Tribal Renewable Energy Final Technical Report

Tab 1

Executive Summary

Project Title:	Three Affiliated Tribes Renewable Energy Feasibility Study
Date of Report:	May 24, 2006
Recipient Organization:	Three Affiliated Tribes of the Ft. Berthold Reservation
Award Number:	DE-FG36-04GO14021
Partners:	Three Affiliated Tribes of the Fort Berthold Reservation Distributed Generation Systems, Inc. (cost sharing partner)

Executive Summary

Background

The Three Affiliated Tribes of the Mandan, Hidatsa and Arikara on the Fort Berthold Reservation (MHA Nation) are a Federally Recognized Sovereign Nations, located along the Missouri River, encircled by counties of Mountrail, McLean, Dunn, McKenzie, Mercer and Ward in the State of North Dakota is pleased to report its finding of the energy assessments to the Department of Energy's on Renewable Energy Development on Tribal Lands under a Renewable Energy Feasibility Study grant provided by Department of Energy, DOE Award Number: DE-FG36-04GO14021. The Tribe selected Distributed Generation Systems, Inc. (Disgen), of Lakewood, Colorado as its contractor to aid in the preparation of this report and technical management of this study.

The study assessed the feasibility of a commercial wind facility on lands selected and owned by the Tribes and examined the potential for the development renewable energy resources located on Tribal Lands.

Summary Results

MHA Nation commissioned Disgen to conduct or create the following tasks in achieving the feasibility study goals:

1. Wind resource assessment sufficient to obtain financing

MHA Nation, in conjunction with Disgen, selected a tribally-owned parcel of land as the subject of the commercial wind facility feasibility assessment. The tribe and Disgen erected a 50-meter tower on a wind sites identified previously in a DOE funded study conducted by Disgen (Wind Resource for Native American Lands in North and South Dakota, October 2000) called Parshall. Parshall is located in the upper eastern corner of the reservation near the Tribe's proposed oil and gas refinery in the town of Makoti. The average wind speed for the Parshall Project Areas was found to be 16.8 mph (7.51 m/s) at the height of 50 meters, a Class 5 Wind Resource. A net capacity factor ranged from 29.4% to 38.5% for different manufacturer of wind turbines was determined. The analysis was completed by a meteorologist, Ed McCarthy in Martinez, CA after collecting 14 months of wind data. The data has been tabulated in a form suitable for financing and is provided in Tab 2.

The average annual wind speed of 16.8 mph or Class 5 is suitable for financing.

2. Phase I Avian resource assessment

Disgen, upon approval of the MHA Nation, contracted with Western EcoSystems Technology, Inc (West) of Cheyenne, Wyoming to conduct the Phase One Screening Report. The final report was completed on September 20, 2004. West is the leading biological research firm with special skills in avian assessments as they related to wind turbines.
The Phase One research focused on identifying any potential environmental impediments to proceeding with the development of a wind energy project, a "show stopper analysis". The research is guided by the Endangered Species Act, the Eagle Protection Act and the Migratory Bird Treat Act. The biological resources are evaluated through a search of existing data, including communications with local scientist in the state of North Dakota. A site visitation to evaluate habitat, loom for raptor nests, prey populations and other biological resources was conducted on June 15, 2004.
The Phase One research reported that the proposed project area has relatively few issues that may pose a problem since most of the project areas were tilled agricultural and hayfields. The research raised two issues that the proposed project should address if the project goes into development. One, the wind turbines should be in located as far as possible from Lake Sakakawea. Placing wind turbines away from the lake would reduce any potential collision from migratory birds that use the nearby lake. Two, acknowledge that the potential for ephemeral wetlands to form in wet years is possible. Overall these issues are manageable and none of these issues are considered to be fatal flaws that would inhibit project development. The overall risk is low, however, and the issue would be addressed through formal consultation with the U.S. Fish and Wildlife Service.

A detailed report is enclosed Tab 3 for further review and discussion.

3. Preliminary cultural assessment

Class I Cultural Resource Records and Literature Survey

This survey screened existing literature for the presence of culturally sensitive resources with in the prospective project area. Tribal elders were also interviewed to determine the spiritual importance of the prospective site. The report also details the past use of the area to provide historical perspective. The report was prepared by Archaeologist Kent Good of Kent Good and Associates in consultation with Elgin Crowsbreast Cultural Resource Program Director of the MHA Nation.

Thirteen known sites were identified in the primary and secondary project area collectively. Only one site within the secondary project area would be of concern to development. This area is relatively close to the river within the secondary project area and thus is les likely to be considered for development. All of the sites could be reasonably avoided by avoidance buffers.

