by Ordinance #440, June 22, 2010

**Functional Road Class**

- Principal Arterial
- Minor Arterial
- Major Collector
- Minor Collector

- Roads
- Orderly Annexation Area
- Protected Rivers & Streams
- Townships
- Sections

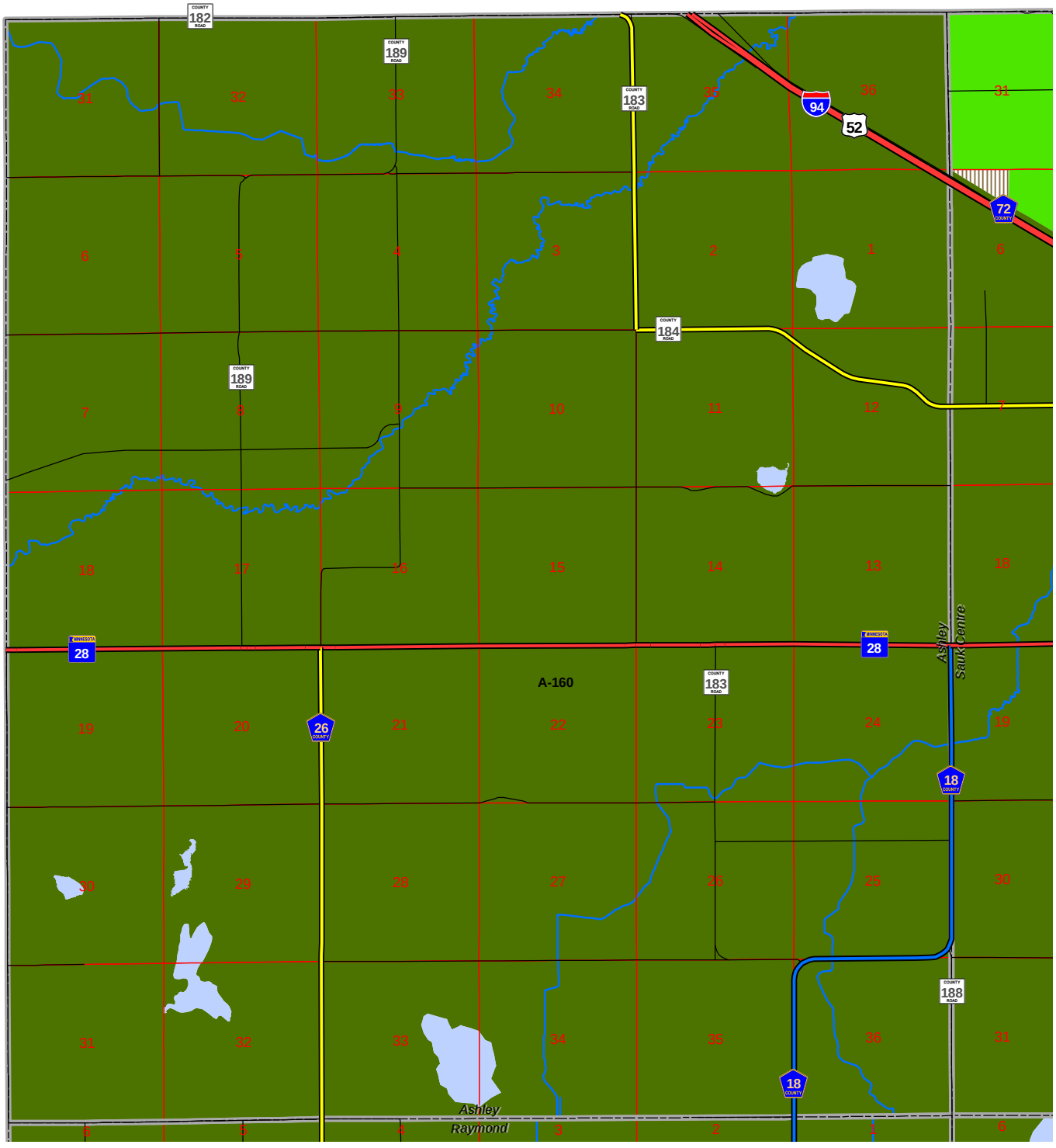
**Zoning Districts**

- Agricultural District A-160
- Agricultural District A-80
- Agricultural District A-40
- Commercial (C)
- Educational/Ecclesiastical (EE)
- Industrial (I)
- Municipality
- Urban Expansion (UE)
- Protected Lake
- Residential District R-1
- Residential District R-5
- Residential District R-10
- Residential District R-20
- Residential Manufactured Home (RMH)
- Rural Townsite (RT)
- Scenic River District (SR)
- Transition District T-20

N

0 0.5 1
Miles





# Raymond Township Official Zoning Map

Zoning Ordinance #439
June 22, 2010

Amended by Ordinance #440, June 22, 2010

**Functional Road Class**

- Principal Arterial
- Minor Arterial
- Major Collector
- Minor Collector
- Roads
- Orderly Annexation Area
- Protected Rivers & Streams
- Townships
- Sections

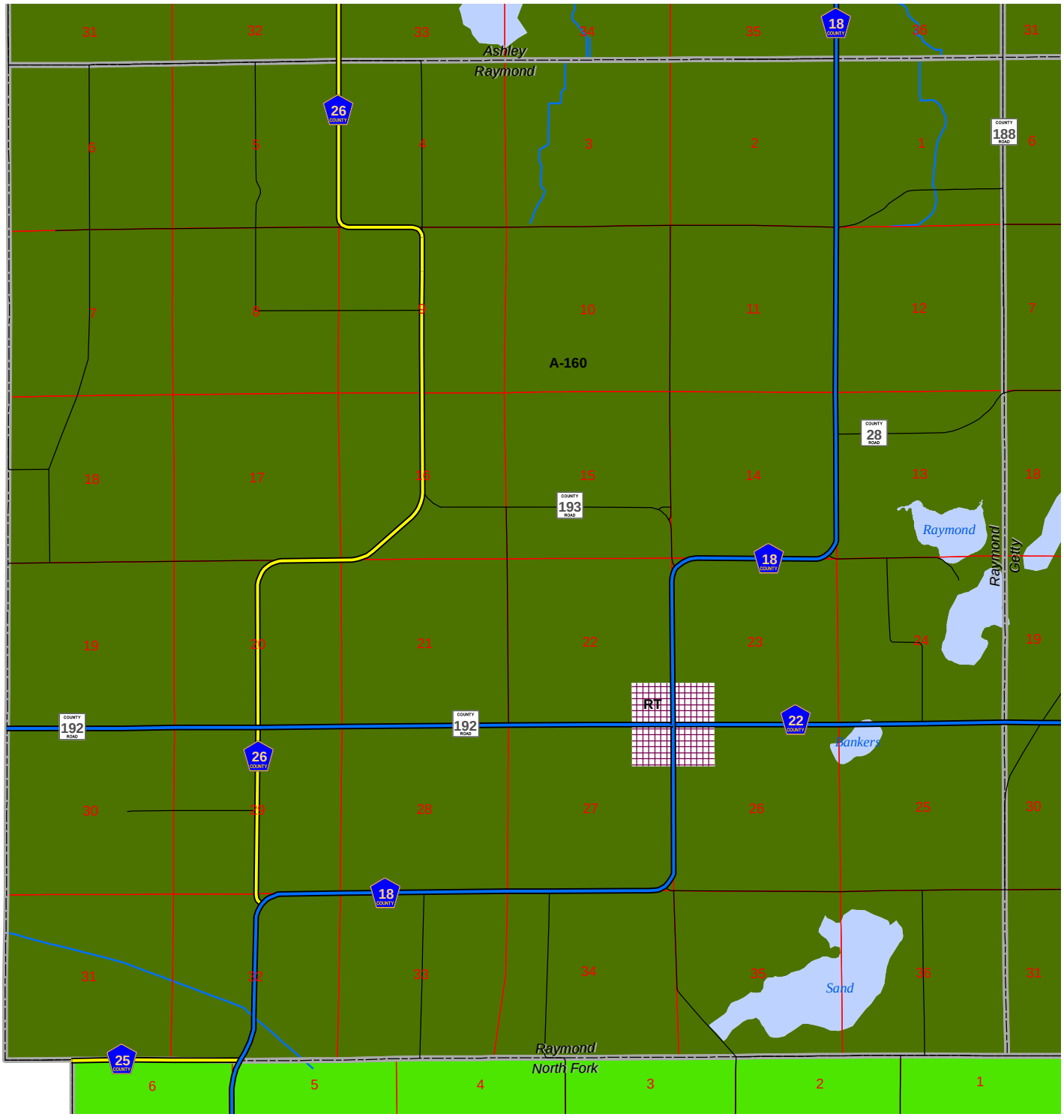
**Zoning Districts**

- Agricultural District A-160
- Agricultural District A-80
- Agricultural District A-40
- Commercial (C)
- Educational/Ecclesiastical (EE)
- Industrial (I)
- Municipality
- Urban Expansion (UE)
- Protected Lake
- Residential District R-1
- Residential District R-5
- Residential District R-10
- Residential District R-20
- Residential Manufactured Home (RMH)
- Rural Townsite (RT)
- Scenic River District (SR)
- Transition District T-20

N

0 0.5 1
Miles





# Appendix B

# Technical Noise Report

## EXECUTIVE SUMMARY

HDR Engineering, Inc. (HDR) performed a noise analysis in support of the proposed Black Oak Wind Project. The analysis modeled all proposed wind turbines operating simultaneously at their highest noise emission operating condition and calculated project-related noise levels at 104 noise-sensitive receptors within the study area.

Analysis results indicate the following:

- The noise analysis was conducted in accordance with the accepted environmental noise assessment practices in the industry and in accordance with methods used on projects approved by the State of Minnesota.
- Predicted noise levels from a single turbine at 1,000 feet for the GE 1.6xle, Vestas V90 and Vestas V112 turbines are 43, 41 and 44 dBA respectively.
- The maximum noise level from all wind turbines operating simultaneously at their highest rated operating speed is calculated to be 45 dBA at the nearest noise-sensitive receptor.
- Average project-related noise levels at residences for all turbine models range from 28 – 30 dBA, on an hourly Leq basis.
- Wind turbine noise levels at any residence are compatible with criteria from Minnesota State Noise Pollution Control Rules 7030.0040 for acceptable levels of noise within residential land uses.
- Maximum calculated noise levels for all turbine models are at least 5 dB below the nighttime L50 noise limit of 50 dBA.

## NOISE PERCEPTION

Noise is defined as unwanted sound. Sound is made up of tiny fluctuations in air pressure. Sound, within the range of human hearing, can vary in pressure by over one million units. Therefore, a logarithmic scale, known as the decibel scale (dB), is used to quantify sound pressure and to compress the scale to a more manageable range.

Sound is characterized by both its amplitude (how loud it is) and frequency (or pitch). The human ear does not hear all frequencies equally. In fact, the human hearing organs of the inner ear deemphasize very low and very high frequencies. The A-weighted scale (dBA) is used to reflect the selective sensitivity of human hearing. This scale puts more weight on the range of frequencies that the average human ear perceives, and less weight on those that we do not hear as

well, such as very high and very low frequencies. The C-weighted scale (dBC) is used to reflect human sensitivity at louder levels. This scale puts more weight on the lower frequencies than does the A-weighted scale.

The human range of hearing extends from approximately 3 dBA to around 140 dBA. Table 1 shows a range of typical noise levels from common activities.

Table 1. Common Noise Sources and Levels

| Sound Pressure Level (dBA) | Typical Sources |
|---|---|
| 120 | Jet aircraft takeoff at 100 feet |
| 110 | Same aircraft at 400 feet |
| 90 | Motorcycle at 25 feet |
| | Gas lawn mower at 3 feet |
| 80 | Garbage disposal |
| 70 | City street corner |
| 60 | Conversational speech |
| 50 | Typical office |
| 40 | Living room (without TV) |
| 30 | Quiet bedroom at night |

*SOURCE: Environmental Impact Analysis Handbook, ed. by Rau and Wooten, 1980*

Environmental noise is often expressed as a sound level occurring over a stated period of time, typically one hour. When the acoustic energy is averaged over the stated period of time, the resulting equivalent sound level represents the energy-based average sound level. This is called the equivalent level, or Leq. Therefore, the Leq represents a constant sound that, over the specified period, has the same acoustic energy as the time-varying sound.

## EVALUATION CRITERIA

Project-related noise was assessed based on the Minnesota Pollution Control Agency (MPCA) noise rules for residential land uses. The daytime and nighttime noise limits are an L50 of 60 and 50 dBA respectively. The L50 is the noise level exceeded 50% of the time. Public concern over the low frequency component of noise emitted by wind turbines was examined in the recent Minnesota Department of Healthy (MDH) white paper "Public Health Impacts of Wind Turbines" (MDH, 2009), which indicates a 5 dBA buffer provides an adequate surrogate for low-frequency noise. The nighttime L50 standard is the most stringent noise limit in the MPCA standards; therefore, when combined with the 5 dBA buffer suggested by the MDH white paper,

analysis results are appropriate and conservative for evaluating the acceptability of calculated wind turbine noise levels.

The Cadna-A model used for this analysis calculates an Leq occurring in the stated time period (one hour). The MPCA L50 descriptor represents the noise level exceeded 50% of the time, which – by inspection, is a statistical median noise level. For a constant noise source, the Leq and the L50 will be equal. Most noise sources, including wind turbines, exhibit some fluctuation, resulting in a statistical distribution of noise levels over time. Even with a fluctuating noise source, the Leq is a close approximation or even a conservative overestimate of the $L_{50}$. For purposes of this analysis, the predicted Leq can be considered a reasonable and appropriate estimate of the L50.

## METHODOLOGY

Cadna-A, an acoustical analysis software designed for evaluating environmental noise from stationary and mobile sources, was used to calculate the Leq for all three turbine models. Cadna-A is a three-dimensional noise model based on ISO 9613, "Attenuation of Sound during Propagation Outdoors," adopted by the International Standards Organization (ISO) in 1996. This standard provides a widely-accepted engineering method for the calculation of outdoor environmental noise levels from sources of known sound emission. Sound propagation is a product of *several* attenuation terms including geometric divergence, ground effect, atmospheric absorptions, screening by obstacles and meteorological conditions.

In order to provide cumulative noise analysis results, Cadna-A calculated noise emissions from all proposed turbines (the turbine layout shape file was imported into Cadna-A). The Cadna-A modeling done for this project did not utilize project-specific terrain. By eliminating terrain, the Cadna-A model assumes flat ground and reduces the opportunity for terrain to potentially block the line-of-sight between turbines and receptors, generally resulting in a more conservative, overestimated, predicted sound level.

In lieu of specific state and county specifications for ground absorption, a ground absorption factor of 0.7 was used as suggested in the "Noise Guidelines for Wind Farms" document published by the Ontario Ministry of the Environment. This ground absorption factor takes into account the majority of cultivated terrain in the project area; in effect it assumes 70% of the ground cover is porous, or acoustically absorptive, and 30% of the ground is an exposed hard surface, or acoustically reflective.

A 0% acoustical absorption means that the surface is perfectly reflective. Smooth, debris-free ice, mirrors and paved parking lots are examples of surfaces that approach perfect reflective surfaces. Even during the winter, the ground surface characteristics in the project area are not

representative of a paved parking lot or the like. Ground surfaces in the project area during the winter vary and can include soft powdered snow cover, sleet, and small areas of ice, many of which may be interrupted by vegetation. Thus, a 0% absorption rate, although conservative, would not be appropriate to use in the noise model, and the guidelines published by the Ontario Ministry of the Environment were employed.

Additionally, by eliminating wind rose data from the model, Cadna-A conservatively calculates noise levels at all receptors by assuming that each receptor is downwind from every turbine at once, regardless of actual turbine directions, with favorable sound propagation conditions. Because of the described assumptions and the analysis utilized the loudest sound power level provided by the manufacturers; the analysis provides a conservative prediction of noise levels.

The level of wind turbine sound varies with the operating speed of the turbine. Sound is generated from the wind turbine at points near the hub or nacelle, 80 meters (262.5 feet) to 100 meters (344.5 feet) in the air, from the blade tips as they rotate. For the noise evaluation, the Applicant obtained sound power levels ($L_W$) of the wind turbines selected for this project. These levels were provided by the wind turbine manufacturers according to standardized measurement procedures and account for all sound generating elements associated with wind turbines. The Cadna-A model utilized the noise emission level at the highest rated operating speed as shown in Table 2.

Table 2. Noise Emissions Data Provided by Turbine Manufacturers

| Turbine Make and Model | Sound Power Level (dBA) |
|---|---|
| GE 1.6xle | 106.0 |
| Vestas V90 | 105.0 |
| Vestas V112 | 106.5 |

In order to provide cumulative noise analysis results, Cadna-A calculated noise emissions from all proposed turbines and the sound propagation to all receptors within the study area, up to 805 meters (2,640 feet) from the Project boundary. This analysis represents the noise level due to all wind turbines operating at the wind-speed corresponding with the turbines' highest noise emission rating.

## EXISTING ENVIRONMENT

The term *ambient acoustic environment* refers to the all encompassing sound in a given environment or community. The outdoor ambient acoustic environment is a composite of sound from many sources from varying distances and directions. Common sound sources within an agricultural and/or rural environment include, but are not limited to, sound from farm equipment

such as tractors and combines, sound generated from traffic on roadways, sounds from wildlife, and wind rustling through the vegetation.

Typically, the ambient acoustic environment of a rural or agriculturally-oriented community has average sound levels ranging from 30 dBA to 60 dBA Leq. This range is based on HDR's extensive and qualified experience in reviewing noise levels in rural settings with high wind resources. In agricultural and/or rural communities, higher sound levels typically exist near roadways and near areas that experience greater human activities such as farming. In addition, compared with similar environments with lower quality wind resources, those environments with higher wind resources generally experience higher sound levels.

## NOISE ASSESMENT

When in motion, the wind turbines emit a perceptible sound. The level of this sound varies with the speed of the turbine and the distance of the listener from the turbine. Sound is generated from the wind turbine at points near the hub or nacelle, 80 to 100 meters (262 to 328 feet) in the air, from the blade tips as they rotate. The analysis accounted for all noise generating elements associated with wind turbines.

The Applicant proposes minimum setbacks for turbines from residences of 1,000 feet, plus any additional distance necessary to achieve a setback for the 50 dBA nighttime L50 noise level. A model was developed, using Cadna-A to determine the noise level of a single turbine at a distance of 1,000 feet. All three proposed turbine types will comply with the MPCA noise limit of 50 dBA L50 at a distance of 1,000 feet. Predicted noise levels from a single turbine at 1,000 feet for the GE 1.6xle, Vestas V90, and Vestas V112 turbines are 43, 41, and 44 dBA respectively.

Project-related noise levels, from all proposed turbines, were calculated at residences using Cadna-A. Table 3 presents a summary of the noise analysis results.

Table 3. Summary of Noise Analysis

| Turbine Make and Model | Maximum Project Related Leq, dBA | Average Project-Related Leq, dBA |
|---|---|---|
| GE 1.6xle W | 45 | 30 |
| Vestas V90 | 44 | 28 |
| Vestas V112 | 45 | 28 |

The maximum calculated noise level, based on assumptions incorporated into the Cadna-A model and the most current turbine layout, results in a 45 dBA Leq at the nearest noise-sensitive

receptor. Average project-related noise levels at residences for all turbine models range from 28 – 30dBA, on an hourly Leq basis.

The baseline noise isopleths (a line or curve of equal values) are depicted in Figures 5-1 through 5-3. As depicted in the multi-turbine constraint maps all proposed turbine layouts comply with MPCA noise guidelines. Based on the preliminary turbine layouts shown on Figures 5-1 through 5-3, the maximum calculated noise levels for all turbine models are at least 5 dB below the nighttime L50 noise limit of 50 dBA. The applicant has committed to siting turbines to meet the L50 noise limit of 45 dBA, based upon the nighttime L50 noise limit of 50 dBA with a 5 dB buffer as a surrogate for low-frequency noise as suggested by MDH.

## LOW FREQUENCY NOISE

The MDH white paper also recommended an evaluation of the low-frequency component of turbine noise, as a possible additional cause of irritation. Sound levels from modern wind turbines pose no risk of hearing loss or any other nonauditory effect. (Ising and Kruppa 2004) While subaudible, low frequency sound and infrasound are most commonly associated with noise complaints about wind turbines, there is a consensus among acoustic experts that these frequencies are of no consequence to health. (Colby *et al.* 2009) Although some people may be annoyed at the presence of sound from wind turbines, annoyance is a highly-individualized phenomenon, and is not an identified medical condition (Colby *et al.* 2009). The primary concern about wind turbine sound is its fluctuating nature, which can occur under certain circumstances such as turbulent wind conditions. A small number of individuals with particular sensitivities may find this sound annoying, but the reaction depends primarily on the personal characteristics of the listener, as opposed to the intensity of the sound level (Colby *et al.* 2009). The substantial body of peer-reviewed literature on the subject of wind turbine noise indicates that there is nothing unique about the sounds and vibrations emitted by wind turbines, and that there is no evidence that the audible or subaudible sounds emitted by wind turbines have any direct adverse physiological effects (Colby *et al.* 2009).

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

When studying 1.5 MW wind turbines from a distance of 65 meters (213 feet), Levanthall found that modern upwind turbines produce pulses which are considered infrasound, but only at low levels, typically 50 to 70 dB, which are well below the hearing threshold. Based on his study,

Levanthall further concludes that infrasound is inaudible at frequencies below 16 Hz. The threshold which is audible varies by individuals, but Levanthall states that "…it is most unlikely that an individual will be able to hear sound at any frequency which is more than 20 dB below the median threshold for hearing." (Colby, et al. 2009).

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

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

## CONCLUSIONS

Analysis results indicate the following:

- The noise analysis was conducted in accordance with the accepted environmental noise assessment practices in the industry and in accordance with methods used on projects approved by the State of Minnesota.
- The maximum noise level from all wind turbines operating simultaneously at their highest rated operating speed is calculated to be 45 dBA at the nearest noise-sensitive receptor.
- Average project-related noise levels at residences for all turbine models range from 28 – 30 dBA, on an hourly Leq basis.

- Wind turbine noise levels at any residence are compatible with criteria from Minnesota State Noise Pollution Control Rules 7030.0040 for acceptable levels of noise within residential land uses.
- Maximum calculated noise levels for all turbine models are at least 5 dB below the nighttime L50 standard of 50 dBA.

In conclusion, analysis results and recent literature on wind turbine noise effects indicate that noise as modeled from the proposed wind turbines will not have any undue adverse effect on residences in the Project area as a result of noise that accompanies operation of the project.

Potential noise impacts to nearby residents and other potentially affected parties will be taken into consideration as part of the siting of the turbines. The Applicant proposes minimum setbacks for turbines from residences of 1,000 feet, plus any additional distance necessary to achieve the setback for the 45 dBA nighttime L50 noise level. To the extent that the sound characteristics of the selected turbine vary, the Applicant will ensure compliance with MPCA noise standards. Per the guidance from the MDH whitepaper, the preliminary layout has been modeled to consider cumulative impacts from all wind turbines, and maximum calculated noise levels for all turbine models are at least 5 dB below the MPCA's nighttime L50 noise limit of 50 dBA, which the MDH suggested as a surrogate for low-frequency noise.

# Appendix C

# Phase I Literature Search Report

# Geronimo Black Oak Wind Farm Project

*A Phase Ia Literature Search Report*
*In Stearns County, Minnesota*

**PUBLIC VERSION**

**For**

**Geronimo Wind Energy,**
**Edina, Minnesota**

**By**

**Stephen Sabatke, M.A.**
**And**
**Melissa Lundberg**

**HDR Engineering, Inc.**
**701 Xenia Avenue South**
**Suite 600**
**Minneapolis , MN 55416**
**(763) 591-5400**

**SHPO Project No: 2010-3485**

**December 2010**

# Table of Contents

# 1.0 Introduction

This report documents the archaeological and facilities resource data collection effort (Phase Ia Literature Search Report) conducted for the proposed Black Oak Wind Farm Project (project), in Stearns County. In May of 2009 HDR Engineering, Inc. (HDR) began assisting Geronimo Wind Energy (Geronimo) in preparing a Minnesota Large Wind Energy Conversion System (LWECS) permit application. In June 2009 and again in May 2010, HDR reviewed information on file at the Minnesota State Historic Preservation Office (MNSHPO) located in St. Paul, Minnesota, to review relevant archaeological and facility properties documentation. This documentation will be used during project planning. Cultural resource data, housed at MNSHPO, consisted of cultural resource site files, cultural resource site leads, and previous professional cultural resource surveys and reports. In addition, HDR reviewed 19th Century Public Land Survey (PLS) maps to identify potential historic-period cultural features in the Project Review Area.

During the first week of July 2009, HDR senior archaeologist Michael Madson performed a windshield survey of the original Project Review Area for the project, which was defined as the Project Study Area plus one mile buffer zone surrounding the project area. This survey was conducted to review the existing environment and understand the landform types in the project vicinity. Initial project area documentation was completed at this time.

The project is located in the township, range, and sections shown in Table 1. A map (Figure 1) attached to the end of this report visually represents this area.

**Table 1. Original Black Oak Project Review Area Legal Descriptions**

| County | Township | Range | Section |
|---|---|---|---|
| Stearns | 126 | 35 | 25-27, 35, 36 |
| Stearns | 125 | 35 | 1-3, 11-14, 23 |

Sine this initial review the project boundary expanded to the north in November 2010, the additional 1 mile boundary surrounding the new Project Area has not been reviewed at this time. Prior to construction, six additional sections (Township 126 Range 35 Sections 22-24, 28 and Township 126 Range 34 Sections 19 and 30) will be reviewed for resources at the MNSHPO.

The project is located within the Minnesota Archaeological Resource Region known as the Central Lakes Deciduous, and sub-region Central Lakes Deciduous South.

# 2.0 SHPO Correspondence

In June 2010, Geronimo contacted MNSHPO and the Minnesota Office of the State Archaeologist (MN OSA) to request a review of potential project-related impacts on known or suspected cultural resources within the proposed Project Study Area. In July 2010, MNSHPO responded to the project initiation letter (SHPO Number: 2010-3485). MNSHPO recommended that Geronimo sponsor an archival records search within the Project Review Area and an archaeological resource inventory of the Project Study Area.

# 3.0 Regulatory Framework

As currently defined, this proposed action has been determined not to be a federal undertaking under Section 106 of the National Historic Preservation Act of 1966, as amended, and its implementing regulations (36CRF 800). If the project changes or if future information indicates the action is a federal undertaking, then this report may serve as a basis for additional study.

It is likely that this project is subject to regulations associated with:

- The Minnesota Wind Siting Act (Minnesota Statutes Chapter 216F)
- Minnesota Administrative Rules Chapter 7836 Wind Siting
- The Minnesota Department of Commerce, Energy Facility, Permitting, Siting, and Routing Department's PUC LWECS Site permit
- Minnesota Statute Chapter 138.661-138.699 (Minnesota Historic Sites Act)
- The Minnesota Pollution Control Agency's (PCA) National Pollutant Discharge Elimination System (NPDES) Permit No: MN R100001 (Appendix A, Part G. Discharges Affecting Historic Places Or Archeological Sites)

# 4.0 Brief Environmental and Historic Context

The proposed wind farm project is located within the Central Lakes Deciduous South archaeological sub-region. The following environmental history of this sub-region is based on information contained in an overview entitled "Minnesota's Environment and Native American Culture History" by Gibbon, Johnson, and Hobbs (2002). In addition, other sources of information are used to add to the description of this region. These sources are noted when used in the text.

The Central Lakes Deciduous sub-region of Minnesota includes all of Anoka, Benton, Chisago, Hennepin, Isanti, Mille Lacs, Morrison, Ramsey, Sherburne, Stearns, Todd, Wadena, Washington, and Wright counties. It also contains portions of Becker, Cass, Crow Wing, Dakota, Douglas, Kandiyohi, Kanabec, Meeker, Otter Tail, Pine, Pope, and Swift counties. This region extends into west central Wisconsin.

The topography of the Central Lakes Deciduous South sub-region is made up of moraines, till plains, and outwash plains. Many lakes, rivers, and other wetlands are found throughout the region. During the period of Euro-American contact, the vegetation near the project area was a mixed deciduous-coniferous forest dominated by oak and dominated by pine in the northern regions. Most soils in this region have medium to coarse texture with forest soils in the north and east and prairie soils in the south and west. The average annual precipitation ranges from 22 to 28 inches. The average January high temperatures range from 12 to 24 °F and the average July highs range from 78 to 82 °F. The frost-free season lasts up to 140 days in the north and up to 160 days in the south. Subsistence resources at the time of Euro-American contact would have included: white-tailed deer, beaver, bear, moose in the north and east, and small herds of bison and elk in the south and west. Fish and waterfowl would have been plentiful throughout the region with extensive beds of wild rice found throughout most of the region. Acorns would also have been an abundant food source.

## 4.1 Physiographic region

The topographic features in the area are complex because of numerous geologic events throughout the millennia occurring within the region. Descriptions of the topographic regions found near the

project are based on information contained in an overview entitled "Physiography of Minnesota" by H.E. Wright, Jr. (1972:569-572). The topographic regions identified are entitled: Brainerd-Automba Drumlin Area, Anoka Sand Plain Area, Western St. Croix Moraine, Wadena Drumlin Area, and Alexandria Moraine Area. A brief discussion of each is exhibited below.

**Brainerd-Automba Drumlin Area (Wright 1972:569):** This area constitutes most of the ground moraine of the Rainy and Superior lobes. Much of this area is marked by drumlin fields. The largest of these drumlin fields is located south of Mille Lacs Lake and identified as the Pierz area. However, the entire area is interrupted by outwash pains, the largest being the Mississippi River valley. Areas south of Mille Lacs Lake contain sharp erosional valleys with swamps, lakes, or streams. These locations are considered to be tunnel valleys, which were formed by subglacial streams flowing under very great hydrostatic pressure.

**Anoka Sandplain Area (Wright 1972:569):** This broad sandplain was formed largely by glacial drainage from the north and west. This location was covered initially by the Superior lobe and later by the Grantsburg sublobe. Features exist upon this plain and are represented by low areas that were not covered by the outwash plain and high areas representing old sand dunes. Other low areas are represented by lakes and marshes (remnants or old ice blocks), and tunnel valleys formed by subglacial streams flowing under great hydrostatic pressure.

**Western St. Croix Moraine (Wright 1972:570):** This moraine borders the upper Mississippi River on the west for about 100 miles and averages about 6 miles wide with a sharp face to the west. The moraine is transected west of Brained by a gap which carries the Crow River to the Mississippi River. The southern portion of this moraine is cut longitudinally by several broad drainageways. These drainageways were formed by southward flowing outlet streams from post glacial lakes during ice retreat.

**Wadena Drumlin Area (Wright 1972:571):** This area is surrounded by the Itasca moraine in the north, the St. Croix moraine in the east, and was over run by the Des Moines lobe in the south. The drumlins in this region spread to the west and south and are obscured by various outwash plains. Glacial blocks at various locations surrounding this region caused streams and rivers, which would normally flow north, to flow south. After glacial retreat the streams and rivers reversed their course further contributing to outwash plains.

**Alexandria Moraine Area (Wright 1972:572):** This lake dotted moraine extends northward in an arc through west-central Minnesota. It is covered by extensive areas of outwash and contains the drift of two different ice lobes. This moraine contains the thickest glacial drift in Minnesota and reaches some of the highest elevations in western Minnesota. The relief of this area is rugged and heavily wooded. This moraine in general divides the forested east from the prairie west in Minnesota.

### 4.1.1 Rock Formations

Bedrock outcrops in the region are limited to occasional granite rock exposures (Gibbon et al 2002). A brief examination of a bedrock map produced by the University of Minnesota-Minnesota Geological Survey, Bedrock map of Minnesota, Bedrock Geology lists five different bedrock formations located within Stearns County. These formations are described as: Quartzfeldspathic gneiss, amphibolites and other high grade metamorphic rock; Meta and sedimentary rocks (argillite, slate, shale, greywacke) of the Virginia, Thomson, and Rove Formations; Metasedimentary rocks

(slate, quartzite, and metagraywacke) intercalated with volcanic rocks and iron formations; Intrusive rocks (granite and granodiorite) of the Penokean orogeny; and Cretaceous rocks dominated by marine sediment, shale, and sandstone.

It is important to note that any rock formation has the potential under the right conditions to produce rock of desirable quality to ancient populations. However, according to Andrefsky in Lithics Macrosopic approaches to analysis (1998:57) for the rock to be useful it must retain these compositional qualities: be fine grained, hard, brittle, and fracture conchoidally. While rock of a desirable quality may exist within the region glacial disturbance may restrict access to these formations and chunks of the material from these formations may be widely scattered in the till.

### 4.1.2 Hydrology

The major river basin in this area is the Mississippi River (Gibbon et al 2002). The Mississippi River flows through the central and eastern portions of this region. The St. Croix River forms the eastern boundary of this region, while the western portion of the region drains into the Red River valley.

### 4.1.3 Flora and Fauna

The vegetation during the contact period comprised of mixed hardwood forest and deciduous forest biomes. During the early settlement period, oak trees were predominant in the south and east and pine in the north (Gibbon et al 2002).

The dominant pre Euro-American fauna in the region was white tail deer. Occasional herds of bison and elk could be found on the southern boundary, while the northern boundary would contain beaver, black bear, and moose. This region would have contained numerous fur bearing mammals, such as; gophers, white-tailed jackrabbits, badgers, red foxes, ground squirrels, coyotes, wolves, raccoons, skunks, weasels, voles, shrews, mice, and in wet areas beaver, muskrat, and mink. Plentiful wetlands allowed for an abundance of fish, waterfowl, and other aquatic animals. Birds in the region include bald eagles, crows, ravens, red - winged blackbirds, owls, and hawks.

### 4.1.4 Paleo-Environment Context

Through an examination of the information contained in MN/Model (Gibbon et al 2002) and the Outline of Historic Contexts for the Prehistoric Period (ca. 12,000 B.P. - A.D. 1700) and The Contact Period Contexts (ca. 1630 A.D. – 1820 A.D.) created by Dobbs, C. A. 1988. the following context was generated.

Around 14,000 years ago gradual warming in the northern hemisphere forced the glacial advance to retreat. The retreat of the glaciers set the stage for the present landscape of Minnesota. About 12,000 years ago sufficient warming had pushed the glacial front out of southern Minnesota and by about 11,000 years ago the glacial front was pushed out of northern Minnesota. Following the retreat of the glacial front, the immediate environment would have been a tundra-like plain followed closely by a spruce parkland like environment where temperature had reach the appropriate level to support it. Immediately following the spruce parkland environment would have been a coniferous dominated forest. Fossil evidence gathered from southern Minnesota suggests that now-extinct megafauna, such as large buffalo, mastodon, and giant beaver, existed along with wolverine, moose, lynx, caribou, mountain line, white-tail deer, and a variety of other animals.

Around 11,500 years ago deciduous forests, following the retreating spruce parkland/coniferous forest front, moved into southern Minnesota and by 10,500 years ago had pushed into central/northern Minnesota. Fossil evidence suggests that animal populations consisted of many birds, fish, amphibians, beaver, black bear, white-tailed deer, porcupine, weasels, moose, fisher, coyote, otter, bobcats, red fox, and timber wolf.

Around 10,000 years ago prairie vegetation, following the retreating deciduous forest front, moved into southern Minnesota. By 8,000 years ago Minnesota, excluding the northeastern arrowhead region of Minnesota, was prairie lands. Numerous bison bone beds can be found in Minnesota dating to this time. Other animals associate with this time period were gophers, white-tailed jackrabbits, badgers, red foxes, ground squirrels, coyotes, raccoons, skunks, weasels, voles, shrews, mice, and in wet areas, beavers, muskrat, mink. Along with numerous fish, waterfowl, and other prairie birds, such as prairie-chickens, sparrows, meadowlarks, red-winged blackbirds, yellow-headed blackbirds owls, and hawks.

Around 6,000 years ago wetter conditions allowed the deciduous forest to reclaim land to the west and south. Starting at 3,000 years ago continued expansion of the deciduous forest west and south would set the boundary of prairie vs. forest as found at European contact. Animal and plant biomes at this time would have greatly resembled those described at European contact.

## 4.2 Brief Historic Context

The following summaries of cultural contexts relevant to the data gathering area are based partially on information contained in a series of statewide historic contexts developed by the Minnesota SHPO (Dobbs 1990a; Dobbs 1990b; SHPO 1993), and in "Minnesota's Environment and Native American Culture History" by Gibbon, Johnson, and Hobbs (2002).

### 4.2.1 Paleoindian Tradition (9500 - 6000 B.C.)

The earliest human inhabitants of Minnesota entered the area about 11,000 years ago as the glacial front was pushed out of northern Minnesota. These peoples, comprising the Paleoindian Tradition, were migratory groups of mobile hunter-gatherers that followed herds of large game animals such as bison, woodland caribou, and mastodon into the tundra and open pine and oak forests that characterized Minnesota as the glaciers retreated. There is little archeological evidence of Paleoindian inhabitants in Minnesota, as they did not generate large artifact deposits. Cultural materials left by these people are often deeply buried underneath more recent sediment. Archaeological finds from this period consist mainly of isolated discoveries of large and distinct projectile points that are characteristic of this tradition. These points are divided into the Fluted Point Pattern (Clovis and Folsom points) and the non-fluted Lanceolate Point Pattern (Plano). Other tool types associated with the Paleoindian tradition include bifacially flaked knives, simple choppers, and large scrapers for processing kills.

### 4.2.2 Archaic Tradition (6000 - 500 B.C.)

As Minnesota became warmer and drier, expanses of prairie began to displace the previous forested land. The melting ice exposed new land surfaces with extensive lakes and large, swift rivers quite unlike any in present-day Minnesota. The landscape was interspersed with large lakes and swiftly flowing rivers fed by the glacial run-off.

The Pleistocene megafauna died out and the human inhabitants had to adapt to the altered landscape. As a result, new tool types and means of subsistence associated with the Archaic Tradition were developed. The Archaic Tradition is distinguished from the Paleo-Indian period by an increased diversity in tool types, the raw materials they were made from, and the exploitation of a larger variety of animal and plant communities. This diversity has been attributed to the adaptation of Archaic peoples to local resources and a relative abundance of animal and plant resources. The archaeological record of the Archaic Tradition displays evidence of the beginnings of cultural variation. Notched and stemmed projectile points, along with groundstone tools and chipped-stone scrapers, knives, punches, and drills, are found in the Archaic toolkit. About 7,000 years ago, copper implements appeared and continued to about 3,500 years ago.

Four distinct Archaic contexts have been identified in Minnesota: Shield Archaic, Lake-Forest Archaic, Prairie Archaic, and Eastern Archaic. Site locations during this time period are generally tied to locations near water. These locations would have been occupied for longer periods and would show larger amounts of artifact deposition. However, small encampments can be found scattered throughout the environment. These types of sites often represent an area of specific resource extraction or a location that takes advantage of a seasonal event such as a bison kill site, a flora gathering site, or a waterfowl breeding site. Artifact deposition at these locations is generally very minimal.

### 4.2.3 Woodland Tradition (500 B.C. - A.D. 1650)

Beginning about 3,000 years ago, the Minnesota's climate began to stabilize and resembled the climate that exists today. Expanses of prairie were found in the western portion of the state. A swath of oak savanna, stretching from the northwest to the southeast, separated the prairie from the pine forests of the arrowhead region.

Woodland period cultures exhibit evidence of an increasingly more sedentary lifestyle. Domestication of plants, ceramic technology, long-term re-occurring occupation of seasonal village sites, and mound construction emerged in the Woodland period. These innovations were not adopted in all areas of the state at the same time or necessarily together. Because they are not as deeply buried, Woodland sites are encountered more often than Paleo-Indian or Archaic sites. Woodland sites can also be more definitively attributed to a tradition based on ceramics and distinct tool types. Known ceramic traditions have allowed the Woodland period to be divided into an Early, Middle, and Late chronological framework. In Minnesota, the Woodland tradition is also divided into an earlier Initial Woodland period (including the Early and Middle periods, ca. 500 B.C. – A.D. 500) and a later Terminal Woodland period (including the Late period, ca. A.D. 500-1650).

Regional differences in the Woodland period resulted in the identification of distinct regional complexes such as such as Howard Lake, Fox Lake, Malmo, and Laurel. Within central Minnesota, a Transitional Woodland period, from 500 to 1000 A.D., has been defined and is associated with St. Croix and Onamia ceramics. Within Northern Minnesota, the geographic distribution of the distinctive ceramics and burial practices of the period have allowed archaeologists to identify archaeological cultures such as Kathio, Blackduck, and Psinomani. In northern Minnesota, it was Terminal Woodland people who met the first Europeans to visit the state in the middle of the 17th century (Gibbon, Johnson, and Hobbs, 2002).

