Site Permit Application for a Large Wind Energy Conversion System

G. McNeilus Wind Farm
Large Wind Energy Conversion System Site Permit

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Abbreviations

BMP	Best Management Practices
CON	Certificate of Need
CRP	Conservation Reserve Program
CWI	Minnesota County Well Index
DOE	Department of Energy
DPS	Department of Public Service
EMF	Electric and Magnetic Field
EPC	Engineering Procurement Construction
°F	Degrees Fahrenheit
FAA	Federal Aviation Administration
FEMA	Federal Emergency Management Agency
FIRM	Flood Insurance Rate Map
FSA	Farm Service Agency
ft	Feet
km	kilometer
kV	Kilovolt
kVA	Kilovolt ampere
kW	Kilowatt
LWECS	Large Wind Energy Conversion System
m	Meter
mi	miles
m/s	Meters per second
MDH	Minnesota Department of Health
MEQB	Minnesota Environmental Quality Board
MISO	Midwest Independent Transmission System Operator
MN	Minnesota

MN-DNR	Minnesota Department of Natural Resources
MPCA	Minnesota Pollution Control Agency
mph	Miles per hour
MW	Megawatt
MWh	Megawatt hour
NCDC	National Climatic Data Center
NE	Northeast
NHD	Natural Heritage Database
NIEHS	National Institute of Environmental Health Sciences
NPDES	National Pollutant Discharge Elimination System
NRCS	Natural Resources Conservation Program
NRHP	National Register of Historic Places
NSP	Northern States Power
NW	Northwest
NWI	National Wetland Inventory
O & M	Operations and Management
PUC	Public Utilities Commission
RD	Rotor Diameter
SCADA	Supervisory Control and Data Acquisition System
SE	Southeast
SHPO	State Historic Preservation Office
SNA	Scientific and Natural Area
T&E	Threatened and Endangered
U.S.	United States
US-FWS	United States Fish and Wildlife Service
V	Volts
WMA	Wildlife Management Area
WRAP	Wind Resource Analysis Program

1.0 INTRODUCTION

G. McNeilus Wind, LLC (GMW) is submitting this application to the Minnesota Environmental Quality Board (MEQB) for a Site Permit to construct and operate a large wind energy conversion system (LWECS), as defined in the Wind Siting Act, Minnesota Stat.116C.691, of approximately 16.5 to 18.2 megawatts (MW) in size. The proposed project, the G. McNeilus Wind Farm (Project), will be located on a site in Ashland Township in Dodge County. GMW is a wind energy development company based in Dodge Center, Minnesota.

1.1 PROJECT SUMMARY

1.1.1 PROJECT DESCRIPTION

GMW proposes to own, finance, design, construct, and manage the Project. NEG Micon will perform operation and maintenance for the Project for a period of at least five years.

The Project will consist of approximately 11 NEG Micon NM72C 1.5 or NM82 1.65 MW wind turbine generators, and associated electrical collection system. The total nameplate capacity of the Project is 16.5 MW to 18.2 MW, depending on the selected turbine rating. The turbines will be mounted on freestanding tubular towers. The towers will be 70 to 80 meters (m) (230 to 262 feet (ft)) at hub height. The blade length is 35 to 40 m (114 to 131 ft) and the rotor diameter (RD) is 72 to 82 m (236 to 269 ft). The total turbine height is 105 to 120 m (345 to 394 ft).

The associated electrical collection system will include underground electrical collection lines, pad-mounted step-up transformers, and connection to the aboveground 34.5 kilovolt (kV) transmission line. The Project will connect to an existing 34.5 kV transmission line that runs to the GMLLC Substation in Dodge Center and provides an interconnection point with the Xcel Energy (Xcel) transmission system. It is anticipated that any new transmission lines and substation improvements required for the Project will be constructed in consultation and coordination with Xcel, formerly Northern States Power Company (NSP) and the Midwest ISO (MISO).

1.1.2 PROPOSED SITE

The proposed Project is located in Dodge County. The Project site is within Sections 9, 10, 15, 16, 22, and 27 in Township 106N and Range 17W (Ashland Township). The approximately 3,800-acre project site lies south of the City of Dodge Center, Minnesota. The General Vicinity Map for the project site is presented as Figure 1. The Site Location Map with site boundaries of the proposed LWECS is presented in Figure 2. See Section 6.0 for a description of the project site.

1.1.3 PROJECTED OUTPUT

Under estimated average wind conditions in Dodge County and incorporating various siting and other related losses, the Project will deliver approximately 50,589 MWh per year using the 1.5 MW turbines and 55,801 MWh per year using the 1.65 MW turbines.

1.1.4 SITING PLAN

The turbines and associated facilities will be sited on agricultural land in Dodge County, Minnesota.

The preliminary layout of the project site (Figure 3) has been designed to optimize wind output while minimizing project impacts on man-made and natural resource features. Spacing between individual turbines is on average 3 to 5 RD. East-west spacing between turbines will average 3 to 4 RD. North-south spacing between turbines will average between 4 and 5 RD.

GMW has incorporated at least a 1.5 to 2 RD setback from the project site boundaries and existing roads. In addition, turbines will not be located in Wildlife Management Areas (WMAs), Scientific and Natural Areas (SNAs), or Type 3, 4, or 5 wetlands.

1.1.5 COMMERCIAL OPERATION DATE

GMW expects the Project to be fully operational by August 2005, although some of the turbines may begin operation as early as the fall of 2004.

1.1.6 OPERATION AND MAINTENANCE

NEG Micon will be responsible for the operation and maintenance of the wind farm for five years, after which GMW will take over operation and maintenance for the life of the project. The life of the Project is anticipated to be 30 years.

1.1.7 SITE CONTROL

The underlying land at the site is owned by GM, LLC. GMW has reached agreement on lease terms with GM, LLC for its turbine sites.

1.1.8 PERMITS AND LICENSES

GMW will obtain all permits and approvals that are necessary but not covered by the MEQB Site Permit. Potential permits and approvals for the Project are identified in Section 7.0.

1.1.9 DEVELOPMENT AND CONSTRUCTION

GMW with the help of NEG Micon will act as the Engineering Procurement Construction (EPC) contractor. They will perform or manage all development and installation activities. NEG Micon has constructed and sold over 11,000 wind turbines worldwide and has experience in the manufacture, assembly, installation, erection and commission and testing of wind farms. Specifically, the EPC contractor will:

- perform site resource analysis and siting;
- undertake environmental review; and
- obtain specific permits and licenses for the Project.
- perform civil engineering for erection and installation of the Project;
- construct foundations, towers and transformers;
- assemble and install 11 wind turbines;
- install the communication system, including supervisory control and data acquisition software and hardware and telephone or fiber-optic cable; and
- construct the feeder and electrical energy collection system.

1.2 OWNERSHIP OF THE PROPOSED FACILITY

GMW proposes to own, finance, design, construct, and manage the Project. GM Transmission, LLC will own and operate the electric transmission necessary to provide outlet from the Project into Xcel's transmission system.

1.3 APPLICANT OWNERSHIP OF OTHER LWECS IN MINNESOTA

The Applicant, GMW, does not own any other LWECS in Minnesota. The applicant owns two small wind projects near Adams (1.5 MW each); the output of both projects is sold to Alliant Energy.

The Applicant is owned by Garwin and Grant McNeilus. They, or their affiliates, do own some additional small projects in Dodge Center and Adams, each of which is under two MW in size and separately owned and operated.

There are 14 other small wind projects of varying sizes located near the proposed projects in Dodge Center owned by independent nonprofit corporations or other independent individuals or entities. Four additional 1.5 MW projects are also located in Adams and owned by others.

1.4 COMPLIANCE WITH MINNESOTA RULES 4401 AND WIND SITING ACT

The Wind Siting Act requires an application for a Site Permit for a LWECS to meet the substantive criteria set forth in Minn. Stat. 116C.57, subd. 4. This application provides information necessary to demonstrate compliance with these criteria and the MEQB Rules (Minnesota Rules Chapter 4401). The siting of LWECS is to be made in an orderly manner compatible with environmental preservation, sustainable development, and the efficient use of resources.

On February 7, 2002, MEQB adopted Wind Siting Rules (Minnesota Rules Chapter 4401) that implement the permitting requirements for LWECS. The rules govern the contents and treatment of applications for site permits under the Wind Siting Act. To the extent available, GMW has presented information required by the Wind Siting Rules. In addition, sufficient project design, wind resource and technical information have been provided for a thorough evaluation of the reasonableness of the proposed site as a location for the Project.

1.4.1 CERTIFICATE OF NEED

As described in Minnesota's Rules Chapter 4401.0450, Subp. 2, the applicant must state whether the project requires a Certificate of Need (CON) from the Minnesota Public Utilities Commission (PUC) for power generated and sold on the open market. If a CON is not required, the applicant must describe the intended use of the power and the power purchase agreement for sale of the power generated by the LWCES.

GMW will privately finance the Project. The Project will be constructed on lands owned by GMW, or associated entities. GMW anticipates that a power purchase agreement will be negotiated with Xcel or another electrical utility after construction of the Project and prior to operation. Therefore, a CON will not be required prior to receiving a site permit from the MEQB.

2.0 GENERAL DESCRIPTION OF THE PROPOSED FACILITY

2.1 WIND POWER TECHNOLOGY

As the wind passes over the blades of a wind turbine, it creates lift and causes the rotor to turn. The rotor is connected by a hub and main shaft to a system of gears which is connected to dual-wound generators. The proposed wind farm will use NEG Micon NM72C-1.5 MW turbine or the NEG Micon NM82-1.65 MW wind turbines. The NM72C has a rotor diameter of 72 m (236 ft) and nominal output of 1.5 MW. The NM82 is similar except the rotor diameter is 82 m (269 ft) and has a nominal output of 1.65 MW. Each turbine is equipped with a wind speed and direction sensor that signals to the turbine's control system when sufficient winds are present for operation. The NM72C turbine begins operation in wind speeds of 4 m/s (8.9 mph) and reaches its rated capacity (1.5 MW) at a wind speed of 15 m/s (33.5 mph). The NM72C turbine is designed to operate in wind speeds of up to 25 m/s (56.0 mph). The NM82 turbine begins operation in wind speeds of 3 m/s (6.7 mph) and reaches its rated capacity (1.65 MW) at a wind speed of 16 m/s (35.8 mph). The NM82 turbine is designed to operate in wind speeds of up to 20 m/s (44.7 mph).

The electricity generated by each turbine is brought to a pad-mounted transformer where the voltage is raised (stepped up) to the feeder line voltage. The electricity is collected by a system of underground cables within the wind site. Typically, the underground cable is run along the access roads and brought above ground and interconnected to a project feeder system at the public road right-of-way. The feeder system distributes power to the utility point of interconnection. At the point of interconnection, the power is transformed to transmission level voltage and transmitted to system load and customers via Xcel's transmission and feeder system.

2.2 PHYSICAL DESCRIPTION

The proposed Project will consist of installing 11 NEG Micon NM72C-1.5 MW or NM82C-1.65 MW wind turbines at the site. Currently, there are 41 turbines ranging in size from 900 kilowatts (KW) to 1.5 MW located within the proposed site area. The proposed 1.5 MW or 1.65 MW wind turbines are three-bladed, pitch-regulated, upwind machines that will be installed on freestanding 70 or 80 m (262 ft) tubular towers, respectively. Each blade is 35 or 40 m (114 or 131 ft) long. The RD is 72 or 82 m (236 or 269 ft) across. The total swept area of the rotor is 4,072 or 5,281 square meters (approximately 43,831 to 56,844 square feet). Each tower will be secured by a concrete foundation that can vary in design depending on the soil conditions. A control panel inside the base of each turbine tower houses communication and electronic circuitry. Figure 4 is a diagram of the NEG Micon NM82C-1.5 MW wind turbine.