Mr. Crowsbreast interviewed elders and traditionalist for an ethnographic perspective of the project area. No ceremonial or spiritual knowledge of the area was identified. However he recommends continuous consultation as the project progresses as concerns may surface as the project area refines to a smaller area.

Overall Mr. Good gave the site a medium to high potential to contain important cultural resources. This can be attributed to the relative proximity to the Missouri River. Areas closer to the river are more likely to contain cultural remains. The project area is more likely to utilize the primary project area land further from the river. A full pedestrian inventory of the project area should be conducted once the project proceeds into development. The use of qualified tribal specialist would be preferred for this task.

A detailed report is enclosed in Tab 4 for further review and discussion.

4. Review of local Transmission Capabilities and Market Assessment.

Disgen performed a preliminary evaluation of the transmission capabilities using a wind project size of 30 MW to determine the potential points of interconnection to the nearest transmission system. Disgen has identified the Parshall Substation owned by Mountrail-Williams Electric Cooperative as the most economical interconnection point. The substation would require a dedicated 69kV feeder line (8 miles) to be built from the project area to the substation. A distribution line near the project was also reviewed but the capacity of the line would not be able to accommodate a 30 MW project.
MHA Nation is made aware that the interconnection procedure is a three tier process that could take 165 days to complete and require deposits made to the connecting utility of approximately $160,000.

A more detailed explanation is located in Tab 5.

5. Preliminary set of economic projections;

Disgen has provided a set of preliminary project economics for a 30MW facility to be interconnected to the Mountrail-Williams Electric Cooperative system as a baseline to the economic viability of this proposed project. This model assumed a Tribally owned project on Tribal trust lands, without using the existing production tax credit, and using no loans. It also assumed no property taxes being paid to the state North Dakota and Federal Government and no landowner payments to the MHA Nation. The breakeven energy sales price is 5.00 cents per kWh to make this propose wind project to work. If the Tribe chooses to take on a private investment partner who needs to utilize the existing Production Tax Credit, and negotiates a 3.5% landowner payment, the rate of return and price per kWh can only improve. Disgen is able to deliver the scenarios at the Tribes request. Tab 6 shows the preliminary proforma.

6. Quantification of biomass resources on tribal lands.

7. Preliminary assessment wind/pumped storage hybrid systems

This preliminary study is to review the capability for constructing a pumped-storage hydropower system on the Fort Berthold Indian Reservation. Pumped-storage hydropower is an energy storage system that is generally used to store off-peak power generation from other power sources. That off-peak generation is then used to meet peak load needs or to provide emergency power injection to the grid when a plant goes offline. When the demand for electricity is low, pumped storage facility stores energy by pumping water from a lower reservoir to an upper reservoir.

Given that three required consideration are needed for a pumped-storage system to function is net effective head (elevation difference of reservoirs), water flow and the need for satisfy an electrical load. The areas around MHA Nation lands near the Lake Sakakawea has a very limited geographical attributes to support a commercially viable pumped storage system, so it is not recommended that further study by implemented.

- The net effective head is limited approximately 200 feet for the proposed project area which severely limited the energy production from any hydro turbine.
- The amount of water need to be drawn from the Lake Sakakawea would very substantial in relation to the amount of produce electrical energy.
- Environmental and permitting concerns for an "open" pumped storage system would be very difficult to permit and very time consuming. This open system would require a substantial amount of land to be flooded to get minimal amount of generation.
- Most of the cultural significant are also near the shoreline and ridges near the existing lake.

8. Options for Tribal Employment and Economic Development

The proposed 30MW wind farm, if constructed will provide Tribal jobs during a construction period of at least 180 days. After the construction, 2 to 4 full-time operations and maintenance jobs will be required. The O&M jobs will be of manufacturing quality and will be required for the life of the facility, which is expected to be 25 years. A single administrative person will required for reporting on project performance and accounting functions. For the first few years, there will be a need for post-construction monitoring of environmental impacts, particularly in recording bird strikes, if any.

Other value added economic opportunities exist during the construction period. Concrete and aggregate will be needed to supply the wind turbine base and roads leading to the wind site. Construction workers will need to feed and housed in the local community areas.

The Tribe selected a representative to learn and build its' capacity for any energy development activities. Terry Fredericks learn the following items during this activity of the feasibility study that included wind Resource Assessment Capabilities, energy assessment, and energy project management.