### 4.2.4 Mississippian/Plains Village (A.D. 1000 – 1500)

About 1,000 years ago, a new tradition developed in southern Minnesota. In the western part of the state, this tradition is known as the Plains Village Tradition and in the eastern part of the state, this tradition is known as the Mississippian Tradition. These traditions are distinguished from Woodland traditions by an intensification of agriculture, including cultivation of corn, and larger, more complex societies. These influences spread into southwestern Minnesota from the Missouri River and into southeastern Minnesota from the Mississippi River and have possible ties to cultures of the southern United States and possibly Mexico. Mississippian/Plains Village sites are distinguished by distinct ceramic styles, large village complexes, a greater density of artifacts, and community vegetable storage pits. Effigy mounds in the shape of animals such as birds and snakes, as well as flat-topped mounds and villages encircled by protective palisades, were constructed in this period.

### 4.2.5 Fur Trade/Contact (1630s – 1858)

By the 1620s, the first European goods may have reached the upper Midwest through trade with the Ottawa and Huron. The first fur trade contact in this area occurred between 1659 and 1660, when two French explorers named Sieur des Groseilliers and Sieur de Radisson entered present day Minnesota in search of natural resources such as furs. Increasing number of explorers and fur tradesmen would reach the area in the years following first contact. This time period is recognized by the establishment, operation, and adaptation of gathering mammals of a fur bearing nature in exchange for other goods and materials. This exchange linked the Northern Plains to a worldwide economic and political system. By the late 1670s, a trade agreement had been established between merchants in Quebec and Montreal with the Dakota. This relationship initiated the French period of exploration and occupation in Minnesota, which lasted into the early 1760s. During this period of French influence much of the state and the surrounding region were occupied with an extensive network of forts and fur trading posts.

The 1763 Treaty of Paris, which brought an end to the Seven Years War, began a half century of British activity in Minnesota. This time period brought further development of the fur trade industry with more trading posts and consequently major changes in the distribution of Native American people in the region. By 1800, the Ojibwa took control of the lakes and forests of northern Minnesota, and the Dakota moved south along the Minnesota River valley.

The 1783 Treaty of Paris, which brought the American Revolutionary War to an end, granted legal possession of the region that ultimately became Minnesota up to the east bank of the Mississippi River to the United States. The United States later gained the lands on the west bank of the Mississippi River through the Louisiana Purchase of 1803. The United States generally began to exert control of Minnesota after Zebulon Pike's 1805-1807 expedition, and later with the establishment of Fort Snelling at the junction of the Minnesota and Mississippi rivers in 1819. The changes in Native American life brought about by French, British, and later United States control of Minnesota included migrations of Native American populations from the east, depopulation of native peoples in certain areas because of introduced diseases and tribal warfare, and resulted in the gradual movement of the Ojibwa into northern Minnesota and movement of the Dakota into southern Minnesota. The Native American populations in Minnesota also began to switch from hunting for subsistence to hunting for trade and Native American manufacturing materials began to be replaced by European materials.

Travel and settlement of the state were mostly restricted to corridors along larger bodies of water. In 1837 the Dakota, Winnebago, and Ojibwa signed treaties that opened up east-central Minnesota to logging and settlement, and by 1849 Minnesota had become organized as a Territory. Following the establishment of Minnesota as a state in 1858, Euro-American settlement increased, bringing a wave of new towns, cities, and non-fur trade-related enterprises. The Dakota War of 1862 further altered the distribution of Native American people in Minnesota with the removal of the majority of the Dakota from Minnesota.

### 4.2.6 Northern Minnesota Lumbering (1870 – 1930s)

After 1870, the lumbering industry in Minnesota expanded northward and westward from the east central part of the state known as the St. Croix Triangle, where lumbering began in the 1830s. This expansion was fueled by increased capital investment, expanded markets, and advancements in logging, lumbering equipment, and transportation. Logging occurred primarily near major rivers and their tributaries, the primary transportation arteries for logs. After 1870, railroads provided the single most important factor in the rapid growth of the lumber industry, as their expansion onto the Great Plains expanded the market for Minnesota lumber. New railroads in northern Minnesota opened timberland to loggers, reduced dependence on risky water transportation, and allowed the operation of lumber mills closer to the timber supply. Railroads had become the primary mover of logs by 1910. After peaking at the turn of the century, the lumber industry of Minnesota started to decline, with the last major sawmills closing in the 1930s. After 1890, an agricultural land boom began in northern Minnesota as lumber companies, railroads, chambers of commerce, land colonization companies, real estate companies, the State Bureau of Immigration, and other private and public agencies encouraged settlement of the cutover. Poor soil, an unfavorable climate, and the high cost of cultivating cutover land made farming here unprofitable, and with the lumber industry's rapid decline in the 1920s and a national farm-sector depression, many farms were abandoned in the 1920s and 1930s.

### 4.2.7 Minnesota Tourism and Recreation in the Lake Regions (1870 – 1945)

Beginning in the 1870s, railroads transported vacationers in search of scenery, fishing, hunting, and canoeing to northern Minnesota. After World War I, improved roads, increased automobile usage, increased leisure time, and extensive promotional campaigns fueled a rapid expansion of the resort industry. Tourists and seasonal residents came from the Twin Cities and other urban areas, other states in the Midwest, and from the South. During the 1930s, the expansion of Minnesota's state parks and forests provided additional facilities and attractions to vacationers. Many resorts began as lumber camps and private lodges constructed by hunting and fishing associations, however a majority of them began as collections of tourist cabins constructed by local farmers and landowners. In the 1920s, a classic resort configuration consisted of a central lodge surrounded by individual cabins. Other structure types associated with the vacation industry included lakeside summer cottages, seasonal estates, planned recreational communities, private sporting clubs, youth camps, and public tourist camps. Some of these structure types would develop into motels and other structures associated with tourism, but not necessarily with the resort industry

## 5.0 Recorded Archaeological Sites

The records search at MN SHPO produced zero archaeological sites within the original Project Review Area. However, it is likely that additional undiscovered archaeological sites exist within the project boundary.

# 6.0 Recorded Historic Facilities

The records search at SHPO produced three standing structures (Table 2) within the original Project Review Area. These structures are represented by a school, a church, and a maintenance shed). None of these resources are located within the project boundary. No federal agency has made a determination of significance for these facilities to date.

**Table 2. Previously Identified Archaeological and Historic Facilities Within the Project Review Area**

| Site Number | Legal Description | | | Location in Relation to Project Boundary | Property Name/ Description | Eligibility Determination |
|---|---|---|---|---|---|---|
| | Township | Range | Section | | | |
| Confidential | | | | Within 1 mile | Rural Schoolhouse | Not Evaluated |
| | | | | Within 1 mile | Church of St. Anthony | Not Evaluated |
| | | | | Within 1 mile | Padua Town Maintenance Shed | Not Evaluated |

Rural Schoolhouse is located in Raymond Township of Stearns County. Documentation as of June 1979 shows the school house is still standing. However, the condition of the school house at the time of documentation can not be determined.

Church of St. Anthony is located in Raymond Township of Stearns County. The church was documented in June of 1979 and in 2000 an announcement was made in the local newspaper that it was going to close due to a shortage of priests. The current status of the church has not been confirmed.

Padua Town Maintenance Shed is located in Raymond Township of Stearns County. Documentation as of June 1979 shows that the shed is still standing. However, the condition of the shed at the time of documentation can not be determined.

Due to the project boundary expanding in November 2010, a full 1 mile boundary surrounding the Project Area was not searched for cultural resources. Prior to construction, six additional sections (Township 126 Range 35 Sections 22-24, 28 and Township 126 Range 34 Sections 19 and 30) will need to be searched for archaeological resources and historic facilities at the MN SHPO.

The sections now included within the new Project Review Area will be reviewed before construction is initiated. Any additional data recorded from these sections will be added to the Phase I report.

# 7.0 Previous Archaeological and Facility Investigations

The records search at SHPO produced zero previous cultural resource report in the original Project Review Area.

The sections now included within the new Project Review Area will be reviewed before construction is imitated. Any additional data recorded from these sections will be added to the Phase I report.

## 7.1 Public Land Survey Maps/Andreas Maps/Trygg Maps/and Mounds and Burial Review

19th Century Public Land Survey (PLS) maps examined for the original Project Review Area have identified an archaeological/historic facilities resources within the Project Review Area. The PLS maps represent the resources as a road running from Pembina to St. Cloud and the Mississippi (also known as a *Red River Road*).

The sections now included within the new Project Review Area will be reviewed before construction is initiated. Any additional data recorded from these sections will be added to the Phase I report.

**Table 3. Red River Road Township, Range, and Sections**

| Township | Range | Section | Resource Type | Description |
|---|---|---|---|---|
| Confidential | | | Road/Trail | Pembina to St. Cloud and the Mississippi Road (Red River Road) |

The presence of this resource in the Project Review Area shows that early American settlement had reached this vicinity by around 1860.

Review of the Andreas illustrated hand book (*An Illustrated Historical Atlas of the State of Minnesota*) published in 1871 documents no properties within the Project Study Area, but it does identify some roads in some of the sections within the Project Study Area..

Trygg maps of the area show no more information then what is contained in the PLS maps.

Minnesota's Indian Mounds and Burial Sites: A Synthesis of Prehistoric and Early Historic Archaeological Data book identifies about 50 mounds in Stearns County. None of these mounds are identified near the project boundary.

# 8.0 Implications for Archaeological and Facility resources

No recorded archaeological and no previous cultural resource reports are located within one mile of the original Project Review Area, or within the Project Study Area. The absence of listed archaeological does not mean the Project Study Area is clear of significant archaeological resources. It is possible there are both recorded and unrecorded resources within the Project Study Area that may be significant, but have not been identified. Three historic facilities have been found in the Project Review Area to date. Further investigation of the Project Study Area may be warranted to identify additional facilities.

HDR visually observed a handful of resources that may be considered historic archaeology locations. These locations are represented by abandoned farmsteads, historic farmstead scatters, and farmstead ruins. Further investigation of these locations may be needed to consider project effects on them.

A handful of historic facilities may have been identified in the Project Review Area. These locations are represented by farmsteads. Further investigation of these locations may be needed to consider project effects on them.

After review of all the information gathered, HDR believes that the Project Study Area has potential to yield additional archaeological and/or historic facility resources. Specific locations needing further ground survey for archaeological resources will be water crossings, high landforms, and areas of pervious significant land use. In addition HDR feels the because of the close proximity of documented early historic transportation corridors, that the Project Review Area has an increased chance to contain resource of this nature.

The construction of the wind farm will determine the potential impacts to cultural resources. Geronimo in coordination with HDR will consider impacts to identified resources to the extent practical. Constructing the wind farm, when possible, to avoid sensitive resources in the Project Study Area.

# 9.0 Conclusion

HDR recommends a Phase I archaeological reconnaissance survey for the Project Study Area. The survey should occur at a time when ground visibility is 25 percent or greater to minimize shovel testing. Surveyors should use a methodology that reviews the probable construction impact locations, but pays special attention to the high to medium probability areas within the Project Study Area that will receive construction impact. The investigation must be conducted by a professional archaeologist permitted by the State of Minnesota per Minnesota Statutes 138.31-.42. Investigators should document the ground disturbing activities in the Project Study Area, the existing resources in the area, and offer recommendations for avoidance. If avoidance is not practical or can not be achieved additional investigation of the resource may be needed and further discussion with regulating agencies would be needed. This additional information would require the development of a new scope and budget.

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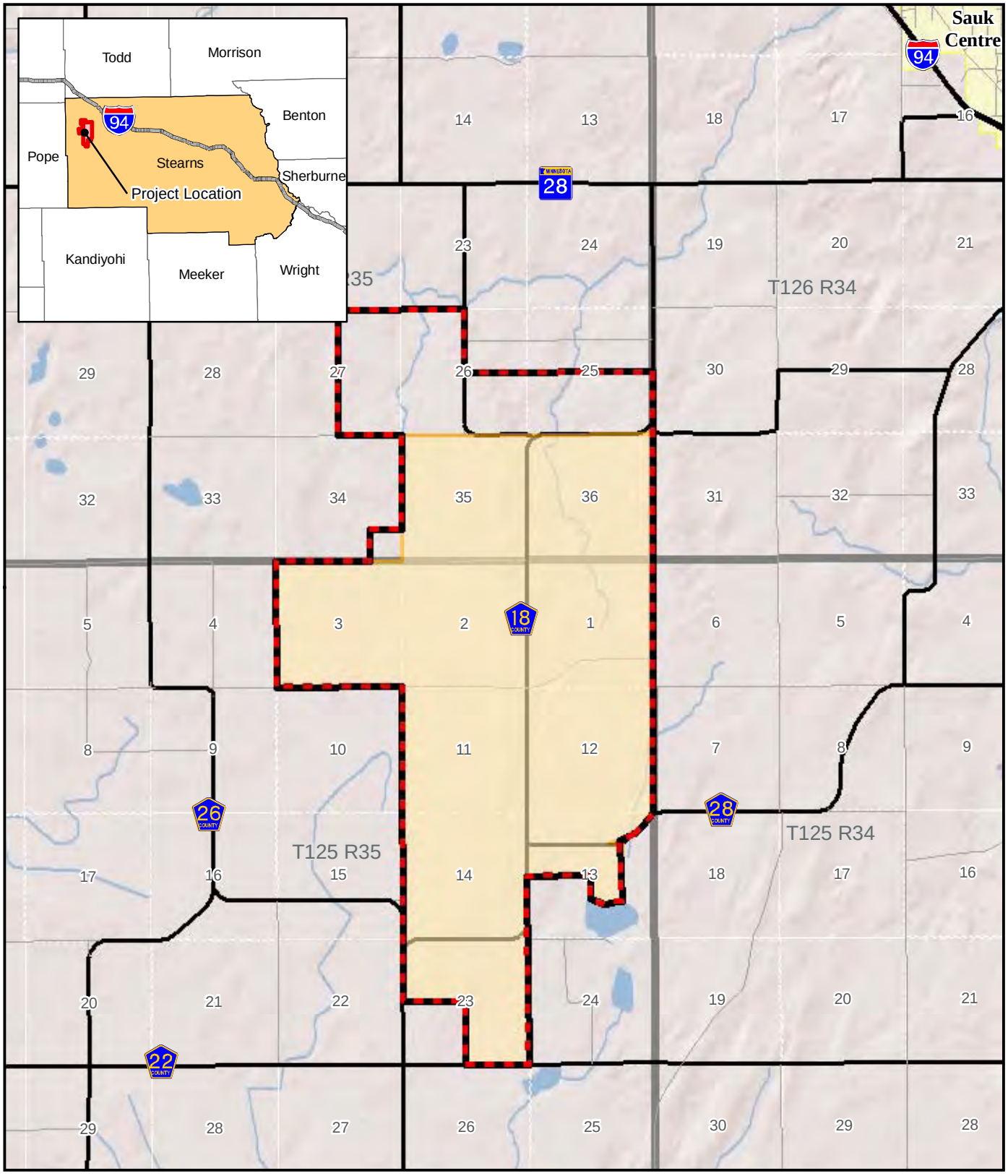
**Figure 1. Cultural Resources Map**




HDR

GERONIMO WIND ENERGY

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Legend
- Project Boundary
- Old Project Boundary
- Cities
- Townships

Cultural Resources Map- Public Version
Black Oak Wind Farm
Geronimo Wind Energy
Stearns County, MN

Map Document: (\\mspe-gis-file\GISProj\Geronimo\113816_Black_Oak\map_docs\mxd\Cultural\Fig1_CulturalResourcesMap.mxd)
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# Appendix D

# Animals in Project Area

## 2007 North American Breeding Bird Survey Route: New London, 50064

**Source: http://www.mbr-pwrc.usgs.gov/cgi-bin/rtena226.pl?50064**

| Common | Scientific | Birds/Route |
|---|---|---|
| Alder Flycatcher | *Empidonax alnorum* | 0.13 |
| American Coot | *Fulica americana* | 0.13 |
| American Crow | *Corvus brachyrhynchos* | 28.38 |
| American Goldfinch | *Carduelis tristis* | 13.13 |
| American Kestrel | *Falco sparverius* | 2.63 |
| American Redstart | *Setophaga ruticilla* | 0.38 |
| American Robin | *Turdus migratorius* | 42 |
| American White Pelican | *Pelecanus erythrorhynchos* | 3.5 |
| Baltimore Oriole | *Icterus galbula* | 0.75 |
| Bank Swallow | *Riparia riparia* | 1 |
| Barn Swallow | *Hirundo rustica* | 27.75 |
| Bell's Vireo | *Vireo bellii* | 0.63 |
| Belted Kingfisher | *Ceryle alcyon* | 0.13 |
| Black Tern | *Chlidonias niger* | 1 |
| Black-billed Cuckoo | *Coccyzus erythropthalmus* | 0.88 |
| Black-capped Chickadee | *Poecile atricapillus* | 0.5 |
| Black-crn. Night Heron | *Nycticorax nycticorax* | 0.13 |
| Blue Jay | *Cyanocitta cristata* | 4.75 |
| Blue-winged Teal | *Anas discors* | 0.75 |
| Bobolink | *Dolichonyx oryzivorus* | 20.75 |
| Brewer's Blackbird | *Euphagus cyanocephalus* | 6.63 |
| Brown Thrasher | *Toxostoma rufum* | 2.38 |
| Brown-headed Cowbird | *Molothrus ater* | 27.63 |
| Canada Goose | *Branta canadensis* | 1.38 |
| Cedar Waxwing | *Bombycilla cedrorum* | 5.13 |
| Chimney Swift | *Chaetura pelagica* | 5 |
| Chipping Sparrow | *Spizella passerina* | 10.25 |
| Clay-colored Sparrow | *Spizella pallida* | 7.88 |
| Cliff Swallow | *Petrochelidon pyrrhonota* | 41.5 |
| Common Grackle | *Quiscalus quiscula* | 122.88 |
| Common Loon | *Gavia immer* | 0.25 |
| Common Nighthawk | *Chordeiles minor* | 0.13 |
| Common Yellowthroat | *Geothlypis trichas* | 66.88 |
| Dickcissel | *Spiza americana* | 3.75 |
| Double-crest. Cormorant | *Phalacrocorax auritus* | 0.5 |
| Downy Woodpecker | *Picoides pubescens* | 0.38 |
| Eastern Bluebird | *Sialia sialis* | 0.88 |
| Eastern Kingbird | *Tyrannus tyrannus* | 2 |
| Eastern Meadowlark | *Sturnella magna* | 4 |

| | | |
|---|---|---|
| Eastern Phoebe | *Sayornis phoebe* | 1.63 |
| Eastern Towhee | *Pipilo erythrophthalmus* | 0.13 |
| Eastern Wood-Pewee | *Contopus virens* | 2.38 |
| European Starling | *Sturnus vulgaris* | 59.5 |
| Field Sparrow | *Spizella pusilla* | 0.13 |
| Gadwall | *Anas strepera* | 1.5 |
| Grasshopper Sparrow | *Ammodramus savannarum* | 35.63 |
| Gray Catbird | *Dumetella carolinensis* | 4.13 |
| Gray Partridge | *Perdix perdix* | 0.13 |
| Great Blue Heron | *Ardea herodias* | 0.75 |
| Great Egret | *Ardea alba* | 3 |
| Great Horned Owl | *Bubo virginianus* | 1 |
| Grt. Crested Flycatcher | *Myiarchus crinitus* | 1.38 |
| Hairy Woodpecker | *Picoides villosus* | 0.13 |
| Henslow's Sparrow | *Ammodramus henslowii* | 0.13 |
| Horned Lark | *Eremophila alpestris* | 45.63 |
| House Finch | *Carpodacus mexicanus* | 0.5 |
| House Sparrow | *Passer domesticus* | 28.63 |
| House Wren | *Troglodytes aedon* | 13 |
| Indigo Bunting | *Passerina cyanea* | 0.75 |
| Killdeer | *Charadrius vociferus* | 27.63 |
| Lark Sparrow | *Chondestes grammacus* | 0.5 |
| Least Flycatcher | *Empidonax minimus* | 1 |
| Mallard | *Anas platyrhynchos* | 13.88 |
| Marbled Godwit | *Limosa fedoa* | 0.88 |
| Marsh Wren | *Cistothorus palustris* | 6 |
| Mourning Dove | *Zenaida macroura* | 65.63 |
| N. Rough-winged Swallow | *Stelgidopteryx serripennis* | 1.13 |
| Northern Cardinal | *Cardinalis cardinalis* | 0.88 |
| Northern Flicker | *Colaptes spp.* | 1.38 |
| Northern Harrier | *Circus cyaneus* | 2 |
| Orchard Oriole | *Icterus spurius* | 0.25 |
| Pied-billed Grebe | *Podilymbus podiceps* | 0.5 |
| Purple Martin | *Progne subis* | 2.25 |
| Red-bellied Woodpecker | *Melanerpes carolinus* | 0.13 |
| Red-eyed Vireo | *Vireo olivaceus* | 2.5 |
| Red-headed Woodpecker | *Melanerpes erythrocephalus* | 0.13 |
| Red-tailed Hawk | *Buteo jamaicensis* | 1.75 |
| Red-winged Blackbird | *Agelaius phoeniceus* | 169.38 |
| Ring-billed Gull | *Larus delawarensis* | 0.38 |
| Ring-necked Pheasant | *Phasianus colchicus* | 33.38 |
| Rock Dove | *Columba livia* | 12.13 |
| Rose-breasted Grosbeak | *Pheucticus ludovicianus* | 1.63 |
| Savannah Sparrow | *Passerculus sandwichensis* | 5 |

| | | |
|---|---|---|
| Sedge Wren | *Cistothorus platensis* | 17.75 |
| Song Sparrow | *Melospiza melodia* | 15.5 |
| Sora | *Porzana carolina* | 0.38 |
| Swamp Sparrow | *Melospiza georgiana* | 1.88 |
| Tree Swallow | *Tachycineta bicolor* | 3.38 |
| Upland Sandpiper | *Bartramia longicauda* | 2.25 |
| Veery | *Catharus fuscescens* | 0.25 |
| Vesper Sparrow | *Pooecetes gramineus* | 6.75 |
| Virginia Rail | *Rallus limicola* | 0.13 |
| Warbling Vireo | *Vireo gilvus* | 4.5 |
| Western Meadowlark | *Sturnella neglecta* | 9.75 |
| White-breasted Nuthatch | *Sitta carolinensis* | 0.75 |
| Willow Flycatcher | *Empidonax traillii* | 1 |
| Willow/Alder Flycatcher | *Empidonax spp.* | 1.13 |
| Wood Duck | *Aix sponsa* | 2 |
| Wood Thrush | *Hylocichla mustelina* | 0.25 |
| Yellow Warbler | *Dendroica petechia* | 7.38 |
| Yellow-head. Blackbird | *Xanthocephalus xanthocepha* | 9.5 |

**Block T125R35a in Stearns County** (expected 123)
MN Breeding Bird Atlas
Counts in the table indicate number of records recorded for the block of each type.
Observed is the sum of all sightings.
Expected species is calculated as the number of birds that are **C**ommon or **U**ncommon for the County.
The Summer and Nest columns contain historical information about the county in which the block resides.
The species expected to be seen in a particular block is dependant on the habitat in the block.
Yellow highlight indicates a new county breeding record.

| Species Name | Summer | Nest | Observed | Possible | Probable | Confirmed |
|---|---|---|---|---|---|---|
| Ducks, Geese, Swans | | | | | | |
| Canada Goose | **C** | **N** | | | | |
| Trumpeter Swan | **O** | **N** | | | | |
| Wood Duck | **C** | **N** | | | | |
| American Wigeon | **O** | **N** | | | | |
| Mallard | **C** | **N** | | | **pair in habitat** | |
| Blue-winged Teal | **C** | **N** | | | | |
| Northern Shoveler | **U** | **N** | | | | |
| Northern Pintail | **U** | **N** | | | | |
| Canvasback | **O** | **N** | | | | |
| Redhead | **U** | | | | | |
| Ring-necked Duck | **U** | **N** | | | | |
| Hooded Merganser | **C** | **N** | | | | |
| Ruddy Duck | **C** | **N** | | | | |
| Pheasants, Grouse, Turkeys, Allies | | | | | | |
| Gray Partridge | **U** | **N** | | | | |
| Ring-necked Pheasant | **C** | **N** | | **on habitat** | | |
| Ruffed Grouse | **U** | **N** | | | | |
| Wild Turkey | **U** | **N** | | | | |
| Loons | | | | | | |
| Common Loon | **C** | **N** | | **on habitat on habitat** | | |
| Grebes | | | | | | |
| Pied-billed Grebe | **C** | **N** | | | | |
| Red-necked Grebe | **U** | **N** | | | | |
| Pelicans | | | | | | |
| American White Pelican | **U** | | | | | |
| Cormorants | | | | | | |
| Double-crested Cormorant | **C** | | | | | |
| Herons, Egrets, Bitterns | | | | | | |
| American Bittern | **U** | | | | | |
| Least Bittern | **O** | **N** | | | | |
| Great Blue Heron | **C** | **N** | | | | |
| Great Egret | **C** | **N** | | | | |
| Green Heron | **C** | **N** | | | | |
| New World Vultures | | | | | | |
| Turkey Vulture | **U** | | | | | |
| Osprey | | | | | | |
| Osprey | **O** | **N** | | | | |
| Hawks, Eagles, Kites | | | | | | |
| Bald Eagle | **U** | **N** | | | | |
| Northern Harrier | **U** | **N** | | | | |
| Cooper's Hawk | **U** | **N** | | | | |
| Red-shouldered Hawk | **U** | **N** | | | | |
| Broad-winged Hawk | **U** | **N** | | | | |
| Red-tailed Hawk | **C** | **N** | | | | |

| | | | | | | |
|---|---|---|---|---|---|---|
| Vesper Sparrow | **C** | **N** | | | | **carrying food** |
| Savannah Sparrow | **C** | | | | | **carrying food** |
| Grasshopper Sparrow | **U** | | | | | |
| Le Conte's Sparrow | **O** | | | | **pair in habitat** | |
| Song Sparrow | **C** | **N** | | **on habitat** | | |
| Swamp Sparrow | **C** | **N** | | | | |
| Tanagers, Cardinals, Grosbeaks | | | | | | |
| Scarlet Tanager | **U** | **N** | | | | |
| Northern Cardinal | **C** | **N** | | | | |
| Rose-breasted Grosbeak | **C** | **N** | | | | |
| Indigo Bunting | **C** | **N** | | | | |
| Dickcissel | **C** | | | **on habitat** | | |
| Blackbirds, Orioles, Allies | | | | | | |
| Bobolink | **C** | **N** | | | | |
| Red-winged Blackbird | **C** | **N** | | | **pair in habitat** | |
| Western Meadowlark | **C** | **N** | | | | |
| Yellow-headed Blackbird | **C** | **N** | | | | |
| Brewer's Blackbird | **C** | **N** | | | | |
| Common Grackle | **C** | **N** | | | **pair in habitat** | |
| Brown-headed Cowbird | **C** | **N** | | | | |
| Orchard Oriole | **U** | | | | | |
| Baltimore Oriole | **C** | **N** | | | | |
| Finches | | | | | | |
| House Finch | **C** | **N** | | | | |
| Pine Siskin | **O** | **N** | | | | |
| American Goldfinch | **C** | **N** | | | | |
| Old World Sparrows | | | | | | |
| House Sparrow | **C** | **N** | | **on habitat** | | |
| | | | | | | |
| Total Number of Species | **140** | **116** | **1** | **9** | **8** | **3** |

| | | | | | | |
|---|---|---|---|---|---|---|
| Falcons, Caracaras | | | | | | |
| American Kestrel | **C** | **N** | | | | |
| Rails, Gallinules, Coots | | | | | | |
| Virginia Rail | **U** | **N** | | | | |
| Sora | **C** | **N** | | | | |
| Common Moorhen | **O** | **N** | | | | |
| American Coot | **C** | **N** | | | | |
| Cranes | | | | | | |
| Sandhill Crane | **U** | **N** | | | | |
| Plovers | | | | | | |
| Killdeer | **C** | **N** | | | **pair in habitat** | |
| Sandpipers, Phalaropes, Allies | | | | | | |
| Spotted Sandpiper | **C** | **N** | | | | |
| Solitary Sandpiper | **U** | | | | | |
| Upland Sandpiper | **U** | **N** | | | | |
| Marbled Godwit | **O** | **N** | | | | |
| Wilson's Snipe | **U** | **N** | | | | |
| American Woodcock | **O** | **N** | | | | |
| Gulls, Terns | | | | | | |
| Franklin's Gull | **U** | | | | | |
| Ring-billed Gull | **O** | **N** | | | | |
| Black Tern | **C** | **N** | | | | |
| Forster's Tern | **C** | | | | | |
| Pigeons, Doves | | | | | | |
| Rock Pigeon | **C** | **N** | | **on habitat** | | |
| Mourning Dove | **C** | **N** | | | **pair in habitat** | |
| Cuckoos | | | | | | |
| Yellow-billed Cuckoo | **U** | | | | | |
| Black-billed Cuckoo | **U** | | | | | |
| Owls | | | | | | |
| Eastern Screech-Owl | **U** | **N** | | | | |
| Great Horned Owl | **C** | **N** | | | | |
| Barred Owl | **U** | | | | | |
| Long-eared Owl | **O** | **N** | | | | |
| Nightjars | | | | | | |
| Common Nighthawk | **U** | | | | | |
| Whip-poor-will | **U** | | | | | |
| Swifts | | | | | | |
| Chimney Swift | **C** | **N** | | | | |
| Hummingbirds | | | | | | |
| Ruby-throated Hummingbird | **C** | **N** | | | | |
| Kingfishers | | | | | | |
| Belted Kingfisher | **C** | **N** | | | | |
| Woodpeckers | | | | | | |
| Red-headed Woodpecker | **U** | **N** | | | | |
| Red-bellied Woodpecker | **C** | **N** | | | | |
| Yellow-bellied Sapsucker | **U** | **N** | | | | |
| Downy Woodpecker | **C** | **N** | | | | |
| Hairy Woodpecker | **C** | **N** | | | | |
| Northern Flicker | **C** | **N** | **1** | | | |
| Pileated Woodpecker | **U** | **N** | | | | |
| Tyrant Flycatchers | | | | | | |
| Eastern Wood-Pewee | **C** | **N** | | | | |
| Alder Flycatcher | **O** | **N** | | | | |
| Willow Flycatcher | **U** | | | | | |
| Least Flycatcher | **C** | **N** | | | | |
| | | | | | | |

| | | | | | | |
|---|---|---|---|---|---|---|
| Eastern Phoebe | **C** | **N** | | | | |
| Great Crested Flycatcher | **C** | **N** | | | | |
| Western Kingbird | **O** | **N** | | | | |
| Eastern Kingbird | **C** | **N** | | | | |
| Vireos | | | | | | |
| Yellow-throated Vireo | **U** | **N** | | | | |
| Warbling Vireo | **C** | **N** | | | | |
| Red-eyed Vireo | **C** | **N** | | | | |
| Crows, Jays, Magpies | | | | | | |
| Blue Jay | **C** | **N** | | | | |
| American Crow | **C** | **N** | | | | |
| Larks | | | | | | |
| Horned Lark | **C** | **N** | | **on habitat** | | |
| Swallows | | | | | | |
| Purple Martin | **U** | **N** | | | | |
| Tree Swallow | **C** | **N** | | | | |
| Northern Rough-winged Swallow | **C** | **N** | | | | |
| Bank Swallow | **C** | **N** | | | | |
| Cliff Swallow | **C** | **N** | | | | |
| Barn Swallow | **C** | **N** | | | **courtship** | |
| Chickadees, Titmice | | | | | | |
| Black-capped Chickadee | **C** | **N** | | | | |
| Nuthatches | | | | | | |
| Red-breasted Nuthatch | **O** | **N** | | | | |
| White-breasted Nuthatch | **C** | **N** | | | | |
| Wrens | | | | | | |
| House Wren | **C** | **N** | | **on habitat** | | |
| Sedge Wren | **C** | | | | | |
| Marsh Wren | **C** | **N** | | | | |
| Gnatcatchers | | | | | | |
| Blue-gray Gnatcatcher | **U** | | | | | |
| Thrushes | | | | | | |
| Eastern Bluebird | **C** | **N** | | | | |
| Veery | **O** | **N** | | | | |
| Wood Thrush | **U** | | | | | |
| American Robin | **C** | **N** | | | | **carrying food** |
| Mockingbirds, Thrashers | | | | | | |
| Gray Catbird | **C** | **N** | | | | |
| Brown Thrasher | **C** | **N** | | | | |
| Starlings | | | | | | |
| European Starling | **C** | **N** | | **on habitat** | | |
| Waxwings | | | | | | |
| Cedar Waxwing | **C** | **N** | | | | |
| Wood Warblers | | | | | | |
| Yellow Warbler | **C** | **N** | | | | |
| Chestnut-sided Warbler | **U** | | | | | |
| Pine Warbler | **O** | **N** | | | | |
| American Redstart | **C** | **N** | | | | |
| Ovenbird | **U** | | | | | |
| Common Yellowthroat | **C** | **N** | | | **mult singing** | |
| Towhees, Sparrows, Longspurs | | | | | | |
| Chipping Sparrow | **C** | **N** | | | | |
| Clay-colored Sparrow | **C** | **N** | | | | |
| Field Sparrow | **C** | **N** | | | | |

# GUIDE TO THE NONGAME MAMMALS OF CENTRAL MINNESOTA-REGION 3W

MINNESOTA
DEPARTMENT OF
NATURAL
RESOURCES

September 1, 1979

# Guide to the Nongame Mammals of Central Minnesota

## Region 3 West

By Carrol Henderson and Julie Reitter

This preliminary guide has been prepared as a reference to the occurrence and distribution of nongame mammals of Region 3 West in central Minnesota. Taxonomy is based on Jones, et al., (1975). Identification marks are described in Burt and Grossenheider (1964).

Game mammals have not been included in this survey.

Counties in this region are Wadena, Cass, Crow Wing, Todd, Morrison, Benton, Stearns, Wright, and Sherburne. Figure 1 is a map of Region 3 West.

Table 1 is a list of the nongame mammals of Region 3 West.

TABLE 1 - Nongame Mammals of Region 3 West

Marsupials

- Virginia opossum (A)

Insectivores

- Masked shrew
- Arctic shrew
- Northern water shrew
- Pygmy shrew
- Short-tailed shrew
- Star-nosed mole
- Eastern mole

Bats

- Little brown bat
- Keen's little brown bat*
- Silver-haired bat
- Eastern pipistrelle (?)*
- Big brown bat*
- Red bat
- Hoary bat

Carnivores

- Marten (?)*
- Short-tailed weasel
- Least weasel (?)*
- Long-tailed weasel*

Carnivores (cont.)

- Spotted skunk*
- Striped skunk
- Coyote
- Gray wolf*
- Cougar (?)*

Squirrels

- Woodchuck
- Thirteen-lined ground squirrel
- Franklin's ground squirrel
- Eastern chipmunk
- Least chipmunk
- Red squirrel
- Southern flying squirrel*
- Northern flying squirrel*

Other Rodents

- Porcupine
- Plains pocket gopher
- Plains pocket mouse
- Deer mouse
- White-footed mouse
- Southern bog lemming
- Northern bog lemming (?)
- Gapper's red-backed vole
- Meadow vole

Other Rodents (cont.)

Prairie vole
Norway rat (E)
House mouse (E)
Meadow jumping mouse
Woodland jumping mouse (?)

Ungulates

American Elk (X)

Key

* - Priority species - reports needed
** - Priority species - known only from this region
E - Exotic species
? - Hypothetical species
A - Accidental species
X - Extirpated species

A total of 40 nongame mammal species are found in Region 3 West. The eastern pipistrelle, marten, least weasel, cougar, northern bog lemming, and woodland jumping mouse are hypothetical species.

The opossum is accidental. It is not a regular species.

The house mouse and Norway rat are the only exotic species.

Priority Species

There are no species which are found only in Region 3 West. Priority species for which more data is needed are the Keen's little brown bat, big brown bat, long-tailed weasel, spotted skunk, gray wolf, southern flying squirrel, and northern flying squirrel.

Threatened and Endangered Species

The gray wolf is officially a threatened species.

Data Collection

If you encounter any new county records, be sure to record the date, county, township, range, section number (or distance and direction from the nearest town) and habitat in which the animal was found. Note all identifying features which distinguish that species from similar ones. Photographs or plaster casts of tracks are important for large mammals like cougars. Skulls of small mammal specimens should be retained for documentation of new county records.

Mammal records should be sent to the Nongame Supervisor, Department of Natural Resources, Box 7, Centennial Bldg., 658 Cedar St., St. Paul, Minnesota 55155.

County Records

County records for this region are given in Table 2.

TABLE 2 - Nongame Mammals of Region 3 West

| | WADENA | CASS | CROW WING | TODD | MORRISON | BENTON | STEARNS | WRIGHT | SHERBURNE |
|---|---|---|---|---|---|---|---|---|---|
| Virginia Opossum | | | | | | | | X4 | |
| Masked Shrew | X2 | X6+ | X6- | X6- | X6+ | | | | X4,6+ |
| Arctic Shrew | X2 | | X6- | | | | | | X4,6+ |
| Northern Water Shrew | | | | | X6+ | | | | X6+ |
| Pygmy Shrew | X2,8 | | | | | | | | X6+,8 |
| Short-tailed Shrew | X2 | X6- | | | X6+ | | | | X4,6- |
| Star-nosed Mole | | X6+ | X6- | | | | | | X4,6- |
| Eastern Mole | | | | | | | | | X6+ |
| Little Brown Bat | | | | | X6+ | | X6- | | X6+ |
| Keen's Little Brown Bat | | | | | | | X6+ | | X6- |
| Silver-Haired Bat | X8 | | | | | | X6- | X8 | X6+ |
| Eastern Pipistrelle | | | | | | | | | |
| Big Brown Bat | | | | | X6+ | | X6- | | |
| Red Bat | | | | | | X8 | | | X6- |
| Hoary Bat | | | | | | X6- | X6- | | X6- |
| Marten | | | | | | | | | |
| Short-tailed Weasel | X2 | | | | | | | | X6- |
| Least Weasel | | | | | | | | | |
| Long-tailed Weasel | | | | X6- | | | | X6+ | X6- |
| Spotted Skunk | | | | | X6- | | | X6- | X6- |
| Striped Skunk | X6- | X6- | X6- | X6- | X6- | X6- | X6- | X6- | X4,6- |
| Coyote | X4,6- | X4,6- | X4,6- | X4 | X4 | | X4 | X4 | X4,6- |
| Gray Wolf | | | | | | | | | |

| | WADENA | CASS | CROW WING | TODD | MORRISON | BENTON | STEARNS | WRIGHT | SHERBURNE |
|---|---|---|---|---|---|---|---|---|---|
| Cougar | | | | | | | | | |
| Woodchuck | | X4,6+ | | | | | | | X6- |
| Thirteen-lined Ground Squirrel | | X4 | | | | | X6+ | | X4,6+ |
| Franklin's Ground Squirrel | | X4,6- | | | | | | X6+ | X6- |
| Eastern Chipmunk | X2 | X6+ | | | X6+ | | | | X4,6+ |
| Least Chipmunk | X2 | X6+ | | | | | | | |
| Red Squirrel | X2 | X4,6- | | | | | | | X4,6+ |
| Southern Flying Squirrel | | | X8 | | | | | | X6+ |
| Northern Flying Squirrel | X2,6+ | X6+ | | | | | | | X6- |
| Plains Pocket Gopher | | | | | | | | | X6+ |
| Plains Pocket Mouse | | | | | | | | | X6+ |
| Deer Mouse | X2 | X6+ | | | X6+ | | X6+ | | X4,6+ |
| White-footed Mouse | X2 | | | | X6+ | | X6+ | | X4,6+ |
| Southern Bog Lemming | X2,8 | | | | | | | | X6- |
| Northern Bog Lemming | | | | | | | | | |
| Gapper's Red-backed Vole | X2 | X6+ | | | X6+ | | | | X4,6+ |
| Meadow Vole | X2 | | | | X6+ | | | | X4,6+ |
| Prairie Vole | X8 | | | | | | | | X6+ |
| Norway Rat | | | | | | | | | X6- |
| House Mouse | | | | | | | | | X6- |
| Meadow Jumping Mouse | X2,6+ | | | | X6+ | | X6+ | | X4,6+ |
| Woodland Jumping Mouse | | | | | | | | | |
| Porcupine | | X4 | | | | | | | X6- |
| American Elk | | | | | | | | | |

## LITERATURE CITED

X-2 Birney, E.C. and Gerda E. Nordquist 1978. The importance of peatland habitats to small mammals in Minnesota. Mimeo. 52 pp.