A step-up transformer will be installed at each turbine to raise the voltage to the feeder line voltage. Both power and communication cables will be buried in trenches adjacent to the project access roads on private property. In cases where such infrastructure must be sited on property that is not owned by the applicant, GMW will obtain transmission easements for the necessary property. Each wind turbine is accessible via all-weather Class 5 gravel roads providing access to the turbines via public road. At the point where the access and public roads meet, the communication and power lines will rise from underground to overhead lines. Figure 5 shows the path of energy and Figure 6 shows a typical wind farm facility layout.

2.3 PROJECT LAYOUT

GMW will develop a site plan for the turbines that optimizes the wind resources on the site, while minimizing the impact to nearby residences and to potentially sensitive areas.

The new turbines will be placed in the eastern half of Section 9, the western half of Section 15, the NE ¼ of Section 16, and the NW ¼ of Section 27. The turbines will be spaced at least 3 to 4 RD apart east to west, and 4 to 5 RD apart north to south.

In addition, GMW has incorporated at least a 1.5 to 2 RD setback from the project site boundaries and existing roads.

2.4 ASSOCIATED FACILITIES

In addition to the 11 NEG Micon wind turbines and the 1500-2000-kVA step-up transformers, the wind project will include gravel access roads that allow for easy access to the wind turbines year-round. These roads will be approximately 5 m (16 ft) wide and low profile to allow cross-travel by farm equipment. Additionally, consideration will be taken in locating access roads to minimize impact on current or future agriculture operations. Figure 3 shows the layout of access roads.

The Project will use two existing meteorological towers, both located within the proposed site area, to measure the site's wind speed, temperature and pressure, and project performance. The towers are both approximately 71.6 m (235 ft) in height. The towers will be lighted to comply with Federal Aviation Administration (FAA) regulations.

2.5 LAND RIGHTS

GMW owns the land required for the project. GM Transmission, LLC owns the existing overhead transmission line that runs from the wind farm to the GMLLC Substation located south of Dodge Center. GM Transmission, LLC also owns the substation. The connection to the Xcel transmission system is made at the GMLLC Substation.

3.0 PROPOSED SITE

3.1 IDENTIFICATION OF PROJECT SITE

The site boundary, which includes turbine setbacks, is 3,800 acres. The expected turbine sites, access roads, and associated facilities will permanently impact approximately 5.5 acres. See

Section 6.0 and Figure 3 for a detailed description of the Project boundary and location of the site impacts. Turbine locations are approximate and are subject to change during micrositing.

3.2 WIND RESOURCES – GENERAL

Wind-powered electric generation is entirely dependent on the availability of the wind resource at a specific location. The energy available from the wind increases at the third power of the wind speed. In other words, a doubling of the wind speed will increase the available energy by a factor of eight times. Therefore, wind farms should be designed and laid out so as to take maximum advantage of the available wind resource.

The Minnesota Department of Commerce, formerly the Minnesota Department of Public Service (DPS), the United States Department of Energy (DOE), and Xcel have conducted wind resource assessment studies since the early 1980s. In 1986, the DOE updated its *Wind Energy Resource Atlas* of the United States. This document contained wind energy resource maps for each state, and the Minnesota map identified the proposed Project Site as Class 4 wind regime located near the transition from Class 3 to Class 4 wind regime. A Class 4 wind regime has a mean annual wind speed of 6.7 to 7.3 m/s (15.2 to 16.3 mph) at 40 m (131 ft) above ground level. The remainder of the state, about 80 percent of the land area, had Class 2 and 3 winds, which are considered marginal for wind energy development at this time. The DOE study was national in scope and included only a small number of wind monitoring stations in the Upper Midwest region.

The Minnesota Department of Commerce published the fourteenth edition of the *Wind Resource Analysis Program (WRAP) Report* in 2002. The *WRAP Report* presents wind analysis data from monitoring stations across the state of Minnesota. At the project area, the mean annual wind speed at an elevation of 50 m (164 ft) is mapped as 6.61 to 6.81 m/s (14.8 to 15.2 mph). At an elevation of 70 m (230 ft) above ground level, mean annual wind speed is mapped as 6.81 to 7.01 m/s (15.2-15.7 mph).

3.3 WIND CHARACTERISTICS IN PROJECT AREA

The wind characteristics in the Project Area may be estimated using the wind data collected in Rochester, Minnesota, which is located approximately 25 miles east of the site.

3.3.1 INTERANNUAL VARIATION

There is less than a five percent variation between the yearly averages as calculated for the Rochester Airport using seven years of measurements at 10 m (30 ft) above ground. The interannual variation can be seen in Figure 7.

3.3.2 Seasonal Variation

There is some seasonal variation in wind speeds during the year. The highest average wind speeds were recorded during the winter months, November to April. This is followed by a decline in the average wind speeds during the summer months, and an increase during the fall months. July has the lowest average wind speed. The seasonal cycle of wind speeds, as a percentage of the annual average, can be seen in Figure 8.

3.3.3 Diurnal Conditions

Diurnal data was used from long-term data from the Rochester airport. The sensor for the Rochester airport is at a 10-meter elevation. The conditions at the Rochester airport are similar as those of an enXco study at Chandler, Minnesota. Chandler, Minnesota has similar geographic conditions, and terrain as that of the Rochester airport. Having essentially identical 10-meter results and similar topography and ground cover, it can be inferred that wind speeds at 30, 50, and 70 meters above ground near the Rochester and Dodge center areas will be similar to those measured at Chandler. The results can be seen in Figure 9 for Rochester and the corresponding graph for Chandler can be seen in Figure 10.

3.3.4 Atmospheric Stability

Current reports for the Rochester 70-meter wind measurement site do not include atmospheric stability. However, it is expected that for open, relatively flat terrain, stability conditions will not vary significantly in the Southern Minnesota region.

3.3.5 Hub Height Turbulence

The turbulence intensity at hub height is a function of the wind velocity and surface roughness. Current reports for the Rochester 70-meter wind measurement site do not include turbulence measurements. However, it is expected that for open, relatively flat terrain, turbulence conditions will not vary significantly in the Southern Minnesota region.

3.3.6 Extreme Wind Conditions

Wind gusts have been recorded in the 70 mph range in the southeastern part of Minnesota, however these instances are very rare. For the seven years of wind data analyzed (1984-89,91) the maximum hour average wind speed recorded at the 10-meter level at the Rochester airport was 48.3 mph.

3.3.7 Wind Speed Frequency Distribution

The wind speed frequency shown in Table 1 was created using seven years of data from the Rochester Airport. Table 1 shows that 59% of the time the wind velocities are within the range of 4 to 7 m/s range at 10 m. This corresponds to a 6 to 10 m/s velocity at 70 m using the wind shear calculation shown in Section 3.3.8.

Table 1
Wind Speed Frequency

Speed (m/s)	Frequency of occurrence
0	287
1	475
2	3089
3	7687
4	11026
5	9902
6	8308
7	6798
8	5310
9	3340
10	2187
11	1332
12	820
13	424
14	174
15	110
16	44
17	16
18	20
19	15
Greater than 20	4
Totals	**61368**

3.3.8 Wind Variation with Height

Wind shear is the relative change in wind speed as a function of height. Wind shear is calculated using a power function based upon the relative distance from the ground. The general equation used for calculating wind shear is $S/S_0 = (H/H_0)^a$ where S_0 and H_0 are the speed and height of the lower level and a is the power coefficient. The power coefficient can vary greatly due to terrain roughness and due to atmospheric stability. The power coefficient will also change slightly as height increases. The coefficient determined for this the Rochester Xcel monitoring location is 0.21.

3.3.9 Spatial Wind Variation

Little variation is expected across the project area, because of the relatively flat, open terrain. Wind speeds should be quite similar at all the tower sites proposed for this project.

3.3.10 Wind Rose

The prevailing wind directions in the area are from the South and Northwest. The largest peaks of direction are correlated with the South, South West South, and North West. A complete distribution can be seen in Figure 11.

3.4 OTHER METEROLOGICAL CONDITIONS

3.4.1 Average Weather Conditions

The closest weather station near the project site with historical climate data is in Rochester, MN. Table 2 represents the National Climatic Data Center (NCDC) normals between 1971-2000 for the Rochester weather station #217004.

Table 2
Temperature and Precipitation
(Recorded in the Period 1971-2000 at Rochester, Minnesota)

Month	Temperature (°F)			Precipitation (Inches)	Snowfall (Inches)
	Average Daily Maximum	Average Daily Minimum	Mean		
January	19.9	3.7	11.8	0.94	12.0
February	26.2	10.6	18.4	0.75	8.1
March	38.7	22.6	30.6	1.88	9.0
April	54.8	34.6	44.7	3.01	4.3
May	67.7	46.1	56.9	3.53	0.0
June	76.6	55.6	66.1	4.00	0.0
July	80.1	60.1	70.1	4.61	0.0
August	77.5	58.0	67.7	4.33	0.0
September	69.2	48.7	58.9	3.12	0.0
October	56.9	37.1	47.0	2.20	1.0
November	38.7	23.7	31.2	2.01	7.1
December	24.5	10.1	17.3	1.02	11.7
Yearly Average	**52.6**	**34.2**	**43.4**	**31.4**	**53.2**

Source: Midwest Regional Climate Center, June 2003.

3.4.2 EXTREME WEATHER CONDITIONS

In Dodge County, the NCDC has 166 extreme weather events on record for the period between January 1, 1950 and February 28, 2003. These events include thunderstorms, tornadoes, hail, heavy snow and ice, extreme cold, and heat waves. Tornadoes and severe thunderstorms strike occasionally. The state of Minnesota sees approximately 15 to 20 tornadoes a year. On average there are 23 thunderstorms during the summer months in the Dodge County. These storms are local in extent and of short duration. They result in damage to small geographic areas. Hail occasionally falls in scattered areas during the warmer periods. Neither hail nor lightning from severe storms presents a problem for operation of the proposed development. Wind turbines; however, are not designed to survive tornado-force winds of 89+ m/s (200+ mph). In the winter, icing events are variable in frequency. It is expected that the average annual energy loss will be 2 percent due to icing.

3.5 ENERGY PROJECTIONS

3.5.1 PROPOSED ARRAY SPACING FOR WIND TURBINES

Turbine placement was designed to provide 3 to 4 RD crosswind spacing (distance between turbines) and 4 to 5 RD downwind spacing (distance between strings of turbines).

3.5.2 BASE ENERGY PROJECTIONS

Under estimated average wind conditions in Dodge County and incorporating various siting and other related losses, the Project will deliver approximately 50,589 MWh per year using the 1.5 MW turbines and 55,801 MWh per year using the 1.65 MW turbines.

4.0 COSTS ANALYSIS

This section describes the cost-related implications of the Project site as a means of assessing its suitability for development. The site-specific wind resource, construction costs, and operating costs have been considered.

4.1 CAPITAL AND OPERATIONAL COSTS

The total installed capital cost for the Project is estimated to be in the range of $14.3 to $17.6 million. Costs include electrical and communication systems, roads and interconnection facilities. Ongoing operations and maintenance costs are estimated to be in the range of $220,000 to $275,000 per year. A large wind project (> 12 MW) is taxed at a rate of

$1.20/MWh (M.S. 227.029, subd. 2 -3). GMW expects the annual tax liability for the Project to be in the range of $60,000 to $67,000.