Summary

The wind resource assessment at MHA Nation on the Fort Berthold Reservation is very capable of supporting a viable commercial wind facility. The average wind speed indicates a high wind class. The interconnection opportunities are limited but there are no technical barriers to interconnect to existing systems. The Phase One screen and cultural screening indicate no show stoppers that can't be mitigated. The baseline financial analysis shows a marketable value for selling the energy produced from a wind facility and can only get better by using the production tax credits and getting some federal low interest loans for financing the 30 MW wind project.

Recommendations

It is recommended that the Mandan, Hidatsa, and Arikara Nation prepare solicitation proposals to obtain the necessary funds to conduct the pre-construction development of a 30 MW wind facility. A budget of at least $500,000 would be necessary in completing the pre-construction activities for the following:

a. **Transmission Planning**
   Manage the process for accessing the existing transmission system. Third party studies deposits may be required.
b. **Interconnection Agreement Management**
   Manage the data and materials needed by utility to execute an Interconnection agreement.
c. **Power Purchase Agreement Management**
   Manage the data and materials needed to develop and implement a legal agreement in the sale of green energy and the Renewable Energy Credits over a defined period of time and at a specific price.
d. **Pre Construction Overview**
   Manage the development and implementation of a pre-construction activities
   Negotiate wind turbine procurement.
   Negotiate contractor procurement.
e. **Business Planning**
   Manage the development and implementation of a financing structure that will allow MHA Nation to reap the maximum economic benefit for the project.
f. **Wind Resource and Site Assessment Activities**
   Wind Resource Assessment – Continue to gather wind data and report findings
   Site Layout Management – Develop Turbine and site layout plats
   Manage, coordinate, and design the site layout of the wind turbine placement.
   Coordinate geotechnical and civil work to accommodate selected wind turbine.
g. **Environmental Assessment Management and production.**
   Produce report for the Environmental Assessment document and approvals.
h. **Public Scoping Activities.**
   Involve the Tribal community for support for the project.

The Tribe shall be the sole decision maker regarding whether to follow this feasibility assessment with a development phase of the project based on alternatives prepared by Disgen. Disgen serves at the direction of the Tribes, focusing on creating the maximum economic benefit for the Tribes and its members.

Tribal Renewable Energy Final Technical Report

Tab 2

Wind Assessment

Project Title:	Three Affiliated Tribes Renewable Energy Feasibility Study
Date of Report:	May 24, 2006
Recipient Organization:	Three Affiliated Tribes of the Ft. Berthold Reservation
Award Number:	DE-FG36-04GO14021
Partners:	Three Affiliated Tribes of the Fort Berthold Reservation Distributed Generation Systems, Inc. (cost sharing partner)

Preliminary Wind Resource Assessment and Theoretical Energy Estimates for Ft. Berthold Reservation Three Affiliated Tribes

Prepared For:

DISGEN, Inc.
200 Union, Suite 304
Lakewood, Colorado 80228

Prepared By:

E.F. McCarthy & Associates
511 Frumenti Ct.
Martinez, CA 94553

February 2006

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1.0 Introduction and Summary

A climatology, wind resource assessment, and preliminary theoretical energy estimates for seven turbines are prepared for a project in Central North Dakota on the Ft. Berthold Indian Reservation (Three Affiliated Tribes).

The average wind speed measured over the entire period of record (October 2004 – January 2006) is 16.8 mph (7.5 mps); the average wind speed measured over a 1-year period (December 2004 – November 2005) at 50 meters above ground level is 16.9 mph (7.6 mps). Adjusted to the long-term using data from local National Weather Service (NWS) site, the 80-meter hub height wind speed is estimated as 17.6 mph (7.9 mps). Theoretical energy estimates are prepared for ninet different turbines: Suzlon S88, Vestas V82, GE 1.5MW (70.5 and 77-meter rotor); Vestas V-90; Vestas V-82,Gamesa G80, Gamesa G87, and Mitsubishi 1000A. The theoretical energy estimates for each of the turbines are presented in Table 1.