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X-4 Department of Natural Resources Wildlife data files of wildlife breeding and distribution records. Section of Wildlife, St. Paul.

X-6 Gunderson, H.L. and J.R. Beer 1953. The Mammals of Minnesota. Univ. Minn. Press Mpls. 190 pp. (6+ = specimans seen, 6- = authentic records)

X-8 Heaney, L.R. and E.C. Birney 1975. Comments on the distribution and natural history of some mammals in Minnesota. Canadian Field Nat. 89:29-34

X-9 Jones, J.K. Jr., D.C. Carter and H.H. Genoways 1975. Rev. checklist of North American Mammals North of Mexico. Occ. Pap. Mus. Texas Tech. Univ. 28:1-14

# Guide to the Reptiles and Amphibians of Central Minnesota-Region 3W

Minnesota Department of Natural Resources

August 1, 1980

# Guide to the Herpetofauna of Central Minnesota

## Region 3 - West

This preliminary guide has been prepared as a reference to the occurrence and distribution of reptiles and amphibians of Region 3 - West in Central Minnesota. Taxonomy and identification are based on "A Field Guide to Reptiles and Amphibians" by Roger Conant (Second Edition 1975). Figure 1 is a map of the region.

Counties Included: Benton, Cass, Crow Wing, Morrison, Sherburne, Stearns, Todd, Wadena and Wright.

## SPECIES LIST

### Turtles

- Common snapping turtle
- Map turtle
- Western painted turtle
- *Blanding's turtle
- Western spiny softshell
- Smooth softshell

### Lizards

- Northern prairie skink

### Snakes

- Red-bellied snake
- Texas brown (Dekay's) snake
- Northern water snake
- Western plains garter snake
- Red-sided garter snake } s.s.
- Eastern garter snake }
- Eastern hognose snake
- *Western smooth green snake } s.s.
- *Eastern smooth green snake }
- Bullsnake

### Salamanders

- Blue-spotted salamander
- Eastern tiger salamander
- Mudpuppy (?)
- *Central (Common) newt (?)
- *Red-backed salamander (?)

### Toads

- American toad

### Frogs

- Northern spring peeper
- Common (gray) treefrog
- Boreal chorus frog } s.s.
- Western chorus frog }
- Mink frog
- Northern leopard frog
- Green frog
- Wood frog

s.s. - single species
(?) - hypothetical species - reports needed
* - special interest species - reports needed


### Summary

A total of 24 species are found in Region 3 - West. The mudpuppy, central newt, and red-backed salamander are probably present but have not yet been recorded. The common garter snake, smooth green snake and chorus frog are represented by two subspecies.

Four species are of special interest: the Blanding's turtle, which is unofficially considered threatened by the state, the smooth green snake, red-backed salamander, and central newt. Any sightings of these species should be recorded and sent to the nongame supervisor.

County records for this region are given on the following pages. If you encounter any new county records, the speciman should be captured and either photographed from several angles or preserved in isopropyl alcohol. The best identification record for frogs and toads is a recording of the call. Record the collector's name and address, date, county, township, range, section number (or distance and direction from the nearest town), and the habitat in which the animal was found. The nongame supervisor should be contacted concerning disposition of specimens.

Unless otherwise specified, all county records on the following pages are derived from Reptiles and Amphibians of Minnesota by Walter J. Breckenridge.

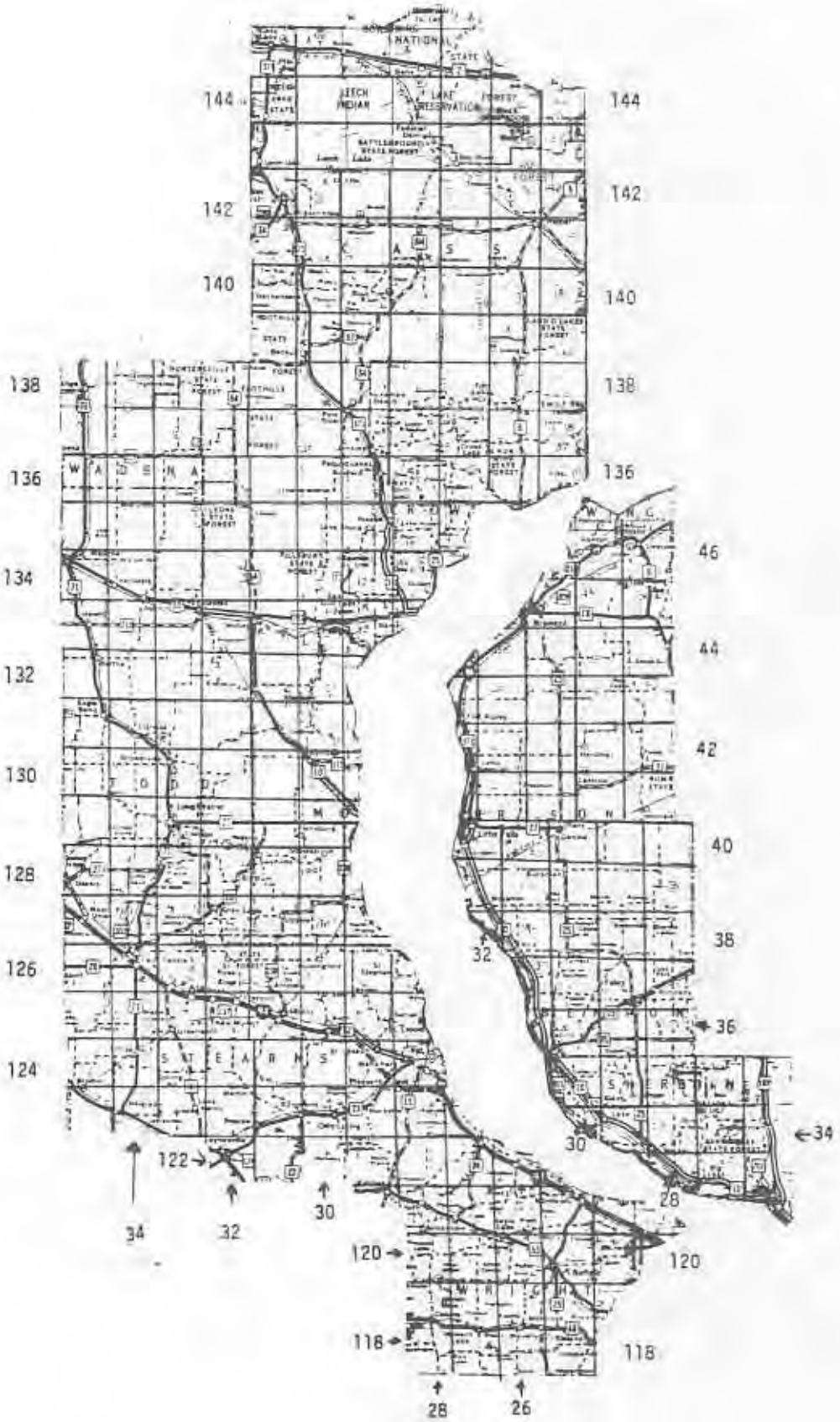


Figure 1. Map of Region 3-West. Township numbers are on right and left margins. Range numbers are on the bottom margin.

# Reptiles and Amphibians of Minnesota - Region 3 West

| | Wadena | Cass | Crow Wing | Todd | Morrison | Benton | Stearns | Wright | Sherburne |
|---|---|---|---|---|---|---|---|---|---|
| **Turtles** | | | | | | | | | |
| Common Snapping Turtle | | X | X | X | X | X | X | X | X |
| Map Turtle | | | | | | | X | X | |
| Western Painted Turtle | | X | DNR X | X | X | X | X | X | X |
| Blanding's Turtle | X | X | X | | X | X | | | X |
| Western Spiny Softshell | | | X | | | X | X | DNR X | X |
| Smooth Softshell | | | | | | | | X-DNR | X-DNR |
| **Lizards** | | | | | | | | | |
| Northern Prairie Skink | X | X | X | | X | X | X | | X |
| **Snakes** | | | | | | | | | |
| Red-bellied Snake | | X | X | | X | | | X | X |
| Texas Brown Snake | | | | | | | X | X | X |
| Northern Water Snake | | | | | | | | | X |
| Western Plains Garter Snake | | X | X | X | X | X | X | X | X |
| Red-sided Garter Snake ) | | | X | | | X | X | | X |
| ) s.s. | | | | | | | | | |
| Eastern Garter Snake ) | X | X | X | | | X | X | X | X |
| Eastern Hognose Snake | X | X | X | X | | | X | X | |
| Western Smooth Green Snake ) | | | X | | X | | | | X |
| ) s.s. | | | | | | | | | |
| Eastern Smooth Green Snake ) | | | X | | X | | | | X |
| Bullsnake | | | | | X | X | | | X |
| **Salamanders** | | | | | | | | | |
| Mudpuppy (?) | | | | | | | | | |
| Central Newt (?) | | | | | | | | | |
| Blue-spotted Salamander | | | X | | X | | | | X |
| Eastern Tiger Salamander | | X | X | | X | X | X | X | X |

| | Wadena | Cass | Crow Wing | Todd | Morrison | Benton | Stearns | Wright | Sherburne |
|---|---|---|---|---|---|---|---|---|---|
| Salamanders - Continued | | | | | | | | | |
| Red-backed Salamander (?) | | | | | | | | | |
| Toads | | | | | | | | | |
| American Toad | | X | X | | | | | | X |
| Frogs | | | | | | | | | |
| Northern spring peeper | | X | X | | | | | | |
| Gray treefrog | | X | X | | | | X | DNR X | X |
| Boreal chorus frog ) s.s. | X | X | X | | | | X | | X |
| Western chorus frog) | X | X | X | | | | X | | X |
| Mink frog | | ? | X | | | | | | |
| Northern leopard frog | | X | X | X | | X | X | | X |
| Green frog | | X | X | | | | X | | X |
| Wood frog | X | X | X | | X | | | | X |

# AVIAN SURVEYS FOR THE PAYNESVILLE WIND RESOURCE AREA

## STEARNS COUNTY, MINNESOTA

**September 2009 - September 2010**

**PREPARED FOR:**

Paynesville Wind, LLC
Geronimo Wind Energy, LLC
7650 Edinborough Way, Suite 725
Edina, MN 55435

and

HDR Engineering, Inc
701 Xenia Avenue South, Suite 600
Minneapolis, MN 55416

**PREPARED BY:**

Hamer Environmental L.P.,
P.O. Box 2561
Mount Vernon, WA, 98273
www.HamerEnvironmental.com

**October 27, 2010**

Detection Data

A total of 18,182 individual birds, representing 96 species, were detected and positively identified during the 34 visits to each of the 10 survey stations (Table 1)[2]. In addition, 2,154 individual birds were detected but there was not sufficient information to identify them to species, either because they were too distant or because they were seen by the surveyor for only a very brief moment. These included many unidentifiable blackbirds (1,089 individuals), gulls (91), sparrows (126, which included birds from other families exhibiting sparrow-like skulking behavior), swallows (59), as well as several woodpeckers (3), warblers (3), flycatchers (2), and one accipiter hawk, one wren, and one vireo; many other birds were observed at too great a distance to identify to family or genus level (778). One species, the Snowy Egret, was added to the site list during the extra ten minutes of the trial 30 minute survey period. As requested by wildlife agency personnel, we also provide a list of species detected at each individual station in Appendix A, which (unlike Table 1) includes detections within different periods of the year as well as all the birds which were identifiable only to the family or genus level, or were identifiable only as birds.

**Table 1. Species detected at all distances during 340 Avian-Use Point-Count Surveys with 20 minute durations, Paynesville Wind Resource Area, September 2009 to September 2010. Table includes number of stations where detected (out of 10 total), total number of detections, and species status (Endangered or Threatened [THR], Down-Listed [DL], indication as a species in need of conservation in Minnesota (Special Concern [SPC] or "Conservation Need" [CN], see Minnesota Department of Natural Resources 2007, 2010). "BBS" indicates species not covered by other conservation prioritization efforts, but for which local or regional declines are apparent from our query of Breeding Bird Survey data. Species names and order of taxonomic presentation generally follow the American Ornithologists Union (2010).**

| Common Name | Scientific Name | # Stations where found (of 10) | Total Detections | State Status | Federal Status |
|---|---|---|---|---|---|
| Canada Goose | *Branta canadensis* | 10 | 1,699 | | |
| Tundra/Trumpeter Swan[1] | *Cygnus spp.*[1] | 5 | 190 | THR | |
| Wood Duck | *Aix sponsa* | 1 | 3 | | |
| Mallard | *Anas platyrhynchos* | 8 | 83 | | |
| Blue-winged Teal | *Anas discors* | 1 | 1 | | |
| Ring-necked Pheasant | *Phasianus colchicus* | 10 | 79 | | |

[2] The reference to the total number of "individual birds" refers to number of avian detection events, which is an index of abundance based on the effort we put in, rather an assessment of total density. "Individual birds" refers to *surveyor detections* of a bird (sometimes including those within flocks). The use of "detect", "detections", and "detected" repeatedly throughout this document is meant to infer an event (surveyor noting a bird) rather than an absolute assessment of the number of individuals using the site.

| Common Name | Scientific Name | # Stations where found (of 10) | Total Detections | State Status | Federal Status |
|---|---|---|---|---|---|
| Common Loon | *Gavia immer* | 1 | 1 | CN | |
| American White Pelican | *Pelecanus erythrorhynchos* | 4 | 26 | SPC | |
| Double-crested Cormorant | *Phalacrocorax auritus* | 3 | 40 | | |
| Great Blue Heron | *Ardea herodias* | 2 | 2 | | |
| Snowy Egret | *Egretta thula* | 1 | 1 | | |
| Green Heron | *Butorides virescens* | 1 | 1 | | |
| Turkey Vulture | *Cathartes aura* | 8 | 13 | | |
| Bald Eagle | *Haliaeetus leucocephalus* | 4 | 6 | SPC | DL |
| Northern Harrier | *Circus cyaneus* | 10 | 54 | CN | |
| Sharp-shinned Hawk | *Accipiter striatus* | 3 | 3 | | |
| Cooper's Hawk | *Accipiter cooperii* | 3 | 4 | | |
| Broad-winged Hawk | *Buteo platypterus* | 1 | 1 | | |
| Red-tailed Hawk | *Buteo jamaicensis* | 10 | 46 | | |
| Rough-legged Hawk | *Buteo lagopus* | 2 | 2 | | |
| American Kestrel | *Falco sparverius* | 8 | 24 | | |
| Merlin | *Falco columbarius* | 2 | 2 | | |
| Sora | *Porzana carolina* | 1 | 3 | | |
| Sandhill Crane | *Grus canadensis* | 2 | 3 | | |
| Killdeer | *Charadrius vociferus* | 10 | 145 | | |
| Lesser Yellowlegs | *Tringa flavipes* | 1 | 14 | | |
| Upland Sandpiper | *Bartramia longicauda* | 1 | 1 | CN | |
| White-rumped Sandpiper | *Calidris fuscicollis* | 3 | 26 | CN | |
| Wilson's Snipe | *Gallinago delicata* | 1 | 1 | | |
| Franklin's Gull | *Leucophaeus pipixcan* | 5 | 1,264 | SPC | |
| Ring-billed Gull | *Larus delawarensis* | 9 | 664 | | |
| Rock Pigeon | *Columba livia* | 10 | 429 | | |
| Mourning Dove | *Zenaida macroura* | 10 | 174 | | |
| Black-billed Cuckoo | *Coccyzus erythropthalmus* | 1 | 1 | CN | |
| Great Horned Owl | *Bubo virginianus* | 3 | 3 | | |

| Common Name | Scientific Name | # Stations where found (of 10) | Total Detections | State Status | Federal Status |
|---|---|---|---|---|---|
| Chimney Swift | *Chaetura pelagica* | 1 | 1 | | |
| Belted Kingfisher | *Megaceryle alcyon* | 2 | 2 | | |
| Red-bellied Woodpecker | *Melanerpes carolinus* | 6 | 20 | | |
| Downy Woodpecker | *Picoides pubescens* | 7 | 27 | | |
| Hairy Woodpecker | *Picoides villosus* | 7 | 20 | | |
| Northern Flicker | *Colaptes auratus* | 6 | 22 | | |
| Pileated Woodpecker | *Dryocopus pileatus* | 6 | 9 | | |
| Eastern Phoebe | *Sayornis phoebe* | 5 | 10 | | |
| Great Crested Flycatcher | *Myiarchus crinitus* | 3 | 3 | | |
| Western Kingbird | *Tyrannus verticalis* | 1 | 1 | | |
| Eastern Kingbird | *Tyrannus tyrannus* | 1 | 5 | | |
| Philadelphia Vireo | *Vireo philadelphicus* | 4 | 10 | | |
| Red-eyed Vireo | *Vireo olivaceus* | 6 | 15 | | |
| Blue Jay | *Cyanocitta cristata* | 10 | 242 | | |
| American Crow | *Corvus brachyrhynchos* | 10 | 441 | | |
| Horned Lark | *Eremophila alpestris* | 10 | 785 | | |
| Tree Swallow | *Tachycineta bicolor* | 10 | 541 | | |
| Northern Rough-winged Swallow | *Stelgidopteryx serripennis* | 2 | 2 | CN | |
| Cliff Swallow | *Petrochelidon pyrrhonota* | 4 | 15 | | |
| Barn Swallow | *Hirundo rustica* | 10 | 425 | | |
| Black-capped Chickadee | *Poecile atricapillus* | 7 | 55 | | |
| Red-breasted Nuthatch | *Sitta canadensis* | 1 | 1 | | |
| White-breasted Nuthatch | *Sitta carolinensis* | 10 | 45 | | |
| House Wren | *Troglodytes aedon* | 9 | 33 | | |
| Sedge Wren | *Cistothorus platensis* | 4 | 15 | CN | |
| Ruby-crowned Kinglet | *Regulus calendula* | 1 | 3 | | |
| Eastern Bluebird | *Sialia sialis* | 2 | 9 | | |
| American Robin | *Turdus migratorius* | 10 | 215 | | |
| Gray Catbird | *Dumetella carolinensis* | 4 | 6 | | |

| Common Name | Scientific Name | # Stations where found (of 10) | Total Detections | State Status | Federal Status |
|---|---|---|---|---|---|
| Brown Thrasher | *Toxostoma rufum* | 6 | 12 | CN | |
| European Starling | *Sturnus vulgaris* | 10 | 384 | | |
| Cedar Waxwing | *Bombycilla cedrorum* | 2 | 38 | | |
| Yellow Warbler | *Dendroica petechia* | 7 | 19 | | |
| Common Yellowthroat | *Geothlypis trichas* | 10 | 88 | | |
| American Tree Sparrow | *Spizella arborea* | 2 | 5 | | |
| Chipping Sparrow | *Spizella passerina* | 7 | 44 | | |
| Clay-colored Sparrow | *Spizella pallida* | 4 | 37 | | |
| Field Sparrow | *Spizella pusilla* | 2 | 4 | CN | |
| Vesper Sparrow | *Pooecetes gramineus* | 10 | 187 | | |
| Savannah Sparrow | *Passerculus sandwichensis* | 8 | 89 | | |
| Grasshopper Sparrow | *Ammodramus savannarum* | 2 | 5 | CN | |
| Song Sparrow | *Melospiza melodia* | 10 | 180 | | |
| Swamp Sparrow | *Melospiza georgiana* | 2 | 4 | CN | |
| Dark-eyed Junco | *Junco hyemalis* | 6 | 22 | | |
| Lapland Longspur | *Calcarius lapponicus* | 9 | 402 | | |
| Snow Bunting | *Plectrophenax nivalis* | 3 | 13 | | |
| Northern Cardinal | *Cardinalis cardinalis* | 2 | 3 | | |
| Rose-breasted Grosbeak | *Pheucticus ludovicianus* | 1 | 1 | CN | |
| Indigo Bunting | *Passerina cyanea* | 9 | 37 | | |
| Dickcissel | *Spiza americana* | 1 | 11 | CN | |
| Bobolink | *Dolichonyx oryzivorus* | 9 | 40 | CN | |
| Red-winged Blackbird | *Agelaius phoeniceus* | 10 | 4,530 | | |
| Western Meadowlark | *Sturnella neglecta* | 6 | 35 | BBS | |
| Brewer's Blackbird | *Euphagus cyanocephalus* | 10 | 2,769 | | |
| Common Grackle | *Quiscalus quiscula* | 10 | 257 | | |
| Brown-headed Cowbird | *Molothrus ater* | 9 | 64 | | |
| Orchard Oriole | *Icterus spurious* | 1 | 1 | | |
| Baltimore Oriole | *Icterus galbula* | 6 | 7 | | |

| Common Name | Scientific Name | # Stations where found (of 10) | Total Detections | State Status | Federal Status |
|---|---|---|---|---|---|
| House Finch | *Carpodacus mexicanus* | 2 | 4 | | |
| American Goldfinch | *Spinus tristis* | 10 | 597 | | |
| House Sparrow | *Passer domesticus* | 10 | 306 | | |
| Unknown Species | *Spp.* | 10 | 2,154 | | |
| Totals | 96 (identified species) | 10 | 20,336 | 1+3+15 | 0(1 DL) |

[1] *Flocks of Swans observed were likely a mix of Trumpeter and Tundra Swans.*

The station with highest species richness was station 6 (68 species), followed by station 8 (57), station 7 (52), and station 4 (51). Station 2 had the lowest number of species (43), and remaining stations had between 45-49 species detected. Stations with the highest number of detections were stations 7 (3,212 detections), 3 (2,752), 8 (2, 523), and 5 (2,422). Stations with the lowest numbers of detections included stations 10 (1,104 detections) and 9 (1,176). Total number of detections for each species, including those identified to family or genus only, can be found in Appendix A.

Comparison of Standardized Use Data to Other WRAs

In order to facilitate comparisons of our data to other wind projects, we also summarize bird use per 20-minute survey per 800 meter radius, separated by season of year, for each bird species group (raptors, waterbirds, waterfowl, passerines/landbirds, and all birds; Table 15, Appendix B). When limiting survey time to 20 minutes and detection distance to 800 meters or less, a total of 18,816 birds were detected, 2,034 of which were unidentified as to species. A total of 16,782 birds were positively identified as one of 95 species. All species were detected within the 20 minute survey period except the Snowy Egret. Overall mean annual use rates (birds/plot/20 min survey/800 m) were 0.36 raptors/survey, 2.09 waterfowl/survey, and 4.37 waterbirds/survey. Combined waterfowl/waterbird use was 6.46 birds/survey and passerine use was 34.06 birds/survey. The highest seasonal use was during the fall (111.2 birds/survey), which was largely driven by Red-winged Blackbird use (29.7 birds/survey), Brewer's Blackbird (22.7 birds/survey), waterbird use (18.9 birds/survey) and unidentified blackbird (8 birds/survey). Seasonal rates for each species group and species are presented in Table 15, Appendix B. Many more individuals of several species were detected when calculating abundance using unlimited distance surveys (Table 1).

State Listed and Conservation-Priority Species

No species were detected which are currently listed under the federal Endangered Species Act. However, several species were detected using the PWRA that are prioritized on state-level conservation efforts, most notably the Tundra/Trumpeter Swan group, with the Trumpeter Swan currently designated as Threatened by the State of Minnesota. Flocks of swans observed in the field were likely a mix of Trumpeter and Tundra Swans. The proportion of these flocks that may have been made up of either species is unknown.

# Appendix E

# Agency Correspondence

June 14, 2010

Mr. Michael North
Minnesota Department of Natural Resources
Regional Environmental Assessment Ecologist
1601 Minnesota Drive
Brainerd, MN 56401

RE: Black Oak Wind Farm in Stearns County, MN

Dear Mr. North:

HDR Engineering, Inc. (HDR) met with you in July, 2009 to discuss requesting your agency's comments in regards to the Black Oak Wind Farm, proposed by Geronimo Wind Energy, LLC (Geronimo) in Stearns County, MN (Figure 1). Recently, the project boundary has changed and now includes additional sections adjacent to the previous project boundary. The proposed project will be up to 40 MW. This summer, Geronimo will submit a Site Permit Application for a Large Wind Energy Conversion System to the Minnesota Public Utilities Commission (PUC).

Typically wind facility construction includes erecting wind turbines and constructing associated facilities such as gravel access roads, an underground collector system and overhead 34.5 kV and 69 or 115 kV transmission lines. Although final turbine locations, access roads and electrical connections have not been determined at this time, the table below identifies Township sections potentially affected by the project:

**Table 1 –Sections within Project Boundary**

| Township Name | Township | Range | Section |
|---|---|---|---|
| Ashley | 126N | 35W | 35, 36 |
| Raymond | 125N | 35W | 1-3, 11-14, 23 |

We welcome any comments the Minnesota Department of Natural Resources may have at this time or throughout the permit application process. Table 1 identifies sections within the Project boundary. In particular, HDR requests your review of the sections located in Ashley and Raymond townships identified in Table 1 for potential permit requirements for the DNR. Your comments will be incorporated into the PUC review process for the project.

HDR Engineering, Inc.
701 Xenia Avenue South, Suite 600
Minneapolis, MN 55416
Phone (763) 591-5400
*Fax (763) 591-5413*
www.hdrinc.com

Enclosed is a map detailing the location and project boundary of the Black Oak project area to facilitate your review. If you require further information or have questions regarding this matter, please call me at (763) 591-5479.

Sincerely,

Mike DeRuyter
Environmental Scientist

Enclosures:
Figure 1 - Project Location Map

Cc: Patrick Smith, Geronimo Wind Energy, LLC

HDR Engineering, Inc.
701 Xenia Avenue South, Suite 600
Minneapolis, MN 55416
Phone (763) 591-5400
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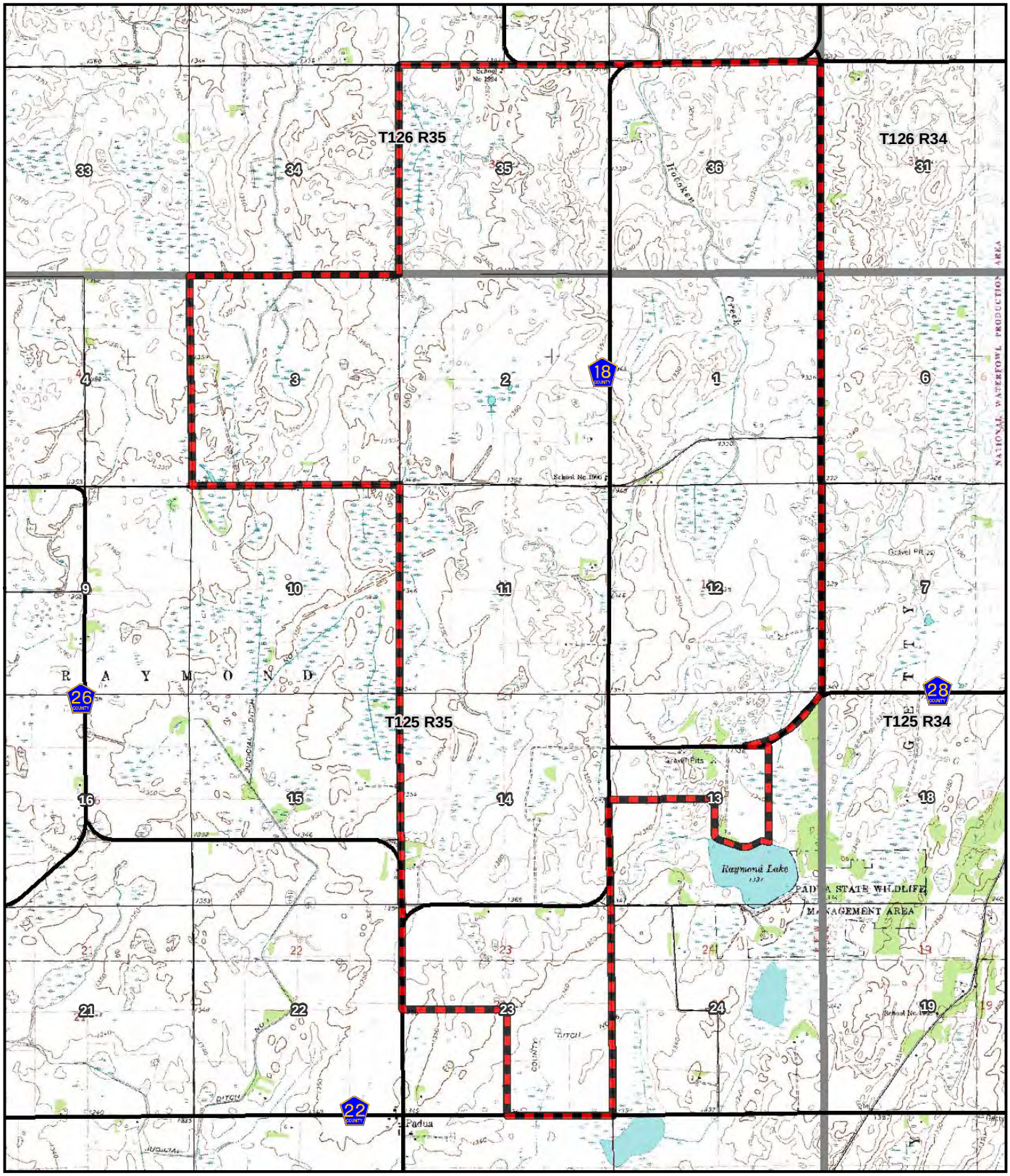


Figure 1. Project Location
Black Oak Wind Farm
Geronimo Wind Energy
Stearns County, MN

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June 14, 2010

Mr. Tom Hingsberger
Department of the Army
Corps of Engineers
St. Paul District, Attn: OP-R
190 Fifth Street East, Suite 401
St. Paul, MN 55101-1638

RE: Black Oak Wind Farm in Stearns County, MN

Dear Mr. Hingsberger:

HDR Engineering, Inc. (HDR) is currently gathering environmental information for the Black Oak Wind Farm, proposed by Geronimo Wind Energy, LLC (Geronimo) in Stearns County, MN (Figure 1). The proposed project will be up to 40 MW. This summer, Geronimo will submit a Site Permit Application for a Large Wind Energy Conversion System to the Minnesota Public Utilities Commission (PUC).

Typically wind facility construction includes erecting wind turbines and constructing associated facilities such as gravel access roads, an underground collector system and overhead 34.5 kV and 69 or 115 kV transmission lines. Although final turbine locations, access roads and electrical connections have not been determined at this time, the table below identifies Township sections potentially affected by the project:

**Table 1 – Sections within Project Boundary**

| Township Name | Township | Range | Section |
|---|---|---|---|
| Ashley | 126N | 35W | 35, 36 |
| Raymond | 125N | 35W | 1-3, 11-14, 23 |

We welcome any comments the U.S. Army Corps of Engineers may have at this time or throughout the permit application process. In particular, HDR requests your review of the sections identified in Table 1 for jurisdictional waters or other potential permit requirements for the USACE. Your comments will be incorporated into the PUC review process for the project.

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Sincerely,

Mike DeRuyter
Environmental Scientist

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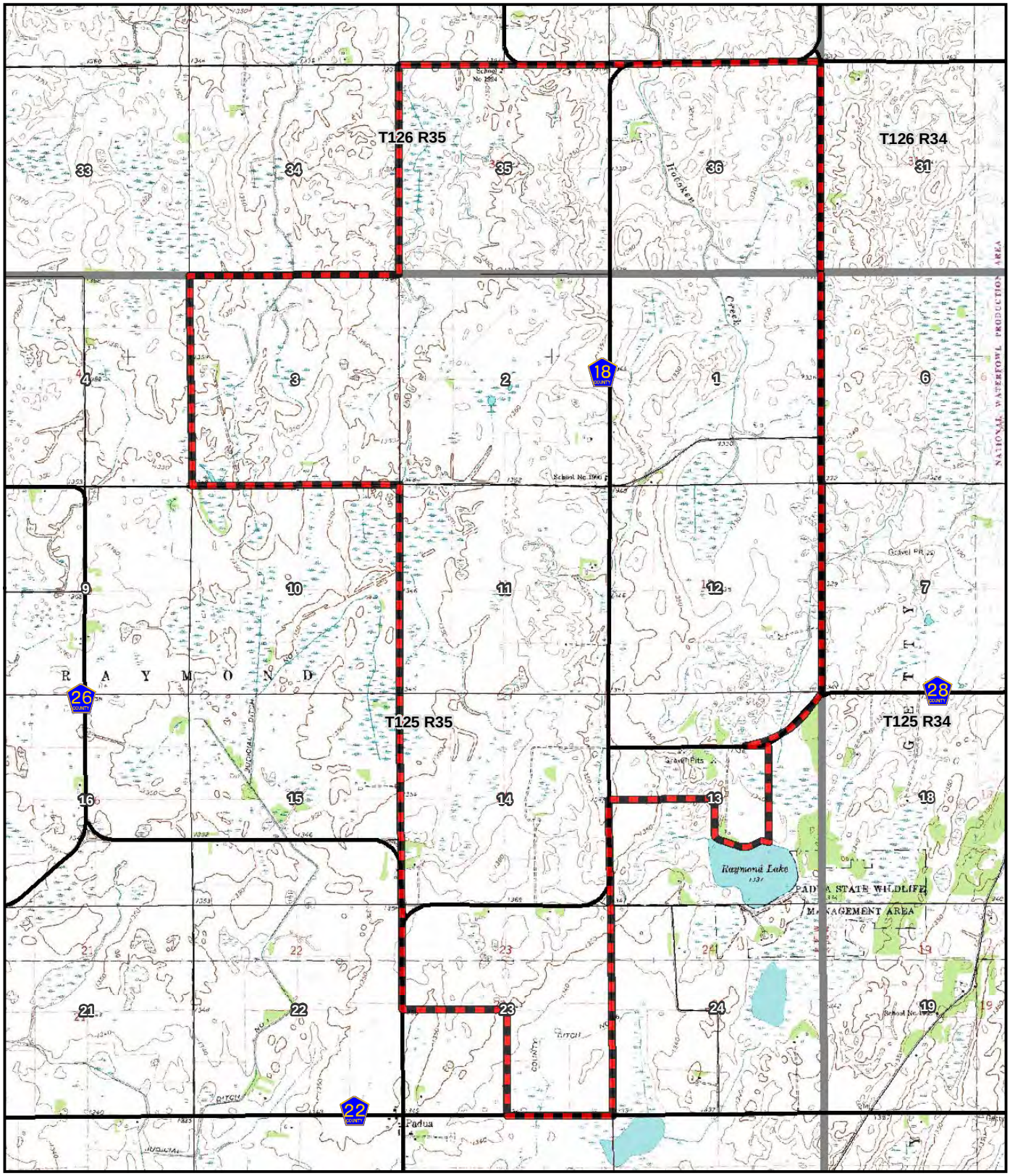


Figure 1. Project Location
Black Oak Wind Farm
Geronimo Wind Energy
Stearns County, MN

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June 21, 2010

Mary Ann Heidemann
Manager of Government Programs and Compliance
Minnesota Historical Society
345 Kellogg Boulevard West
Saint Paul, Minnesota 55102

**RE: Project Notice: Black Oak Wind Farm,
Stearns County, Minnesota**

Dear Mary Ann:

Geronimo Wind Energy, (Geronimo) is exploring development of the "Black Oak Wind Farm" (Project) in Stearns County, Minnesota. Geronimo has contracted with HDR Engineering, Inc. (HDR) to provide environmental and permitting services for the project. HDR is currently developing a constraint analysis for the Project study area. On behalf of Geronimo, HDR would like to coordinate with your office to review existing data and discuss potential cultural resource issues for this planning effort. Detailed discussion of specific cultural resource issues will occur as project plans, the survey process, and the report process become clear.

The Project site is in the central part of Stearns County. The study area is defined as the approximately 9-square-mile project boundary and a surrounding 1-mile buffer. A table of study area legal descriptions (Table 1) is below and a map is enclosed. Approximately 16 to 25 turbines (depending upon the final turbine model selection) will be installed on the site, for a total of 40 megawatts. The exact location of turbines, access roads, underground cabling alignments, overhead transmission lines, substations footprints, and operation/maintenance buildings has not been determined.

**Table 1. Black Oak Study Area
Legal Descriptions**

| County | Township | Range | Section |
|---|---|---|---|
| Stearns | 126 | 35 | 25-27, 34- 36 |
| Stearns | 126 | 34 | 30, 31 |
| Stearns | 125 | 35 | 1-4, 9-15, 22-27 |
| Stearns | 125 | 34 | 6, 7, 18, 19 |

HDR understands that at this time, the Project does not involve a federal undertaking and is therefore not subject to federal Section 106 historic preservation regulations or guidance. HDR anticipates the Project would be subject to regulations associated with:

- The Minnesota Wind Siting Act (Minnesota Statutes Chapter 216F)
- The Minnesota Administrative Rules Chapter 7836 Wind Siting

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701 Xenia Avenue South, Suite 600
Minneapolis, MN 55416
Phone (763) 591-5400
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- The Minnesota Department of Commerce, Energy Facility, Permitting, Siting, and Routing Department's PUC LWECS Site permit
- Minnesota Statute Chapter 138.661-138.699 (Minnesota Historic Sites Act)
- The Minnesota Pollution Control Agency's (PCA) National Pollutant Discharge Elimination System (NPDES) Permit No: MN R100001 (Appendix A, Part G. Discharges Affecting Historic Places Or Archeological Sites

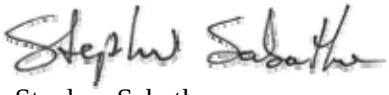
HDR understands that additional coordination with your office may be needed pursuant to these regulations and guidance.

HDR intends to review cultural resource site forms and surveys to establish the known properties in the project vicinity, review Government Land Office maps for additional information, and Geographic Information System-developed maps. The information we collect will be used for project planning and to identify potential project constraints. We will coordinate with your staff to collect data on file at your office.

We look forward to discussing the project and our data collection efforts with you or your staff. If you have any questions or comments please contact me at (763) 278-5992 or by email at stephen.sabatke@hdrinc.com.