4.2 SITE AND DESIGN DEPENDENT COSTS

The overall cost of developing the Project will depend on the relative ease of access to construction sites; site-specific structural requirements, such as foundation design; and lengths of access roadways and underground electrical cables.

Another important factor to consider is the placement of cable. Use of underground cable is necessary to connect the individual wind turbine generators to their respective transformers, communication enclosures, and feeder lines. The underground placement of the cables along the wind turbine strings is preferable for land use and aesthetic purposes on private land. Along public right of ways, overhead lines are required. Additional use of underground cable, in place of overhead feeder lines is not feasible for large amounts of power transported over long distances due to cooling requirements and construction costs, which are higher by approximately four-fold. For example, the approximate cost of one mile of overhead lines is $25,000; the same distance of underground cable costs approximately $100,000.

5.0 ENGINEERING AND OPERATIONAL DESIGN ANALYSIS

This section provides a summary description of the Project's energy system, an overview of the current configuration of the NEG Micon NM72C-1.5 or NM82-1.65 MW turbines and the balance of items that make up the key components of the wind farm. Though GMW is proposing using 1.5 or 1.65 MW turbines, GMW wishes to preserve the right to evaluate and select turbine equipment of varying sizes and outputs. Turbine supply may affect the number and configuration of the turbine array.

5.1 PROJECT AND ASSOCIATED FACILITIES DESCRIPTION

The proposed project will consist of an array of 11 NEG Micon NM72C-1.5 or NM82-1.65 MW turbines, transformers, roads and crane pads. The turbines will be interconnected by underground fiber optics within the wind farm. Underground electrical cables will loop between transformers located at the base of each tower and connect with an existing 34.5 kV feeder line to the GMLLC Substation in Dodge Center.

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

The power collection system will consist of power cables running from the turbine generator to nearby transformers. These transformers will step-up the voltage from 600 V to 34.5 kV. The 34.5 kV cables connecting the transformers will run underground along turbine access roads and connect to an existing 34.5 overhead feeder line. The feeder line will then deliver the power to the GMLLC Substation. At the substation, the electric voltage will be stepped up again to transmission level voltage and enter Xcel's transmission system through Xcel's 69 kV transmission line.

The proposed Project includes a computer-controlled communications system that permits automatic, independent operation and remote supervision, thus allowing the simultaneous control of many wind turbines. Operations personnel from GMW and NEG Micon will access the wind farm on-site using a Supervisory Control and Data Acquisitions (SCADA) system. Operations, maintenance and service arrangements between NEG Micon and GMW will be structured to provide for timely and efficient operations. The computerized data network will provide detailed operating and performance information for each NEG Micon wind turbine. GMW will maintain a computer program and database for tracking each wind turbine's operational history.

5.2 MAJOR NEG MICON 1.5 MW OR 1.65 MW WIND TURBINE ASSEMBLIES AND COMPONENTS

NEG Micon is a Danish wind turbine manufacturing company with over 11,000 turbines and a total capacity of 4,500 MW installed worldwide. The average availability of NEG Micon turbines was 98 percent in 2002. Both the NM72C and the NM82 represents the new class of "Megawatt" machines, which are turbines with nameplate capacities exceeding 1 MW. Both are well suited for installation in areas with low to moderate wind conditions, such as the conditions at the proposed Project site. Both feature a variable pitch design that dynamically controls blade pitch based on load and meteorological conditions, in order to maximize production. The NM72C and the NM82 turbines have rotor diameters of 72 m and 82 m, respectively, ensuring the maximum capture of the available wind energy resource.

5.2.1 ROTOR

The rotor consists of three blades mounted to a rotor hub. The hub is attached to the nacelle, which houses the gearbox, generator, brake, cooling system and other electrical and mechanical systems. The rotor faces into the prevailing wind and rotates clockwise at 17.3 RPM (NM72C) or 14.4 RPM (NM82).

Both turbines use the NEG Micon hydraulic ACTIVE-STALL® technology, which enables the rotor to harness maximum energy from the available wind while minimizing loads and providing fail-safe shut down of the turbine in all conditions. The complete rotor diameter of the NM72C is 72 m (236 ft.), with a swept area of 4,072 m^2 (1 acre). The rotor diameter of the NM82 is 82 m (269 feet), with a swept area of 5,281 m^2 (1.3 acre).

5.2.2 BLADES

The blades of the NM72C turbines are constructed of Fiberglass, Carbon Fiber and Epoxy, whereas the blades of the NM82 turbines are constructed of carbon fiber epoxy and wood. The blade bearing is a 3-piece ball bearing. Each NM72C blade measures 35 m (115 feet) in length, covers an area of approximately 73 m^2 (.02 acre). Each NM82 blade measures 40 m (131 ft) in length and covers an area of approximately 86 m^2 (922 ft^2).

5.2.3 GEARBOX

The main shaft transmits the power to the generator through a combined planetary-helical gearbox. Power is transmitted from the gearbox to the generator via a flexible coupling operating at a constant velocity. All gearboxes are specially designed 1-step planetary, 2-step helical gear design with a ratio of 1:70.2 (NM72C) or 1:84.3 (NM82).

5.2.4 GENERATOR

The NM72C wind turbine generator is a 1-speed water-cooled asynchronous (induction) 6-pole generator, operating with a 1.17 percent slip at rated power. The NM82 wind turbine generator is an asynchronous (induction) 6-pole generator, which operates with a 1.2 percent slip at rated power. Grid connection is accomplished through thyristors that are bypassed after the generator cuts in.

The generator meets protection class requirements of the International Standard IP55 (NM72C) or IP54 (NM82) with all electrical and moving parts totally enclosed for safety and protection from the elements.

5.2.5 BRAKES

The main brake is a fail-safe hydraulic release brake mounted on a high-speed shaft. Turbine braking is accomplished by full blade feathering. A secondary fail-safe mechanical brake system is mounted on the high-speed shaft connecting the gearbox to the generator.

5.2.6 YAW SYSTEM

The wind direction sensor on top of the nacelle communicates with a computer, which evaluates the measured wind parameters and, within a specified time interval, activates the yaw drives to align the nacelle to changing wind directions. The yaw system operates with a ball bearing slewing ring with a planetary gear motor and hydraulic braking system.

5.2.7 TURBINE CONTROLLER

The wind turbine operates automatically through a computer-controlled system, which serves the following functions:

- Before connection to the grid, the speed of rotation is synchronized with the grid frequency in order to limit the cut-in current.
- Thyristor cut-in of the 1.8 MW generator to limit the cut-in current.
- Cut-in current is lower than nominal current.
- Automatic nacelle yawing follows the wind direction.
- Cut-in and cut-out of power factor correction. Power factor correction covers the no-load consumption of generator reactive power.
- Monitoring of the operation.
- Turbine Stop as a result of faults.

The machine can be controlled from the control panel inside the nacelle or from a personal computer (PC) located at the bottom of the tower. It can also be remotely controlled through the SCADA system, with local lockout capability provided at the turbine controller.

Using the tower top control panel, the machine can be stopped, started, and turned out of the wind. Service switches at the tower top prevent service personnel at the bottom of the tower from operating certain systems of the turbine while service personnel are in the nacelle. To override any machine operation, controls located in the tower base and the nacelle can be activated to quickly and safely stop the turbine in the event of an emergency.

5.2.8 NACELLE

The nacelle cover is a fiberglass shell enclosure with sound-insulating foam applied to the inside. Access from the tower into the nacelle is through a manhole in the bedplate.

The nacelle functions as a housing to protect the mechanical and electrical equipment from the outside environment. It allows sufficient room and working space around the drive train for service and maintenance personnel to perform their jobs safely and comfortably. The nacelle is ventilated and well illuminated with a skylight hatch, enabling work to be carried out safely.

Most service and maintenance work can be carried out from inside the nacelle; however, a hatch at the front end of the nacelle gives easy and safe access to the blades and the hub. When the rotor is stopped and secured in the right position with a hydraulic rotor lock, there is access through a top hatch for maintenance functions.

5.2.9 TOWER

The turbine towers on which the nacelle is mounted have a height of 78 meters (258 feet) (NM72C) or 80 meters (262 feet) (NM82). All surfaces are sandblasted and multi layer coated for protection against corrosion. Access to the turbine is through a lockable steel door at the base of the tower. Once inside the tower, the nacelle can be accessed by ladder cage using a safety harness.

5.2.10 LIGHTNING PROTECTION

The entire turbine is equipped with a lightning protection system. The turbine is grounded and shielded to protect against lightning. The grounding system will be installed during foundation work, and must be accommodated to local soil conditions. The resistance to neutral earth must be in accordance with local utility or code requirements. Lightning conductors are placed in each rotor blade and on the nacelle. The machine frame, crane-bar and crane-pillar are equal-potential bonded.

The grounding system is constructed as a closed ring conductor with grounding rods that provide the following advantages:

Personnel Safety

The ring conductor limits the step and contact voltage for individuals, near the tower foundation in case of lightning strike.

Operational Safety

The grounding rods ensure a steady and low resistance to neutral earth for the entire grounding system.

5.3 PROJECT ELECTRICAL SYSTEM

Power will be generated at 600 volts and stepped up to 34.5 kV at a transformer mounted near the base of the tower. Multiple transformers will be looped together using 34.5 kV cable running underground along the turbine access roads to an existing 34.5 kV overhead feeder line. The power generated will be routed along the overhead feeder line to the GMLLC Substation. Fiber optic communications lines will run underground to connect all the turbines and run parallel to both the underground and overhead electrical conductors.

5.4 NM72C AND NM82 TURBINE OPERATION

The NM72C and NM82 wind turbines are conventional horizontal-axis wind energy converters with three blades, suited and designed for operation in medium to high wind speeds, like those found near Dodge Center. The turbine is equipped with an induction generator capable of generating up to 1,500 (NM72C) or 1,650 (NM82) kilowatts of power, depending on the wind available. The wind turbine begins generating power at wind speeds of 4 m/s (9 mph) (NM72C) and 3.5 m/s (7.8 mph) (NM82). When winds exceed 25 m/s (55.9 mph) (NM72C) or 20 m/s (44.7 mph) (NM82) the wind turbine will automatically shut off, ready to operate again in lower wind speeds.

5.5 PROJECT'S TRANSMISSION LINES AND INTERCONNECTION SYSTEM

The Project's transmission line extends approximately five miles north to the GMLLC Substation in Dodge Center. The location of the existing 34.5 overhead line is shown on Figure 2 and a photograph of the existing line is shown in Figure 12. The existing overhead transmission line is a 34.5 kV line, which runs along the west side of Highway 56, and will receive power from the underground collection system.

At the GMLLC Substation, the power from the project will be stepped up to 69 kV and connect to Xcel Energy's transmission system. The point of interconnection for the project will be located at the existing GMLLC Substation. The substation serves as an interconnection point for existing wind turbines in that are adjacent to the proposed turbines. The point of interconnection will include a utility metering pole assembly within a fenced yard.