Table 1 - Theoretical Energy Estimates

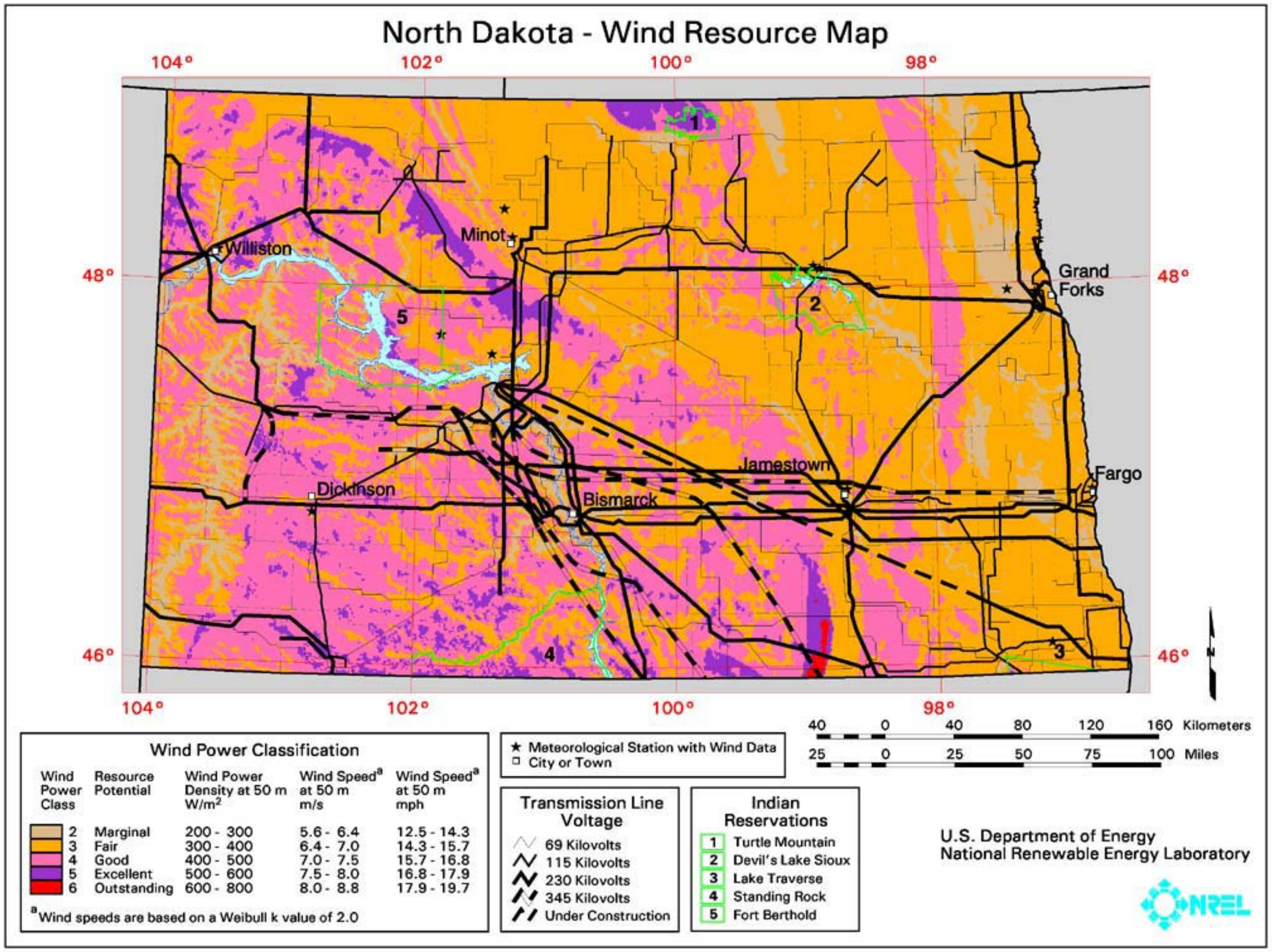
Turbine	Rotor Diameter (m)	Rating (kW)	Hub Height (m)	Gross Theoretical Energy (kWh)	Net Theoretical Energy (kWh)	Turbine Capacity Factor (Net) (%)	Annual Wind Speed (mps)
Gamesa G80	80	2000	80	6,778,000	5,964,000	34.04%	7.9
Gamesa G87	87	2000	80	7,451,000	6,557,000	37.42%	7.9
GE 1.5	70.5	1500	80	5,239,000	4,610,000	35.08%	7.9
GE 1.5 (77m)	77	1500	80	5,663,000	4,984,000	37.93%	7.9
Bonus 2.3	82	2300	80	8,584,000	7,554,000	37.49%	7.9
Vestas V82	74	1650	80	6,322,000	5,563,000	38.49%	7.9
Vestas V90	90	3000	80	8,779,000	7,725,000	29.40%	7.9
Suzlon S88	82	2100	80	7,568,000	6,660,000	36.20%	7.9
MWT-1000A	61	1000	69	3,465,000	3,050,000	34.81%	7.7

2.0 Site Description

The meteorological tower is located on the Ft. Berthold Indian Reservation, Home of the Three Affiliated tribes (Mandan, Hidatsa, Arikara). The reservation is located in west-central North Dakota and straddles the Missouri River and includes portions of Mountrail, McClean, Mercer, Dunn, and McKenzie Counties. The tower is located in McLean County at an elevation of 668 meters (2192 Ft) east of Lake Sakakwea. There are no local obstructions to the wind flow from any direction. The land use in the region is dry-land farming and cattle grazing.