Sincerely,

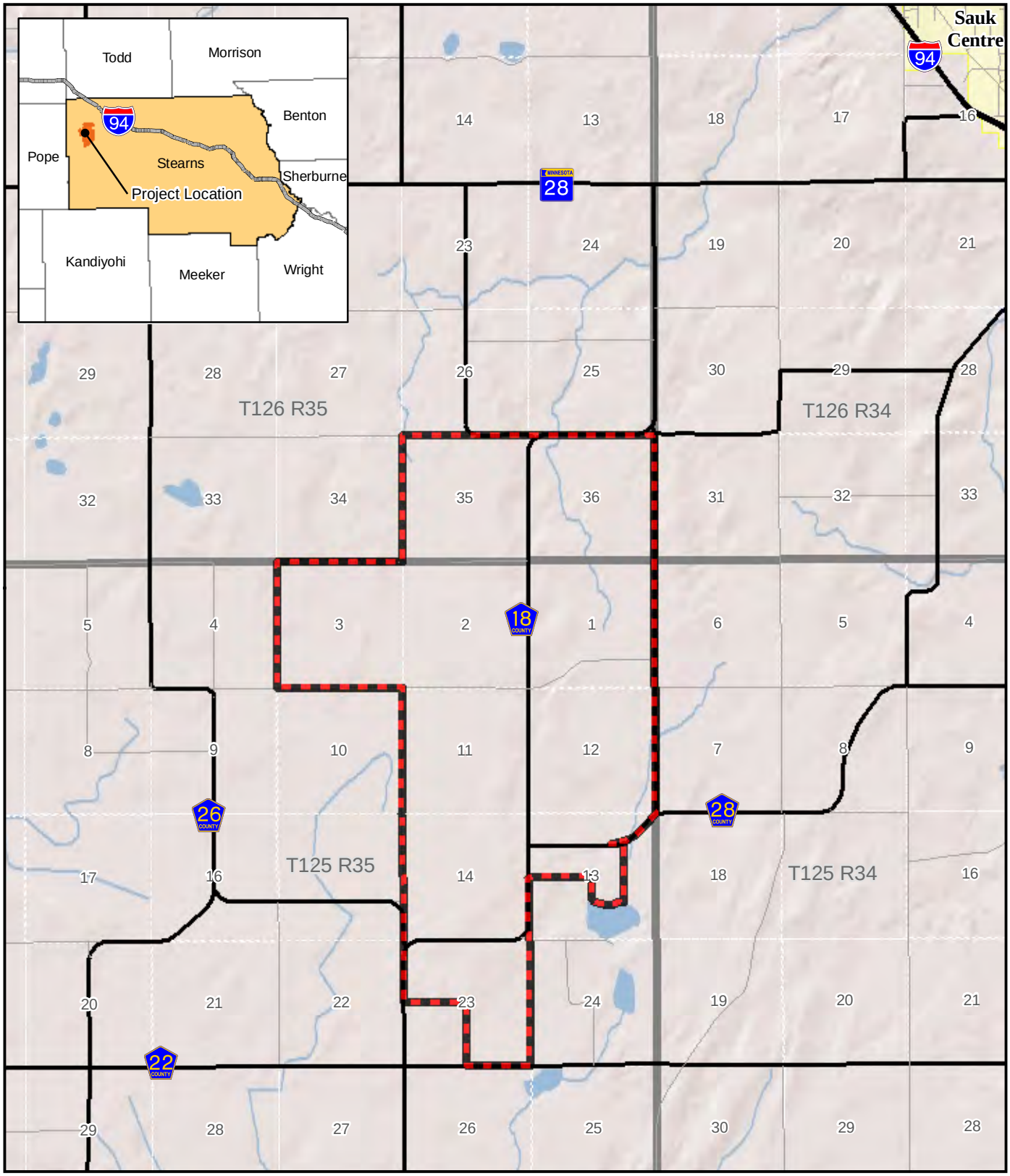
**HDR Engineering, Inc.**



Stephen Sabatke
Archaeologist

cc: David Birkholz, Minnesota Office of Energy Security
Scott Anfinson, State Archaeologist
Mike DeRuyter, HDR Environmental Scientist
Karyn O'Brien, Geronimo Environmental Planner

Enclosures: Project Location Map (Figure 1)




HDR

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Project Boundary

Cities

Townships

Figure 1. Project Location Map
Black Oak Wind Farm
Geronimo Wind Energy
Stearns County, MN

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June 21, 2010

David Birkholz
Minnesota Office of Energy Security
Minnesota Department of Commerce
85 7th Place East, Suite 500
St. Paul, MN 55155

**RE: Project Notice: Black Oak Wind Farm, Stearns County, Minnesota**

Dear David:

Geronimo Wind Energy (Geronimo) is exploring development of the "Black Oak Wind Farm" (Project) in Stearns County, Minnesota. Geronimo has contracted with HDR Engineering, Inc. (HDR) to provide environmental and permitting services for the project. HDR is currently developing a constraint analysis for the Project study area. On behalf of Geronimo, HDR would like to coordinate with your office to review existing data and discuss potential cultural resource issues for this planning effort. Detailed discussion of specific cultural resource issues will occur as project plans, the survey process, and the report process become clear.

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- The Minnesota Administrative Rules Chapter 7836 Wind Siting

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- The Minnesota Department of Commerce, Energy Facility, Permitting, Siting, and Routing Department's PUC LWECS Site permit
- Minnesota Statute Chapter 138.661-138.699 (Minnesota Historic Sites Act)
- The Minnesota Pollution Control Agency's (PCA) National Pollutant Discharge Elimination System (NPDES) Permit No: MN R100001 (Appendix A, Part G. Discharges Affecting Historic Places Or Archeological Sites

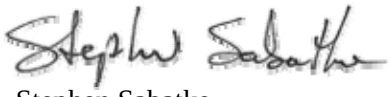
HDR understands that additional coordination with your office may be needed pursuant to these regulations and guidance.

HDR intends to review cultural resource site forms and surveys to establish the known properties in the project vicinity, review Government Land Office maps for additional information, and Geographic Information System-developed maps. The information we collect will be used for project planning and to identify potential project constraints. We will coordinate with your staff to collect data on file at your office.

We look forward to discussing the project and our data collection efforts with you or your staff. If you have any questions or comments please contact me at (763) 278-5992 or by email at stephen.sabatke@hdrinc.com.

Sincerely,

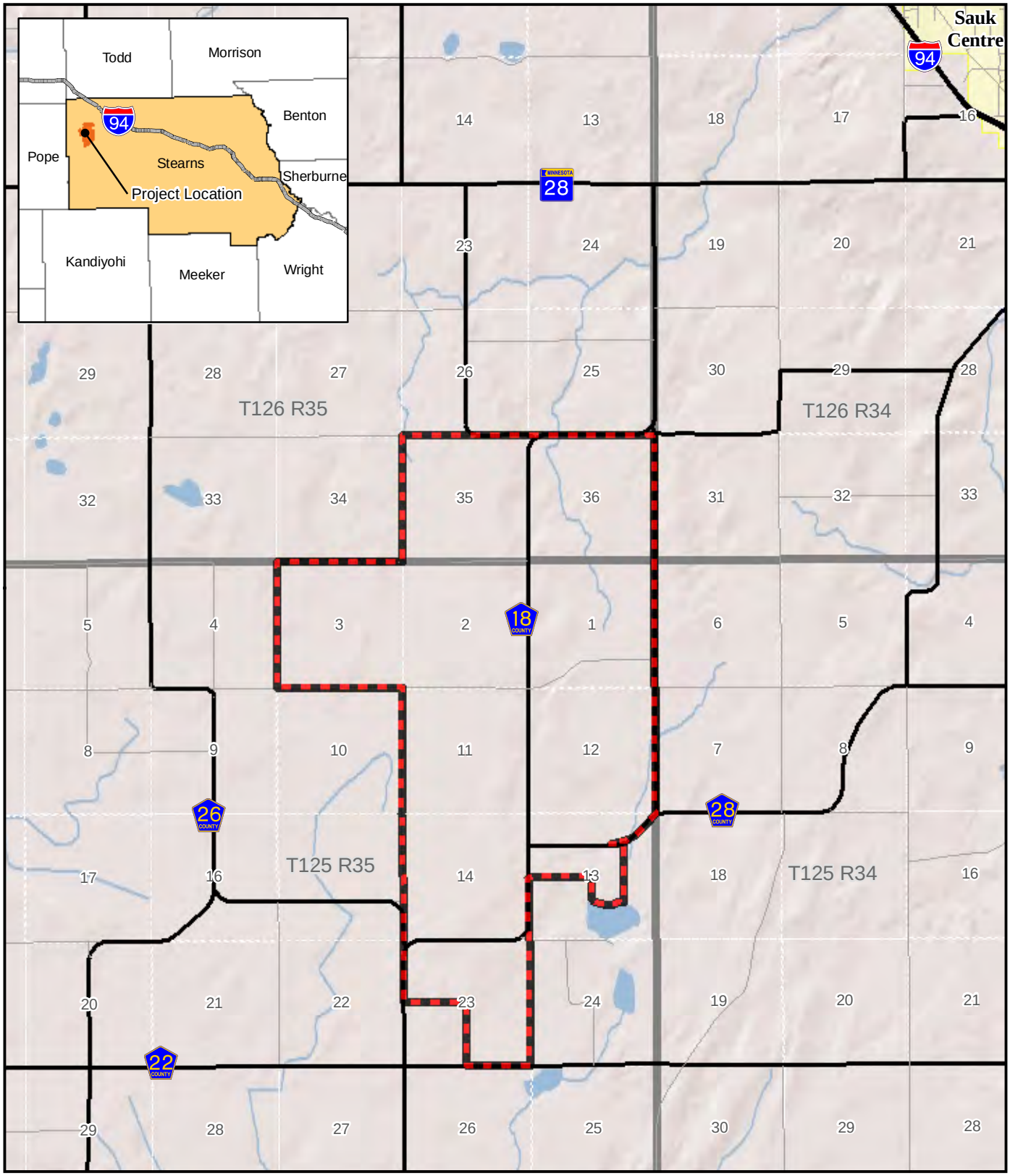
**HDR Engineering, Inc.**



Stephen Sabatke
Archaeologist

cc: Mary Ann Heidemann, Manager of Government Programs and Compliance
Scott Anfinson, State Archaeologist
Mike DeRuyter, HDR Environmental Scientist
Karyn O'Brien, Geronimo Environmental Planner

Enclosures: Project Location Map (Figure 1)




HDR

GERONIMO WIND ENERGY

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Legend

Project Boundary

Cities

Townships

Figure 1. Project Location Map
Black Oak Wind Farm
Geronimo Wind Energy
Stearns County, MN

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June 21, 2010

Scott Anfinson
State Archaeologist
Minnesota Office of the State Archaeologist
Fort Snelling History Center
Saint Paul, Minnesota 55111

**RE: Project Notice: Black Oak Wind Farm, Stearns County, Minnesota**

Dear Scott:

Geronimo Wind Energy, (Geronimo) is exploring development of the "Black Oak Wind Farm" (Project) in Stearns County, Minnesota. Geronimo has contracted with HDR Engineering, Inc. (HDR) to provide environmental and permitting services for the project. HDR is currently developing a constraint analysis for the Project study area. On behalf of Geronimo, HDR would like to coordinate with your office to review existing data and discuss potential cultural resource issues for this planning effort. Detailed discussion of specific cultural resource issues will occur as project plans, the survey process, and the report process become clear.

The Project site is in the central part of Stearns County. The study area is defined as the approximately 9-square-mile project boundary and a surrounding 1-mile buffer. A table of study area legal descriptions (Table 1) is below and a map is enclosed. Approximately 16 to 25 turbines (depending upon the final turbine model selection) will be installed on the site, for a total of 40 megawatts. The exact location of turbines, access roads, underground cabling alignments, overhead transmission lines, substations footprints, and operation/maintenance buildings has not been determined.

**Table 1. Black Oak Study Area Legal Descriptions**

| County | Township | Range | Section |
|---|---|---|---|
| Stearns | 126 | 35 | 25-27, 34- 36 |
| Stearns | 126 | 34 | 30, 31 |
| Stearns | 125 | 35 | 1-4, 9-15, 22-27 |
| Stearns | 125 | 34 | 6, 7, 18, 19 |

HDR understands that at this time the Project does not involve a federal undertaking and is therefore not subject to federal Section 106 historic preservation regulations or guidance. HDR anticipates the Project would be subject to regulations associated with:

- The Minnesota Wind Siting Act (Minnesota Statutes Chapter 216F)
- The Minnesota Administrative Rules Chapter 7836 Wind Siting

- The Minnesota Department of Commerce, Energy Facility, Permitting, Siting, and Routing Department's PUC LWECS Site permit

HDR Engineering, Inc.

701 Xenia Avenue South, Suite 600
Minneapolis, MN 55416

Phone (763) 591-5400
Fax (763) 591-5413
www.hdrinc.com

- Minnesota Statute Chapter 138.661-138.699 (Minnesota Historic Sites Act)
- The Minnesota Pollution Control Agency's (PCA) National Pollutant Discharge Elimination System (NPDES) Permit No: MN R100001 (Appendix A, Part G. Discharges Affecting Historic Places Or Archeological Sites

HDR understands that additional coordination with your office may be needed pursuant to these regulations and guidance.

HDR intends to review cultural resource site forms and surveys to establish the known properties in the project vicinity, review Government Land Office maps for additional information, and Geographic Information System-developed maps. The information we collect will be used for project planning and to identify potential project constraints. We will coordinate with your staff to collect data on file at your office.

We look forward to discussing the project and our data collection efforts with you or your staff. If you have any questions or comments please contact me at (763) 278-5992 or by email at stephen.sabatke@hdrinc.com.

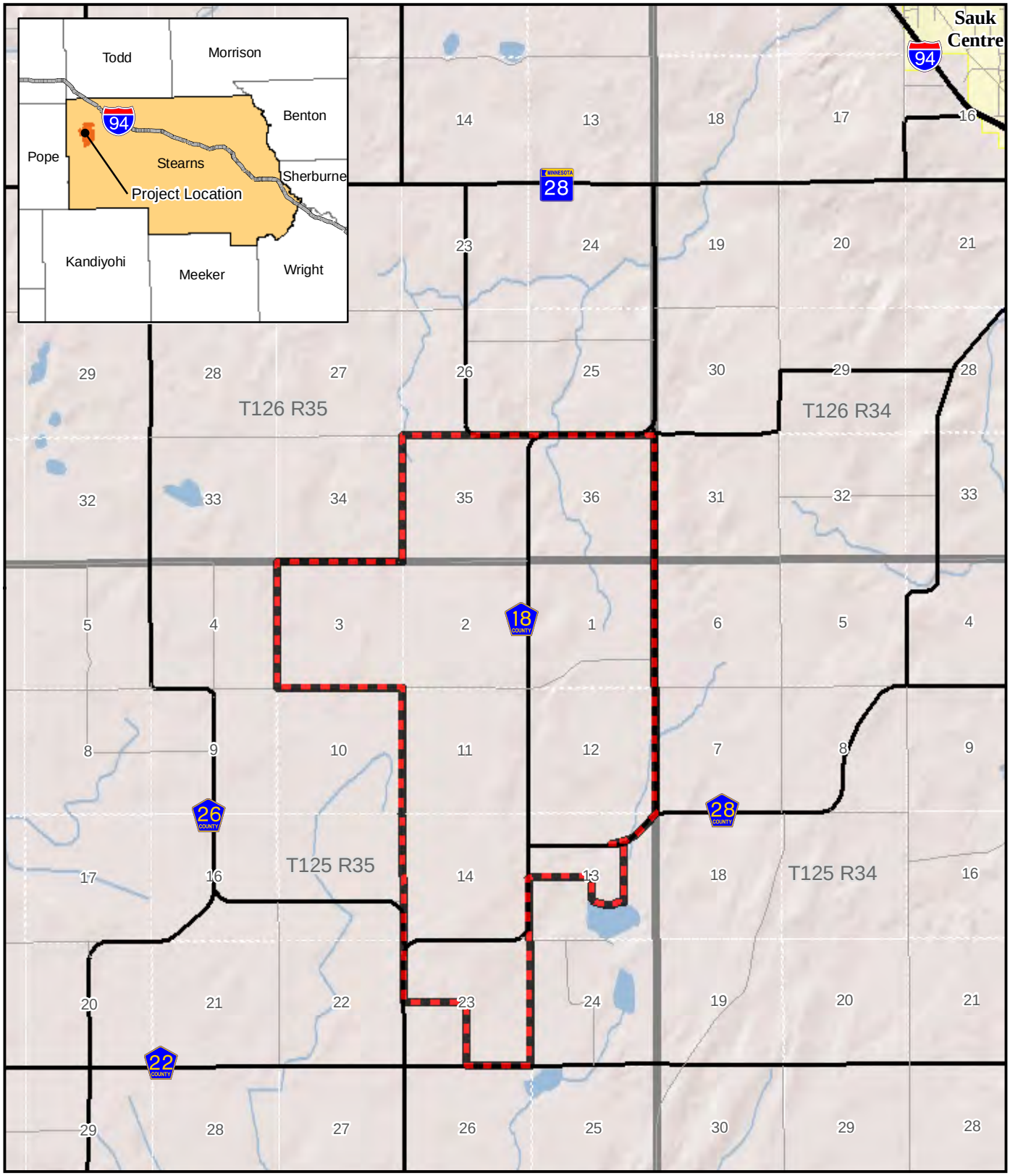
Sincerely,

**HDR Engineering, Inc.**

Stephen Sabatke
Archaeologist

cc: Mary Ann Heidemann, Manager of Government Programs and Compliance
David Birkholz, Minnesota Office of Energy Security
Mike DeRuyter, HDR Environmental Scientist
Karyn O'Brien, Geronimo Environmental Planner

Enclosures: Project Location Map (Figure 1)




HDR

GERONIMO WIND ENERGY

N

Miles

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Legend

Project Boundary

Cities

Townships

Figure 1. Project Location Map
Black Oak Wind Farm
Geronimo Wind Energy
Stearns County, MN

Map Document: (Z:\Geronimo\113816_Black_Oak\map_docs\mxd\Cultural\Fig1_ProjectLocationMap.mxd)
6/22/2010 -- 9:38:41 AM

NO STAPLES
PLEASE

| For Agency Use Only: | |
|---|---|
| Received _____ Due _____ RUSH Inv _____ | #Sec _____ Contact Rqsted? _____ |
| Search Radius _____mi. ER / All Map'd _____ | #EOs _____ Survey Rqsted? _____ |
| NoR / NoF / NoE / Std / Sub Let _____ Log out _____ | #Com _____ |
| | Related ERDB# _____ |

Minnesota
DEPARTMENT OF NATURAL RESOURCES

# NATURAL HERITAGE INFORMATION SYSTEM (NHIS) DATA REQUEST FORM

Please read the instructions on page 3 before filling out the form. Thank you!

## WHO IS REQUESTING THE INFORMATION?

Name and Title: Mike DeRuyter, Environmental Scientist

Agency/Company: HDR Engineering, Inc.

Mailing Address: 701 Xenia Avenue South, Suite 600 (Street) | Minneapolis (City) | MN (State) | 55416 (Zip Code)

Phone: 763-591-5479 e-mail: michael.deruyter@hdrinc.com

Responses will be sent via email. If you prefer US Mail check here: ☐

## THIS INFORMATION IS BEING REQUESTED FOR A:

☐ Federal EA ☐ State EAW ☑ PUC Site Application ☐ Watershed Plan
☐ Federal EIS ☐ State EIS ☐ Local Government Permit ☐ Research Project
☐ NEPA Checklist ☐ AUAR
☐ Other (describe) _____

## INFORMATION WE NEED FROM YOU:

1) **Enclose a map** of the project boundary/area of interest (topographic maps or aerial photos are preferred).
2) Please **provide a GIS shapefile*** (NAD 83, UTM Zone 15N) of the project boundary/area of interest.
3) List the following locational information* (attach additional sheets if necessary):

For Agency Use: Region / MCBS Status

For Agency Use: TRS Confirmed ☐

| County | Township # | Range # | Section(s) (please list **all** sections) |
|---|---|---|---|
| Stearns | 126N | 35W | 25-27, 34-36 |
| Stearns | 125N | 35W | 1-3, 11-14, 23 |
| | | | |
| | | | |

4) Please provide the following information (attach additional sheets if necessary):

Project Name: Black Oak Wind Farm

Project Proposer: Black Oak Wind, LLC/Geronimo Wind Energy

Description of Project (including types of disturbance anticipated from the project):

Proposed construction and operation of a 40 MW Large Wind Energy Conversion System (wind farm). Up to 26 wind turbines are proposed within the 7,064 acre project area. Between 13 and 20 acres of cropland would be permanently removed from crop production for turbine and access road construction. Temporary disturbances to cropland (primarily), and potentially some pasture would occur during construction for temporary access roads, staging areas, and installation of underground electrical cabling.

Describe the existing land use of the project site. What types of land cover/habitat will be impacted by the proposed project?

Primarily cropland (corn and soybeans), and grazed pasture.

List any waterbodies (e.g., rivers, intermittent streams, lakes, wetlands) that may be affected by the proposed project, and how they may be impacted (e.g., dewatering, discharge, riverbed disturbance).

NWI data indicates intermittent streams and isolated wetlands scattered throughout the project site.

To your knowledge, has the project undergone a previous Natural Heritage review? If so, please list the correspondence #: ERDB # 20090191. How does this request differ from the previous request (e.g., change in scope, change in boundary, project being revived, project expansion, different phase)?

Expanded site area with additional sections- portions of Sections 25, 26, 27, 34 of Ashley Township, Sections 3 and 23 of Raymond Township have been added to the original site boundary. Section 7 of Getty Township has been removed from the Project boundary.

To your knowledge, have any native plant community or rare species surveys been conducted within the site? If so, please list:

County biological surveys; no project specific surveys have been completed to date.

List any DNR Permits or Licenses that you will be applying for or have already applied for as part of this project:

No permits have been applied for to date- unknown at this time whether DNR permits or licenses will be required.

## INFORMATION WE PROVIDE TO YOU:

1) The response will include a Natural Heritage letter. If applicable, the letter will discuss potential impacts to rare features.

☑ Check here if this information is being requested for a formal environmental review document (e.g., EAW, EIS) **and** your company/agency has a staff ecologist who will be making the impact determination **and** you do not want DNR staff to provide any interpretation of impacts.

2) The response will also include an Index Report of known aggregation sites and known occurrences of federally and state-listed plants and animals*within an approximate one-mile radius of the project boundary/area of interest.

☑ Check here if you would also like geologic features and rare species with no legal status included in the report.

3) If desired, a Detailed Report that contains more information on each occurrence can be obtained. Please note that the Detailed Report may contain specific location information that is protected under *Minnesota Statutes*, section 84.0872, subd. 2, and, as such, the Detailed Report may not be included in any public document (e.g., an EAW). The Index Report and Natural Heritage letter can be included in any public environmental review document.

☑ Check here if you would also like to receive a Detailed Report.

## FEES / TURNAROUND TIME

There is a fee* for this service. Requests generally take **3-4 weeks** from date of receipt to process, and are processed in the order received. Rush requests* are processed in 2 weeks or less if workloads allow, but are not guaranteed.

☐ Check here to RUSH this request. You will be charged an additional $50.

| | |
|---|---|
| I have read the entire form, and the information supplied above is complete and accurate. I understand that material supplied to me from the Minnesota Natural Heritage Information System is copyrighted and that I am not permitted to reproduce or publish any of this copyrighted material without prior written permission from the Minnesota DNR. Further, if permission to publish is given, I understand that I must credit the Minnesota Division of Ecological Resources, Minnesota Department of Natural Resources, as the source of the material. | |
| Signature (**required**) | Note: Digital signatures representing the name of a person shall be sufficient to show that such person has signed this document. |

Mail or email completed form to:
Lisa Joyal, Natural Heritage Review Coordinator
Division of Ecological Resources
Minnesota Department of Natural Resources
500 Lafayette Road, Box 25
St. Paul, Minnesota 55155
lisa.joyal@state.mn.us

Form is available at
http://files.dnr.state.mn.us/eco/nhnrp/nhis_data_request.pdf

Revised July 2009

# Instructions for the
# Natural Heritage Information System (NHIS) Data Request Form

The Division of Ecological Resources maintains the Natural Heritage Information System (NHIS), a collection of databases that provides information on Minnesota's rare plants and animals, native plant communities, and other rare features. The NHIS is continually updated as new information becomes available, and the Minnesota County Biological Survey (MCBS) is a major source of this information.

- Use this form to request information on rare features within an approximate one-mile radius of an area of interest. You may reproduce this form for your own use or to distribute. An **electronic copy** of the form is available at the DNR's web site at http://files.dnr.state.mn.us/eco/nhnrp/nhis_data_request.pdf

- If you are interested in obtaining the Rare Features Database electronically as a GIS shapefile, do not fill out this form. Please see http://files.dnr.state.mn.us/eco/nhnrp/natural_heritage_data.pdf for more information on this option.

WHO IS REQUESTING THE INFORMATION?

- The person whose name is entered on the form under the "Who is Requesting the Information" section must sign the form as an acknowledgment of the State of Minnesota's copyright on all generated reports. All correspondence and invoices will be sent to this person. Please do not ask us to send this information to a different party.
- Please include a complete mailing address. Responses will be sent via email unless you specify differently.

INFORMATION WE NEED FROM YOU:

- Include a legible map (topographic maps or aerial photographs are preferred) clearly showing:

  1) location and boundaries of the project,
  2) associated infrastructure, and
  3) any waterbodies that may be affected by the proposed project.

- If the project boundary is large **or** complex, please provide a **GIS shapefile** (NAD 83, UTM Zone 15) of the project boundary/area of interest. Do not include any buffers. An additional "digitizing fee" may be charged for projects that require a substantial amount of time to digitize.
- Provide a complete list of sections that the proposed project or area of interest falls within. Do not include any buffer area. Please double-check this information. Incorrect sections can delay the processing of your request, and may result in an invalid review.
- Please provide a detailed **project description**, attaching separate pages to the form if necessary. Identify the type of development (e.g., housing, commercial, utility, ethanol facility, wind farm) being proposed, the size and # of units (if applicable), construction methods, and **any associated infrastructure** such as access roads, utility connections, and water supply and/or discharge pipelines.
- We cannot begin processing data requests until we receive all parts of the request, including a map and a completed, signed form.

INFORMATION WE PROVIDE TO YOU:

- The Natural Heritage review and database reports are valid for environmental review purposes for one year, and they are only valid for the project location and description provided on the form. Please contact Lisa Joyal at lisa.joyal@state.mn.us if project details change or if a data update is needed.
- Please note that the Natural Heritage review and database reports do not address/contain locations of the gray wolf (*Canis lupus*), federally-listed as threatened and state-listed as special concern, or Canada lynx (*Lynx canadensis*), federally-listed as threatened, as these species are not currently tracked in the Natural Heritage Information System.

FEES / TURNAROUND TIME:

- There is a fee for this service. All fees are subject to change. The current fee schedule is available at http://files.dnr.state.mn.us/eco/nhnrp/natural_heritage_data.pdf. The minimum charge is $90.00, and increases based on the time it takes us to process the request (dependent upon project size and the results of the query). Please do not include payment with your request; an invoice will be sent to you.
- There is generally a **3-4 week turn-around time** to process requests. Rush requests (2 week turn-around) are charged an additional $50. The two-week turnaround is not guaranteed, and the option of a rush request is not always available depending on current workloads.

PLEASE SEE NEXT PAGE FOR ADDITIONAL SOURCES OF INFORMATION

ADDITIONAL SOURCES OF INFORMATION:

- The DNR Rare Species Guide (http://www.dnr.state.mn.us/rsg/index.html) is the state's authoritative reference for Minnesota's endangered, threatened, and special concern species. It is a dynamic, interactive source that can be queried by county, ECS subsection, watershed, or habitat.
- The DNR Data Deli (http://deli.dnr.state.mn.us/) allows users to download GIS shapefiles of MCBS Sites of Biodiversity Significance, MCBS Native Plant Communities, MCBS Railroad Rights-of-Way Prairies, and Scientific and Natural Area Boundaries.

- Questions? Please contact Lisa Joyal at 651-259-5109 or lisa.joyal@state.mn.us.

Describe the existing land use of the project site. What types of land cover/habitat will be impacted by the proposed project? Primarily cropland (corn and soybeans), and grazed pasture.

List any waterbodies (e.g., rivers, intermittent streams, lakes, wetlands) that may be affected by the proposed project, and how they may be impacted (e.g., dewatering, discharge, riverbed disturbance).

NWI data indicates intermittent streams and isolated wetlands scattered throughout the project site.

To your knowledge, has the project undergone a previous Natural Heritage review? If so, please list the correspondence #: ERDB # 20090191. How does this request differ from the previous request (e.g., change in scope, change in boundary, project being revived, project expansion, different phase)?

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| Signature **(required)** | Note: Digital signatures representing the name of a person shall be sufficient to show that such person has signed this document. |
|---|---|

Mail or email completed form to:

Lisa Joyal, Natural Heritage Review Coordinator
Division of Ecological Resources
Minnesota Department of Natural Resources
500 Lafayette Road, Box 25
St. Paul, Minnesota 55155
lisa.joyal@state.mn.us

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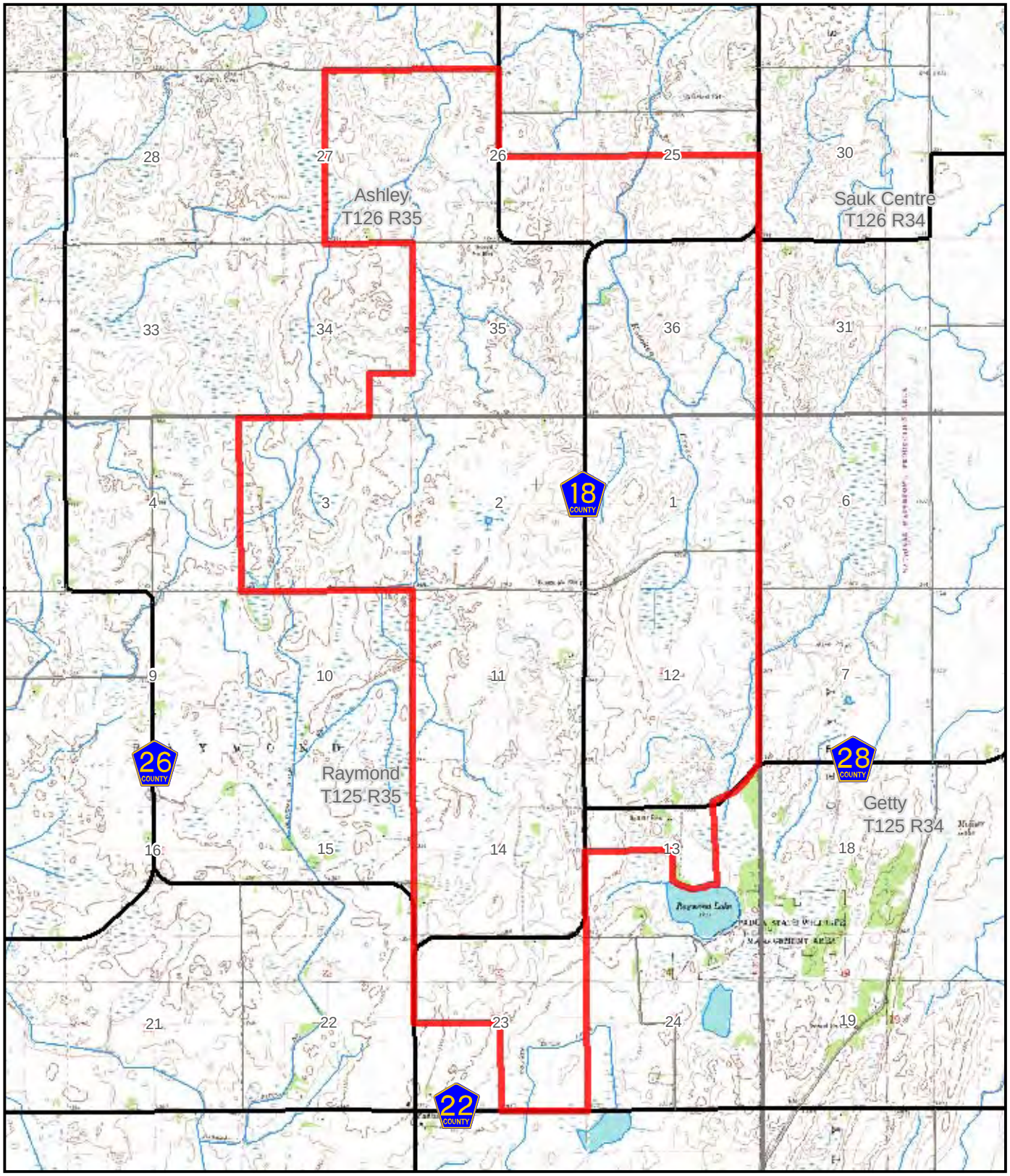
Revised July 2009

* Please see the instructions on page 3.




GERONIMO WIND ENERGY

HDR

**Figure 4-1**
**Project Location Map**

Black Oak Wind Farm
Stearns County, MN

Map Document: (\\mspe-gis-file\GISProj\Geronimo\113816_Black_Oak\map_docs\mxd\LWECS_Site_Permit\Fig4-01_ProjectLocationMap.mxd)
12/2/2010 -- 3:49:34 PM

December 2, 2010

Mr. Tony Sullins
USFWS-Field Office Supervisor
4101 East 80th Street
Bloomington, MN 55425

Re: Geronimo Wind Energy - Black Oak Wind Farm - Stearns County

Dear Mr. Sullins,

Please find the attached map providing an update to the proposed Black Oak Wind Farm located in Stearns County, MN. The proposed project will be up to 40 MW consisting of up to 26 wind energy generators, ranging from 1.6 to 3.0 MW.

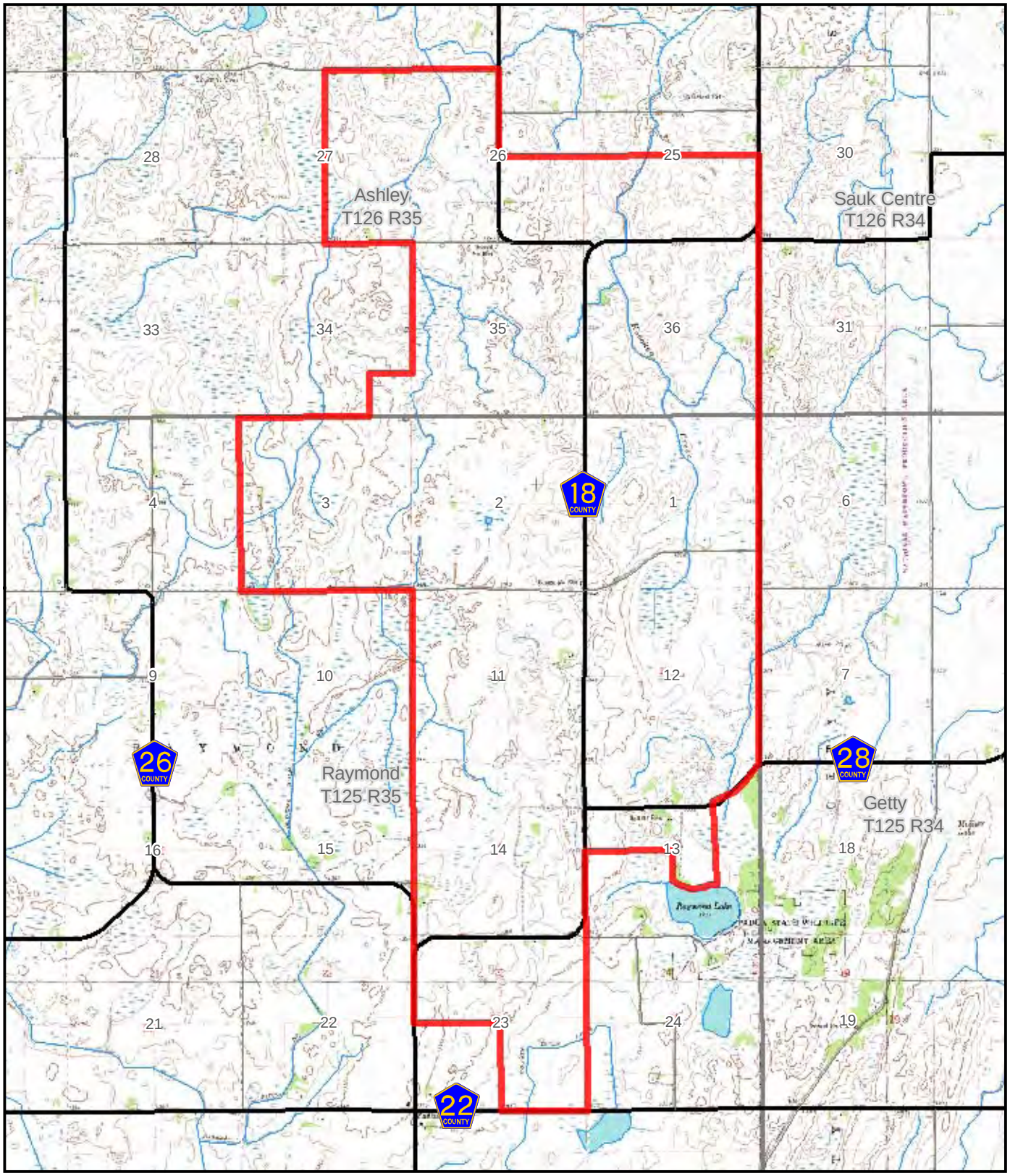
Typically wind facility construction includes erecting wind turbines and constructing associated facilities such as gravel access roads, an underground collector system and overhead 34.5 kV and 115 kV transmission lines. Although final turbine locations, access roads and electrical connections have not been determined at this time, the table below identifies township sections potentially affected by the project:

| Township Name | Township | Range | Section(s) |
|---|---|---|---|
| Ashley | 126N | 35W | 25-27, 34-36 |
| Raymond | 125N | 35W | 1-3, 11-14, 23 |

We welcome any comments that your agency may have at this time or throughout the permit application process. Your comments will be incorporated into the PUC review process for the project. Should you require further information or have questions, please feel free to contact me at your convenience at 952-988-9000 or email me at patrick@geronimowind.com.

Sincerely,

Patrick Smith
Director of Environmental Planning
Geronimo Wind Energy, LLC
952-988-9000




GERONIMO WIND ENERGY

HDR

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Map Document: (\\mspe-gis-file\GISProj\Geronimo\113816_Black_Oak\map_docs\mxd\LWECS_Site_Permit\Fig4-01_ProjectLocationMap.mxd)
12/2/2010 -- 3:49:34 PM

December 2, 2010

Mr. Tom Cinadr
Minnesota Historical Society
State Historic Preservation Office
345 Kellogg Boulevard West
St. Paul, MN 55102

Re: Geronimo Wind Energy to construct Black Oak Wind Farm, Stearns County
SHPO Number: 2010-3485

Dear Mr. Cinadr,

Please find the attached map providing an update to the proposed Black Oak Wind Farm located in Stearns County, MN. The proposed project will be up to 40 MW consisting of up to 26 wind energy generators, ranging from 1.6 to 3.0 MW.

Typically wind facility construction includes erecting wind turbines and constructing associated facilities such as gravel access roads, an underground collector system and overhead 34.5 kV and 115 kV transmission lines. Although final turbine locations, access roads and electrical connections have not been determined at this time, the table below identifies township sections potentially affected by the project:

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Director of Environmental Planning
Geronimo Wind Energy, LLC
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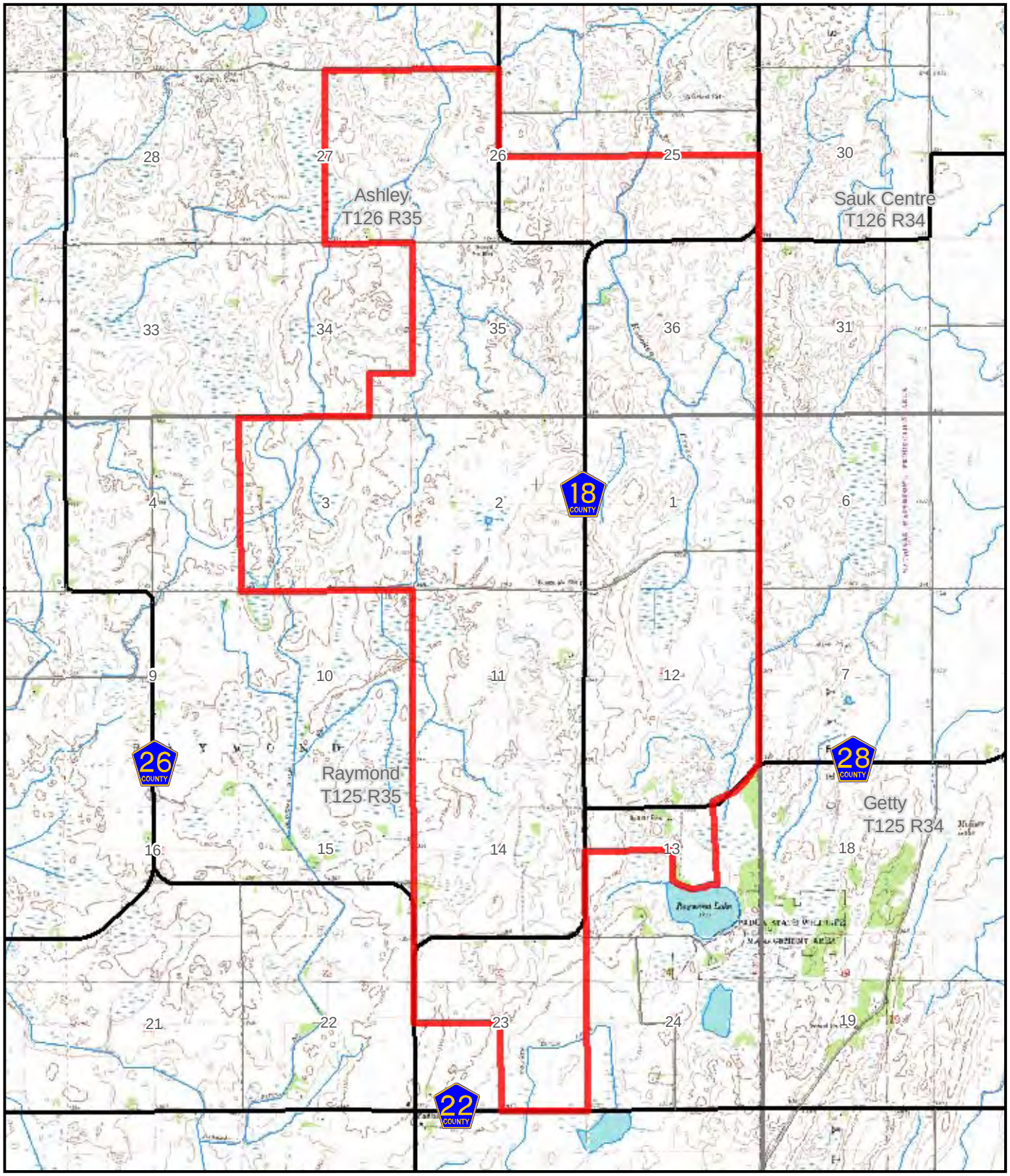


GERONIMO WIND ENERGY

HDR

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Black Oak Wind Farm
Stearns County, MN

Map Document: (\\mspe-gis-file\GISProj\Geronimo\113816_Black_Oak\map_docs\mxd\LWECS_Site_Permit\Fig4-01_ProjectLocationMap.mxd)
12/2/2010 -- 3:49:34 PM

December 3, 2010

David Birkholz
Minnesota Office of Energy Security
Minnesota Department of Commerce
85 7th Place East, Suite 500
St. Paul, MN 55155

Re: Geronimo Wind Energy to construct Black Oak Wind Farm, Stearns County
SHPO Number: 2010-3485

Dear Mr. Birkholz,

Please find the attached map providing an update to the proposed Black Oak Wind Farm located in Stearns County, MN. The proposed project will be up to 40 MW consisting of up to 26 wind energy generators, ranging from 1.6 to 3.0 MW.