5.6 PROJECT CONSTRUCTION

Several activities must be completed prior to the proposed Commercial Operation Date. The majority of the activity relates to equipment ordering lead-time, as well as design and construction of the facility. Below is a preliminary schedule of activities necessary to develop the Project. Pre-construction, construction, and post-construction activities for the Project include:

- Ordering of all necessary components including towers, nacelles, blades, foundations and transformers;
- Obtain applicable local, state, and federal permits;

- Final turbine micrositing;
- Complete survey to establish locations of structures and roadways;
- Soil borings, testing and analysis for proper foundation design and materials;
- Complete construction of access roads, to be used for construction and maintenance. Approximately three miles of access roads will be required, depending on specific turbine locations;
- Construction of overhead feeder lines;
- Design and construction of possible substation improvements;
- Installation of tower foundations;
- Installation of underground cables;
- Tower placement and wind turbine setting;
- Acceptance testing of facility; and
- Commencement of commercial operation.

5.6.1 CONSTRUCTION MANAGEMENT

An EPC contractor will be primarily responsible for the construction management of the Project. The EPC contractor will be responsible for the installation of the turbines and associated equipment including towers, foundations, nacelles and blades.

The EPC contractor will use the services of local contractors, where possible, to assist in the construction of the Project. The EPC contractor, in coordination with local contractors, will undertake the following activities:

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

The EPC contractor also serves as key contact and interface for subcontractor coordination. The EPC contractor will oversee the installation of underground communication and power collection lines.

The Project will be constructed under the direct supervision of on-site construction manager with the assistance of local contractors. The construction consists of the following tasks:

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

The construction team will be on site to handle materials purchasing, construction and quality control. The EPC contractor will manage local subcontractors to complete all aspects of construction.

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

5.6.2 Foundation Design

The NM72C wind turbine 78 m (257-ft) or NM82 wind turbine 80 m (264 ft) tubular towers will be connected by anchor bolts to an underground concrete foundation. The foundation design is represented in Figure 13. Geotechnical surveys, turbine tower load specifications and cost considerations will dictate final design parameters of the foundations.

5.6.3 Civil Works

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

- Construction of roads adjacent to the wind turbine strings to allow construction and continued servicing of the wind turbines;
- Clearing and grading for wind turbine tower foundation installations;
- Trenching for underground cabling for connecting the individual wind turbines and feeder system;
- Clearing and grading for pad-mount transformers and other installations; and
- Installation of any site fencing and security.

Access roads will be constructed along turbine strings or arrays. These roads will be completed in accordance with local building requirements and will be located to facilitate both construction and continued operation and maintenance. Siting roads in areas with unstable soil will be avoided wherever possible. All roads will include appropriate drainage and culverts while still allowing for the crossing of farm equipment. The roads will be approximately 5 m (16 ft) wide and will be covered with road base designed to allow passage under inclement weather conditions. The roads will consist of graded dirt, overlaid with fabric and covered with Class 5 gravel. Once construction is completed, the roads will be regraded, filled and dressed as needed. Underground cabling will be trenched along access roads and existing ROW to connect wind turbines and transmission lines.

5.6.4 COMMISSIONING

The Project will be commissioned after completion of the construction phase. Acceptance of the wind farm is achieved through detailed inspection and testing procedures. Inspection and testing occurs for each component of the wind turbines (e.g., hydraulic system, gearbox, tower, rotor, nacelle, electrical equipment, and blades), as well as the communication system, meteorological system, high voltage collection and feeder system, and the SCADA system.

5.7 PROJECT OPERATION AND MAINTENANCE

GMW will enter into a contractual agreement with NEG Micon to provide service and maintenance for the project. The service and maintenance activities will be performed by qualified technicians, trained specifically on NEG Micon turbines.

GMW will use an existing operations manager who is located at the site. The operations manager will oversee the maintenance and service program, ensure utility interconnection and respond to turbine outages. The operations manager will be responsible for all management, administration, service and maintenance activities. After the initial warranty period, GMW may elect to take over service and maintenance duties.

The maintenance and operations facilities will be equipped with all necessary tools, instruments and spare parts to accomplish service, repairs and project/site operational control. Spare parts in relation to the electrical infrastructure will also be maintained based on similar historic project demands. The project staff will be complemented with the necessary service vehicles – light trucks, boom trucks, cranes, etc. – to ensure timely response.

Turbine maintenance will be accomplished as an on-going cyclical function during the project lifetime, so as to minimize downtime. Transformer and pole-line maintenance will be accomplished on an annual basis and will be scheduled and performed during non- or low-wind periods.

Maintenance outages in relation to wind turbines will have minimal impact on the energy supply. Turbine maintenance will be accomplished as an on-going cyclical function during the project lifetime. Transformer and pole-line maintenance will be accomplished on an as needed basis and will be scheduled and performed, when possible, during non- or low-wind periods.

5.7.1 PROJECT CONTROL, MANAGEMENT AND SERVICE

GMW and NEG Micon will control, monitor, operate, and maintain the Project by means of a SCADA computer software program.

Using specialized software, GMW and NEG Micon are able to actively monitor, control, maintain, operate and trouble-shoot problems regarding the wind turbines, electrical collection and transmission infrastructure, and the communication and control infrastructure.

The primary functions of the SCADA is to:

- Monitor wind farm status;
- Allow for autonomous turbine operation;
- Alert operations personnel to wind farm conditions requiring resolution;
- Provide a user/operator interface for controlling and monitoring wind turbines;
- Collect meteorological performance data from turbines;
- Monitor field communications;

- Provide diagnostic capabilities of wind turbine performance for operators and maintenance personnel;
- Collect wind turbine and wind farm material and labor resource information;
- Provide information archive capabilities;
- Provide inventory control capabilities; and
- Provide information reporting on a regular basis.

5.7.2 MAINTENANCE SCHEDULE

An operations manager will remotely monitor the Project on a daily basis. This will be accompanied by a visual inspection by a maintenance manager. Several daily checks will be made in the first three months of commercial operation to see that the wind farm is operating within expected parameters.

Once commissioned, service and maintenance for the Project is carefully planned and divided into the following intervals:

- **First Service Inspection.** The first service inspection will take place one to three months after the turbines have been commissioned. At this inspection, particular attention is paid to the tightening up of all bolts, a full greasing and filtering of gear oil;
- **Semi-Annual Service Inspection.** Regular service inspections commence six months after the first. The semi-annual inspection consists of lubrication and a safety test of the turbine;
- **Annual Service Inspection.** The yearly service inspection consists of a semi-annual inspection plus a full component check. Bolts are checked with a torque wrench, and tightened as necessary. The check covers 10 percent of every bolt assembly. If any bolts are found to be loose, all bolts in that assembly are tightened 100 percent and the event is logged;
- **Two Years Service Inspection.** The two years service inspection consists of the annual inspection, plus checking and tightening of terminal connectors; and
- **Five Years Service Inspection**. The five years inspection consists of the annual inspection, an extensive inspection of the wind braking system, checking and testing of oil and grease, balance check and tightness of terminal connectors.

5.7.3 GENERAL MAINTENANCE DUTIES

GMW's O&M crew will perform all scheduled and unscheduled maintenance including periodic operational checks and tests, regular preventive maintenance on all turbines, related plant facilities and equipment, safety systems, controls, instruments, and machinery. Specific duties include:

- Maintenance on the wind turbines and on the mechanical, electrical power, and communications system;
- Performance of all routine inspections;
- Maintenance of all oil levels and changing oil filters;
- Maintenance of the control systems, all structures associated with the wind farm, access roads, drainage systems and other facilities necessary for the operation of the wind farm;
- Maintenance of all O&M field maintenance manuals, service bulletins, revisions and documentation for the wind farm;
- Maintenance of all parts, price lists, and computer software;
- Maintenance and operation of interconnection facilities;
- Provide all labor, services, consumables and parts required to perform scheduled and unscheduled maintenance on the wind farm, including repairs and replacement of parts and removal of failed parts;
- Cooperate with regulatory agencies, as may be required, in regards to avian and other wildlife issues. This may include reporting and monitoring;
- Manage lubricants, solvents and other hazardous materials as required by local and/or state regulations;
- Maintain appropriate levels of spare parts in order to maintain equipment. Order and maintain spare parts inventory;
- Provide all necessary equipment including industrial cranes for removal and reinstallation of turbines;
- Hire, train and supervise a work force necessary to meet the general maintenance requirements; and
- Implement appropriate security methods.

5.7.4 OPERATIONS AND MAINTENANCE FACILITY

It is anticipated that the operations, maintenance and control facility will be conducted at an existing on-site maintenance facility. The maintenance facility is located along State Highway 56 in Section 22, adjacent to existing wind turbines. The maintenance facility will be equipped with all necessary tools, instruments and spare parts to accomplish service, repairs and project/site operational control. Spare parts in relation to the electrical infrastructure will also be maintained based on similar historic project demands. The project staff will be complemented with the necessary service vehicles, such as light trucks, boom trucks, cranes, etc., to ensure timely response.

5.8 PROJECT SCHEDULE

5.8.1 LAND ACQUISITION, INSTALLATION, OPERATION, DECOMMISSIONING, AND RESTORATION

GMW will be responsible for all land acquisition, operation, maintenance, decommissioning and site restoration. The contractor will be responsible for construction of the wind farm.

5.8.2 PERMITS

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

5.8.3 EQUIPMENT PROCUREMENT, MANUFACTURE, AND DELIVERY

GMW will order the NEG Micon wind turbine components as soon as practicable. Once the turbines have been ordered, delivery is anticipated within six months.

5.8.4 CONSTRUCTION

The contractor will be responsible for completing all wind farm construction, including roads, wind turbine assembly, electrical and communications work.

5.8.5 CONSTRUCTION FINANCING

GMW will be responsible for financing all pre-development, development and construction activities. GMW anticipates financing the cost of all pre-development activities through internal funds or independent construction financing.

5.8.6 PERMANENT FINANCING

GMW anticipates obtaining permanent financing from an institutional lender and equity investors prior to commercial operation of the wind farm.

5.8.7 EXPECTED COMMERCIAL OPERATION DATE

GMW expects the Project to be fully operational by August 2005, although some turbines may begin operation as early as the fall of 2004. The remaining turbines described in this application will be constructed as transmission capacity becomes available.

5.8.8 DECOMMISSIONING AND RESTORATION

GMW will decommission the facility to comply with county requirements (Section 2105). The county requires the following measures upon decommissioning of the facility:

- Removal of all structures and debris to a depth of 1.2 m (4 ft)
- Restoration of the soil and vegetation (consistent with the surrounding vegetation)

Another option may be to re-apply for a Site Permit and continue operation of the wind farm, by providing energy to Xcel or to the open market. Proper retrofits and upgraded infrastructure may allow the wind farm to produce efficiently and successfully for many more years.

5.8.8.1 Estimated Decommissioning Costs in Current Dollars

GMW will be responsible for all costs to decommission the Project and associated facilities. Dodge County requires the decommissioning plan to include $3,000 per turbine to be held in escrow by the County. The money would only be withdrawn upon successful implementation of a decommissioning plan. If GMW fails to meet the goals and objectives of the decommissioning plan, the County reserves the right to use all or a portion of the money in escrow to finish the plan.

5.8.8.2 List of Decommissioning Activities

Decommissioning of the site includes total removal of all turbines and related facilities at the termination of the Project Site Permit. Related facilities shall include all access roads, equipment, towers, foundations, buildings, transformers and cables or wires to a depth of 1.2 m (4 ft) below grade. Additionally, any disturbed surface shall be graded, reseeded, and restored as best as possible to its original state.

6.0 ENVIRONMENTAL ANALYSIS

6.1 DESCRIPTION OF ENVIRONMENTAL SETTING (INTRODUCTION)

Dodge County has some of the highest land in southeastern Minnesota. The Zumbro Watershed is a prominent feature in the landscape and drains a majority of the county. The Project is proposed for development on high ground in Dodge County. This area is primarily used for agricultural purposes and is a rural community in southeastern Minnesota.

6.1.1 PROJECT SITE

The project site consists of all sections that include turbines and access roads as presented in Figure 3. The project site includes 3,800 acres.

6.1.2 IMPACTED AREA

The impacted area consists of all land that will be disturbed by turbine foundations, access roads, and related facilities. Approximately 5.5 acres, of the facility will be impacted, assuming a one-half acre disturbance per turbine.

6.2 HUMAN SETTLEMENT

6.2.1 DEMOGRAPHICS/HOMES

6.2.1.1 General Description of Resources

The proposed wind farm is located within a lightly populated rural area in southeastern Minnesota, located approximately one mile south of the town of Dodge Center in Dodge County. Information on demographics, income levels and housing for this section was obtained from the U.S. Census Bureau website.

The population of Dodge County in 2000 was 17,731 and 96.6 percent of the population is white. The average household size in Dodge County was 2.73, and the total number of housing units is 6,642. Agriculture and agricultural support are the predominant areas of occupation in the county. The 1999 median household income for the county was $47,437.

6.2.1.2 Impacts

Impacts to demographics and residences by the proposed construction and operation of the wind farm are not anticipated. It is likely that the county will benefit from the tax revenue generated by the presence of the wind farm. Additionally, local service-related businesses will benefit in the short term due to the increase in the number of workers during construction.

6.2.1.3 Mitigative Measures

In accordance with MEQB LWECS Site Permit requirements for previous projects, minimum setbacks for turbines from residences are 152 m (500 feet) from occupied homesteads and 76 m (250 ft) from roads. See Section 6.2.2 for setbacks that are necessary to comply with MPCA standards.

6.2.2 NOISE

6.2.2.1 General Description of Resources

Background noise levels in the project area are typical of those in rural settings, where existing noise levels are commonly in the low to mid-40 dBA. These are relatively low background levels and are generally representative of the site. Higher levels exist near roads and other areas of human activity. The windy conditions in this region tend to increase ambient noise levels compared to other rural areas.

For the noise evaluation, GMW used representative sound power levels (L_p) of the NEG Micon NM72C 1.5 MW and NEG Micon NM82 1.65 MW wind turbines that were provided by the manufacturer. To the extent that the sound characteristics of the selected turbines vary, GMLLC will ensure compliance with MPCA noise standards and will submit an updated noise analysis to the MEQB.

6.2.2.2 Impacts

When in motion, the wind turbines emit a perceptible sound. The level of this noise varies with the speed of the turbine and the distance of the listener to the turbine. On relatively windy days, the turbines create more noise, however, the ambient or natural wind noise level tends to override the turbine noise as distance from the turbines increases.

The wind turbines will create sources of additional noise. Since the noise levels provided did not include any time-weighted average sound levels, the sound power levels of 104.5 dBA for the NM72C MW turbine and 106 dBA for the NM82 1.65 MW turbine were converted to a sound pressure levels and compared to the Minnesota Daytime and Nighttime L_{10} and L_{50} Standards given in Minn. Rule 7030.0040. The turbines were modeled to determine at what distance turbine noise would not exceed Minnesota Pollution Control Agency (MPCA) noise standards. Turbines were modeled using the following equation for a hemispherical point source: $L_p = L_w - 10 \log (2*pi*r^2) - A_{atm}$ where L_p is defined as the sound pressure level at the distance of interest (r), L_w is the sound power level provided by the turbine manufacturer, and A_{atm} defined as the attenuation provided by atmospheric absorption. Sound is generated from the wind turbine at points near the hub or nacelle, eighty meters in the air, as well as from the blade rotation and motors near ground level. Therefore the noise source could be considered both spherical and hemispherical. Use of the sound propagation equation for a hemispherical point source is therefore conservative and predicts the maximum distance for noise exceedances.

The maximum distance calculated where an exceedance of a state noise standard would no longer occur for the Nighttime L_{50} standard of 50 dBA was 190 m (623 ft) for the 1.5 MW turbine and 225 m (738 ft) for the 1.65 MW turbine. Therefore, to avoid exceedances of the MPCA Nighttime L_{50} Standard no 1.5 MW turbines should be sited within 190 m (623 ft) of an occupied residence and no 1.65 MW turbines should be sited within 225 m (738 ft) of an occupied residence.

As long as there are no occupied structures within 190 meters (623 feet) or 225 meters (738 feet) of active 1.5 MW and 1.65 MW turbines respectively, the noise levels will meet Minn. Rule 7030.0040 measured at occupied residences. Noise from the turbines will be less discernible on windy days, except in areas in the immediate vicinity of the turbines.

6.2.2.3 Mitigative Measures

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

6.2.3 AESTHETICS

6.2.3.1 General Description of Resources

Agricultural fields and farmsteads visually dominate the wind farm site. The landscape can be classified as rural open space. The photo in Figure 14 shows a typical landscape within the project area. The photograph is taken to show the agricultural land in Section 15, Township 106 North, Range 17 West and the existing turbines to the north in Section 10. Vegetation is predominantly corn and soybeans. A mix of deciduous and coniferous trees planted for windbreaks typically surrounds farmsteads.

The settlements in Dodge County are residences and farm buildings (inhabited and uninhabited), which are focal points in the expansive open space of the project vicinity. There are currently several turbines within the Site that have altered the visual character of the surrounding area, and have become a dominant feature within the landscape. The proposed turbines on the site will be visible from a number of vantage points. The proposed turbines will be most visually apparent driving along State Highway 56 from the north and south, and along the various county and township roads adjacent to the wind farm. The existing turbines are readily visible from the southern edge of Dodge Center. From a distance, the turbines will be visible from areas east and west of Dodge Center along U.S. Trunk Highway 14, various county and township roads, the city of Dodge Center, and the Bud Jensen Wildlife Management Area (WMA). Figure 15 is of Section 22, Township 106 North, and Range 17 West, facing south toward a farmstead near existing turbines. Highway 56 is to the west.

6.2.3.2 Impacts

The placement of 11 turbines will have an effect on the visual quality within the site vicinity. However, discussion of the aesthetic effect of the proposed wind farm is based on subjective human response. The wind farm would have a combination of effects on the visual quality/rural character of the area. Wind towers could be perceived as a visual intrusion, intruding on the natural aesthetic value of the current landscape. Wind turbines already existing near the project have altered the landscape in the area from agricultural to wind farm/agricultural. The proposed project will intensify the visual character imposed by the existing wind turbines.

On the other hand, wind farms have their own aesthetic quality, distinguishing them from other non-agricultural land uses. The wind farm does not generate much traffic or significantly increase day-to-day human activity in the area. Therefore, the project site would retain the rural sense and remote characteristic of the vicinity. Although "industrial" in form and purpose, turbines are essentially "farming" the wind for energy. The proposed land use would not involve any ongoing industrial use of non-renewable resources or emissions into the environment. Although the turbines are hi- tech in appearance, they are compatible with the rural, agricultural heritage of the area.

6.2.3.3 Mitigative Measures

GMW proposes the following mitigative measures:

- Turbines will not be located in biologically sensitive areas such as wetlands or prairie remnants.
- Turbines will not be illuminated, except as required by FAA regulations.
- Existing roads will be used for construction and maintenance where possible. Road construction will be minimized.
- Temporarily disturbed areas will be reseeded with native vegetation.

6.2.4 PUBLIC SERVICES/INFRASTRUCTURE

6.2.4.1 General Description of Resources

The proposed wind farm project is located in a community of approximately 2,200 people in southeastern Minnesota. There is an established transportation and utility network that provides access and necessary services to the light industry, small cities, homesteads and farms existing near the study area.

The following is a description of the existing infrastructure.

Electrical Service

Xcel Energy maintains a 69 kV electrical transmission line that runs through the downtown area of Dodge Center. Adjacent to this transmission line GM, LLC constructed the GMLLC Substation to connect existing turbines with Xcel Energy's transmission system. An existing 34.5 kV feeder line connects this substation with the existing turbines. The Project will use this existing feeder line and substation to connect the new wind turbines with Xcel's Transmission system (Figure 2).

Traffic Routing

No Interstate will service the Project, although U.S. Trunk Highway 14 does provide access into the project area. Minnesota State Highway 56 runs north to south through the project area. Various county and township roads provide access to the proposed site. Access to the site also includes two-lane paved and gravel roads and minimum maintenance gravel roads.

Water Supply

Construction, operation, and maintenance of the proposed wind farm will not significantly impact the water supply for the area. The project will not require the appropriation of ground or surface waters. The installation or abandonment of wells is not required for the project. However, in the event wells are abandoned, they will be capped as required by Minnesota Law and the Minnesota Department of Health.

Sanitary Sewer

Sanitary sewer systems are only available to the residences, and commercial and industrial operations located within Dodge Center. The majority of the rural residents have a septic system to handle sanitary wastes.

Railroad

An active railroad line operated by Dakota, Minnesota, and Eastern Railroad currently runs approximately 2.4 km (1.5 mi) north of the project area.

Telephone

Service is provided by KMTelecom. Construction, operation, and maintenance of the proposed wind farm will not impact the telephone service to the area.

Radio Towers

There are two Federal Communications Commission (FCC) registered radio towers within 16 km (10 mi) of the project area in Dodge Center.

Radar

There are no FAA operated radar installations within a 16 km (10 mi) radius of the site.

Television Reception

Residents receive television signals from network and public stations in the Twin Cities and Rochester, MN.

6.2.4.2 Impacts

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

Electrical Service

Construction of the project will add up to 11 wind turbines and transformers to the existing transmission feeder system in the proposed wind farm area. In addition, a network of approximately three miles of underground lines will be constructed on site on private property.

The power generated by the wind turbines will be collected at the GMLLC Substation adjacent to an Xcel Energy 69 kV in Dodge Center.

GMW shall not operate the wind farm so as to cause microwave, television, radio, electronic, or navigation interference contrary to FCC regulations or other law.

6.2.4.3 Mitigative Measures

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

In the event the wind farm or its operation causes such interference with microwave, television, radio, electronic, or navigation, GMW shall promptly take measures necessary to correct the problem on an individual basis.

6.2.5 ARCHAEOLOGICAL, CULTURAL, AND HISTORIC RESOURCES

6.2.5.1 General Description of Resources

Review of the Minnesota State Historic Preservation Office (SHPO) records indicate that there is one historic standing structure and no prehistoric or historic sites identified within one-mile of the site. The previously recorded historic structure, which has not been examined for National Register of Historic Places (NRHP) eligibility, is the Ashland Township Hall, located in the northeast quarter of Section 16, Township 106 North, Range 17 West.

6.2.5.2 Impacts

The proposed construction has the potential to add to the visual impacts in the region of the site. However, wind turbines are currently located in the area and are within a quarter mile of Ashland Township Hall.

6.2.5.3 Mitigative Measures

SHPO does not recommend that a Phase I archaeological survey be conducted due to the absence of previously recorded historic sites and prehistoric sites. The area is considered to have a low potential for cultural resources.

If any cultural resources are noted during construction, their integrity and significance will be addressed in terms of the site's potential eligibility to the NHRP. If such sites are determined to be eligible for the NRHP, appropriate mitigative measures will need to be developed in consultation with the Minnesota SHPO, the State Archaeologist, and consulting American Indian communities, as appropriate.