Typically wind facility construction includes erecting wind turbines and constructing associated facilities such as gravel access roads, an underground collector system and overhead 34.5 kV and 115 kV transmission lines. Although final turbine locations, access roads and electrical connections have not been determined at this time, the table below identifies township sections potentially affected by the project:

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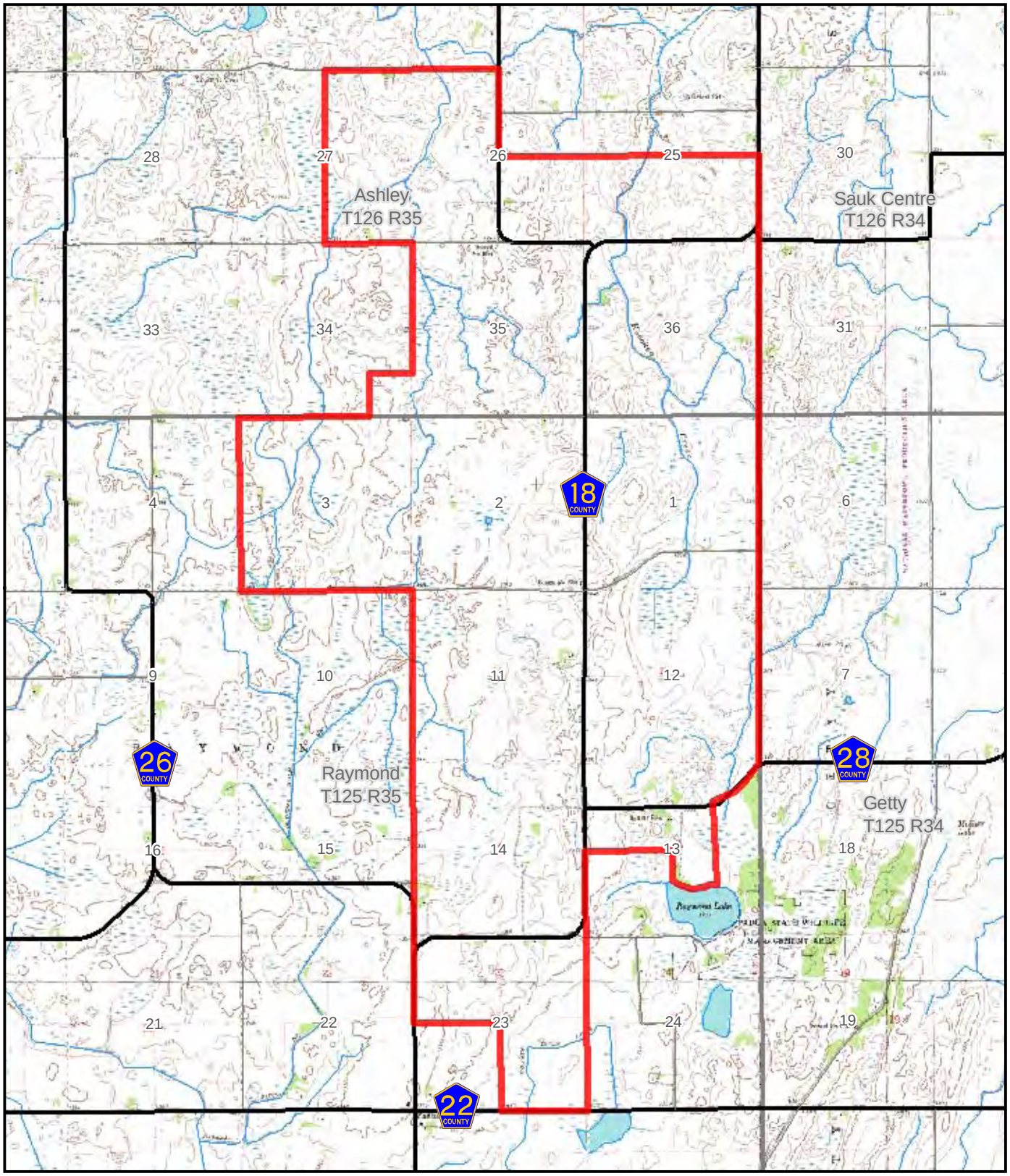
Director of Environmental Planning
Geronimo Wind Energy, LLC
952-988-9000




GERONIMO WIND ENERGY

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Stearns County, MN

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12/2/2010 -- 3:49:34 PM

December 3, 2010

Scott Anfinson
State Archaeologist
Minnesota Office of the State Archaeologist
Fort Snelling History Center
Saint Paul, Minnesota 55111

Re: Geronimo Wind Energy to construct Black Oak Wind Farm, Stearns County
SHPO Number: 2010-3485

Dear Mr. Anfinson,

Please find the attached map providing an update to the proposed Black Oak Wind Farm located in Stearns County, MN. The proposed project will be up to 40 MW consisting of up to 26 wind energy generators, ranging from 1.6 to 3.0 MW.

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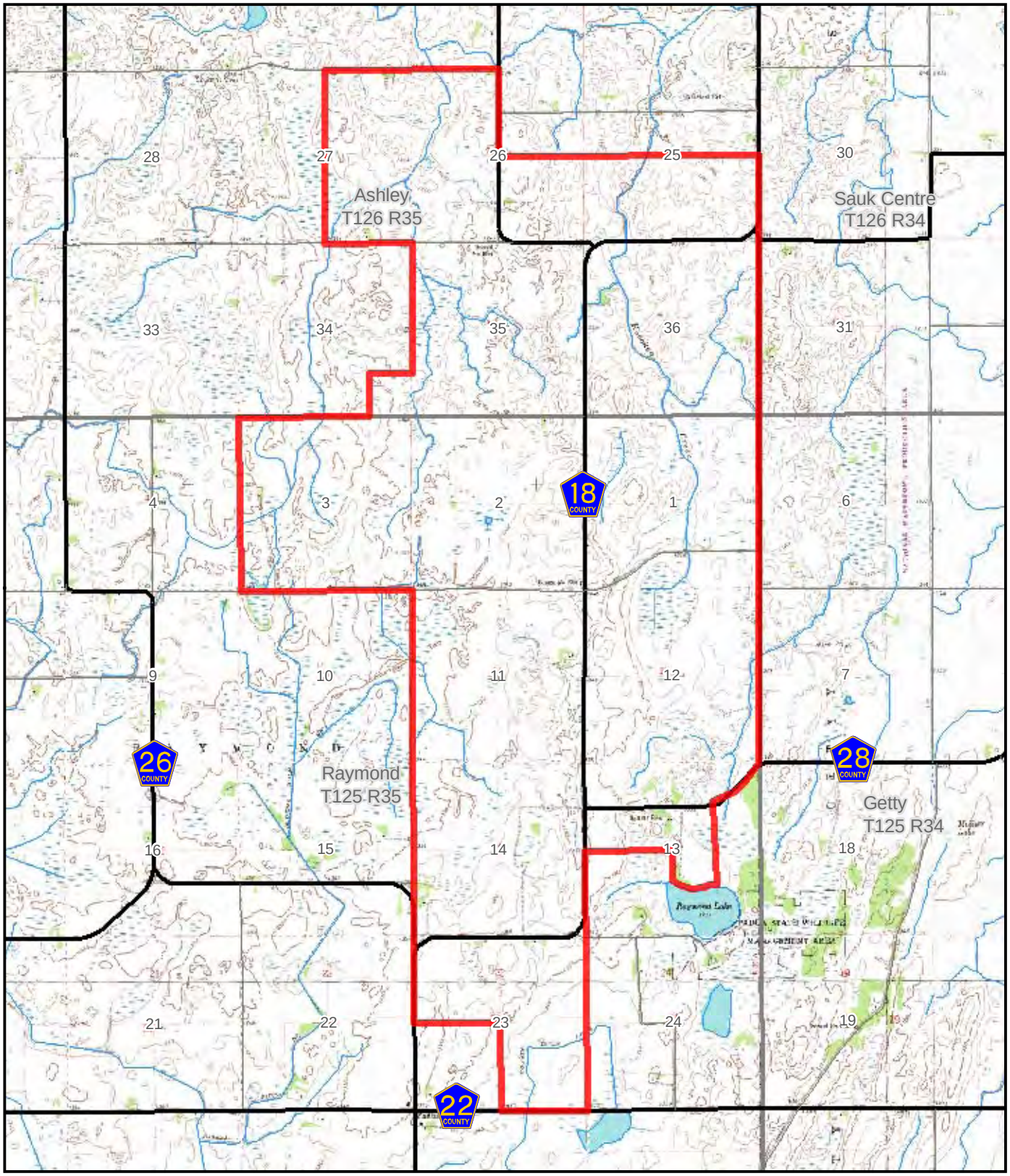
Sincerely,

Patrick Smith
Director of Environmental Planning
Geronimo Wind Energy, LLC
952-988-9000

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# Agency Response Letters

HDR | ONE COMPANY *Many Solutions*℠

# Meeting Notes

| | | |
|---|---|---|
| Subject: Geronimo Wind Projects | | |
| Client: Geronimo Wind | Project No:113816 | |
| Project: Black Oak | Meeting Location: | Minnesota Valley National Wildlife Refuge, Bloomington, MN and Conference Call |
| Meeting Date: July 21, 2009 | Notes by: | Mike DeRuyter |

**NOTE: ALTHOUGH SEVERAL GERONIMO WIND PROJECTS WERE DISCUSSED AT THIS MEETING, THESE MINUTES HAVE BEEN EDITED TO ONLY INCLUDE THE PORTIONS OF THE DISCUSSION RELEVANT TO THE BLACK OAK PROJECT*

**ATTENDEES:**

***Mike North*** – (conference call) Minnesota DNR Regional Environmental Assessment Ecologist, Central Region, michael.north@drn.state.mn.us, 320-255-4279, ext. 235

***John Schaldweiler*** – (conference call) Minnesota DNR , Ecological Resources Regional Manager, South Region, john.schladweiler@dnr.state.mn.us, 507-359-6003

***Todd Mattson*** – HDR, Senior Environmental Project Manager, todd.mattson@hdrinc.com, 763-278-5931

***Mike DeRuyter*** – HDR, Environmental Scientist, michael.deruyter@hdrinc.com, 763-591-5479

***Patrick Smith*** – Geronimo, Environmental Specialist, patrick@geronimowind.com, 952-988-9000

***Charlie Daum*** – Geronimo, Director of Development, charlie@geronimowind.com, 952-988-9000

***Justin Pickar*** – Geronimo, Development Associate, justin@geronimowind.com, 952-988-9000

***Kevin Mixon*** – (conference call) Minnesota DNR, Regional Environmental Assessment Ecologist, South region, kevin.mixon@dnr.state.mn.us , 507-359-6073

***Nick Snavely*** – (conference call) Minnesota DNR, Assistant Area Wildlife Manager, nicholas.snavely@dnr.state.mn.us, 320-255-4279

***Rich Davis*** – USFWS Fish and Wildlife Biologist, Richard_Davis@fws.gov, 612-725-3548, ext. 2214

TOPICS DISCUSSED

Introduce Geronimo Projects
Near term projects and schedule
Site characterization
Additional Wildlife Studies

ACTION/NOTES

*Geronimo Projects:* Multiple projects in early development stages throughout the state, including the Black Oak Wind Farm in Stearns County.

*Near Term Projects and Schedules*: The Black Oak Wind Farm is being considered for permitting in 2010 or 2011. Geronimo is considering participation in the U.S. Department of Energy's loan guarantee program. While details about this program are not yet fully understood, this would be a non-discretionary federal funding mechanism that is expected to trigger NEPA review at an EA level.

*Site Characterization*:

HDR said that site characterization studies are being completed based on USFWS wind farm siting guidelines. Emphasis will be placed on avoidance of significant habitat and features. Geronimo has committed to developing an Avian and Bat Protection Plan (ABPP) that will include specific commitments to project design standards that minimize impacts to birds and bats. HDR asked whether there are any specific issues regarding migratory birds that USFWS has, and how they want them addressed. USFWS staff said they had not looked at the Black Oak site in regard to avian issues.

DNR staff also said they are working on a guidance document for wind projects that will include recommendations for setbacks from natural features. He said the draft document is not available yet, but they expect to adopt the draft in August or September. He said to expect the following setbacks to be included in the draft recommendations:

1,000 feet from Public Waters
600 feet from Circular 39 Types 3, 4, and 5 wetlands
¼ mile from native prairie
5 rotor diameter from WMAs in all directions
Other areas that DNR staff want avoided, based on input from regional and Natural Heritage Program staff

HDR asked if any industry comments had been solicited during the development of these recommendations. DNR staff said that industry comment was not requested because the guidance is based solely on DNR's mission as an agency to protect the resource.
HDR asked if the recommendations are based on any scientific research relating to wind turbine impacts. DNR staff said that the 600 foot setback from Type 3, 4, and 5 wetlands is included in many county ordinances, and the 1,000 foot setback from Public Waters is meant to avoid shadow flicker and other impacts to Public Waters. DNR staff emphasized that the forthcoming guidance will be only be recommendations, not requirements, and that there would be flexibility based on site specific circumstances.

DNR staff asked how long the leases would be.  Geronimo said they would be for 20 years, with three 10-year extensions possible.

DNR staff asked that during installation of collector lines, vehicles would be cleaned off after passing through wetland areas in order to avoid spreading exotic species.

# Minnesota Department of Natural Resources

Division of Ecological Resources, Box 25

500 Lafayette Road

St. Paul, Minnesota 55155-4025

Phone: (651) 259-5109 Fax: (651) 296-1811 E-mail: lisa.joyal@dnr.state.mn.us


December 22, 2008

Mr. Patrick Smith
Geronimo Wind Energy
5050 Lincoln Drive, #420
Edina, MN 55436

Re: Request for Natural Heritage information in the vicinity of the proposed Black Oak Wind Farm, Stearns County
Correspondence # : ERDB 20090191

| Township (N) | Range (W) | Section(s) |
|---|---|---|
| 126 | 35 | 35, 36 |
| 125 | 35 | 1, 2, 11-14 |
| 125 | 34 | 7 |

Dear Mr. Smith,

As requested, the Minnesota Natural Heritage Information System has been queried to determine if any rare species or other significant natural features are known to occur within an approximate one-mile radius of the proposed project. Based on this query, several rare features have been documented within the search area (for details, see the enclosed database reports). Please address the following issues in the Public Utilities Commission (PUC) Site Permit Application for this project:

- The Padua Wildlife Management Area (WMA) is located southeast of the project boundary (a GIS shapefile of the State Wildlife Management Area Boundaries can be downloaded from the DNR Data Deli at http://deli.dnr.state.mn.us/). We recommend a minimum ¼ mile setback from all WMAs for all wind turbines. Please contact the Area Wildlife Manager, Fred Bengtson at 320-255-4279, to discuss any concerns he may have about turbines being sited near the WMA.

- There are also several USFWS Waterfowl Production Areas (WPAs) in the vicinity of the project area. If you have not done so already, I encourage you to contact the USFWS Twin Cities Field Office at 612-725-3548.

- The southeast portion of the project boundary contains part of a Central Region Regionally Significant Ecological Area (RSEA). The DNR Central Region (in partnership with the Metropolitan Council for the 7-county metro area), identified these ecologically significant terrestrial and wetland areas by conducting a landscape-scale assessment based on the size and shape of the ecological area, land cover within the ecological area, adjacent land cover/use, and connectivity to other ecological areas. The purpose of the data is to inform regional scale land use decisions, especially as it relates to balancing development and natural resource protection. A GIS shapefile of this data layer can be downloaded from the DNR Data Deli at http://deli.dnr.state.mn.us. For more information on RSEAs, or to view pdf versions of the final maps, please visit http://www.dnr.state.mn.us/rsea/index.html. If you would like help interpreting the RSEA data, contact Hannah Texler, Regional Plant Ecologist for DNR's Central Region, at 651-259-5811 or hannah.texler@dnr.state.mn.us.

- In 1997, there were breeding season observations of the marbled godwit (*Limosa fedoa*), a state-listed bird of special concern, and the upland sandpiper (*Bartramia longicauda*) in the vicinity of the project. In addition, the WMAs and WPAs in the vicinity provide habitat during the breeding season and during migration for many other species of birds. Given this, and the potential for wind turbines to cause avian mortality, we strongly encourage pre- and post-construction avian monitoring. Any cumulative impact assessment should also address the issue of avian mortality.

- Please send me a copy of the Preconstruction Biological Preservation Survey (Section III.D.1. of the Site Permit) required by the PUC.

- If applicable, please send me a copy of the native prairie protection and management plan (Section III.C.6. of the Site Permit). The plan should include measures to avoid impacts to native prairie and measures to mitigate for impacts if unavoidable.

- Given that the proposed project is within an important complex of wildlife habitats and conservation lands, we also encourage you to consider alternate locations for the proposed wind farm so that the most appropriate site in this area may be selected. Further guidance on wind farm siting can be found at http://www.fws.gov/midwest/Eco_Serv/wind/index.htm.

The Natural Heritage Information System (NHIS), a collection of databases that contains information about Minnesota's rare natural features, is maintained by the Division of Ecological Resources, Department of Natural Resources. The NHIS 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. However, the NHIS is not an exhaustive inventory and thus does not represent all of the occurrences of rare features within the state. Therefore, ecologically significant features for which we have no records may exist within the project area.

The enclosed results include an Index Report and a Detailed Report of records in the Rare Features Database, the main database of the NHIS. To control the release of specific location information, which might result in the destruction of a rare feature, both reports are copyrighted.

The Index Report provides rare feature locations only to the nearest section, and may be reprinted, unaltered, in an environmental review document (e.g., EAW or EIS), municipal natural resource plan, or report compiled by your company for the project listed above. If you wish to reproduce the index report for any other purpose, please contact me to request written permission. **The Detailed Report is for your personal use only as it may include specific location information that is considered nonpublic data under *Minnesota Statutes*, section 84.0872, subd. 2. If you wish to reprint or publish the Detailed Report for any purpose, please contact me to request written permission.**

Please be aware that this letter focuses only on potential effects to *rare natural features*; there may be other natural resource concerns associated with the proposed project. This letter does not constitute review or approval by the Department of Natural Resources as a whole. If you would like further information on the environmental review process, please contact your Regional Environmental Assessment Ecologist, Mike North, at 320-255-4279 ext. 235.

An invoice in the amount of $86.82 will be mailed to you under separate cover within two weeks of the date of this letter. You are being billed for the database search and printouts, and staff scientist review. Thank you for consulting us on this matter, and for your interest in preserving Minnesota's rare natural resources.

Sincerely,

Lisa Joyal

Lisa Joyal
Endangered Species Environmental Review Coordinator

enc. Rare Features Database: Index Report
Rare Features Database: Detail Report
Rare Features Database Reports: An Explanation of Fields

cc: Fred Bengston
Mike North
Matt Langan

Printed October 2008
Data valid for one year

**Minnesota Natural Heritage Information System: Rare Features Database**
**Index Report of records within 1 mile radius of:**
Black Oak Windfarm
Multiple TRS
Stearns County

| Element Name and Occurrence Number | Federal Status | MN Status | State Rank | Global Rank | Last Observed Date | EO ID # |
|---|---|---|---|---|---|---|
| **Stearns County, MN** | | | | | | |
| Bartramia longicauda (Upland Sandpiper) #395<br>Location Description: T126N R35W S34, T126N R35W S33, T126N R35W S27 | | NON | S4B | G5 | 1997-07-01 | 22840 |
| Cypripedium candidum (Small White Lady's-slipper) #270<br>Location Description: T126N R35W S34, T126N R35W S33 | | SPC | S3 | G4 | 1997-06-06 | 22299 |
| Limosa fedoa (Marbled Godwit) #159<br>Location Description: T126N R35W S34, T126N R35W S33 | | SPC | S3B | G5 | 1997-06-06 | 22775 |
| Mesic Prairie (Southern) Type #458<br>Location Description: T126N R35W S34, T126N R35W S33 | | N/A | S2 | GNR | 1997-05-06 | 24727 |
| Oarisma powesheik (Powesheik Skipper) #127<br>Location Description: T125N R34W S6, T125N R34W S5 | | SPC | S3 | G2G3 | 1997-07-09 | 24295 |

**Records Printed =** 5

Minnesota Department of Natural Resources

Division of Ecological Resources
940 Industrial Drive South, Suite 103
Sauk Rapids, Minnesota 56379

RECEIVED
JUL - 9 2010
HDR Engineering, Inc.

Minnesota
DEPARTMENT OF NATURAL RESOURCES

July 6, 2010

Mr. Mike DeRuyter
Environmental Scientist
HDR Engineering, Inc.
701 Xenia Avenue South, Suite 600
Minneapolis, Minnesota 55416

Dear Mr. DeRuyter:

The Minnesota Department of Natural Resources has reviewed your letter of June 14, 2010, requesting comments on the proposed Black Oak Windfarm in portions of Ashley and Raymond townships, in Stearns County.

The proposed windfarm is immediately west of, and adjacent to, the proposed Getty Windfarm. The proposed windfarm is located in an area of gently rolling topography in prairie pothole country. Although much of the prairie has been converted to cropfields in the windfarm boundary, there are numerous seasonal and semipermanent wetlands scattered throughout the site, along with hayfields and remnants of native grasslands.

The Padua Wildlife Management Area (WMA) is located at the southeast corner of the project boundary. Numerous federal Waterfowl Production Areas (WPAs) also occur throughout the general area. We recommend a minimum ½ mile setback from all WMA's, semipermanent wetlands, and other protected habitats (e.g., ReInvest in Minnesota easements) for all wind turbines. The USFWS also recommends a minimum ½ mile setback from all WPAs for all wind turbines.

I conducted a site visit and avian inventory of the windfarm site on June 23, 2010. From what I observed, the U.S.G.S. topographic maps you sent with your letter accurately reflect the locations of woodlots and wetlands. Species present were typical of rural agricultural areas (e.g., ring-necked pheasant, mourning dove, killdeer, barn swallows, American robins, horned larks, vesper sparrows, red-winged blackbirds, brown-headed cowbirds). Some of the common wetland species were common yellowthroat and song sparrow, and a common loon was on Raymond Lake. Grassland specialists included savannah sparrows, dickcissels, and LeConte's sparrows. I logged these observations into the Minnesota Breeding Bird Atlas database, so you can get a complete list of what species were present by going to www.mnbba.org and selecting the township quadrants that fall in the project boundary.

The most interesting area of habitat I found is an apparent wet prairie (that has not been previously mapped by MCBS) occupying about 240 acres in the NW1/4 and the N1/2SW1/4 of Section 11, Raymond Township. If any turbines are proposed in this area, a thorough vegetative and avian assessment should be conducted to characterize the quality of the site; this is the location where I found LeConte's sparrows.

I also conducted a drive-by avian survey of the adjacent proposed Getty Windfarm site on March 26, 2010. I noted a few scattered pairs of Canada geese and mallards and numerous pairs of horned larks throughout the area, an apparent pair of red-tailed hawks in Sections 5 and 6 of Getty Twp., and a few killdeer and a northern harrier. I also saw 110 tundra swans sitting on or flying in and out of one seasonal wetland in Section 18 of Getty Township, along with 60 Canada geese and over 200 mallards and ring-necked ducks also sitting on the wetland (where a turbine was proposed). On June 23rd that wetland was dry and planted to corn. I therefore recommend that springtime wetland and waterbird surveys be conducted where NWI maps indicate potential wetlands in order to get an accurate depiction of seasonal waterbird use of the area.

Given recent research on impacts to bats, the DNR has concerns about how impacts to bats will be mitigated. We understand there has been some progress on using electromagnetic fields to deter bats from colliding with wind turbines. We recommend that you review the following sources to see if they might provide an adequate means of mitigating impacts:

> Nicholls, Barry, and Paul A. Racey. Bats Avoid Radar Installations: Could Electromagnetic Fields Deter Bats from Colliding with Wind Turbines? School of Biological Sciences, University of Aberdeen, Aberdeen, United Kingdom. http://www.plosone.org/article/info:doi/10.1371/journal.pone.0000297
>
> Nicholls, Barry, and Paul A. Racey. The Aversive Effect of Electromagnetic Radiation on Foraging Bats—A Possible Means of Discouraging Bats from Approaching Wind Turbines. PLoS One. 2009; 4(7): e6246. Published online 2009 July 16. doi: 10.1371/journal.pone.0006246.

The southeast portion of the project boundary contains part of a Central Region Regionally Significant Ecological Area (RSEA). The DNR Central Region identified these ecologically significant terrestrial and wetland areas by conducting a landscape-scale assessment based on the size and shape of the ecological area, land cover within the ecological area, adjacent land cover/use, and connectivity to other ecological areas. The purpose of the data is to inform regional scale land use decisions, especially as it relates to balancing development and natural resource protection. A GIS shapefile of this data layer can be downloaded from the DNR Data Deli at http://deli.dnr.state.mn.us. For more information on RSEAs, or to view pdf versions of the final maps, please visit http://www.dnr.state.mn.us/rsea/index.html. If you would like help interpreting the RSEA data, contact Hannah Texler, Regional Plant Ecologist for DNR's Central Region, at 651-259-5811.

There are records of other state listed species in the area, but not necessarily within the boundary of the proposed windfarm. The Powesheik skipper (*Oarisma powesheik*) is a

state-listed species of special concern known to occur in the project area. Additionally, in 1997, there were breeding season observations of the marbled godwit, a state-listed bird of special concern, and the upland sandpiper in the vicinity of the project. If you have not done so already, please contact Lisa Joyal, DNR Endangered Species Environmental Review Coordinator, at 651-259-5109 to arrange for a Natural Heritage Database search.

Also please be aware that any transmission line crossings of Wildlife Management Areas or public waters requires a License to Cross Public Lands or a License to Cross Public Waters from the DNR. There are a small number of Public Waters in the windfarm boundary, including Hoboken Creek and an unnamed tributary to Hoboken Creek. For applications to cross public lands or waters, please contact Trina Zieman at 651-259-5792.

Our Section of Wildlife also has other recommendations. First, minimize lighting on tops of turbines, and avoid continuous lighting at night in order to minimize impacts to migrating birds during inclement weather and fog. Second, we would prefer transmission lines be underground. If not underground, then large swan diverters should be installed on lines (if more than one line, stagger diverters 50 feet apart on each line, so that there would be one diverter every 25 feet along the needed span) at all river/stream crossings and where line crosses or comes close to wetlands, lakes and associated travel corridors. Also, diverters should be installed up to 500 feet on either side of a crossing since waterbirds do not totally restrict themselves to the flight space directly over a lake, river or wetland corridor.

In summary, given the number of semipermanent and seasonal wetlands present, and the documented avian resources in the area, it seems premature to apply for a site permit for a Large Wind Energy Conversion System until after springtime habitat conditions can be assessed. We recommend 1 full year of pre-application and 2 full years of post-construction avian and bat surveys be conducted to adequately assess the year-around use of the site by these resources.

As a general comment, we recommend the utility do strategic siting of turbines in consultation with DNR field staff before entering into agreements with landowners in order to avoid as many wetlands, rivers, lakes and permanently protected habitats as possible, thereby minimizing impacts to resources.

Thank you for the opportunity to comment on the proposed project. If you have additional questions, I may be reached at 320-255-4279 est. 235.

Sincerely,

Michael R. North

Michael R. North
Regional Environmental Assessment Ecologist

ERDB20090191

# United States Department of the Interior

FISH AND WILDLIFE SERVICE
Twin Cities Field Office
4101 American Blvd E.
Bloomington, Minnesota 55425-1665

March 26, 2010

Patrick Smith
Geronimo Wind Energy
5050 Lincoln Dr #420
Edina, Minnesota 55436

Re: Black Oak Wind Farm Review, Stearns County, Minnesota
FWS TAILS #32410-2009-FA-0145

Dear Mr. Smith:

This is in response to your request for our review of the proposed Black Oak Wind Farm Stearns County, Minnesota. The proposed project includes the installation of wind turbines, and associated infrastructure including roads, transmission lines, and staging areas. The macro-siting project boundary provided to our office covers a total area of approximately 4,813 acres located in all or parts of sections 1, 2, and 11-14 Township 125 North, Range 35 West and sections 35 and 36 Township 126 North, Range 35 West, Stearns County, Minnesota.

Representatives from the U.S. Fish and Wildlife Service (Service), Geronimo Wind Energy, HDR, and the Minnesota Department of Natural Resources (DNR) participated in a meeting/conference call on July 21, 2009, to discuss the project proposal, wildlife survey recommendations, setback recommendation, and potential migratory bird issues related to this project.

The following comments are being provided pursuant to the Endangered Species Act (ESA), Migratory Bird Treaty Act (MBTA), Bald and Golden Eagle Protection Act, and Fish and Wildlife Act of 1956. This information is being provided to assist you in making an informed decision regarding wildlife issues, site selection, project design, and compliance with applicable laws.

The Service has been in contact with the DNR as they have developed recommended survey protocols and site evaluations that will satisfy both state and federal wildlife statutes, and this letter describes these measures, in part. We appreciate your early coordination with both the Service and the DNR, and recommend continued collaboration on this project to ensure wildlife and habitat issues are fully and appropriately addressed.

The Fish and Wildlife Service supports the development of wind power as an alternative energy source. However, wind farms can have negative impacts on wildlife and their habitats if not sited and designed with potential wildlife and habitat impacts in mind. Selection of the best sites

for turbine placement is enhanced by ruling out sites with known, high concentrations of birds and/or bats passing within the rotor-swept area of the turbines or where the effects of habitat fragmentation will be detrimental. In support of wind power generation as a wildlife-friendly, renewable source of power, development sites with comparatively low bird, bat and other wildlife values would be preferable and would have relatively lower impacts on wildlife.

The Service recommends that impacts to streams and wetlands be avoided, and buffers surrounding these systems be preserved. Streams and wetlands provide valuable habitat for fish and wildlife resources, and the filtering capacity of wetlands helps to improve water quality. Naturally-vegetated buffers surrounding these systems are also important in preserving their wildlife-habitat and water quality-enhancement properties. Furthermore, forested riparian systems (wooded areas adjacent to streams) provide important stopover habitat for birds migrating through the region.

The proposed activities do not constitute a water-dependent activity, as described in the Section 404(b)(1) guidelines, 40 CFR 230.10. Therefore, practicable alternatives that do not impact aquatic sites are presumed to be available, unless clearly demonstrated otherwise. Therefore, before applying for a Section 404 permit, the client should closely evaluate all project alternatives that do not affect streams or wetlands, and if possible, select an alternative that avoids impacts to the aquatic resource. If water resources will be impacted, the St. Paul District of the Corps of Engineers should be contacted for possible need of a Section 404 permit.

**Federally-listed Threatened, Endangered, and Candidate Species**

Because of the potential for wind power projects to impact federally-listed species, they are subject to the Endangered Species Act (16 U.S.C. 1531-1544) section 9 provisions governing "take," similar to any other development project. "Take" incidental to a lawful activity may be authorized through the initiation of formal consultation, if a Federal agency is involved. If a federal agency, federal funding, or a federal permit are not involved in the project, an incidental take permit pursuant to section 10(a)(1)(B) of the ESA may be obtained upon completion of a satisfactory habitat conservation plan for the listed species. However, there is no mechanism for authorizing incidental take after the project is constructed and operational.

Currently there are no federally listed candidate, threatened, or endangered species present within Stearns County. At any point during project planning, construction, or operation should additional information on listed or proposed species become available, or new species are listed that may be affected by the project, consultation should be reinitiated with the Twin Cities Field Office.

**Migratory Birds**

The Migratory Bird Treaty Act (16 U.S.C. 703-712; MBTA) implements four treaties that provide for international protection of migratory birds. The MBTA prohibits taking, killing, possession, transportation, and importation of migratory birds, their eggs, parts, and nests, except when specifically authorized by the Department of the Interior. Bald and golden eagles are

afforded additional legal protection under the Bald and Golden Eagle Protection Act (16 U.S.C. 668-668d). Neither the MBTA nor its implementing regulations at 50 CFR Part 21, provide for permitting of "incidental take" of migratory birds.

Monitoring should be conducted to assess the daily movement patterns of any species of raptor whose nest is located within the proposed project site or within two miles of the proposed project site. During the incubation and rearing stage, the location of adult birds should be tracked for at least 4 hours twice per week until consistent activity patterns are established. These monitoring dates will be determined based upon identified species within two miles of the project boundary. Alternate monitoring strategies that assess the degree to which nesting birds utilize the proposed project site will be considered. Information collected will be used to document how frequently the birds enter the proposed project site, and this information can be utilized during micro-siting to minimize substantial risks to birds within close proximity of the project site.

There is a record of a bald eagle nest approximately 5 miles northeast of the proposed project site. During other recommended survey work the project proponent or their consultant should at a minimum take note of any bald eagles flying through or using habitat within the proposed project area, and note the direction of flight, frequency, and foraging areas being utilized.

Shoreland bird and waterfowl species may be more prevalent in the southeast corner of the proposed project area as there is a complex of wetlands and open water habitat adjacent to the proposed project boundary in this area. If turbines will be placed within the southeast corner of the proposed project site we strongly recommend that observation surveys be completed to determine bird species that may be moving through this area during spring and fall migration, and bird species that may be in the area throughout the summer.

The Service recommends observational bird surveys for the entire proposed Black Oak Wind Project site to document species, direction of flight, and height of flight. This recommendation is based on the presence of 16 Waterfowl Production Areas (WPAs) located within 5 miles of the proposed project site, and there is concern that birds utilizing these WPAs will be flying through the proposed project site as they move from one WPA to another. The Service would like the project proponent to utilize this flight survey data to assist them in micro-siting the individual turbines.

We also recommend a habitat survey throughout the proposed project site. There are a number of records of upland sandpiper, marbled godwit, and sandhill crane in the vicinity of the project. Should the habitat survey confirm habitat for any of these aforementioned species, breeding bird surveys may be necessary to determine the utilization of habitat areas within the proposed project site.

The Service's Office of Law Enforcement serves its mission to protect federal trust wildlife species in part by actively monitoring industries known to negatively impact wildlife, and assessing their compliance with Federal law. These industries include oil/gas productions sites, cyanide heap/leach mining operations, industrial waste water sites, and wind power sites. There is no threshold as to the number of birds incidentally killed by wind power sites, or other

industry, past which the Service will seek to initiate enforcement action. However, the Service is less likely to prioritize enforcement action against a site operator that is cooperative in seeking and implementing measures to mitigate take of protected wildlife.

**Migratory Bird Concentration Areas and Conservation Lands**

We recommend that no turbines be located within ¼ mile of Conservation Reserve Program, Wetland Reserve Program, or other similar federally- or state-funded restoration projects.

**Service-owned Lands**

There are no Service owned lands within the proposed project boundary. It was noted during our review that the Behnen WPA is directly west of the northwest corner of the proposed project site, and the Trisko WPA is directly east of the proposed project site. Both the Behnen and Trisko WPAs are within a ½ mile of the Black Oak Wind Project, and the Service recommends that during micro-siting no turbines be placed within a ½ mile of any WPAs. If feasible a one mile setback from WPAs is preferred, which will reduce the potential for striking migratory birds utilizing the open water wetland and grassland habitats located in associated with these areas.

**Interim Service Guidelines**

Research into the actual causes of bat and bird collisions with wind turbines is limited. To assist Service field staffs in review of wind farm proposals, as well as aid wind energy companies in developing best practices for siting and monitoring of wind farms, the Service published *Interim Guidelines to Avoid and Minimize Wildlife Impacts from Wind Turbines* (2003). We encourage any company/licensee proposing a new wind farm to consider the following excerpted suggestions from the guidelines in an effort to minimize impacts to migratory birds and bats.

1) Pre-development evaluations of potential wind farm sites to be conducted by a team of Federal and/or State agency wildlife professions with no vested interest in potential sites;

2) Rank potential sites by risk to wildlife;

3) Avoid placing turbines in documented locations of federally-listed species;

4) Avoid locating turbines in known bird flyways or migration pathways, or near areas of high bird concentrations (i.e., rookeries, leks, refuges, riparian corridors, etc.);

5) Avoid locating turbines near known bat hibernation, breeding, or maternity colonies, in migration corridors, or in flight paths between colonies and feeding areas;

6) Configure turbine arrays to avoid potential avian mortality where feasible. Implement storm water management practices that do not create attractions for birds, and maintain contiguous habitat for area-sensitive species;

7) Avoid fragmenting large, contiguous tracts of wildlife habitat;

8) Use tubular supports with pointed tops rather than lattice supports to minimize bird perching and nesting opportunities;

9) If taller turbines (top of rotor-swept area is greater than 199 feet above ground level) require lights for aviation safety, the minimum amount of lighting specified by the Federal Aviation Administration (FAA) should be used. Unless otherwise requested by the FAA, only white strobe lights should be used at night, and should be of the minimum intensity and frequency of flashes allowable. Red lights should not be used, as they appear to attract night-migrating birds at a higher rate than white lights;

10) Adjust tower height to reduce risk of strikes in areas of high risk for wildlife.

The full text of the guidelines is available at http://www.fws.gov/habitatconservation/wind.pdf. The Service believes that implementing these guidelines may help reduce mortality caused by wind turbines. We encourage you to consider these guidelines in the planning and design of the project. We particularly encourage placement of turbines away from any large wetland, stream corridor, or wooded areas, and avoiding placing turbines between nearby habitat blocks.
If this proposal is to move forward, we strongly recommend that on-the-ground surveys using radar, infrared, and/or acoustic monitoring be conducted during the peak of spring and fall bird migrations and during the breeding season over a period of several years (consistent with the Service's *Interim Guidelines, op. cit.)* to identify breeding and feeding areas and migration stopover sites. Observations made from greater than ¼ mile of target areas are likely to be insufficient to accurately assess bird use of the landscape, particularly if the observer is moving. Generalized ground research survey protocols, such as those followed in the Waterfowl Breeding Population and Habitat Survey (Smith 1995) and the North American Breeding Bird Survey (Pardieck 2001), among others, often do not accept observations made at greater than ¼ mile from the observer due in part to high probabilities of missed detections (R. Russell, personal communication). Furthermore, spring and fall raptor migration surveys may be necessary, as will surveys to document movement patterns of bald eagles that may use the project area or surrounding habitat. We request that any on-the-ground survey protocols be consistent with the Service's Interim Guidelines (2003), and be coordinated with this office and with the Minnesota Department of Natural Resources prior to implementation.

**Pre-construction Surveys**

The Service recommends that Geronimo and their consultants conduct rigorous assessments of bird and bat use of the area before proceeding with project design (i.e., preliminary siting of specific turbines). We strongly recommend development of a protocol for bird/bat surveys at this site, and specific consideration should be given to the potential for occurrence of marbled godwit and upland sandpiper within the proposed project area. We encourage Geronimo to maintain consistency with other wind farm survey protocols, thus allowing us to compare results with other wind farm survey data. These comparisons will potentially provide valuable information that can be applied in future wind farm/turbine macro- and micro-siting.