6.2.6 Recreational Resources

6.2.6.1 General Description of Resources

Recreational opportunities near Dodge Center are primarily sports-related, however opportunities for family activities are available at the City parks. The Community of Dodge Center is home to a sportsman's club for archery, trap shooting, and rifle ranges, the Dodge Center Country Club golf course, tennis courts, and ball fields. Figure 1 depicts the locations of recreation and wildlife areas near the proposed project site.

WMAs are managed to provide wildlife habitat, improve wildlife production and provide public hunting and trapping opportunities. These Minnesota Department of Natural Resources (MN-DNR) lands were acquired and developed primarily with hunting license fees. WMAs are closed to all-terrain vehicles and horses because of potential detrimental effects on wildlife habitat. WMAs located within 8 km (5 mi) from the Project are:

- Bud Jensen WMA located 1 mile east of the site.
- Pheasants Forever WMA located 3 miles northeast of the site.
- Teapail WMA located 4 miles north of the site.
- Wasioja WMA located 4 miles north of the site.

The Claremont State Game Refuge is located 3 km (2 mi) northwest of the project area. State Game Refuges are lands set aside as refuges for animals. Hunting is not allowed on these lands unless designated by the commissioner (Minnesota Statute 97A.085). The Claremont State Game Refuge is open for turkey hunting.

There are no SNAs within the project area.

6.2.6.2 Impacts

Visual impacts will be most evident to recreationalists using the Bud Jensen WMA, which is approximately one mile from the project site. However, the existing wind farm is within 3 km (2 mi) of the WMA, and is currently within the viewshed of this land.

6.2.6.3 Mitigative Measures

Wind turbines will not be located within WMAs, SNAs or in Nature Conservancy Preserves.

6.3 EFFECTS ON PUBLIC HEALTH AND SAFETY

The proposed wind farm site is located in a rural area with low population density and very little residential, commercial or industrial development outside of the cities and towns. Wind power technology has no air or water emissions. As a result, the impacts of the proposed wind farm on public health and safety will be minimal.

6.3.1 AIR TRAFFIC

The Dodge Center Airport is located approximately 0.8 km (0.5 mi) north of the sites northern boundary. The airport has two runways and averages 96 aircraft operations per week. In addition to the airport, two landing strips are located approximately 0.8-2.4 km (0.5 and 1.5 mi) west of the western site boundary. If they are in operation, local farmers and businesses likely use these landing strips.

Section 5.10 of the Dodge Center Zoning Code identifies a safety zone and restricts objects of greater than 45 m (150 ft) in height in an ellipse around the runways (Appendix A). The project will not require the addition of any new overhead transmission lines that may interfere with aircraft operation.

6.3.2 ELECTRIC AND MAGNETIC FIELDS

Existing electric and magnetic fields (EMF) in the project area occur where any electric conductor exists with an electrical current flowing through it.

Examples of such conditions include high-voltage transmission lines, feeder lines, substation transformers, house wiring and electrical appliances. Transmission lines are not fundamentally different from other electrical conductors. EMF can occur indoors and outdoors.

Since 1979 there has been considerable attention focused on understanding the effects of EMF on humans. The most recent and exhaustive reviews of the health effects from power-frequency fields conclude that the evidence of health risk is weak. The National Institute of Environmental Health Sciences (NIEHS) issued its final report, "NIEHS Report on Health Effects from Exposure to Power-Line Frequency Electric and Magnetic Fields" on June 15, 1999, following six years of intensive research. NIEHS concluded that there is little scientific evidence correlating extra low frequency EMF exposures with health risk.

The Minnesota State Interagency Working Group on EMF Issues, consisting of members from five state agencies, issued "A White Paper on Electric and Magnetic Field (EMF) Policy and Mitigation Options" in September of 2002. The Working Group concluded the following:

> "Research on the health effects of EMF has been carried out since the 1970s. Epidemiological studies have mixed results – some have shown no statistically significant association between exposure to EMF and health effects, and some have shown a weak association. More recently laboratory studies have failed to show such an association, or to establish a biological mechanism for how magnetic fields may cause cancer…
>
> The Minnesota Department of Health (MDH) concludes that the current body of evidence is insufficient to establish a cause and effect relationship between EMF and adverse health effects. However, as with many other environmental health issues, the possibility of health risk from EMF cannot be dismissed."

These conclusions are consistent with those reached by the Department of Health in 2000 and similar to conclusions of scientific committees convened by the U.S. Congress, and other international and national health agencies including the 1999 final report by the NIEHS.

6.3.3 SECURITY

The proposed wind farm site is located in an area that has a low population density. Construction and operation of the project will have minimal impacts on the security and safety of the local populace. The following measures will be taken to reduce the chance of physical and property damage, as well as personal injury:

- The towers will be placed at least 76 m (250 ft) from roads and at least 168 m (550 ft) from occupied homesteads. These distances are considered to be safe based on developer experience, and are consistent with prior MEQB permits for LWECS.
- Security measures will be taken during the construction and operation of the project including temporary (safety), warning signs and locks on equipment and wind power facilities.
- Turbines will sit on solid steel enclosed tubular towers in which all electrical equipment will be located, except for the pad-mounted transformer. Access to the tower is only through a solid steel door that will be locked when not in use.

6.3.4 TRAFFIC

The majority of traffic accessing the site would likely travel east/west along U.S. Trunk Highway 14 and south along State Trunk Highway 56 to the proposed site. Some traffic may access the site from the south along State Trunk Highway 56. A minimal amount of traffic could access the site east/west along township roads. The existing average daily traffic (AADT) volume for U.S. Trunk Highway 14 near Dodge Center is 8,200 vehicles. State Trunk Highway 56 has an AADT volume of 4,250 vehicles, just south of Highway 14, and 2,750 south of County Road 10 (See Figure 16). The heavy commercial average daily traffic (HCADT) volume is 830 on U.S. Trunk Highway 14. On Highway 56, the approximate HCADT from the north is 350 vehicles, and from the south the HCADT is 260 vehicles.

During the construction phase, several types of light, medium and heavy-duty construction vehicles will travel to and from the site, as well as private vehicles used by the construction personnel. GMW estimates that there will be up to 35 trips per day in the area during peak construction periods. That volume will occur during the peak time when the majority of the foundation and tower assembly is taking place. At the completion of each construction phase, this equipment will be removed from the site or reduced in number.

The operations phase of the new project will require a maintenance crew driving through the area to monitor and maintain the wind turbines. The maintenance crew will monitor the wind turbines as needed. There would be a slight increase in the typical number of vehicles on-site for occasional turbine and substation repair.

6.3.5 HAZARDOUS MATERIALS

There will be three types of fluids used for the wind turbines that are necessary for operation. These fluids include:

- Gear box oil – synthetic or mineral depending on application
- Hydraulic fluid
- Gear grease

6.3.6 IMPACTS

6.3.6.1 Air Traffic

It appears that one of the towers in Section 9 may be within the restricted airspace. GMW has been working closely with the FAA and the local airport on permitting requirements for each of the existing turbines and will continue these discussions for the new turbines described in this application. Impacts to the Dodge Center Airport are not anticipated.

6.3.6.2 Electric and Magnetic Fields

The project will have no significant impact to public health and safety due to EMF.

6.3.6.3 Traffic

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

6.3.6.4 Security

The proposed wind farm is not expected to impact the security and safety of the local populace.

6.3.6.5 Hazardous Materials

All fluids will be contained within the wind turbine structure. There should be no leakage and no need to dispose of the fluids (except in the rare case of contamination) over the life of the wind turbine.

6.3.7 MITIGATIVE MEASURES

The following are the mitigative measures proposed for the project:

- GMW has negotiated provisions for take off and landing at the airport to accommodate the wind farm.
- GMW will propose mounting two red obstruction lights on each turbine. The lights will be activated full-time, but more prominent during evening hours. Projects throughout the U.S. have been subject to a wide range of FAA rulings including white strobe lights and flashing red lights mounted atop turbines. GMW expects that the FAA will accept the project's proposed lighting.
- If any wastes, fluids or pollutants are generated during any phase of the operation of the Project, they will be handled, processed, treated, stored and disposed of in accordance with Minnesota Rules Chapter 7045 (Hazardous Waste).

No additional mitigative measures are required, since:

- NIEHS concluded that there is little scientific evidence correlating extra low frequency EMF exposures with health risk.
- No effects to local security are expected.
- No long-term significant impacts to state, county, municipal, and township roads are anticipated.

6.4 EFFECTS ON LAND-BASED ECONOMIES

6.4.1 AGRICULTURE/FARMING/FORESTRY/MINING

6.4.1.1 General Description of Resources

Agriculture/Farming

Approximately 246,800 acres of the land in Dodge County are utilized for agricultural purposes. There is an abundance of prime farmland and statewide important soils in Dodge County. The project area is 100% prime farmland. In 2001, corn and soybeans were the primary crops grown, with oats and hay being an additional source of agricultural revenue in the county. According to the 1997 Census of Agriculture, crops accounted for 56% of the market value of products sold in the county. Livestock sales accounted for 44% of the market value. In 2001, the predominant livestock in the county were hogs, pigs, and dairy cows.

Forestry

There are no economically important forests within the project area. Wooded areas are primarily associated with farmsteads and function as windrows.

Mining

Mineral deposits in Dodge County consist of sand and gravel from unconsolidated surficial deposits, and crushed stone from limestone bedrock. Highly desirable sand and gravel deposits in Dodge County occur in fluvial and glaciofluvial materials. These highly desirable deposits are large in extent and consist of sand and gravel generally 6 to 15 m (20 to 50 ft) thick. These deposits have less than 1.5 m (5 ft) of overburden and are therefore easily accessible for development.

Highly desirable crushed stone deposits come from the Prosser and Stewartville Members of the Galena Formation. The Galena is a limestone and dolomitic limestone. The highly desirable resources are derived from areas where the Prosser and Stewartville are more than 12 m (40 ft) thick with less than 6 m (20 ft) of overburden.

In Dodge County, sand and gravel pits and crushed stone quarries are generally located along river and stream valleys. These tend to be areas where the overburden is not thick, making the mineral resource more accessible.

No sand and gravel pits or crushed stone quarries were identified at the project site. The nearest sand and gravel pits are approximately a mile northwest of the site along Dodge Center Creek. The nearest crushed rock quarries are at least 8 km (5 mi) to the north, northeast and east.

The majority of the site has limited potential for aggregate resource development (Anderson, 2002). Sediments associated with Salem Creek and Henslin Creek at the extreme northwest and southeast corners of the site are considered "less desirable sand and gravel deposits." This ranking is the lowest for potential sand and gravel resources; the other two rankings are "moderately desirable" and "highly desirable." Geologic resources are discussed further in Section 6.5.1.

6.4.1.2 Impacts

Agriculture/Farming

Construction of the wind turbines and access roads on the site will result in the disturbance of approximately 5.5 acres. Most of the soil within the project area is considered prime farmland. The loss of agricultural land to the construction of the wind farm will reduce the amount of land that can be cultivated.

Prime farmland is the land that has the best combination of physical and chemical characteristics for producing food, feed, forage, fiber, and oilseed crops. The National Resource Conservation Service (NRCS) has two classifications for prime farmland. The first is where all areas of the soil series are classified prime farmland. The second is where only the drained areas of the soil series are prime farmland. Table B-1 lists the soils considered Prime Farmland within the Project site. Figure 17 shows the soil distribution in the project area.