In addition to on-the-ground (point or transect) surveys, we recommend that the assessments include the use of mobile, horizontally- and vertically-scanning radar to study the direction, altitude, and numbers of flying animals moving through and within the project area during the fall and spring migration of birds and bats, and the breeding period of birds in the area. We recommend that radar be employed for 24 hours a day, 7 days a week during migration, and at a minimum from dawn to dusk during the breeding period. Radar studies are providing useful information in evaluating bird and bat activity at wind generation sites in Wisconsin, Vermont, Massachusetts and other locations. The use of radar coupled with ground-truthing (surveys) can provide a more complete assessment of bird and bat use of a potential wind project area than point counts or other traditional survey methods alone. Such information could inform project design and minimize potential mortality associated with the project.

We recommend installation of two AnaBat SDI detectors per meteorological tower to be used within the project area, and data should be collected from April 15 - November 15, 2010 and 2011. One AnaBat detector should be mounted at 5 meters above ground, and the other should be mounted as close to the rotor-swept area as possible. The AnaBat's sensitivity should be adjusted to detect a calibration tone at 20 meters. AnaBat units must monitor from 0.5 hour before sunset until 0.5 hour after sunrise. This will help to gauge bat activity and to some degree, to determine bat species/guild composition within the project area during spring and fall migration and the maternity season.

**Post-construction Surveys**

The Service recommends the project be monitored post-construction to determine impacts to migratory birds and bats. A specific post-construction monitoring plan should be prepared and reviewed by the Service and should include a scientifically robust, peer reviewed methodology of mortality surveys. Generally the Service recommends that surveys be conducted for a minimum of three years following construction to assess impacts to birds and bats. The duration of post construction surveys is project specific and will be determined based upon pre construction survey results. We also recommend that the post-construction mortality studies be conducted by an independent third party contractor with expertise in bird/bat mortality monitoring. Results of mortality surveys and other forms of monitoring should be used to adjust operations to reduce mortality if necessary and feasible, as well as improve design and siting of future wind generation facilities. **The Developer or its contractor should provide to this office each year, no later than December 31, copies of annual bird/bat mortality monitoring reports.**

**Infrastructure Considerations**

Development of transmission infrastructure associated with wind facilities also poses risks to wildlife. These risks include potential avian mortality, particularly electrocution of raptors (hawks, eagles, kites, falcons, and owls), that could occur when they attempt to perch on uninsulated or unguarded power poles. Recently published information about which types of power line poles and associated hardware (e.g., wires, transformers and conductors) pose the

greatest danger of electrocution to raptors and what modifications can be made to reduce this threat can be found on the internet at http://www.aplic.org/ .

Thank you for the opportunity to provide comments on this proposed project. Please contact me at (612) 725-3548, ext. 2201, or Rich Davis, Fish and Wildlife Biologist, at (612) 725-3548, ext. 2214, if we can be of further assistance.

Sincerely,

Tony Sullins
Field Supervisor

cc: Mike DeRuyter, HDR, Inc.
Beverly Meyer, USFWS Litchfield WMD
Kevin Mixon, MN DNR

Minnesota
Historical Society
STATE HISTORIC PRESERVATION OFFICE

July 13, 2010

Mr. Stephen Sabatke
HDR Engineering, Inc.
701 Xenia Avenue South, Suite 600
Minneapolis, MN 55416

RE: Geronimo Wind Energy to construct Black Oak Wind Farm
Stearns County
SHPO Number: 2010-3485

Dear Mr. Sabatke:

Thank you for the opportunity to review and comment on the above project. It has been reviewed pursuant to the responsibilities given the Minnesota Historical Society by the Minnesota Historic Sites Act and the Minnesota Field Archaeology Act.

Due to the nature of the proposed project, we recommend that an archaeological survey be completed. The survey must meet the requirements of the Secretary of the Interior's Standards for Identification and Evaluation, and should include an evaluation of National Register eligibility for any properties that are identified. For your information, we have enclosed a list of consultants who have expressed an interest in undertaking such surveys.

If the project area can be documented as previously disturbed or previously surveyed, we will re-evaluate the need for survey. Previously disturbed areas are those where the naturally occurring post-glacial soils and sediments have been recently removed. Any previous survey work must meet contemporary standards.

Please note that this comment letter does not address the requirements of Section 106 of the National Historic Preservation Act of 1966 and 36CFR800, procedures of the Advisory Council on Historic Preservation for the protection of historic properties. If this project is considered for federal assistance, or requires a federal license or permit, it should be submitted to our office with reference to the appropriate federal agency.

If you have any questions on our review of this project, please contact me at (651) 259-3456.

Sincerely,

Mary Ann Heidemann
Manager, Government Programs and Compliance

Enclosure: List of Consultants

DEPARTMENT OF THE ARMY
ST. PAUL DISTRICT, CORPS OF ENGINEERS
190 FIFTH STREET EAST, SUITE 401
ST. PAUL MINNESOTA 55101-1638



JUN 28 2010

Operations
Regulatory (2010-02464-TJH)

Mr. Mike DeRuyter
HDR Engineering, Inc.
701 Xenia Avenue South, Suite 600
Minneapolis, Minnesota 55416

Dear Mr. DeRuyter:

We have received your request for comments regarding the Black Oak Wind Farm Project proposed by Geronimo Wind Energy, LLC in Stearns County, Minnesota. Please consider the following general information concerning our regulatory program that may apply to the proposed project.

If the proposal involves activity in navigable waters of the United States, it may be subject to the Corps of Engineers' jurisdiction under Section 10 of the Rivers and Harbors Act of 1899 (Section 10). Section 10 prohibits the construction, excavation, or deposition of materials in, over, or under navigable waters of the United States, or any work that would affect the course, location, condition, or capacity of those waters, unless the work has been authorized by a Department of the Army permit.

If the proposal involves deposition of dredged or fill material into waters of the United States, including discharges associated with mechanical land clearing, it may be subject to the Corps of Engineers' jurisdiction under Section 404 of the Clean Water Act (CWA Section 404). Waters of the United States include navigable waters, their tributaries, and adjacent wetlands (33 CFR § 328.3). CWA Section 301(a) prohibits discharges of dredged or fill material into waters of the United States, unless the work has been authorized by a Department of the Army permit under Section 404. Information about the Corps permitting process can be obtained online at http://www.mvp.usace.army.mil/regulatory.

The Corps' evaluation of a Section 10 and/or a Section 404 permit application involves multiple analyses, including (1) evaluating the proposal's impacts in accordance with the National Environmental Policy Act (NEPA) (33 CFR part 325), (2) determining whether the proposal is contrary to the public interest (33 CFR § 320.4), and (3) in the case of a Section 404 permit, determining whether the proposal complies with the Section 404(b)(1) Guidelines (Guidelines) (40 CFR part 230).

If the proposal requires a Section 404 permit application, the Guidelines specifically require that "no discharge of dredged or fill material shall be permitted if there is a practicable alternative to the proposed discharge which would have less adverse impact on the aquatic ecosystem, so long as the alternative does not have other significant adverse environmental

# Appendix F

# WindPro Shadow Flicker Results

Project:
**SF_V112_94HH**

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**HDR**
701 Xenia Av. So. Suite 600
US-MINNEAPOLI MN 55416

Anjali Malhotra / Anjali.Malhotra@hdrinc.com
Calculated:
12/1/2010 2:26 PM/2.7.473

# SHADOW - Main Result

**Calculation:** Vestas V112 94HH

## Assumptions for shadow calculations

| | | |
|---|---|---|
| Maximum distance for influence | 2,000 | m |
| Minimum sun height over horizon for influence | 3 | ° |
| Day step for calculation | 1 | days |
| Time step for calculation | 1 | minutes |

Sunshine probability S (Average daily sunshine hours) [BISMARCK]

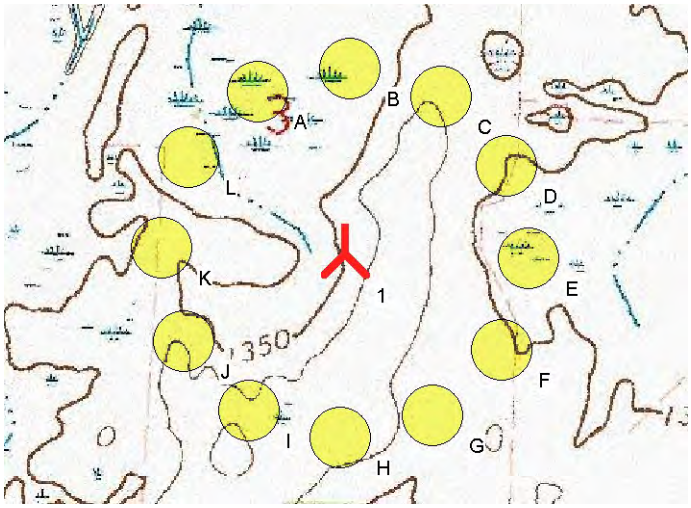
| Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 4.92 | 5.13 | 7.45 | 8.03 | 10.20 | 11.21 | 11.69 | 10.35 | 8.68 | 5.69 | 4.02 | 3.69 |

Operational time

| N | NNE | ENE | E | ESE | SSE | S | SSW | WSW | W | WNW | NNW | Sum |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 817 | 449 | 416 | 498 | 873 | 941 | 956 | 515 | 418 | 782 | 1,014 | 1,081 | 8,760 |

Idle start wind speed: Cut in wind speed from power curve

A ZVI (Zones of Visual Influence) calculation is performed before flicker calculation so non visible WTG do not contribute to calculated flicker values. A WTG will be visible if it is visible from any part of the receiver window. The ZVI calculation is based on the following assumptions:
Height contours used: Height Contours: Contour_m.wpo (6)
Obstacles used in calculation
Eye height: 1.5 m
Grid resolution: 10 m




Scale 1:12,500
New WTG
Shadow receptor

## WTGs

| | UTM NAD83 Zone: 15 East | North | Z | Row data/Description | Valid | WTG type Manufact. | Type-generator | Power, rated | Rotor diameter | Hub height | RPM |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | UTM NAD83 Zone: 15 | | [m] | | | | | [kW] | [m] | [m] | [RPM] |
| 1 | 339,085.16 | 5,058,695.19 | 412.5 | VESTAS V112 3000 112.0 !O! hub:... | Yes | VESTAS | V112-3,000 | 3,000 | 112.0 | 94.0 | 12.8 |

## Shadow receptor-Input

| No. | UTM NAD83 Zone: 15 East | North | Z | Width | Height | Height a.g.l. | Degrees from south cw | Slope of window | Direction mode |
|---|---|---|---|---|---|---|---|---|---|
| | | | [m] | [m] | [m] | [m] | [°] | [°] | |
| A | 338,939.97 | 5,058,963.00 | 411.5 | 1.0 | 1.0 | 1.0 | -180.0 | 90.0 | "Green house mode" |
| B | 339,093.34 | 5,058,999.84 | 411.5 | 1.0 | 1.0 | 1.0 | -180.0 | 90.0 | "Green house mode" |
| C | 339,244.51 | 5,058,954.82 | 414.3 | 1.0 | 1.0 | 1.0 | -180.0 | 90.0 | "Green house mode" |
| D | 339,352.98 | 5,058,840.37 | 412.5 | 1.0 | 1.0 | 1.0 | -180.0 | 90.0 | "Green house mode" |
| E | 339,389.82 | 5,058,687.00 | 411.5 | 1.0 | 1.0 | 1.0 | -180.0 | 90.0 | "Green house mode" |
| F | 339,344.80 | 5,058,535.83 | 413.1 | 1.0 | 1.0 | 1.0 | -180.0 | 90.0 | "Green house mode" |
| G | 339,230.35 | 5,058,427.36 | 414.2 | 1.0 | 1.0 | 1.0 | -180.0 | 90.0 | "Green house mode" |
| H | 339,076.98 | 5,058,390.52 | 414.5 | 1.0 | 1.0 | 1.0 | -180.0 | 90.0 | "Green house mode" |
| I | 338,925.81 | 5,058,435.54 | 416.0 | 1.0 | 1.0 | 1.0 | -180.0 | 90.0 | "Green house mode" |
| J | 338,817.34 | 5,058,549.99 | 413.7 | 1.0 | 1.0 | 1.0 | -180.0 | 90.0 | "Green house mode" |
| K | 338,780.50 | 5,058,703.36 | 411.8 | 1.0 | 1.0 | 1.0 | -180.0 | 90.0 | "Green house mode" |
| L | 338,825.52 | 5,058,854.53 | 411.5 | 1.0 | 1.0 | 1.0 | -180.0 | 90.0 | "Green house mode" |

## Calculation Results

Shadow receptor

| No. | Shadow, worst case Shadow hours per year [h/year] | Shadow days per year [days/year] | Max shadow hours per day [h/day] | Shadow, expected values Shadow hours per year [h/year] |
|---|---|---|---|---|
| A | 146:30 | 114 | 1:28 | 48:19 |

*To be continued on next page...*

Project:
**SF_V112_94HH**

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US-MINNEAPOLI MN 55416

Anjali Malhotra / Anjali.Malhotra@hdrinc.com
Calculated:
12/1/2010 2:26 PM/2.7.473

# SHADOW - Main Result

**Calculation:** Vestas V112 94HH

*...continued from previous page*

| No. | Shadow, worst case: Shadow hours per year [h/year] | Shadow, worst case: Shadow days per year [days/year] | Shadow, worst case: Max shadow hours per day [h/day] | Shadow, expected values: Shadow hours per year [h/year] |
|---|---|---|---|---|
| B | 86:51 | 76 | 1:24 | 24:51 |
| C | 143:57 | 112 | 1:29 | 37:26 |
| D | 115:41 | 111 | 1:22 | 36:48 |
| E | 137:49 | 135 | 1:22 | 62:28 |
| F | 15:06 | 31 | 0:37 | 7:59 |
| G | 0:00 | 0 | 0:00 | 0:00 |
| H | 0:00 | 0 | 0:00 | 0:00 |
| I | 0:00 | 0 | 0:00 | 0:00 |
| J | 17:58 | 34 | 0:41 | 7:31 |
| K | 136:57 | 134 | 1:22 | 62:00 |
| L | 115:07 | 109 | 1:22 | 46:24 |

Total amount of flickering on the shadow receptors caused by each WTG

| No. | Name | Worst case [h/year] | Expected [h/year] |
|---|---|---|---|
| 1 | VESTAS V112 3000 112.0 !O! hub: 94.0 m (1) | 915:55 | 333:51 |

Project:
**SF_V112_94HH**

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Calculated:
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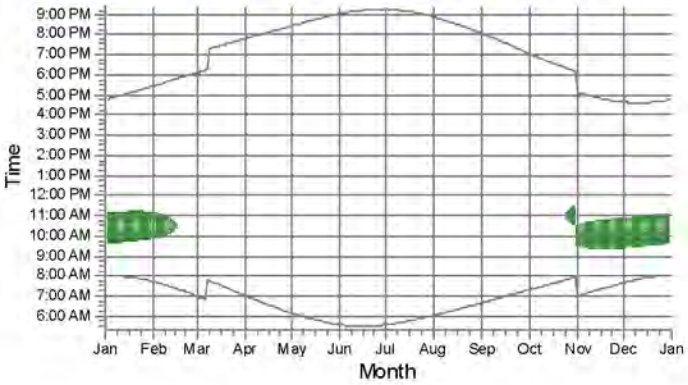
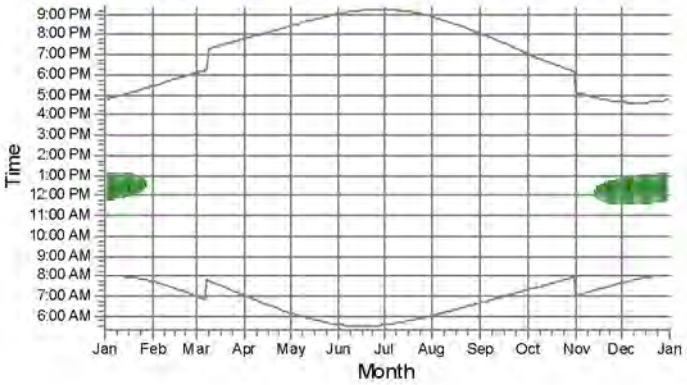
## SHADOW - Calendar, graphical

**Calculation:** Vestas V112 94HH

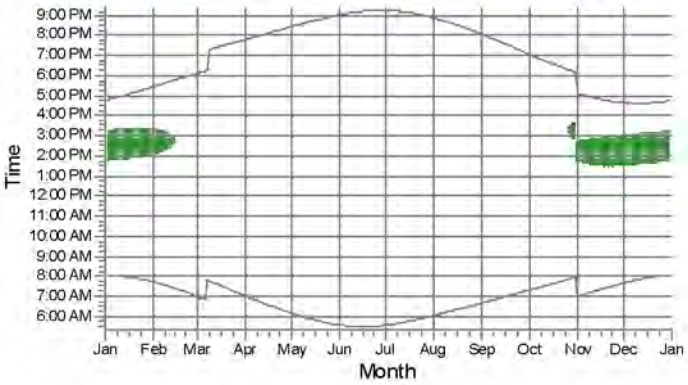
A: Shadow Receptor: 1.0 × 1.0 Azimuth: -180.0° Slope: 90.0° (2)



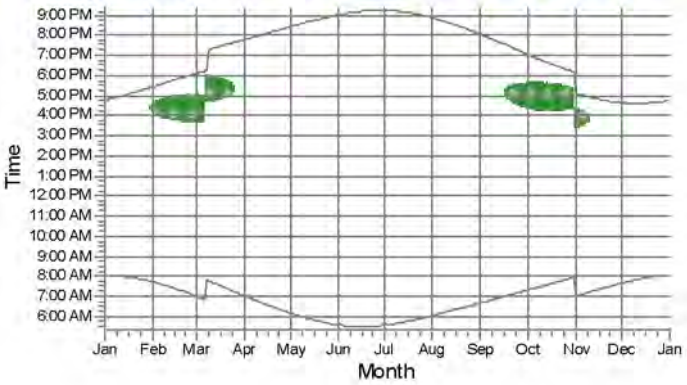

B: Shadow Receptor: 1.0 × 1.0 Azimuth: -180.0° Slope: 90.0° (3)



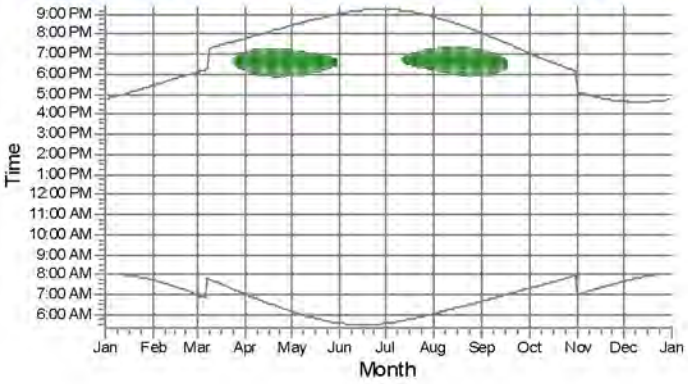

C: Shadow Receptor: 1.0 × 1.0 Azimuth: -180.0° Slope: 90.0° (4)



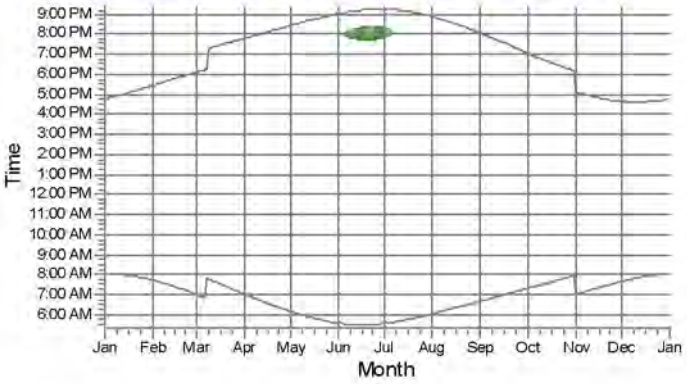

D: Shadow Receptor: 1.0 × 1.0 Azimuth: -180.0° Slope: 90.0° (5)




E: Shadow Receptor: 1.0 × 1.0 Azimuth: -180.0° Slope: 90.0° (6)




F: Shadow Receptor: 1.0 × 1.0 Azimuth: -180.0° Slope: 90.0° (7)




WTGs

1: VESTAS V112 3000 112.0 !O! hub: 94.0 m (1)

Project:
**SF_V112_94HH**

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Anjali Malhotra / Anjali.Malhotra@hdrinc.com

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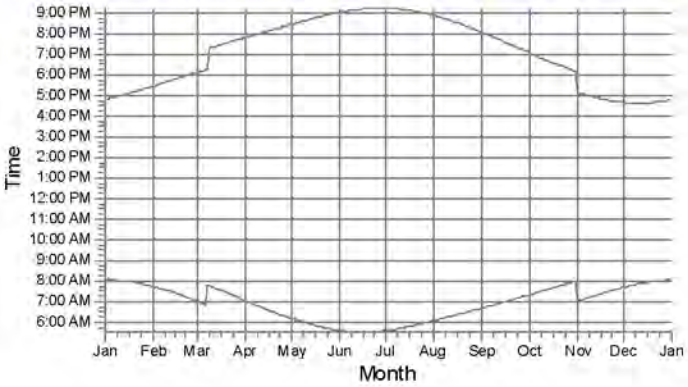
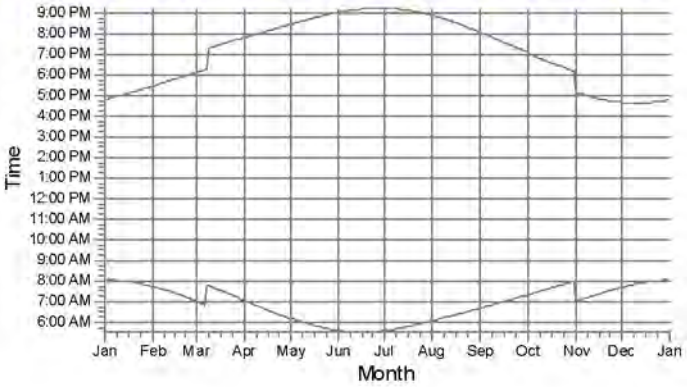
## SHADOW - Calendar, graphical

**Calculation:** Vestas V112 94HH

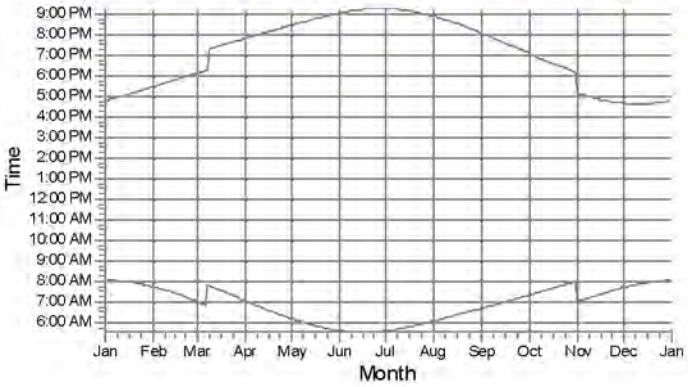
G: Shadow Receptor: 1.0 × 1.0 Azimuth: -180.0° Slope: 90.0° (8)



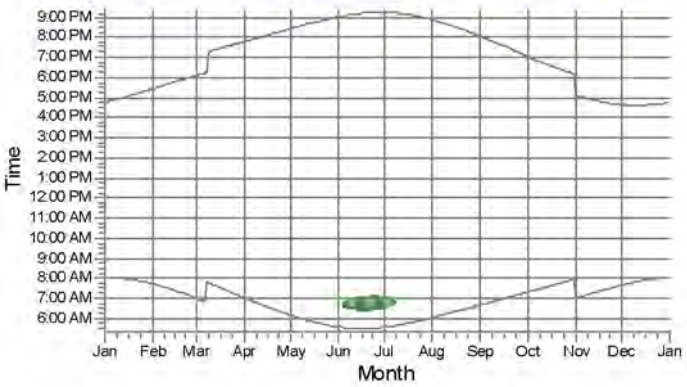

H: Shadow Receptor: 1.0 × 1.0 Azimuth: -180.0° Slope: 90.0° (9)



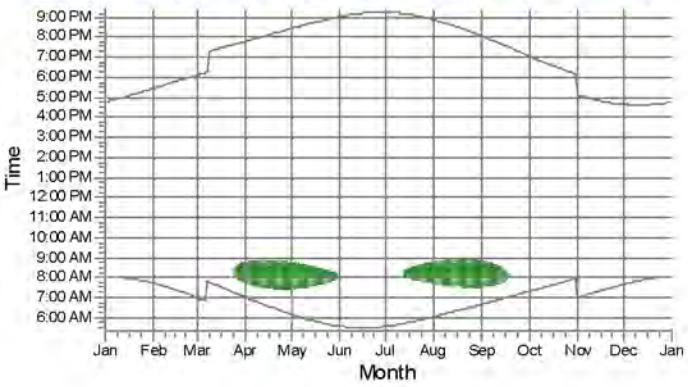

I: Shadow Receptor: 1.0 × 1.0 Azimuth: -180.0° Slope: 90.0° (10)



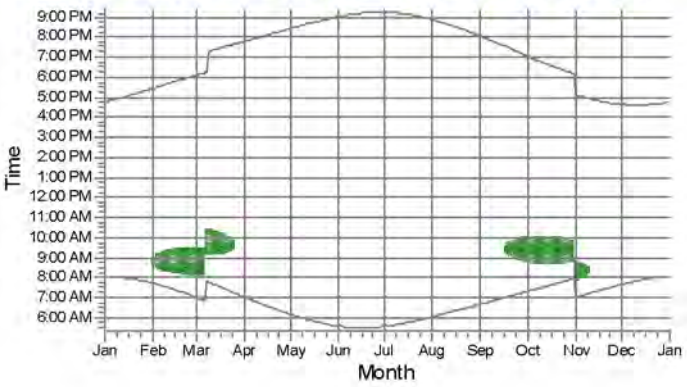

J: Shadow Receptor: 1.0 × 1.0 Azimuth: -180.0° Slope: 90.0° (11)




K: Shadow Receptor: 1.0 × 1.0 Azimuth: -180.0° Slope: 90.0° (12)




L: Shadow Receptor: 1.0 × 1.0 Azimuth: -180.0° Slope: 90.0° (13)




WTGs

1: VESTAS V112 3000 112.0 !O! hub: 94.0 m (1)

Project:
**SF_V112_84HH**

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Anjali Malhotra / Anjali.Malhotra@hdrinc.com

Calculated:
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# SHADOW - Main Result

**Calculation:** V112, HH84, RD 112m_new

## Assumptions for shadow calculations

| | | |
|---|---|---|
| Maximum distance for influence | 2,000 | m |
| Minimum sun height over horizon for influence | 3 | ° |
| Day step for calculation | 1 | days |
| Time step for calculation | 1 | minutes |

Sunshine probability S (Average daily sunshine hours) [BISMARCK]

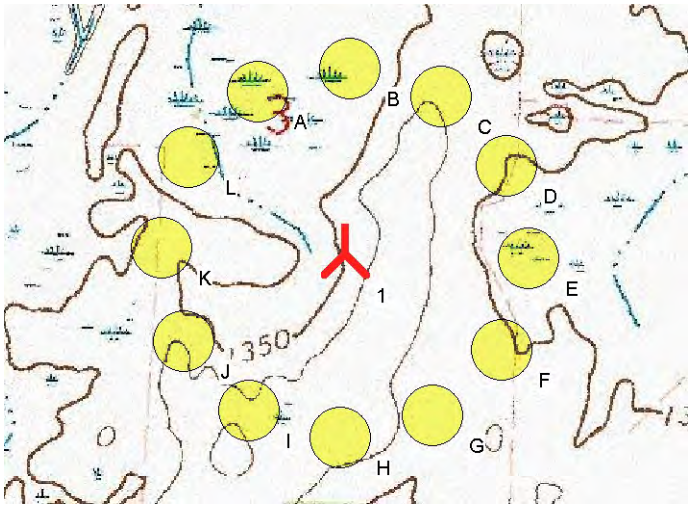
| Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 4.92 | 5.13 | 7.45 | 8.03 | 10.20 | 11.21 | 11.69 | 10.35 | 8.68 | 5.69 | 4.02 | 3.69 |

Operational time

| N | NNE | ENE | E | ESE | SSE | S | SSW | WSW | W | WNW | NNW | Sum |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 817 | 449 | 416 | 498 | 873 | 941 | 956 | 515 | 418 | 782 | 1,014 | 1,081 | 8,760 |

Idle start wind speed: Cut in wind speed from power curve

A ZVI (Zones of Visual Influence) calculation is performed before flicker calculation so non visible WTG do not contribute to calculated flicker values. A WTG will be visible if it is visible from any part of the receiver window. The ZVI calculation is based on the following assumptions:
Height contours used: Height Contours: Contour_m.wpo (6)
Obstacles used in calculation
Eye height: 1.5 m
Grid resolution: 10 m




Scale 1:12,500
New WTG
Shadow receptor

## WTGs

| | UTM NAD83 Zone: 15 East | North | Z | Row data/Description | Valid | WTG type Manufact. | Type-generator | Power, rated | Rotor diameter | Hub height | RPM |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | UTM NAD83 Zone: 15 | | [m] | | | | | [kW] | [m] | [m] | [RPM] |
| 1 | 339,085.16 | 5,058,695.19 | 412.5 | VESTAS V112 3000 112.0 !O! hub:... | Yes | VESTAS | V112-3,000 | 3,000 | 112.0 | 84.0 | 12.8 |

## Shadow receptor-Input

| No. | UTM NAD83 Zone: 15 East | North | Z | Width | Height | Height a.g.l. | Degrees from south cw | Slope of window | Direction mode |
|---|---|---|---|---|---|---|---|---|---|
| | | | [m] | [m] | [m] | [m] | [°] | [°] | |
| A | 338,939.97 | 5,058,963.00 | 411.5 | 1.0 | 1.0 | 1.0 | -180.0 | 90.0 | "Green house mode" |
| B | 339,093.34 | 5,058,999.84 | 411.5 | 1.0 | 1.0 | 1.0 | -180.0 | 90.0 | "Green house mode" |
| C | 339,244.51 | 5,058,954.82 | 414.3 | 1.0 | 1.0 | 1.0 | -180.0 | 90.0 | "Green house mode" |
| D | 339,352.98 | 5,058,840.37 | 412.5 | 1.0 | 1.0 | 1.0 | -180.0 | 90.0 | "Green house mode" |
| E | 339,389.82 | 5,058,687.00 | 411.5 | 1.0 | 1.0 | 1.0 | -180.0 | 90.0 | "Green house mode" |
| F | 339,344.80 | 5,058,535.83 | 413.1 | 1.0 | 1.0 | 1.0 | -180.0 | 90.0 | "Green house mode" |
| G | 339,230.35 | 5,058,427.36 | 414.2 | 1.0 | 1.0 | 1.0 | -180.0 | 90.0 | "Green house mode" |
| H | 339,076.98 | 5,058,390.52 | 414.5 | 1.0 | 1.0 | 1.0 | -180.0 | 90.0 | "Green house mode" |
| I | 338,925.81 | 5,058,435.54 | 416.0 | 1.0 | 1.0 | 1.0 | -180.0 | 90.0 | "Green house mode" |
| J | 338,817.34 | 5,058,549.99 | 413.7 | 1.0 | 1.0 | 1.0 | -180.0 | 90.0 | "Green house mode" |
| K | 338,780.50 | 5,058,703.36 | 411.8 | 1.0 | 1.0 | 1.0 | -180.0 | 90.0 | "Green house mode" |
| L | 338,825.52 | 5,058,854.53 | 411.5 | 1.0 | 1.0 | 1.0 | -180.0 | 90.0 | "Green house mode" |

## Calculation Results

Shadow receptor

| No. | Shadow, worst case Shadow hours per year [h/year] | Shadow days per year [days/year] | Max shadow hours per day [h/day] | Shadow, expected values Shadow hours per year [h/year] |
|---|---|---|---|---|
| A | 135:10 | 106 | 1:30 | 44:23 |

*To be continued on next page...*

Project:
**SF_V112_84HH**

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Anjali Malhotra / Anjali.Malhotra@hdrinc.com
Calculated:
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# SHADOW - Main Result

**Calculation:** V112, HH84, RD 112m_new

*...continued from previous page*

| No. | Shadow, worst case: Shadow hours per year [h/year] | Shadow, worst case: Shadow days per year [days/year] | Shadow, worst case: Max shadow hours per day [h/day] | Shadow, expected values: Shadow hours per year [h/year] |
|---|---|---|---|---|
| B | 64:50 | 64 | 1:16 | 18:23 |
| C | 131:47 | 104 | 1:30 | 34:08 |
| D | 122:28 | 115 | 1:23 | 37:53 |
| E | 133:44 | 129 | 1:23 | 60:05 |
| F | 38:12 | 51 | 0:57 | 20:21 |
| G | 0:00 | 0 | 0:00 | 0:00 |
| H | 0:00 | 0 | 0:00 | 0:00 |
| I | 0:00 | 0 | 0:00 | 0:00 |
| J | 41:04 | 53 | 0:59 | 17:17 |
| K | 133:12 | 128 | 1:23 | 59:47 |
| L | 121:54 | 115 | 1:23 | 47:47 |

Total amount of flickering on the shadow receptors caused by each WTG

| No. | Name | Worst case [h/year] | Expected [h/year] |
|---|---|---|---|
| 1 | VESTAS V112 3000 112.0 !O! hub: 94.0 m (1) | 922:21 | 340:09 |

Project:
**SF_V112_84HH**

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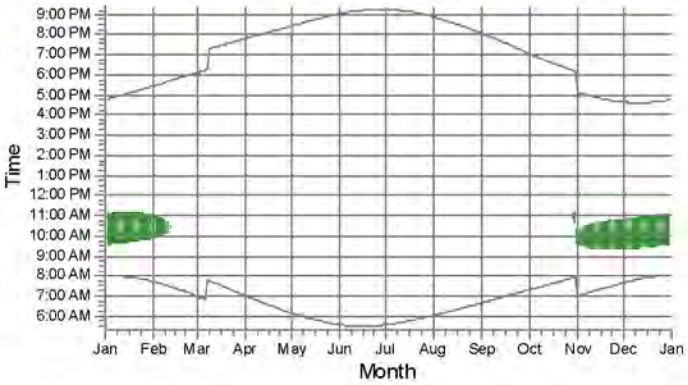
12/1/2010 12:03 PM/2.7.473

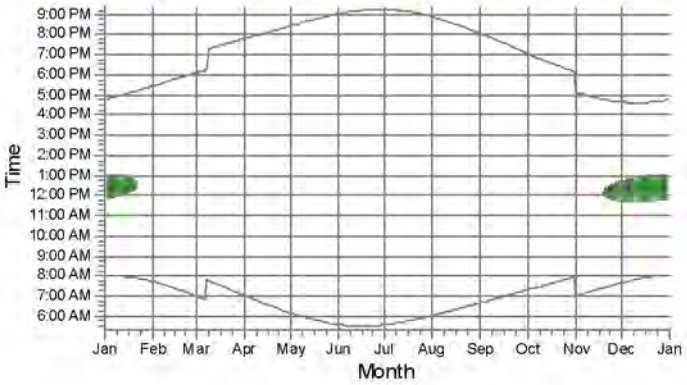
## SHADOW - Calendar, graphical

**Calculation:** V112, HH84, RD 112m_new

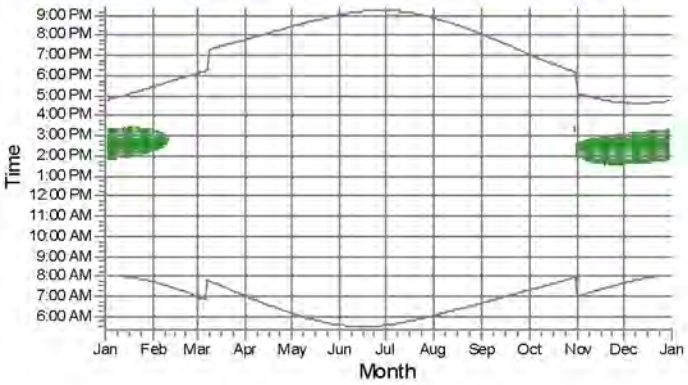
A: Shadow Receptor: 1.0 × 1.0 Azimuth: -180.0° Slope: 90.0° (2)



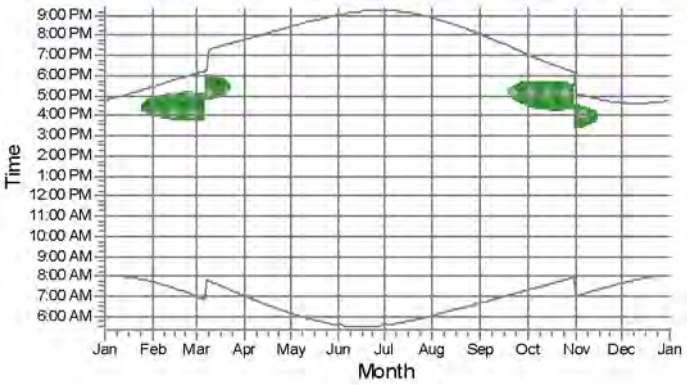

B: Shadow Receptor: 1.0 × 1.0 Azimuth: -180.0° Slope: 90.0° (3)



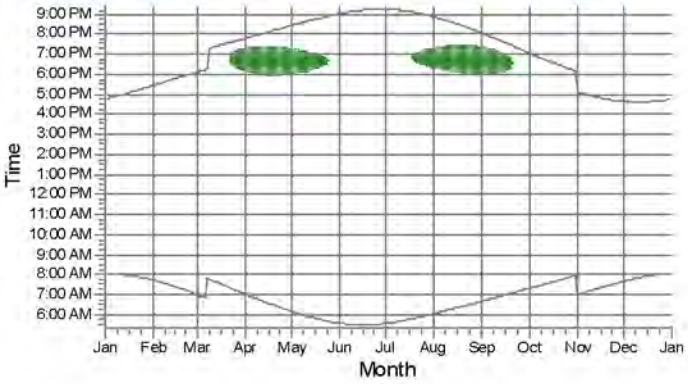

C: Shadow Receptor: 1.0 × 1.0 Azimuth: -180.0° Slope: 90.0° (4)



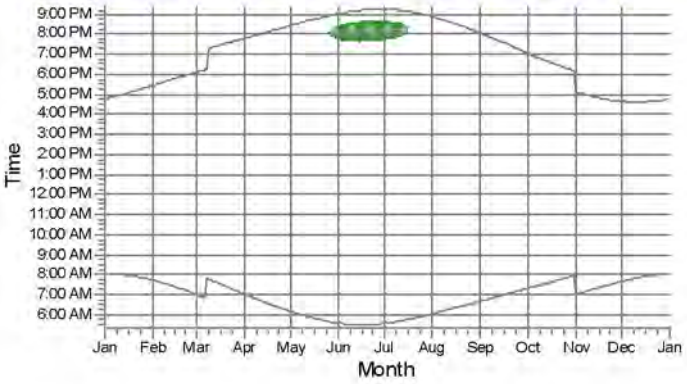

D: Shadow Receptor: 1.0 × 1.0 Azimuth: -180.0° Slope: 90.0° (5)




E: Shadow Receptor: 1.0 × 1.0 Azimuth: -180.0° Slope: 90.0° (6)




F: Shadow Receptor: 1.0 × 1.0 Azimuth: -180.0° Slope: 90.0° (7)




WTGs

1: VESTAS V112 3000 112.0 !O! hub: 94.0 m (1)

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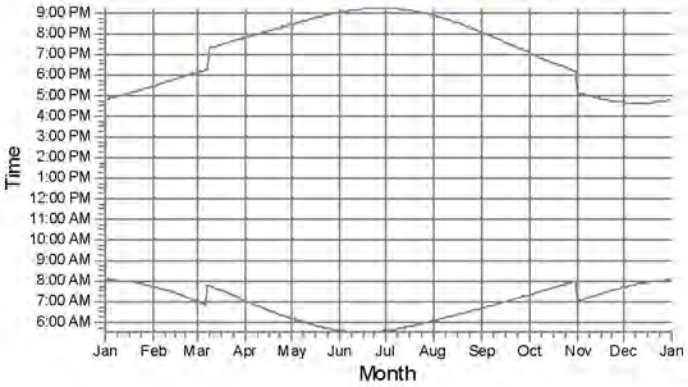
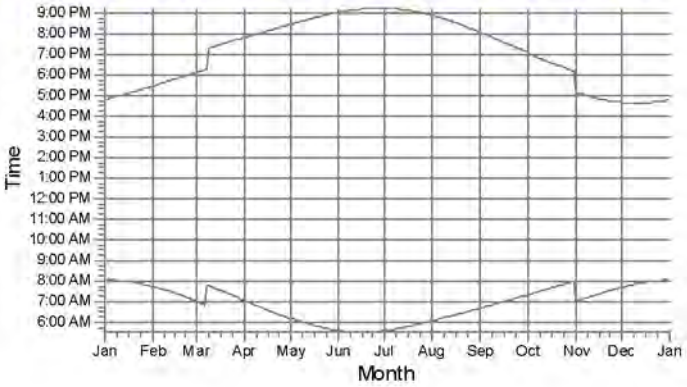
## SHADOW - Calendar, graphical

**Calculation:** V112, HH84, RD 112m_new

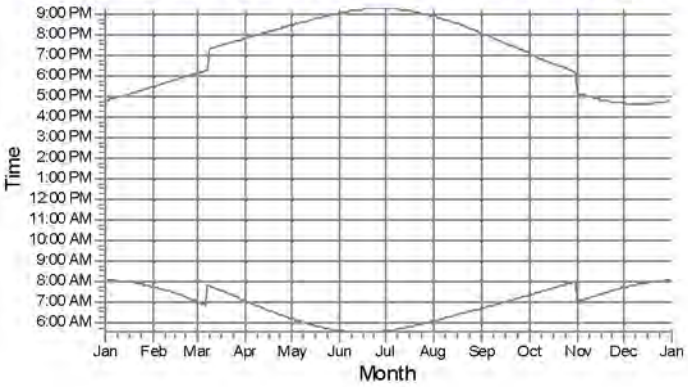
G: Shadow Receptor: 1.0 × 1.0 Azimuth: -180.0° Slope: 90.0° (8)



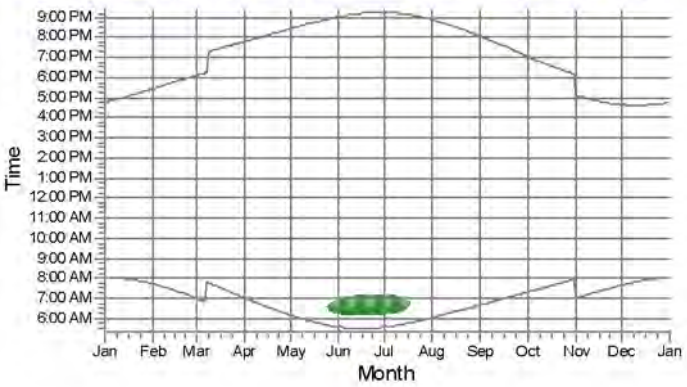

H: Shadow Receptor: 1.0 × 1.0 Azimuth: -180.0° Slope: 90.0° (9)



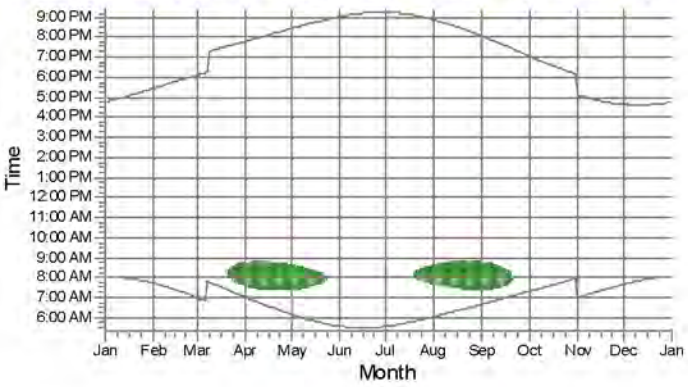

I: Shadow Receptor: 1.0 × 1.0 Azimuth: -180.0° Slope: 90.0° (10)



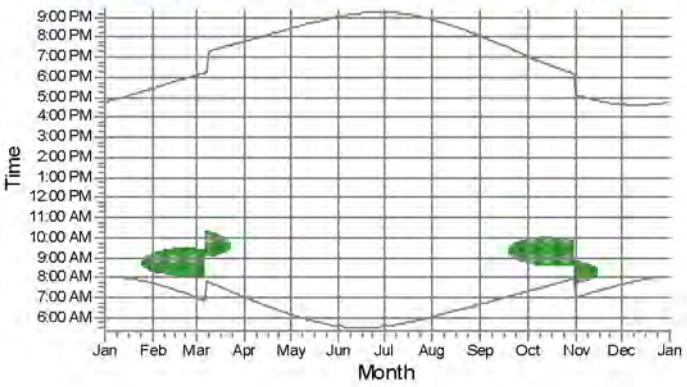

J: Shadow Receptor: 1.0 × 1.0 Azimuth: -180.0° Slope: 90.0° (11)




K: Shadow Receptor: 1.0 × 1.0 Azimuth: -180.0° Slope: 90.0° (12)




L: Shadow Receptor: 1.0 × 1.0 Azimuth: -180.0° Slope: 90.0° (13)




WTGs

1: VESTAS V112 3000 112.0 !O! hub: 94.0 m (1)

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**SF_V90_95HH**

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# SHADOW - Main Result

**Calculation:** Vestas V90, 95 HH, RD 90

## Assumptions for shadow calculations

| | | |
|---|---|---|
| Maximum distance for influence | 2,000 | m |
| Minimum sun height over horizon for influence | 3 | ° |
| Day step for calculation | 1 | days |
| Time step for calculation | 1 | minutes |

Sunshine probability S (Average daily sunshine hours) [BISMARCK]

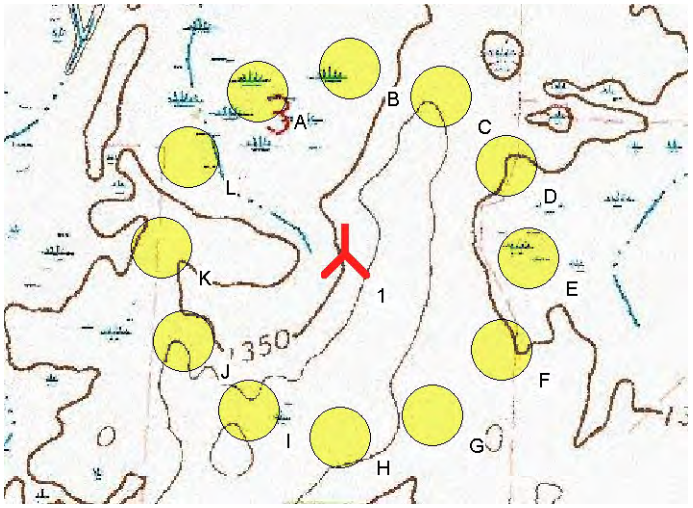
| Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 4.92 | 5.13 | 7.45 | 8.03 | 10.20 | 11.21 | 11.69 | 10.35 | 8.68 | 5.69 | 4.02 | 3.69 |

Operational time

| N | NNE | ENE | E | ESE | SSE | S | SSW | WSW | W | WNW | NNW | Sum |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 817 | 449 | 416 | 498 | 873 | 941 | 956 | 515 | 418 | 782 | 1,014 | 1,081 | 8,760 |

Idle start wind speed: Cut in wind speed from power curve

A ZVI (Zones of Visual Influence) calculation is performed before flicker calculation so non visible WTG do not contribute to calculated flicker values. A WTG will be visible if it is visible from any part of the receiver window. The ZVI calculation is based on the following assumptions:
Height contours used: Height Contours: Contour_m.wpo (6)
Obstacles used in calculation
Eye height: 1.5 m
Grid resolution: 10 m




Scale 1:12,500
New WTG  Shadow receptor

## WTGs

| | UTM NAD83 Zone: 15 | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | East | North | Z | Row data/Description | Valid | Manufact. | Type-generator | Power, rated | Rotor diameter | Hub height | RPM |
| | UTM NAD83 Zone: 15 | | [m] | | | | | [kW] | [m] | [m] | [RPM] |
| 1 | 339,085.16 | 5,058,695.19 | 412.5 | VESTAS V90 1800 90.0 !O! hub: 9... | Yes | VESTAS | V90-1,800 | 1,800 | 90.0 | 95.0 | 14.9 |

## Shadow receptor-Input

| | UTM NAD83 Zone: 15 | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| No. | East | North | Z | Width | Height | Height a.g.l. | Degrees from south cw | Slope of window | Direction mode |
| | | | [m] | [m] | [m] | [m] | [°] | [°] | |
| A | 338,939.97 | 5,058,963.00 | 411.5 | 1.0 | 1.0 | 1.0 | -180.0 | 90.0 | "Green house mode" |
| B | 339,093.34 | 5,058,999.84 | 411.5 | 1.0 | 1.0 | 1.0 | -180.0 | 90.0 | "Green house mode" |
| C | 339,244.51 | 5,058,954.82 | 414.3 | 1.0 | 1.0 | 1.0 | -180.0 | 90.0 | "Green house mode" |
| D | 339,352.98 | 5,058,840.37 | 412.5 | 1.0 | 1.0 | 1.0 | -180.0 | 90.0 | "Green house mode" |
| E | 339,389.82 | 5,058,687.00 | 411.5 | 1.0 | 1.0 | 1.0 | -180.0 | 90.0 | "Green house mode" |
| F | 339,344.80 | 5,058,535.83 | 413.1 | 1.0 | 1.0 | 1.0 | -180.0 | 90.0 | "Green house mode" |
| G | 339,230.35 | 5,058,427.36 | 414.2 | 1.0 | 1.0 | 1.0 | -180.0 | 90.0 | "Green house mode" |
| H | 339,076.98 | 5,058,390.52 | 414.5 | 1.0 | 1.0 | 1.0 | -180.0 | 90.0 | "Green house mode" |
| I | 338,925.81 | 5,058,435.54 | 416.0 | 1.0 | 1.0 | 1.0 | -180.0 | 90.0 | "Green house mode" |
| J | 338,817.34 | 5,058,549.99 | 413.7 | 1.0 | 1.0 | 1.0 | -180.0 | 90.0 | "Green house mode" |
| K | 338,780.50 | 5,058,703.36 | 411.8 | 1.0 | 1.0 | 1.0 | -180.0 | 90.0 | "Green house mode" |
| L | 338,825.52 | 5,058,854.53 | 411.5 | 1.0 | 1.0 | 1.0 | -180.0 | 90.0 | "Green house mode" |

## Calculation Results

Shadow receptor

| | Shadow, worst case | | | Shadow, expected values |
|---|---|---|---|---|
| No. | Shadow hours per year [h/year] | Shadow days per year [days/year] | Max shadow hours per day [h/day] | Shadow hours per year [h/year] |
| A | 108:17 | 104 | 1:11 | 35:34 |

*To be continued on next page...*

Project:
**SF_V90_95HH**

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# SHADOW - Main Result

**Calculation:** Vestas V90, 95 HH, RD 90

*...continued from previous page*

| No. | Shadow, worst case: Shadow hours per year [h/year] | Shadow, worst case: Shadow days per year [days/year] | Shadow, worst case: Max shadow hours per day [h/day] | Shadow, expected values: Shadow hours per year [h/year] |
|---|---|---|---|---|
| B | 55:29 | 64 | 1:05 | 15:45 |
| C | 106:12 | 102 | 1:11 | 27:32 |
| D | 73:35 | 87 | 1:06 | 23:33 |
| E | 86:34 | 104 | 1:06 | 39:01 |
| F | 0:00 | 0 | 0:00 | 0:00 |
| G | 0:00 | 0 | 0:00 | 0:00 |
| H | 0:00 | 0 | 0:00 | 0:00 |
| I | 0:00 | 0 | 0:00 | 0:00 |
| J | 0:00 | 0 | 0:00 | 0:00 |
| K | 86:05 | 103 | 1:06 | 38:45 |
| L | 73:19 | 87 | 1:06 | 29:44 |

Total amount of flickering on the shadow receptors caused by each WTG

| No. | Name | Worst case [h/year] | Expected [h/year] |
|---|---|---|---|
| 1 | VESTAS V90 1800 90.0 !O! hub: 95.0 m (1) | 589:31 | 209:56 |

Project:
**SF_V90_95HH**

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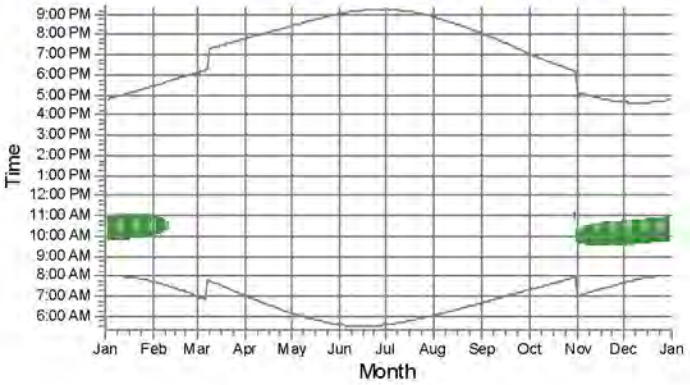
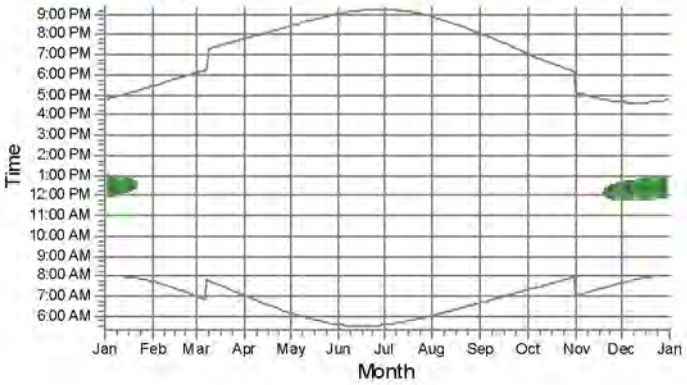
## SHADOW - Calendar, graphical

**Calculation:** Vestas V90, 95 HH, RD 90

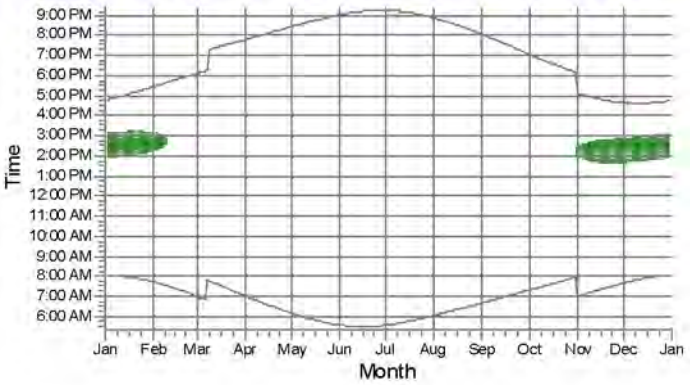
A: Shadow Receptor: 1.0 × 1.0 Azimuth: -180.0° Slope: 90.0° (2)



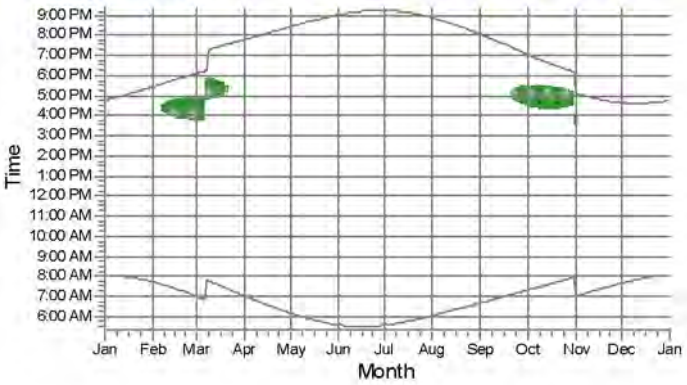

B: Shadow Receptor: 1.0 × 1.0 Azimuth: -180.0° Slope: 90.0° (3)



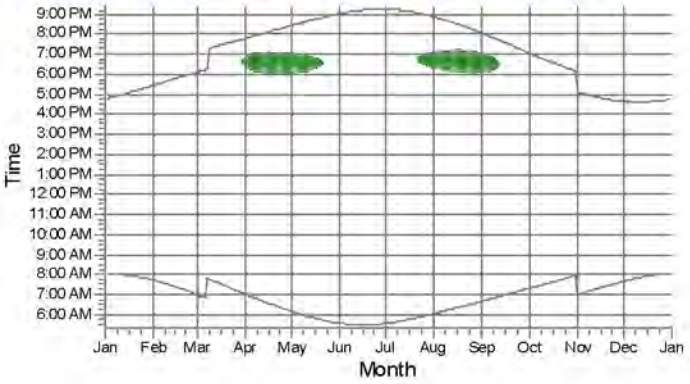

C: Shadow Receptor: 1.0 × 1.0 Azimuth: -180.0° Slope: 90.0° (4)



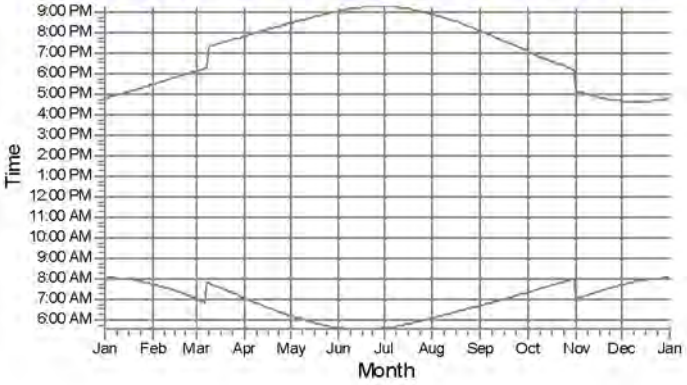

D: Shadow Receptor: 1.0 × 1.0 Azimuth: -180.0° Slope: 90.0° (5)




E: Shadow Receptor: 1.0 × 1.0 Azimuth: -180.0° Slope: 90.0° (6)




F: Shadow Receptor: 1.0 × 1.0 Azimuth: -180.0° Slope: 90.0° (7)




WTGs

1: VESTAS V90 1800 90.0 !O! hub: 95.0 m (1)

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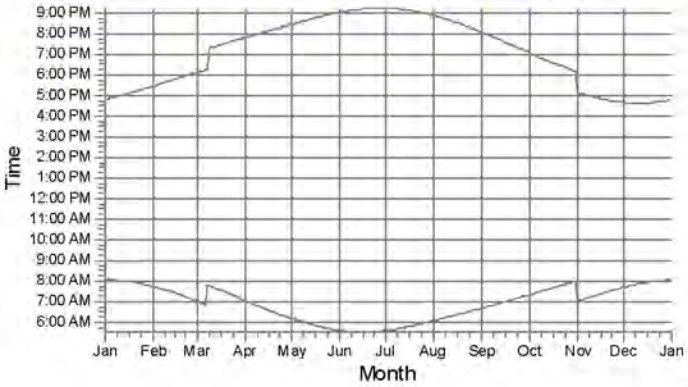
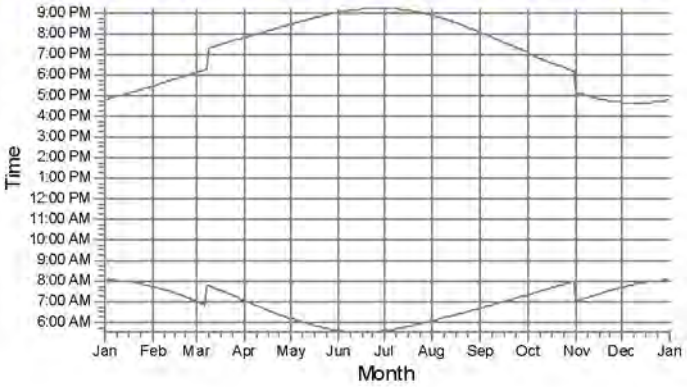
## SHADOW - Calendar, graphical

**Calculation:** Vestas V90, 95 HH, RD 90

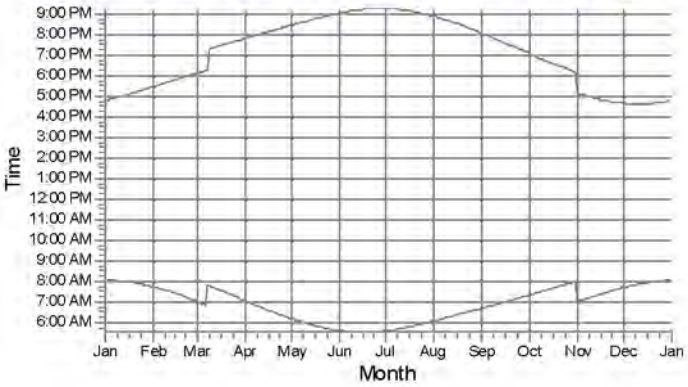
G: Shadow Receptor: 1.0 × 1.0 Azimuth: -180.0° Slope: 90.0° (8)



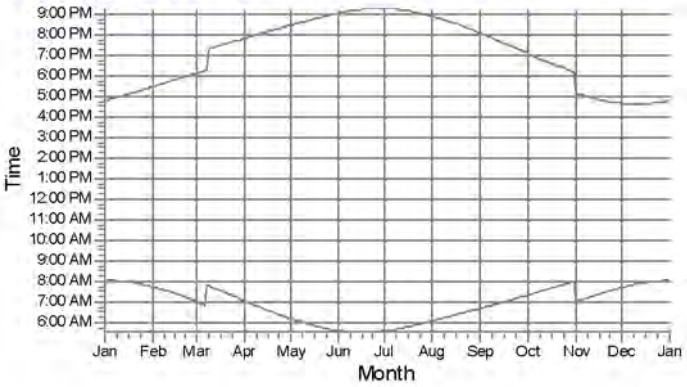

H: Shadow Receptor: 1.0 × 1.0 Azimuth: -180.0° Slope: 90.0° (9)



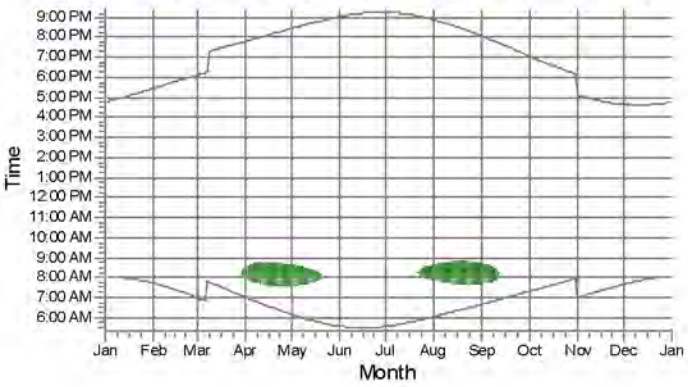

I: Shadow Receptor: 1.0 × 1.0 Azimuth: -180.0° Slope: 90.0° (10)



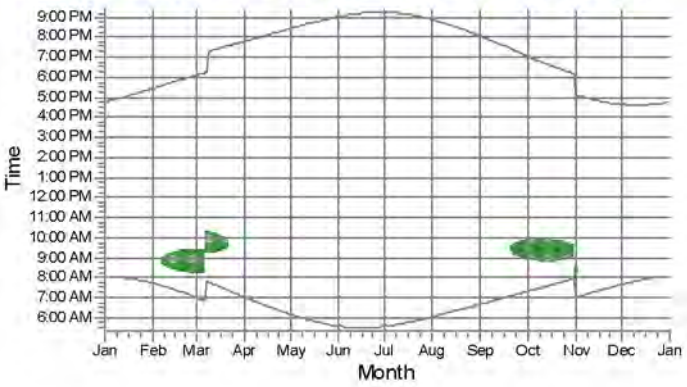

J: Shadow Receptor: 1.0 × 1.0 Azimuth: -180.0° Slope: 90.0° (11)




K: Shadow Receptor: 1.0 × 1.0 Azimuth: -180.0° Slope: 90.0° (12)




L: Shadow Receptor: 1.0 × 1.0 Azimuth: -180.0° Slope: 90.0° (13)




WTGs

1: VESTAS V90 1800 90.0 !O! hub: 95.0 m (1)

Project:
**SF_V90_80HH**

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# SHADOW - Main Result

**Calculation:** Vestas V90, 80 HH, RD 90

## Assumptions for shadow calculations

| | | |
|---|---|---|
| Maximum distance for influence | 2,000 | m |
| Minimum sun height over horizon for influence | 3 | ° |
| Day step for calculation | 1 | days |
| Time step for calculation | 1 | minutes |

Sunshine probability S (Average daily sunshine hours) [BISMARCK]

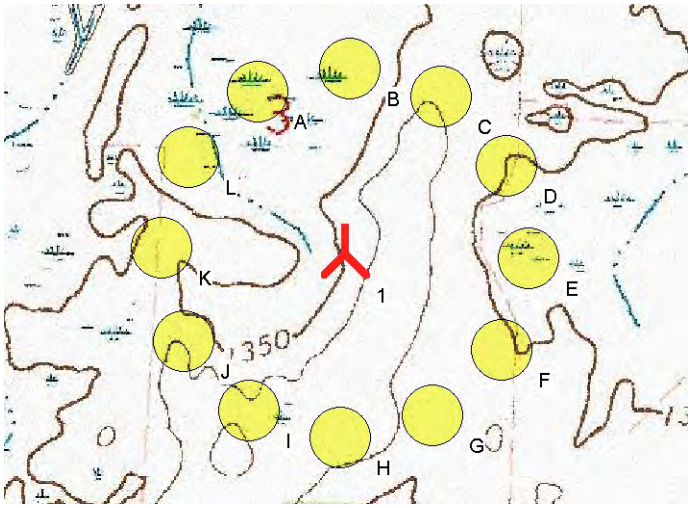
| Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 4.92 | 5.13 | 7.45 | 8.03 | 10.20 | 11.21 | 11.69 | 10.35 | 8.68 | 5.69 | 4.02 | 3.69 |

Operational time

| N | NNE | ENE | E | ESE | SSE | S | SSW | WSW | W | WNW | NNW | Sum |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 817 | 449 | 416 | 498 | 873 | 941 | 956 | 515 | 418 | 782 | 1,014 | 1,081 | 8,760 |

Idle start wind speed: Cut in wind speed from power curve

A ZVI (Zones of Visual Influence) calculation is performed before flicker calculation so non visible WTG do not contribute to calculated flicker values. A WTG will be visible if it is visible from any part of the receiver window. The ZVI calculation is based on the following assumptions:
Height contours used: Height Contours: Contour_m.wpo (6)
Obstacles used in calculation
Eye height: 1.5 m
Grid resolution: 10 m




Scale 1:12,500

New WTG  Shadow receptor

## WTGs

| | UTM NAD83 Zone: 15 East | North | Z | Row data/Description | Valid | WTG type Manufact. | Type-generator | Power, rated | Rotor diameter | Hub height | RPM |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | UTM NAD83 Zone: 15 | | [m] | | | | | [kW] | [m] | [m] | [RPM] |
| 1 | 339,085.16 | 5,058,695.19 | 412.5 | VESTAS V90 1800 90.0 !O! hub: 8... | Yes | VESTAS | V90-1,800 | 1,800 | 90.0 | 80.0 | 14.9 |

## Shadow receptor-Input

| No. | UTM NAD83 Zone: 15 East | North | Z | Width | Height | Height a.g.l. | Degrees from south cw | Slope of window | Direction mode |
|---|---|---|---|---|---|---|---|---|---|
| | | | [m] | [m] | [m] | [m] | [°] | [°] | |
| A | 338,939.97 | 5,058,963.00 | 411.5 | 1.0 | 1.0 | 1.0 | -180.0 | 90.0 | "Green house mode" |
| B | 339,093.34 | 5,058,999.84 | 411.5 | 1.0 | 1.0 | 1.0 | -180.0 | 90.0 | "Green house mode" |
| C | 339,244.51 | 5,058,954.82 | 414.3 | 1.0 | 1.0 | 1.0 | -180.0 | 90.0 | "Green house mode" |
| D | 339,352.98 | 5,058,840.37 | 412.5 | 1.0 | 1.0 | 1.0 | -180.0 | 90.0 | "Green house mode" |
| E | 339,389.82 | 5,058,687.00 | 411.5 | 1.0 | 1.0 | 1.0 | -180.0 | 90.0 | "Green house mode" |
| F | 339,344.80 | 5,058,535.83 | 413.1 | 1.0 | 1.0 | 1.0 | -180.0 | 90.0 | "Green house mode" |
| G | 339,230.35 | 5,058,427.36 | 414.2 | 1.0 | 1.0 | 1.0 | -180.0 | 90.0 | "Green house mode" |
| H | 339,076.98 | 5,058,390.52 | 414.5 | 1.0 | 1.0 | 1.0 | -180.0 | 90.0 | "Green house mode" |
| I | 338,925.81 | 5,058,435.54 | 416.0 | 1.0 | 1.0 | 1.0 | -180.0 | 90.0 | "Green house mode" |
| J | 338,817.34 | 5,058,549.99 | 413.7 | 1.0 | 1.0 | 1.0 | -180.0 | 90.0 | "Green house mode" |
| K | 338,780.50 | 5,058,703.36 | 411.8 | 1.0 | 1.0 | 1.0 | -180.0 | 90.0 | "Green house mode" |
| L | 338,825.52 | 5,058,854.53 | 411.5 | 1.0 | 1.0 | 1.0 | -180.0 | 90.0 | "Green house mode" |

## Calculation Results

Shadow receptor

| No. | Shadow, worst case Shadow hours per year [h/year] | Shadow days per year [days/year] | Max shadow hours per day [h/day] | Shadow, expected values Shadow hours per year [h/year] |
|---|---|---|---|---|
| A | 92:25 | 90 | 1:13 | 30:18 |

*To be continued on next page...*

Project:
**SF_V90_80HH**

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# SHADOW - Main Result

**Calculation:** Vestas V90, 80 HH, RD 90

*...continued from previous page*

| No. | Shadow, worst case: Shadow hours per year [h/year] | Shadow, worst case: Shadow days per year [days/year] | Shadow, worst case: Max shadow hours per day [h/day] | Shadow, expected values: Shadow hours per year [h/year] |
|---|---|---|---|---|
| B | 22:42 | 38 | 0:45 | 6:14 |
| C | 89:14 | 88 | 1:13 | 23:05 |
| D | 79:43 | 93 | 1:07 | 24:17 |
| E | 84:06 | 99 | 1:07 | 37:22 |
| F | 10:44 | 28 | 0:29 | 5:40 |
| G | 0:00 | 0 | 0:00 | 0:00 |
| H | 0:00 | 0 | 0:00 | 0:00 |
| I | 0:00 | 0 | 0:00 | 0:00 |
| J | 13:21 | 31 | 0:32 | 5:35 |
| K | 83:47 | 98 | 1:07 | 37:11 |
| L | 79:14 | 92 | 1:07 | 30:36 |

Total amount of flickering on the shadow receptors caused by each WTG

| No. | Name | Worst case [h/year] | Expected [h/year] |
|---|---|---|---|
| 1 | VESTAS V90 1800 90.0 !O! hub: 80.0 m (1) | 555:16 | 200:21 |

Project:
**SF_V90_80HH**

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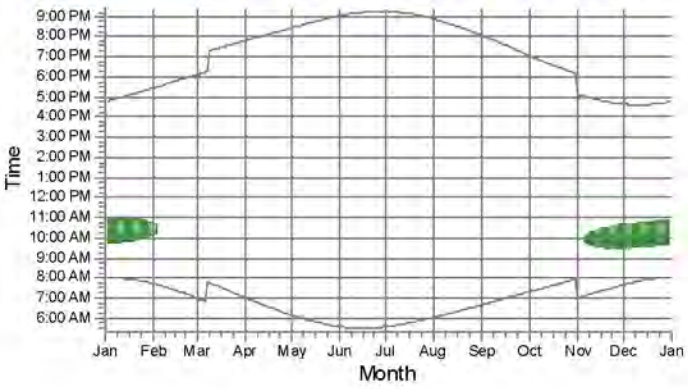
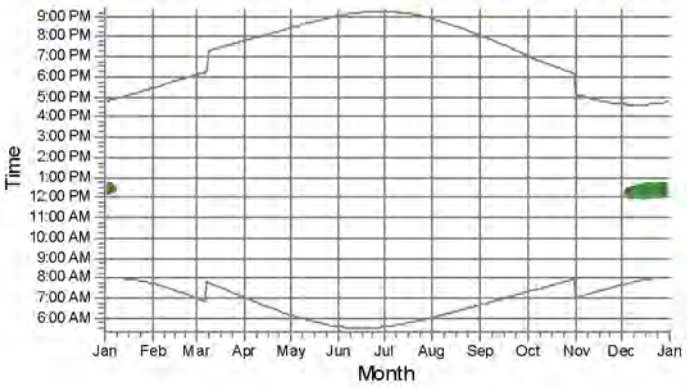
## SHADOW - Calendar, graphical

**Calculation:** Vestas V90, 80 HH, RD 90

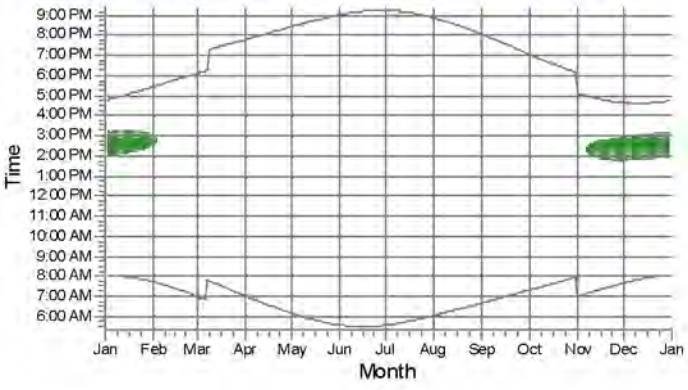
A: Shadow Receptor: 1.0 × 1.0 Azimuth: -180.0° Slope: 90.0° (2)



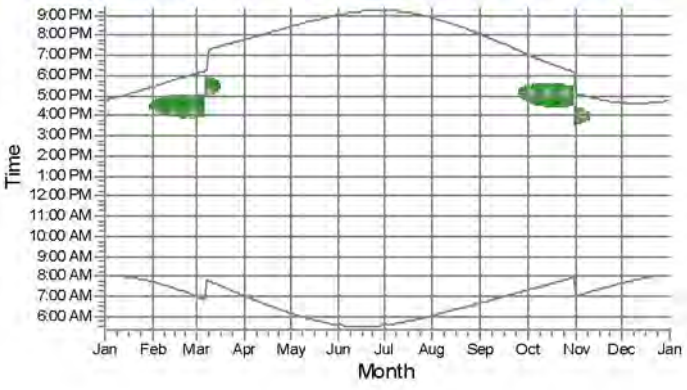

B: Shadow Receptor: 1.0 × 1.0 Azimuth: -180.0° Slope: 90.0° (3)



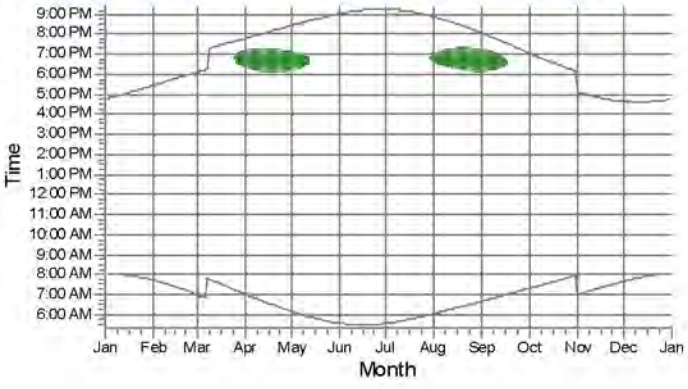

C: Shadow Receptor: 1.0 × 1.0 Azimuth: -180.0° Slope: 90.0° (4)



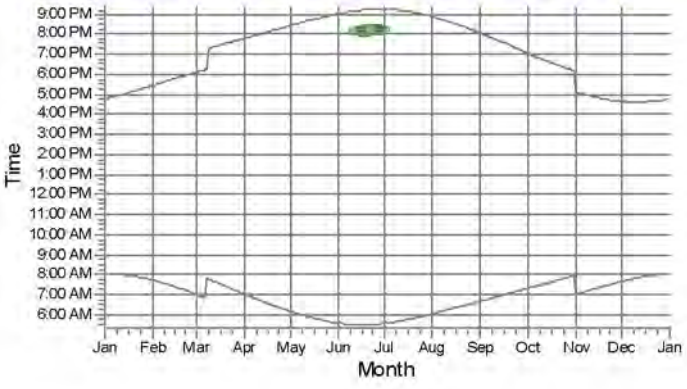

D: Shadow Receptor: 1.0 × 1.0 Azimuth: -180.0° Slope: 90.0° (5)




E: Shadow Receptor: 1.0 × 1.0 Azimuth: -180.0° Slope: 90.0° (6)




F: Shadow Receptor: 1.0 × 1.0 Azimuth: -180.0° Slope: 90.0° (7)




WTGs

1: VESTAS V90 1800 90.0 !O! hub: 80.0 m (1)

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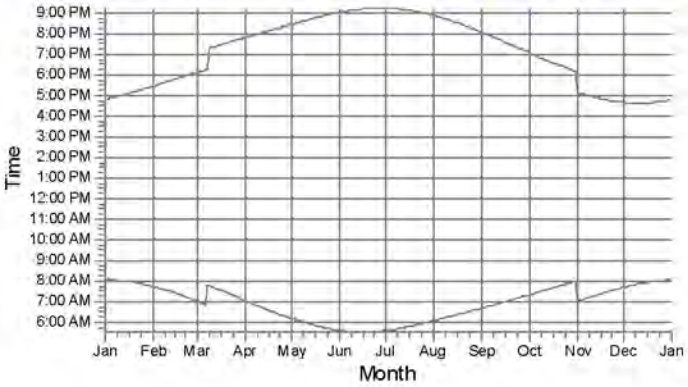
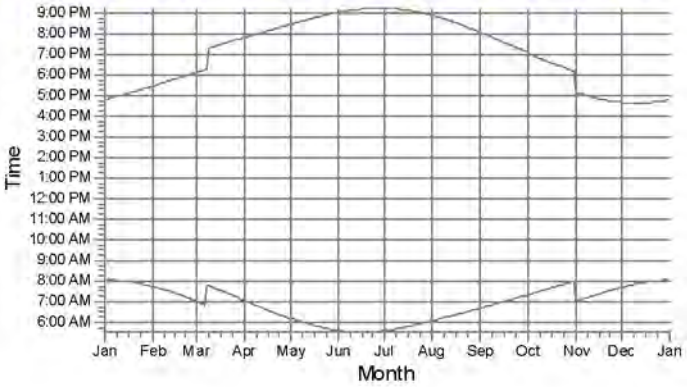
## SHADOW - Calendar, graphical

**Calculation:** Vestas V90, 80 HH, RD 90

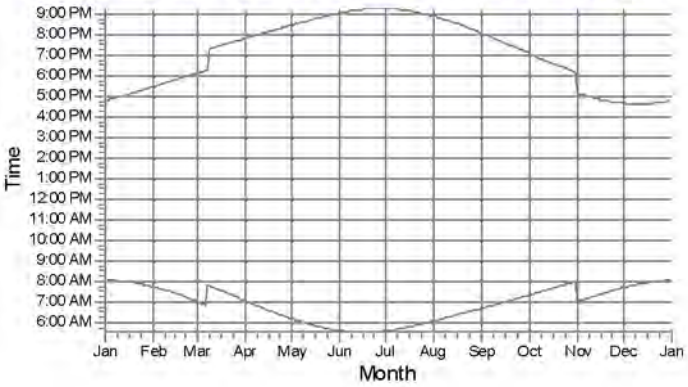
G: Shadow Receptor: 1.0 × 1.0 Azimuth: -180.0° Slope: 90.0° (8)



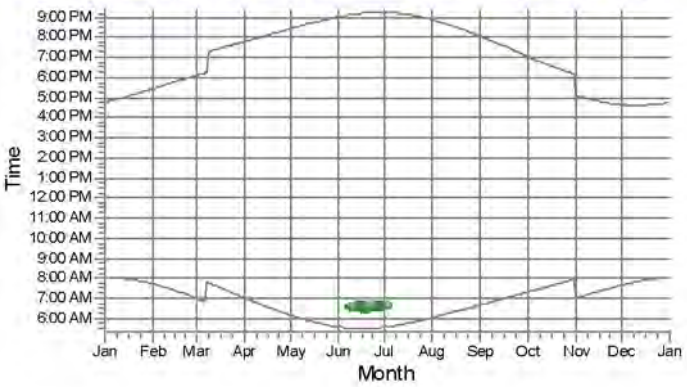

H: Shadow Receptor: 1.0 × 1.0 Azimuth: -180.0° Slope: 90.0° (9)