Forestry

No impacts are anticipated to economically important forested areas. Woodlots associated with farmsteads should not be impacted by the proposed project.

Mining

No impacts are anticipated to sand and gravel or crushed rock mining

6.4.1.3 Mitigative Measures

Agriculture/Farming

Only land for the turbine and access roads will be taken out of crop production. Once the wind turbines are constructed, a majority of the land surrounding the turbines can still be farmed.

Forestry and Mining

As no impacts are anticipated, mitigative measures are not necessary.

6.4.2 TOURISM AND COMMUNITY BENEFITS

6.4.2.1 General Description of Resources

Tourism near the project site primarily focuses on the agricultural activities in the area. Dodge Center, which is north of the project site, is host to Harvest Days in September, but also hosts Centerfest on Fathers Day weekend, and the Dodge Center Open Golf Tournament in August. The primary tourist attraction in the community is Agricultural Tourism (agri-tourism). The community has worked with the University of Minnesota Extension Service to promote agri-tourism in the area. The Extension Service defines agri-tourism as "a set of economic and social activities that occur and link travel with the products, services, and experiences of agriculture." Near the project site, is a farm that promotes alternative energy (wind generation), crop production (ethanol products), and has antiques as an example of agri-tourism in this community. This farm, Land of a Thousand Winds, is part of the Country Heritage Adventures tours, which is a farm tourism coalition that allows individuals to experience Minnesota farming.

6.4.2.2 Impacts

No negative impacts are expected due to the construction of this wind facility. Wind energy generation is currently a tourist attraction to this area. The community could potentially benefit from revenues generated by increased tourism in the area.

6.4.2.3 Mitigation

No impacts to area tourism are anticipated. No mitigation will be necessary.

6.4.3 TOPOGRAPHY

6.4.3.1 General Description of Resources

The topography in eastern Dodge County is very rolling, reflecting stream-dissected bedrock valleys that were formed prior to glaciation. The topography in the western portion of the county is fairly flat. The proposed site itself is on a topographically higher area compared to the surrounding land. The majority of the proposed site is gently rolling. Streams at the northwest and southeast corners of the proposed site cut the land surface. Here, the topography steepens and the elevation drops.

6.4.3.2 Impacts

There would be no impacts to the area topography from the proposed project.

6.4.3.3 Mitigation

As no impacts are anticipated, no mitigative measures are needed.

6.4.4 SOILS

6.4.4.1 General Description of Resources

The soils within the Site can be grouped into categories known as associations. Associations are a group of defined and named soils associated in a characteristic geographic pattern. A soil association has a distinctive pattern of soils, relief, and drainage. Each is a unique natural landscape. Typically, an association consists of one or more major soils and some minor soils. The soils making up one association can make up another, but in a different pattern. Soil Associations 3, 6, and 9 are the three primary associations within the Site; these associations are described in greater detail below.

Soil Association 3

Generally consists of nearly level, somewhat poorly drained to very poorly drained soils formed in glacial till plains or lake-modified till plains. The major soils of this association are the Floyd silty clay loam and Clyde silty clay loam.

Soil Association 6

Generally consists of well drained to somewhat poorly drained soils that formed in glacial till plains. The major soils are the Racine silt loam, Kasson silt loam, Kenyon silt loam, Floyd silty clay loam, and Clyde silty clay loam.

Soil Association 9

Generally consists of moderately well drained to somewhat poorly drained soils that formed in silt over glacial till plains. The major soils are the Kasson silt loam, Skyberg silt loam, Floyd silty clay loam, and Clyde silty clay loam.

The Project site has 15 soil units, and is dominated by Floyd and Clyde silty clay loams, Kasson silt loam, and Skyberg silt loam. A description of each soil unit is attached in Appendix B. The soil map in Figure 17 shows the distribution of soil types at the Site. Map codes for the soil types that are included in each soil series are noted in the series description.

The project site is 100% prime farmland as recognized by the soil units on the Site. According to the Minnesota NRCS,

> "In general, prime farmland soils have an adequate and dependable water supply from precipitation or irrigation. They have a favorable temperature and growing season with acceptable levels of acidity or alkalinity, content of salt or sodium, and few or no rocks. They are permeable to water and air, are not excessively erodible and are not saturated with water for long periods of time. They do not flood frequently or are protected from flooding."

There are four soils within the Site that are classified as "hydric." According to the NRCS, "A hydric soil is a soil that formed under conditions of saturation, flooding, or ponding long enough during the growing season to develop anaerobic conditions in the upper part." Clyde silty clay loam, 0-2% slopes, Floyd and Clyde silty clay loams, Kato silty clay loam, and Mixed alluvial land, poorly drained are considered hydric using this criteria. Additionally, each soil identified within the Site has soil inclusions that are considered hydric. Hydric soils indicate areas that, if all wetland parameters exist, could potentially be identified as a wetland.

6.4.4.2 Impacts

Construction of the wind turbines and access roads will increase the potential for soil erosion during construction and convert prime farmland from agricultural uses to industrial uses. Approximately 5.5 acres in the site will be converted to wind turbines, transformer pads, utility poles, and access roads. See Section 6.5.3 for potential impacts to wetlands.

6.4.4.3 Mitigative Measures

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

6.5 EFFECTS ON THE NATURAL ENVIRONMENT

6.5.1 GEOLOGIC AND GROUNDWATER RESOURCES

6.5.1.1 General Description of Resources

Glacial sediments were deposited during the Pleistocene Epoch cover most of Dodge County. The glacial material tends to be thicker to the western part of the county and thinner to the east. Owing to the eastward thinning, the topography in the eastern part of the county is very rolling, reflecting steam-dissected bedrock valleys that were formed prior to glaciation. The topography in the western portion of the county is fairly flat.

The uppermost bedrock units in the county are marine sandstone, carbonates and shales. These rocks were deposited in the Ordovician and Devonian Periods during the advance and retreat of shallow, semitropical seas. The various sedimentary rocks represent differing depositional environments as the sea level rose and fell. Sandstones represent a shore or beach environment, shales were deposited in a near-shore environment and limestones indicate a calmer, deeper off-shore environment.

The surficial geology of the site primarily consists of undifferentiated tills associated with Pleistocene glaciation. These tills are very poorly sorted sediments deposited by glacial ice. The sediment is composed of unsorted clay, silt, sand, gravel, cobbles and boulders. The majority of the till is in upland areas, where it has been extensively eroded by wind. However, the upland till has not been cut by streams and is therefore topographically flat. The till in the northwest and southeast corners of the site is stream-dissected, having been exposed to stream erosion in addition to wind erosion. The topography of the stream-dissected till is undulating.

Alluvial sediments are present at the extreme southeastern corner of the site. These stream-deposited sediments are well-sorted and stratified fine sand, coarse sand and gravel with layers of silt, clay and organics. These particular deposits are associated with Salem Creek.

Quaternary terrace sediments occur in the extreme northwestern corner of the site along Henslin Creek. These sediments were deposited from meltwater that originated from glaciers to the northwest and consist of stratified fine to coarse sand, gravel with layers of silt and clay and pockets of coarse gravel.

Well logs for 24 wells at the site were obtained from the Minnesota County Well Index (CWI). According to the logs, the thickness of the surficial deposits at the site are generally between 32 to 49 m (105 and 160 ft) thick, though one well encountered only 20 m (65 ft) of overburden.

According to Anderson et al. (1975), the uppermost bedrock at the site is either the Maquoketa Shale or the Dubuque Formation, both of Ordovician age (458 to 447 million years ago). The Maquoketa is made up of dolostone, limestone, sandy dolostone and shale. It can be up to 21 m (70 ft) thick. The Dubuque is composed of limestone and dolostone and is up to 11 m (35 ft) thick.

The site lies in the western part of the Zumbro River watershed. In this part of the watershed, where the surficial deposits are thick, the water table occurs in the unconsolidated overburden.

According to Anderson, et al. (1975), the depth to the water table in the site vicinity is about 12 to 18 m (40 to 60 ft). Groundwater flow is generally east toward the Zumbro River but may be controlled locally by area streams.

Groundwater may be obtained from sand and gravel aquifers buried within the glacial till. Groundwater from aquifers within the till tends to contain more dissolved solids and sulfate than water from alluvial and valley-fill aquifers found elsewhere in the watershed.

Groundwater is also available from the Maquoketa and Dubuque, which, along with the underlying Galena Dolomite and the younger Devonian Cedar Valley Limestone (present to the south of the site), form the Cedar Valley-Maquoketa-Dubuque-Galena aquifer. Water is available from fractures and solution cavities in these formations. Groundwater from the bedrock units tends to be hard and may be high in iron. Flow in this aquifer is generally northeast.

Twenty-four wells were identified at the site using the CWI. Three of these wells are abandoned. The rest of the wells are used for domestic purposes. Not enough information is available to identify the aquifer for 10 of the twenty-four wells. The remaining wells are all open to some combination of the Maquoketa, Dubuque and Galena. One of these wells is also open to overburden.

The glacial till at the site has a limited potential for aggregate resource development (Anderson, 2002). Any aggregate deposits within the till are likely very small in extent and generally consist of finer material, such as sand. The alluvial and terrace sediments associated with Salem Creek and Henslin Creek at the extreme northwest and southeast corners of the site are considered "less desirable sand and gravel deposits" (Anderson, 2002). This ranking is the lowest for potential sand and gravel resources; the other two rankings are "moderately desirable" and "highly desirable." The "less desirable" sand and gravel deposits are typically moderately small to large and consist of sand and fine sand. Area sand and gravel pits are discussed in Section 6.4.1 under Mining. There are no active or inactive industrial pits or quarries at the project site. Additional discussion of geologic resources is provided in Section 6.4.3.

6.5.1.2 Impacts

Twenty-four active or abandoned water wells were identified at the site through the CWI. Any active water wells near proposed turbine locations could be damaged by construction activities. Damaged wells have the potential to provide a conduit for surface contamination to travel to an aquifer. No other impacts to geologic and groundwater resources are anticipated.

6.5.1.3 Mitigative Measures

Best Management Practices will be used during construction to avoid damage to water wells. A licensed contractor, in accordance with the Minnesota Department of Health (MDH) Water Well Code, would abandon any water wells that will not be used in the future.

6.5.2 SURFACE WATER AND FLOODPLAIN RESOURCES

6.5.2.1 General Description of Resources

Surface water and floodplain resources for the study area were identified by reviewing U.S. Geological Survey topographic maps, Flood Insurance Rate Maps (FIRM) produced by the Federal Emergency Management Agency (FEMA), and Minnesota Public Waters and Wetlands map. The major surface waters located within the study area include Henslin Creek and Salem Creek. Henslin Creek is a tributary to Dodge Center Creek, whereas Salem Creek is a tributary to the South Fork of the Zumbro River. The tributary of Salem Creek in Section 27, Township 106 North, Range 17 West is listed as a Public Water (Figure 18). The entire project site is 3,800 acres. Approximately 2,800 acres drains to Salem Creek; Henslin Creek receives the remaining surface waters in the project area.

6.5.2.2 Impacts

Construction of the wind turbines, transformer pads, and access roads will result in the disturbance of approximately 5.5 acres. All new construction will occur in areas that will avoid direct impacts to surface waters in the project area. No impacts will occur within a floodplain, to Henslin Creek, or to Salem Creek, which is a Minnesota Public Water.