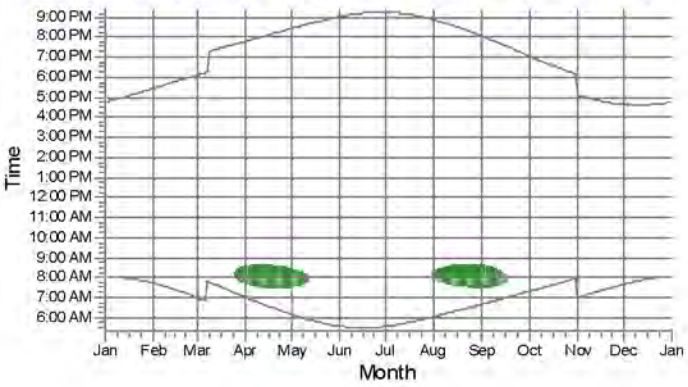

I: Shadow Receptor: 1.0 × 1.0 Azimuth: -180.0° Slope: 90.0° (10)



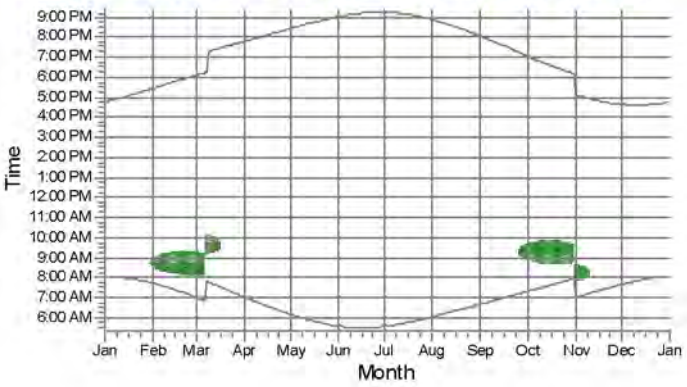

J: Shadow Receptor: 1.0 × 1.0 Azimuth: -180.0° Slope: 90.0° (11)




K: Shadow Receptor: 1.0 × 1.0 Azimuth: -180.0° Slope: 90.0° (12)




L: Shadow Receptor: 1.0 × 1.0 Azimuth: -180.0° Slope: 90.0° (13)




WTGs

1: VESTAS V90 1800 90.0 !O! hub: 80.0 m (1)

Project:
**SF_GE16_80HH**

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# SHADOW - Main Result

**Calculation:** GE1.6xle_HH80m

## Assumptions for shadow calculations

| | | |
|---|---|---|
| Maximum distance for influence | 2,000 | m |
| Minimum sun height over horizon for influence | 3 | ° |
| Day step for calculation | 1 | days |
| Time step for calculation | 1 | minutes |

Sunshine probability S (Average daily sunshine hours) [BISMARCK]

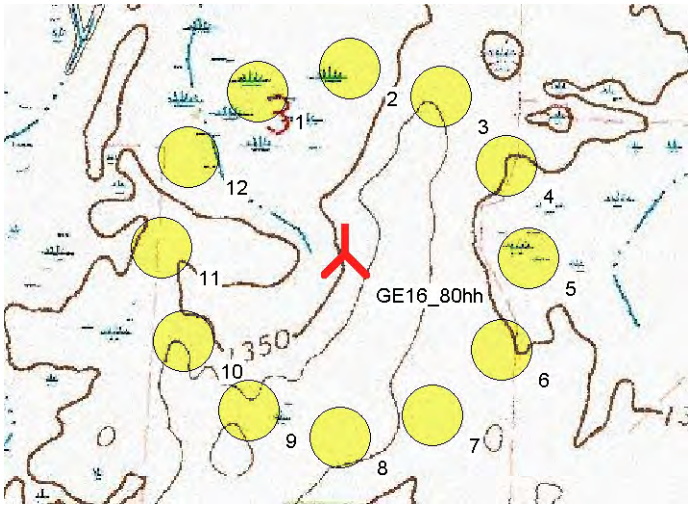
| Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 4.92 | 5.13 | 7.45 | 8.03 | 10.20 | 11.21 | 11.69 | 10.35 | 8.68 | 5.69 | 4.02 | 3.69 |

Operational time

| N | NNE | ENE | E | ESE | SSE | S | SSW | WSW | W | WNW | NNW | Sum |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 817 | 449 | 416 | 498 | 873 | 941 | 956 | 515 | 418 | 782 | 1,014 | 1,081 | 8,760 |

Idle start wind speed: Cut in wind speed from power curve

A ZVI (Zones of Visual Influence) calculation is performed before flicker calculation so non visible WTG do not contribute to calculated flicker values. A WTG will be visible if it is visible from any part of the receiver window. The ZVI calculation is based on the following assumptions:
Height contours used: Height Contours: Contour_m.wpo (6)
Obstacles used in calculation
Eye height: 1.5 m
Grid resolution: 10 m




Scale 1:12,500
New WTG
Shadow receptor

## WTGs

| | UTM NAD83 Zone: 15 East | North | Z | Row data/Description | WTG type Valid | Manufact. | Type-generator | Power, rated | Rotor diameter | Hub height | RPM |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | UTM NAD83 Zone: 15 | | [m] | | | | | [kW] | [m] | [m] | [RPM] |
| GE16_80hh | 339,085.16 | 5,058,695.19 | 412.5 | GE WIND ENERGY G... | Yes | GE WIND ENERGY | GE 1.5 xle-1,500 | 1,500 | 82.5 | 80.0 | 18.0 |

## Shadow receptor-Input

| No. | UTM NAD83 Zone: 15 East | North | Z | Width | Height | Height a.g.l. | Degrees from south cw | Slope of window | Direction mode |
|---|---|---|---|---|---|---|---|---|---|
| | | | [m] | [m] | [m] | [m] | [°] | [°] | |
| 1 | 338,939.97 | 5,058,963.00 | 411.5 | 1.0 | 1.0 | 1.0 | -180.0 | 90.0 | "Green house mode" |
| 2 | 339,093.34 | 5,058,999.84 | 411.5 | 1.0 | 1.0 | 1.0 | -180.0 | 90.0 | "Green house mode" |
| 3 | 339,244.51 | 5,058,954.82 | 414.3 | 1.0 | 1.0 | 1.0 | -180.0 | 90.0 | "Green house mode" |
| 4 | 339,352.98 | 5,058,840.37 | 412.5 | 1.0 | 1.0 | 1.0 | -180.0 | 90.0 | "Green house mode" |
| 5 | 339,389.82 | 5,058,687.00 | 411.5 | 1.0 | 1.0 | 1.0 | -180.0 | 90.0 | "Green house mode" |
| 6 | 339,344.80 | 5,058,535.83 | 413.1 | 1.0 | 1.0 | 1.0 | -180.0 | 90.0 | "Green house mode" |
| 7 | 339,230.35 | 5,058,427.36 | 414.2 | 1.0 | 1.0 | 1.0 | -180.0 | 90.0 | "Green house mode" |
| 8 | 339,076.98 | 5,058,390.52 | 414.5 | 1.0 | 1.0 | 1.0 | -180.0 | 90.0 | "Green house mode" |
| 9 | 338,925.81 | 5,058,435.54 | 416.0 | 1.0 | 1.0 | 1.0 | -180.0 | 90.0 | "Green house mode" |
| 10 | 338,817.34 | 5,058,549.99 | 413.7 | 1.0 | 1.0 | 1.0 | -180.0 | 90.0 | "Green house mode" |
| 11 | 338,780.50 | 5,058,703.36 | 411.8 | 1.0 | 1.0 | 1.0 | -180.0 | 90.0 | "Green house mode" |
| 12 | 338,825.52 | 5,058,854.53 | 411.5 | 1.0 | 1.0 | 1.0 | -180.0 | 90.0 | "Green house mode" |

## Calculation Results

Shadow receptor

| No. | Shadow, worst case Shadow hours per year [h/year] | Shadow days per year [days/year] | Max shadow hours per day [h/day] | Shadow, expected values Shadow hours per year [h/year] |
|---|---|---|---|---|
| 1 | 80:51 | 86 | 1:07 | 26:30 |
| 2 | 12:29 | 28 | 0:33 | 3:20 |

*To be continued on next page...*

Project:
**SF_GE16_80HH**

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# SHADOW - Main Result

**Calculation:** GE1.6xle_HH80m

*...continued from previous page*

| | Shadow, worst case | | | Shadow, expected values |
|---|---|---|---|---|
| No. | Shadow hours per year [h/year] | Shadow days per year [days/year] | Max shadow hours per day [h/day] | Shadow hours per year [h/year] |
| 3 | 77:28 | 84 | 1:07 | 20:01 |
| 4 | 66:36 | 83 | 1:02 | 20:16 |
| 5 | 70:20 | 90 | 1:02 | 31:10 |
| 6 | 0:00 | 0 | 0:00 | 0:00 |
| 7 | 0:00 | 0 | 0:00 | 0:00 |
| 8 | 0:00 | 0 | 0:00 | 0:00 |
| 9 | 0:00 | 0 | 0:00 | 0:00 |
| 10 | 2:10 | 13 | 0:13 | 0:53 |
| 11 | 70:05 | 88 | 1:01 | 31:01 |
| 12 | 66:24 | 84 | 1:02 | 25:36 |

Total amount of flickering on the shadow receptors caused by each WTG

| No. | Name | Worst case [h/year] | Expected [h/year] |
|---|---|---|---|
| GE16_80hh | GE WIND ENERGY GE 1.5 xle 1500 82.5 !O! hub: 80.0 m (1) | 446:23 | 158:51 |

Project:
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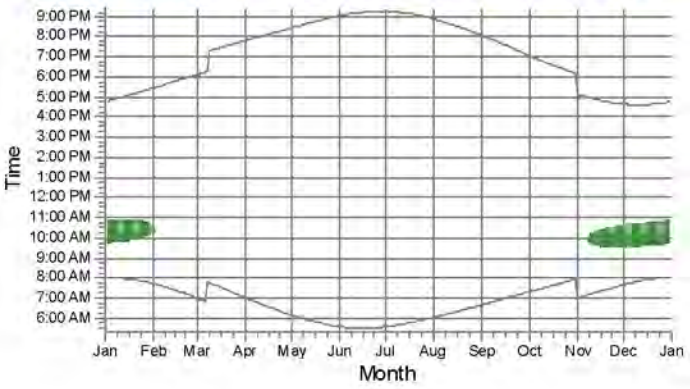
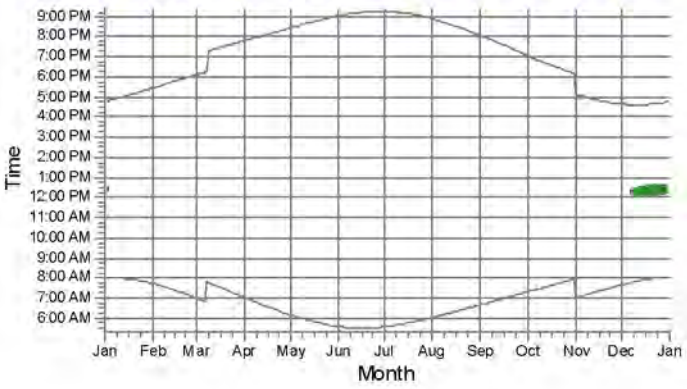
## SHADOW - Calendar, graphical

**Calculation:** GE1.6xle_HH80m

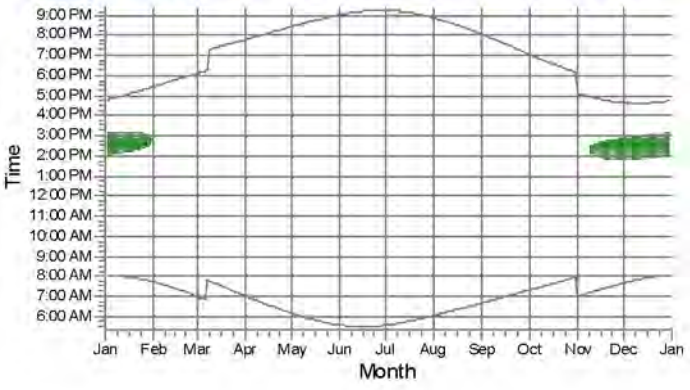
1: Shadow Receptor: 1.0 × 1.0 Azimuth: -180.0° Slope: 90.0° (2)



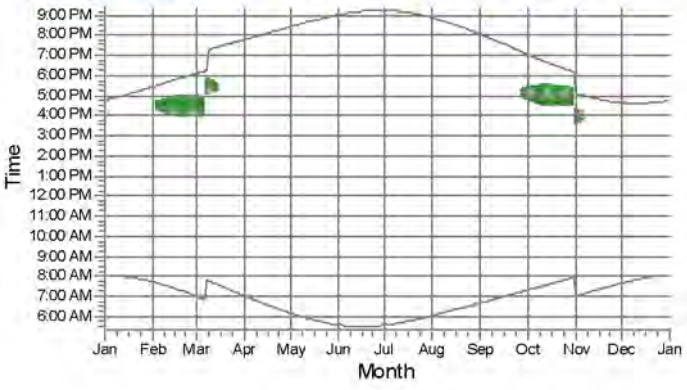

2: Shadow Receptor: 1.0 × 1.0 Azimuth: -180.0° Slope: 90.0° (3)



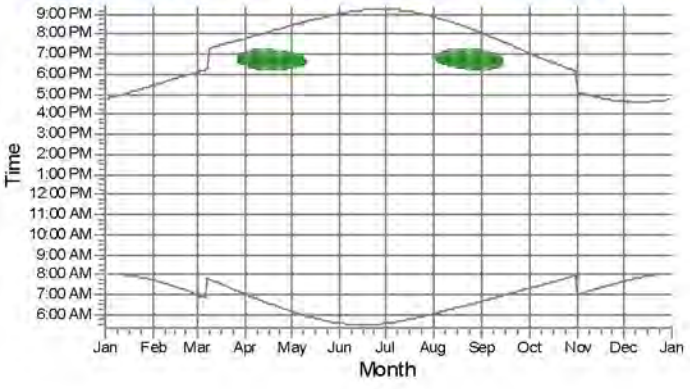

3: Shadow Receptor: 1.0 × 1.0 Azimuth: -180.0° Slope: 90.0° (4)



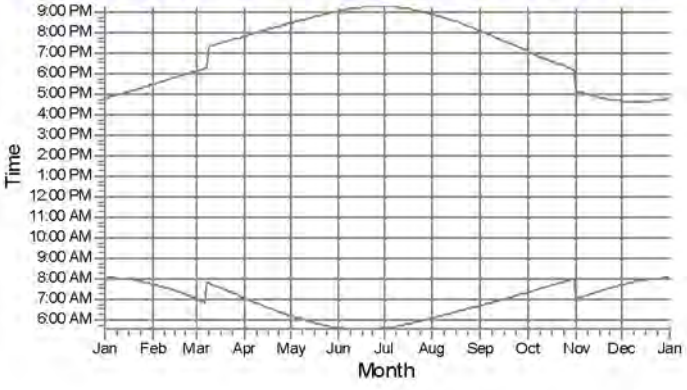

4: Shadow Receptor: 1.0 × 1.0 Azimuth: -180.0° Slope: 90.0° (5)




5: Shadow Receptor: 1.0 × 1.0 Azimuth: -180.0° Slope: 90.0° (6)




6: Shadow Receptor: 1.0 × 1.0 Azimuth: -180.0° Slope: 90.0° (7)




WTGs

GE16_80hh: GE WIND ENERGY GE 1.5 xle 1500 82.5 !O! hub: 80.0 m (1)

Project:
**SF_GE16_80HH**

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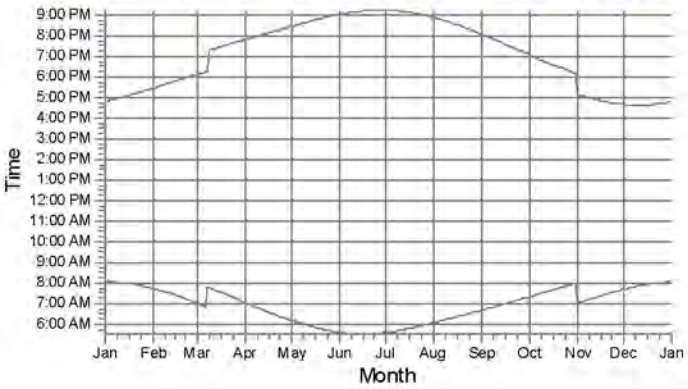
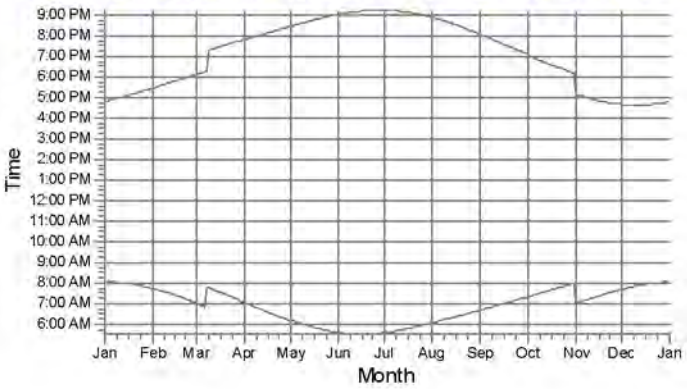
## SHADOW - Calendar, graphical

**Calculation:** GE1.6xle_HH80m

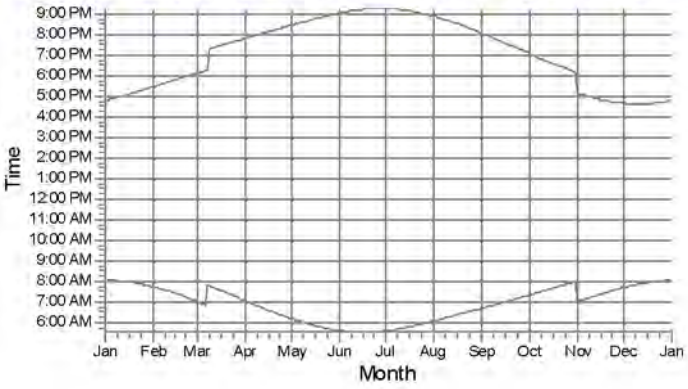
7: Shadow Receptor: 1.0 × 1.0 Azimuth: -180.0° Slope: 90.0° (8)



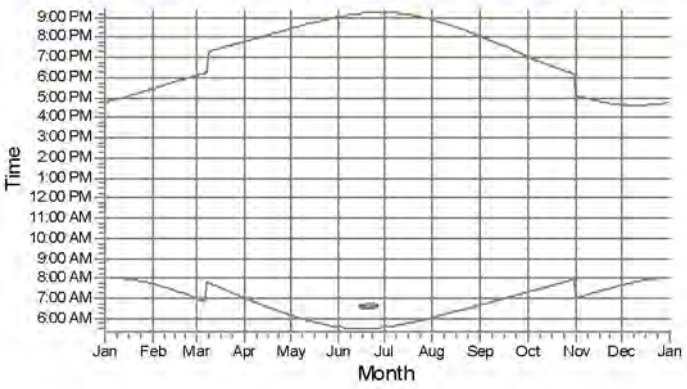

8: Shadow Receptor: 1.0 × 1.0 Azimuth: -180.0° Slope: 90.0° (9)



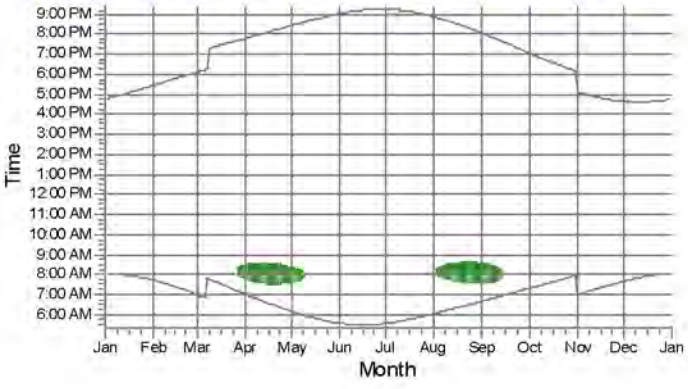

9: Shadow Receptor: 1.0 × 1.0 Azimuth: -180.0° Slope: 90.0° (10)



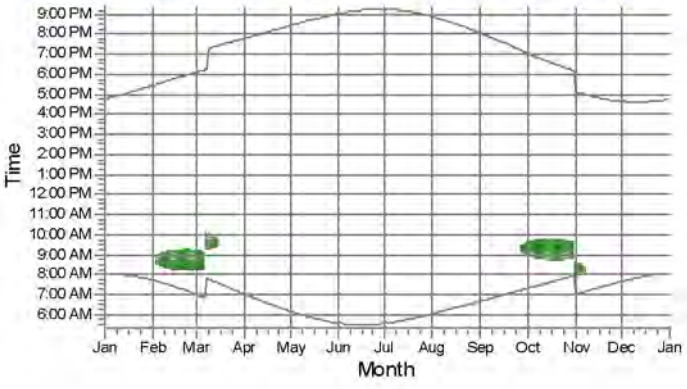

10: Shadow Receptor: 1.0 × 1.0 Azimuth: -180.0° Slope: 90.0° (11)




11: Shadow Receptor: 1.0 × 1.0 Azimuth: -180.0° Slope: 90.0° (12)




12: Shadow Receptor: 1.0 × 1.0 Azimuth: -180.0° Slope: 90.0° (13)




WTGs

GE16_80hh: GE WIND ENERGY GE 1.5 xle 1500 82.5 !O! hub: 80.0 m (1)

Project:
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# SHADOW - Main Result

**Calculation:** GE1.6xle_HH100m

## Assumptions for shadow calculations

| | | |
|---|---|---|
| Maximum distance for influence | 2,000 | m |
| Minimum sun height over horizon for influence | 3 | ° |
| Day step for calculation | 1 | days |
| Time step for calculation | 1 | minutes |

Sunshine probability S (Average daily sunshine hours) [BISMARCK]

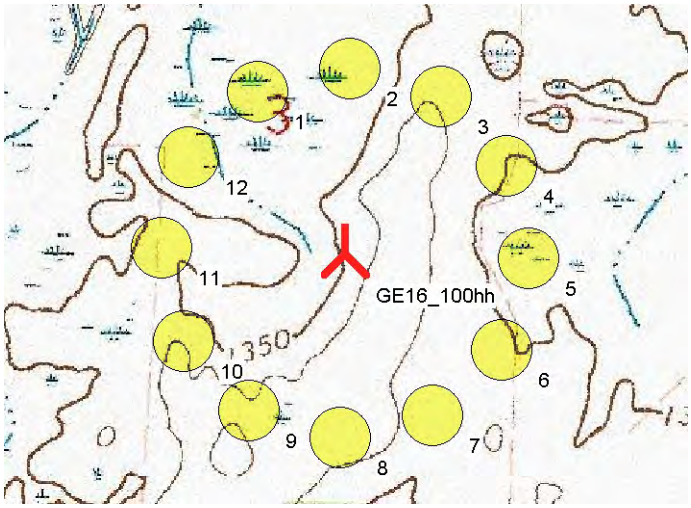
| Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 4.92 | 5.13 | 7.45 | 8.03 | 10.20 | 11.21 | 11.69 | 10.35 | 8.68 | 5.69 | 4.02 | 3.69 |

Operational time

| N | NNE | ENE | E | ESE | SSE | S | SSW | WSW | W | WNW | NNW | Sum |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 817 | 449 | 416 | 498 | 873 | 941 | 956 | 515 | 418 | 782 | 1,014 | 1,081 | 8,760 |

Idle start wind speed: Cut in wind speed from power curve

A ZVI (Zones of Visual Influence) calculation is performed before flicker calculation so non visible WTG do not contribute to calculated flicker values. A WTG will be visible if it is visible from any part of the receiver window. The ZVI calculation is based on the following assumptions:
Height contours used: Height Contours: Contour_m.wpo (6)
Obstacles used in calculation
Eye height: 1.5 m
Grid resolution: 10 m




Scale 1:12,500

New WTG  Shadow receptor

## WTGs

| | UTM NAD83 Zone: 15 East | North | Z | Row data/Description | WTG type Valid | Manufact. | Type-generator | Power, rated | Rotor diameter | Hub height | RPM |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | [m] | | | | | [kW] | [m] | [m] | [RPM] |
| GE16_100hh | 339,085.16 | 5,058,695.19 | 412.5 | GE WIND ENERGY G... | Yes | GE WIND ENERGY | GE 1.5 xle-1,500 | 1,500 | 82.5 | 100.0 | 18.0 |

## Shadow receptor-Input

| No. | UTM NAD83 Zone: 15 East | North | Z | Width | Height | Height a.g.l. | Degrees from south cw | Slope of window | Direction mode |
|---|---|---|---|---|---|---|---|---|---|
| | | | [m] | [m] | [m] | [m] | [°] | [°] | |
| 1 | 338,939.97 | 5,058,963.00 | 411.5 | 1.0 | 1.0 | 1.0 | -180.0 | 90.0 | "Green house mode" |
| 2 | 339,093.34 | 5,058,999.84 | 411.5 | 1.0 | 1.0 | 1.0 | -180.0 | 90.0 | "Green house mode" |
| 3 | 339,244.51 | 5,058,954.82 | 414.3 | 1.0 | 1.0 | 1.0 | -180.0 | 90.0 | "Green house mode" |
| 4 | 339,352.98 | 5,058,840.37 | 412.5 | 1.0 | 1.0 | 1.0 | -180.0 | 90.0 | "Green house mode" |
| 5 | 339,389.82 | 5,058,687.00 | 411.5 | 1.0 | 1.0 | 1.0 | -180.0 | 90.0 | "Green house mode" |
| 6 | 339,344.80 | 5,058,535.83 | 413.1 | 1.0 | 1.0 | 1.0 | -180.0 | 90.0 | "Green house mode" |
| 7 | 339,230.35 | 5,058,427.36 | 414.2 | 1.0 | 1.0 | 1.0 | -180.0 | 90.0 | "Green house mode" |
| 8 | 339,076.98 | 5,058,390.52 | 414.5 | 1.0 | 1.0 | 1.0 | -180.0 | 90.0 | "Green house mode" |
| 9 | 338,925.81 | 5,058,435.54 | 416.0 | 1.0 | 1.0 | 1.0 | -180.0 | 90.0 | "Green house mode" |
| 10 | 338,817.34 | 5,058,549.99 | 413.7 | 1.0 | 1.0 | 1.0 | -180.0 | 90.0 | "Green house mode" |
| 11 | 338,780.50 | 5,058,703.36 | 411.8 | 1.0 | 1.0 | 1.0 | -180.0 | 90.0 | "Green house mode" |
| 12 | 338,825.52 | 5,058,854.53 | 411.5 | 1.0 | 1.0 | 1.0 | -180.0 | 90.0 | "Green house mode" |

## Calculation Results

Shadow receptor

| No. | Shadow, worst case Shadow hours per year [h/year] | Shadow days per year [days/year] | Max shadow hours per day [h/day] | Shadow, expected values Shadow hours per year [h/year] |
|---|---|---|---|---|
| 1 | 98:42 | 105 | 1:04 | 32:27 |
| 2 | 54:19 | 64 | 1:01 | 15:26 |

*To be continued on next page...*

Project:
**SF_GE16_100HH**

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Calculated:
12/1/2010 12:38 PM/2.7.473

# SHADOW - Main Result

**Calculation:** GE1.6xle_HH100m

*...continued from previous page*

| | Shadow, worst case | | | Shadow, expected values |
|---|---|---|---|---|
| No. | Shadow hours per year [h/year] | Shadow days per year [days/year] | Max shadow hours per day [h/day] | Shadow hours per year [h/year] |
| 3 | 97:36 | 102 | 1:05 | 25:19 |
| 4 | 60:16 | 79 | 1:00 | 19:34 |
| 5 | 72:57 | 95 | 1:00 | 33:00 |
| 6 | 0:00 | 0 | 0:00 | 0:00 |
| 7 | 0:00 | 0 | 0:00 | 0:00 |
| 8 | 0:00 | 0 | 0:00 | 0:00 |
| 9 | 0:00 | 0 | 0:00 | 0:00 |
| 10 | 0:00 | 0 | 0:00 | 0:00 |
| 11 | 72:33 | 95 | 1:00 | 32:47 |
| 12 | 59:56 | 79 | 1:00 | 24:40 |

Total amount of flickering on the shadow receptors caused by each WTG

| No. | Name | Worst case [h/year] | Expected [h/year] |
|---|---|---|---|
| GE16_100hh | GE WIND ENERGY GE 1.5 xle 1500 82.5 !O! hub: 100.0 m (1) | 516:18 | 183:16 |

Project:
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Calculated:
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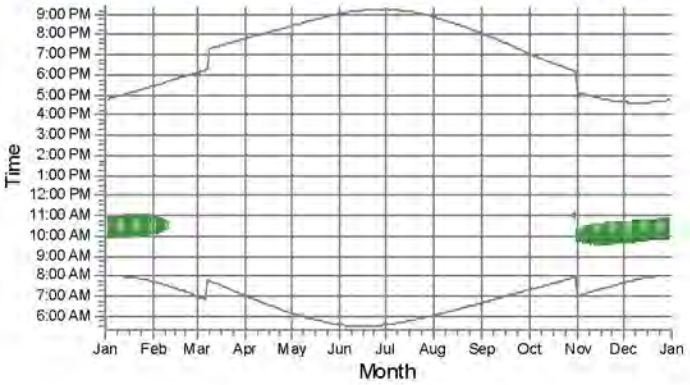
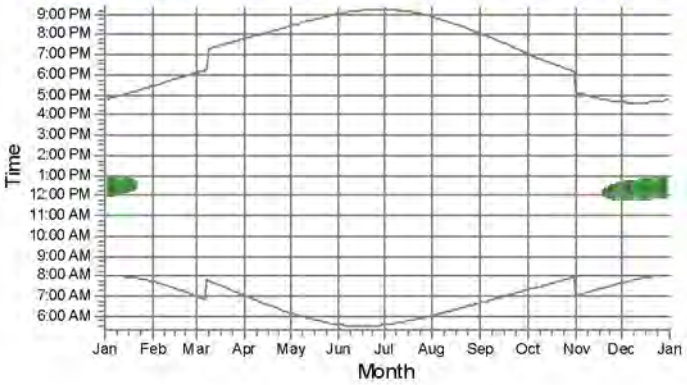
## SHADOW - Calendar, graphical

**Calculation:** GE1.6xle_HH100m

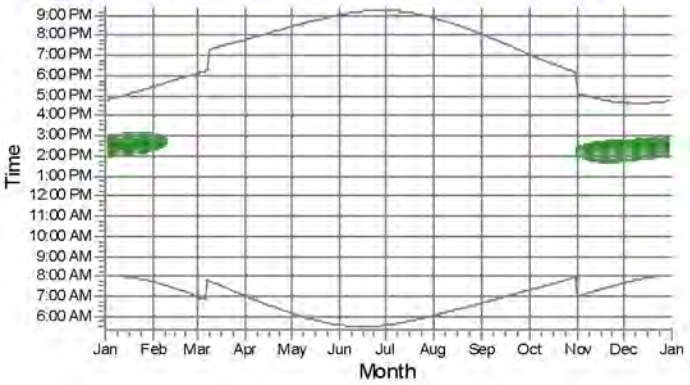
1: Shadow Receptor: 1.0 × 1.0 Azimuth: -180.0° Slope: 90.0° (2)



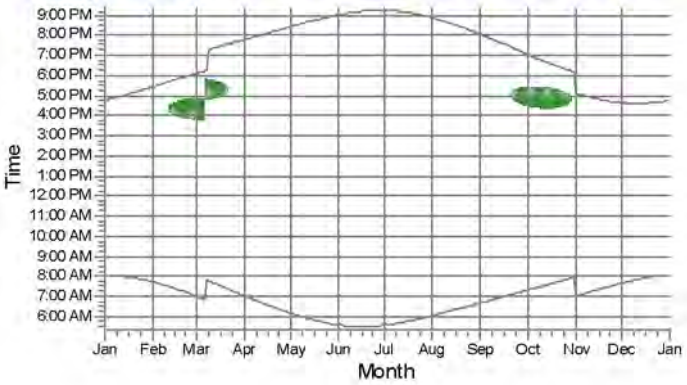

2: Shadow Receptor: 1.0 × 1.0 Azimuth: -180.0° Slope: 90.0° (3)



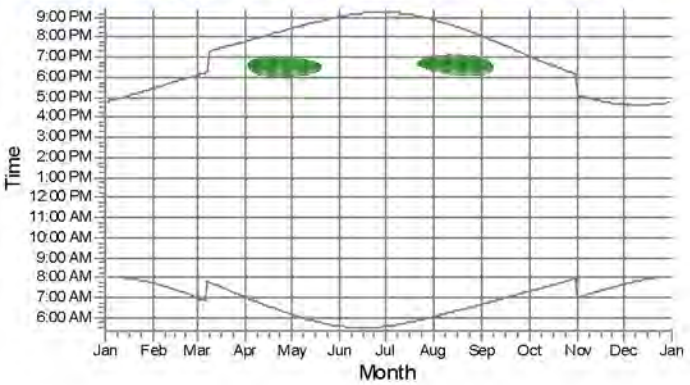

3: Shadow Receptor: 1.0 × 1.0 Azimuth: -180.0° Slope: 90.0° (4)



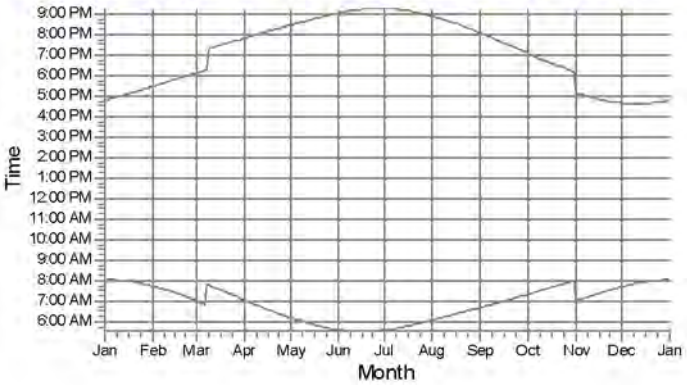

4: Shadow Receptor: 1.0 × 1.0 Azimuth: -180.0° Slope: 90.0° (5)




5: Shadow Receptor: 1.0 × 1.0 Azimuth: -180.0° Slope: 90.0° (6)




6: Shadow Receptor: 1.0 × 1.0 Azimuth: -180.0° Slope: 90.0° (7)




WTGs

GE16_100hh: GE WIND ENERGY GE 1.5 xle 1500 82.5 !O! hub: 100.0 m (1)

Project:
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Calculated:
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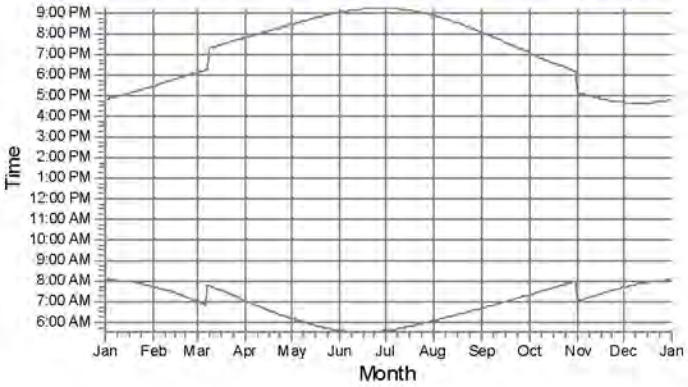
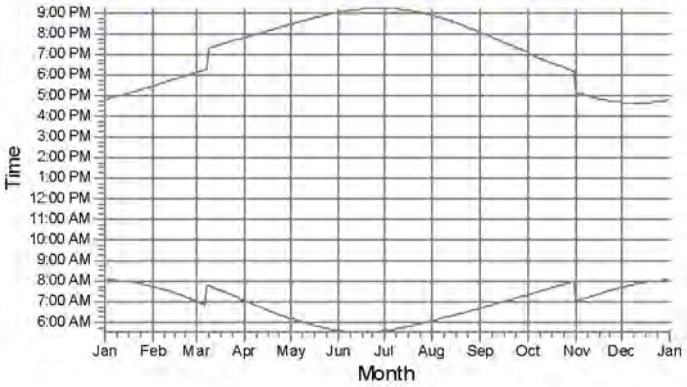
## SHADOW - Calendar, graphical

**Calculation:** GE1.6xle_HH100m

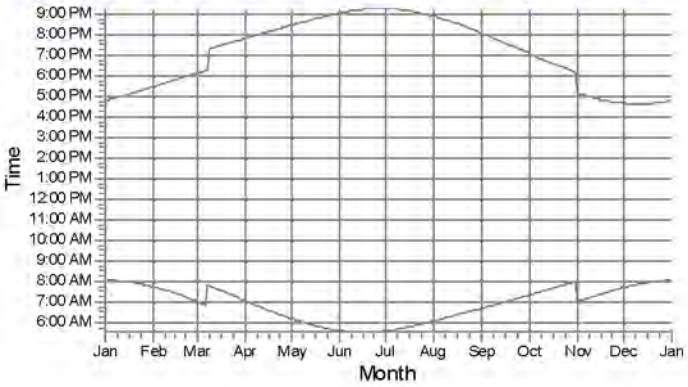
7: Shadow Receptor: 1.0 × 1.0 Azimuth: -180.0° Slope: 90.0° (8)



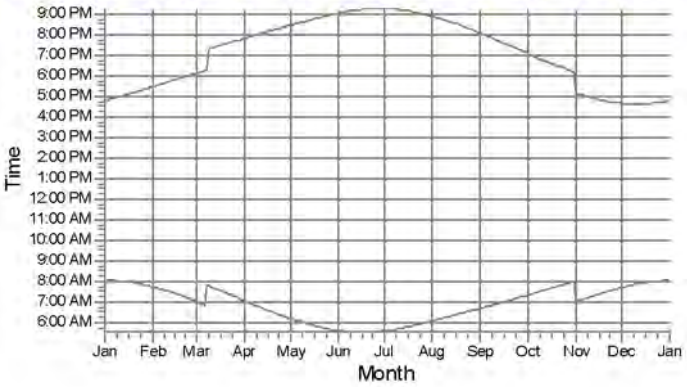

8: Shadow Receptor: 1.0 × 1.0 Azimuth: -180.0° Slope: 90.0° (9)



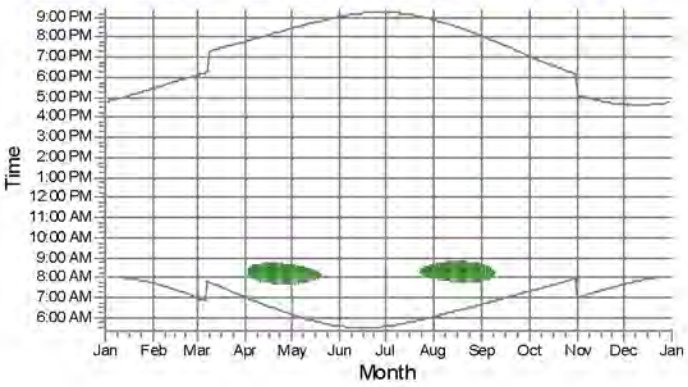

9: Shadow Receptor: 1.0 × 1.0 Azimuth: -180.0° Slope: 90.0° (10)



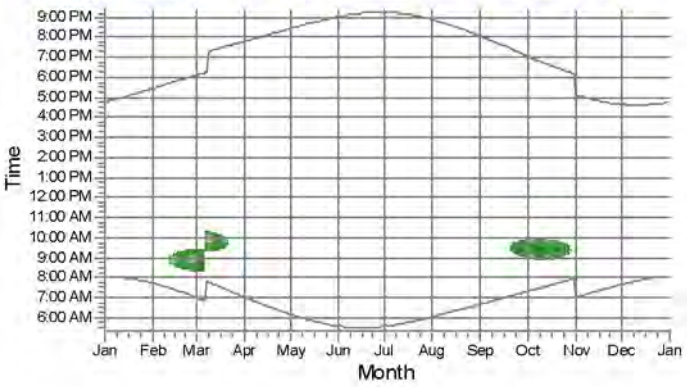

10: Shadow Receptor: 1.0 × 1.0 Azimuth: -180.0° Slope: 90.0° (11)




11: Shadow Receptor: 1.0 × 1.0 Azimuth: -180.0° Slope: 90.0° (12)




12: Shadow Receptor: 1.0 × 1.0 Azimuth: -180.0° Slope: 90.0° (13)




WTGs

GE16_100hh: GE WIND ENERGY GE 1.5 xle 1500 82.5 !O! hub: 100.0 m (1)