6.5.2.3 Mitigative Measures

If access roads are constructed adjacent to streams and drainageways, the access roads will be designed in a manner so runoff from the upper portions of the watershed can flow unrestricted to the lower portion of the watershed. A NPDES storm water discharge permit will be acquired prior to the construction of the wind turbines and access roads. Erosion control measures will be installed prior to construction and maintained throughout construction until disturbed areas have been successfully revegetated. The goal will be to minimize soil erosion and to revegetate the disturbed areas. Appropriate Best Management Practices (BMP) will be implemented at Salem Creek to prevent impacts to this Public Water.

6.5.3 WETLANDS

6.5.3.1 General Description of Resources

National Wetland Inventory (NWI) Maps, National Resource Conservation Service (NRCS) and Farm Service Agency (FSA) aerials, and Minnesota Protected Waters and Wetlands Maps were used to identify wetlands within the Site. The potential wetlands within the study area are primarily associated with Salem Creek. The NWI wetlands are identified on Figure 18. A pre-construction survey will be conducted to identify possible wetlands within the project site.

6.5.3.2 Impacts

Wind turbines will be built to avoid impacts to wetlands. Access roads and supporting facility features will be designed to avoid and minimize impacts to the wetlands.

6.5.3.3 Mitigative Measures

No impacts to wetlands are anticipated due to the construction of the proposed project. BMPs as required by the MPCA will be implemented to prevent erosion and keep sediment from entering the nearby wetlands and water bodies. An NPDES permit will be acquired from the Minnesota Pollution Control Agency prior to construction commencement.

6.5.4 VEGETATION

6.5.4.1 General Description of Resources

Based on review of aerial photographs, land use information, and a visit to the proposed GMW, the majority of the land area at the site is cultivated. The site is in an area that historically had vegetation typical of the deciduous forest-woodland and prairie zones in Minnesota. The typical native prairie grasses of Dodge County include big bluestem (*Andropogon gerardi*), little bluestem (*Andropogon scoparius*), panic grass (*Panicum virgatum*), Indian grass (*Sorghastrum nutana*), prairie cordgrass (*Spartina pectinata*), and side-oats gram (*Bouteloua curtipendula*). Native trees included basswood (*Tilia americana*), sugar maple (*Acer saccharum*), silver maple (*Acer saccharinum*), boxelder (*Acer negundo*), white ash (*Fraxinus americana*), green ash (*Fraxinus pensylvanica*), willows (*Salix spp*.), and bur oak (*Quercus macrocarpa*).

Crops (corn and soybean) are the primary vegetation at the site. Other vegetation on the site is associated with drainageways, an abandoned railroad bed, or homesteads. Vegetation in these areas are primarily trees typical of homesteads and windrows such as box elder, willow, oak, cottonwood, elm, and maple. A pre-construction survey will be conducted for sensitive vegetation. There is no Conservation Reserve Project (CRP) land within the project site.

6.5.4.2 Impacts

Construction of the proposed wind farm will result in the disturbance of approximately 5.5 acres of cultivated land. These areas will be permanently removed from production and replaced by access roads, wind turbines, or transformers to support the proposed design for the wind farm.

6.5.4.3 Mitigative Measures

The following measures will be used to avoid potential impacts to the vegetation on the wind farm site and its subsequent development and operation.

- Avoid disturbance of wetlands during construction and operation of the project.
- Protect existing trees and shrubs.
- Use Best Management Practices during construction and operation of the project to protect topsoil and adjacent resources and to minimize soil erosion. Practices may include containing excavated material, protecting exposed soil and stabilizing restored material, and revegetating non-cropland and range areas with native species.

6.5.5 WILDLIFE

6.5.5.1 General Description of Resources

Wildlife at the site would be typical of those found in agriculture-related habitats. The resident species are representative of Minnesota game and nongame fauna that are associated with fencerows, roadside ditches, wetlands, and areas of non-maintained grasses and shrubs. The majority of the migratory wildlife species are birds, which include waterfowl, raptors and songbirds.

The site has the potential to provide habitat for small mammals such as red fox, eastern cottontail, striped skunk, raccoon, thirteen-lined ground squirrel, meadow vole, and white-footed mice. White-tailed deer, an economically important species, may be present in the area. Deer have a strong affinity for agricultural crops and use grasslands, farm woodlots, wetlands, and stream bottoms for shelter. The agricultural areas associated with the site would potentially provide habitat for bird species that include wild turkey, ruffed grouse, red-tailed hawk, eastern kingbird, American crow, field sparrow, bobolink, red-winged blackbird, meadowlark, horned lark, American goldfinch, and house sparrow. The site has the potential to provide habitat for upland species of reptiles and amphibians such as timber rattlesnakes, blue racers, hognose snake, bull snake, smooth green snake, spring peeper, gray treefrog, and American toad.

6.5.5.2 Impacts

The impact of wind power development on resident wildlife is expected to be minimal. A small reduction in the available habitat that some of the resident wildlife uses for forage or cover will occur. Operation of the wind farm will not change the existing land use.

The Minnesota DNR expressed concern about the possibility of avian and bat mortality due to the construction of the proposed facility. Collisions with wind turbines by avian and species are known to occur. Studies of mortality are varied throughout the United States, with a greater number of mortalities occurring in California than the rest of the nation. A four-year monitoring study in Minnesota at Buffalo Ridge was conducted to determine the risk associated with wind turbines to birds. Impacts primarily involve nocturnal migrants, whereas mortality of resident breeding birds is low. It was determined that from a population perspective, the effects are inconsequential.

On Buffalo Ridge, bat mortality primarily involves migrant or dispersing bats in the fall. Bat collision mortality is virtually non-existent to breeding populations in the area. The research conducted in Minnesota has determined that turbine collisions are not large enough to cause significant population declines.

6.5.5.3 Mitigative Measures

The following measures will be used to help avoid potential impacts to wildlife in the project area during selection of the turbine locations and subsequent development and operation.

- Avoid disturbance of individual wetlands or drainage systems during construction of the project.
- Protect existing trees and shrubs that are important to the wildlife present in the area.
- Maintain sound water and soil conservation practices during construction and operation of the project to protect topsoil and adjacent resources and to minimize soil erosion. Practices may include containing excavated material, protecting exposed soil and stabilizing restored material.
- Revegetate non-cropland and range areas with native species.
- Wind turbines will be sited away from areas of large concentrations of birds and migration corridors.

6.6 RARE AND UNIQUE NATURAL FEATURES

6.6.1 GENERAL DESCRIPTION OF RESOURCES

The Endangered Species Act of 1973, as amended, requires that a consultation pursuant to Section 7 be conducted to insure that a proposed project will not affect the continued existence of any endangered or threatened species or adversely affect their habitats, and that corrective action be taken if adverse impacts may occur. The MN-DNR maintains a Natural Heritage Database (NHD) through their Natural Heritage Program and Nongame Game Wildlife Program, which is the most complete source of data on Minnesota's rare, endangered or otherwise significant plant and animal species, plant communities and other natural features. The US-FWS and the MN-DNR were contacted to review the proposed project for potential effects to threatened and endangered (T&E) species.

The US-FWS stated, "There are currently no federally endangered or threatened species known to occur [at the site]." The MN-DNR response identified Sullivant's Milkweed (*Asclepias sullivantii*) and Rattlesnake-Master (*Eryngium yuccifolium*) within the immediate vicinity of the project area. Response letters from the US-FWS and the MN-DNR are in Appendix C.

6.6.2 IMPACTS

Construction of the proposed wind farm will result in 5.5 acres of vegetation being permanently removed and converted to access roads, wind turbine foundations, or transformer pads to support the proposed design for the wind farm. Impacts to the identified state-listed species are not anticipated, since a survey for native prairie and the species listed above will be conducted to assure avoidance of these features.

6.6.3 MITIGATIVE MEASURES

The Minnesota DNR recommended the project area be surveyed for any remaining prairie habitat. Native prairie provides habitat for many species of rare vegetation.

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

- Conduct a pre-construction survey of the proposed site to determine the presence of state listed species and sensitive habitats (wetlands and native prairie).
- Avoid placing wind power facilities in, or disturbing, those areas identified in the pre-construction survey that contain state-listed species, wetlands, ephemeral and permanent streams, or native prairie.

6.7 ADVERSE HUMAN AND NATURAL ENVIRONMENTAL EFFECTS WHICH CANNOT BE AVOIDED

6.7.1 AESTHETICS

The wind turbine arrays will be prominent features in the landscape. By design, these structures are placed in open areas of higher elevations. Some mitigative measures, as described in Section 6.2.3, can be implemented to somewhat limit visual impacts. However, there is no way to make these structures unnoticeable. The degree to which the visual impacts are considered adverse is subjective, and can be expected to vary depending, for example, on how often the viewer sees the turbines.

6.7.2 COMMITMENT OF LAND

The Project site includes a total of 3,800 acres of land. Approximately 5.5 acres of the 3,800 acres will be converted from natural vegetation or agricultural field to wind turbines, access roads and transformer pads. However, existing land use can continue on the remainder of the land.

6.7.3 TURBINE AND SUBSTATION NOISE

When in motion, the wind turbines emit a perceptible sound. The level of this noise varies with the speed of the turbine and the distance of the listener to the turbine. On relatively windy days, the turbines create more noise, however, the ambient or natural wind noise level tends to override the turbine noise as distance from the turbines increases.

GMW will not site turbines near occupied residences within 190 meters (623 feet) or 225 meters (738 feet) of active 1.5 MW and 1.65 MW turbines, respectively. The noise levels for the project will meet Minn. Rule 7030.0040.

6.7.4 AVIAN IMPACTS

Occasional collisions of avian species with turbine blades occur at wind farms. The frequency of these collisions depends upon the spacing, number, and height of turbines, as well as the distance to wetland and woodland habitats. For the reasons described above, significant avian mortality is not expected. A four-year monitoring study in Minnesota at Buffalo Ridge was conducted to determine the risk associated with wind turbines to birds. Impacts primarily involve nocturnal migrants, whereas mortality of resident breeding birds is low. It was determined that from a population perspective, the effects are inconsequential.

7.0 IDENTIFICATION OF REQUIRED PERMITS/APPROVALS

The federal and state permits or approvals that have been identified as being required for the construction and operation of the project are shown in Table 3. Local review of the project is provided for as part of the public review and participation process.

Table 3
Potential Permits and Approvals Required
for Construction and Operation of the Proposed Facility

Agency	Type of Approval
Federal Permits	
Federal Aviation Administration	Notice of Proposed Construction or Alteration within 6 miles of Public Aviation Facility and structures over 200 feet to complete a 7460 Proposed Construction or Alteration Form
U.S. Army Corps of Engineers	Section 404 Approval
State of Minnesota	
Minnesota Board of Water and Soil Resources	Wetland Conservation Act Approval
Minnesota Environmental Quality Board	Site Permit
Minnesota Department of Health	A licensed contractor, in accordance with the Minnesota Department of Health (MDH) Water Well Code, will abandon any water wells on-site not being used.
Minnesota Department of Natural Resources	Utility Crossing of Public Land and Water
Minnesota Pollution Control Agency	NPDES Construction Permit
	License for Very Small-Quantity Generator of Hazardous Waste
Minnesota Department of Transportation	Installation of Utilities or Miscellaneous work on Trunk Highway Right-of-Way
	Access Driveway Permit
	Drainage Permit
Local Permits	
Dodge County	Utility Permit
	Working in Right-of-Way Permit
	Access Drive/Driveway Extension Permit
	Conditional Use Permit

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Figures

Appendix A

Airport Zoning

Appendix B

Soil Sample Descriptions

Appendix C

Agency Letters