Figure 1 presents the recently released wind resource map of the State of North Dakota. The Ft. Berthold Indian Reservation is indicated as Nimber 5 on the map. The wind resource is characterized as Wind Power Class 3 (Fair) to Wind Power Class 5 (Excellent). The area thought to have the best wind resource is limited to the east shore of Lake Sakakwea while the majority of the reservation is thought to fit into Class 4 (7.0 to 7.5 mps @ 50m agl).

Figure 1 - North Dakota Wind Resource Map



3.0 Meteorological Data

3.1 On-Site Meteorological Monitoring Program

Three levels of wind speed sensors and two levels of wind direction sensors are mounted on an NRG Systems Talltower. Maximum #40 wind speed snsors are installed at three levels, 30 meters, 40 meters, and 50 meters. Wind direction sensors, NRG #200P, are mounted at 40 meters and 50 meters above ground level. The data are collected using an NRG Systems Symphonie logger. Flashcards are pulled on a routine basis and the data are downloaded and stored in an electronic data file. The data collection program started in October 2004. The tower is located at 47^o 50.738 N and 102^o 11.266 West at an elevation of 668 meters (2,192 feet)

3.2 Average Wind Speed

The average wind speeds are presented for each sensor and each level in Tables 2 through 6. The annual average wind speed at the 50-meter level is 16.8 mph. The diurnal wind speed pattern indicates a daytime minimum and a nighttime maximum at the 50-meter level. This diurnal pattern is very typical of a Great Plains site. The average wind speed is consistent with the Wind Power Classification for the Region (Figure 1).

Table 2 - Mean Hourly Wind Speed at 30 Meters (Ch 1)

MEAN HOURLY WIND SPEEDS

FORT BERTHOLD INDIAN RESERVATION
30M WIND SPEED (MPH)

10/01/04 - 01/31/06

Hour	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Mean
01	13.1	13.4	16.7	17.6	16.5	16.8	15.3	15.5	14.4	14.7	16.0	15.7	15.5
02	14.0	13.2	16.5	17.9	16.7	17.1	15.3	15.3	14.2	14.5	15.7	15.2	15.4
03	13.7	13.3	16.2	17.7	16.3	16.0	15.3	15.6	13.7	14.2	15.0	15.6	15.2
04	14.1	12.4	16.0	16.2	15.6	15.8	13.7	15.2	13.5	15.2	15.7	15.8	15.0
05	13.0	12.1	15.8	15.8	16.4	14.6	14.6	15.4	13.4	14.3	15.3	15.3	14.7
06	12.7	11.4	15.9	17.4	16.4	14.2	14.5	14.8	13.0	15.0	15.1	16.0	14.8
07	13.5	11.2	14.9	17.4	15.7	13.6	14.1	14.5	13.4	14.8	15.5	15.2	14.6
08	13.6	11.4	16.4	17.9	14.6	13.3	13.3	14.7	14.3	14.8	14.7	15.0	14.6
09	13.6	12.3	17.0	17.4	15.1	13.4	12.4	13.8	13.1	14.4	14.6	14.4	14.3
10	13.3	12.9	16.9	17.6	16.6	13.1	13.0	13.6	12.2	14.9	14.2	14.3	14.4
11	14.1	12.8	17.0	18.9	18.0	12.9	13.4	14.8	12.6	14.6	14.9	13.7	14.7
12	13.8	13.5	16.6	20.0	18.6	13.3	14.4	15.7	14.4	14.9	14.7	14.0	15.2
13	13.5	14.1	18.4	20.2	18.5	14.3	14.2	16.4	15.4	15.5	16.1	14.8	15.8
14	13.6	14.3	18.9	20.9	19.8	14.3	14.1	16.3	15.3	16.8	16.3	15.2	16.2
15	13.9	15.8	18.9	20.7	19.8	14.5	15.4	16.5	15.7	17.3	17.2	15.5	16.7
16	14.1	16.8	18.6	21.7	19.9	14.1	15.2	16.9	15.7	16.9	17.2	15.4	16.8
17	14.0	16.8	18.1	21.5	19.4	15.1	14.7	16.2	15.8	17.1	17.0	16.0	16.7
18	12.9	16.4	17.8	21.3	20.4	15.4	14.3	16.8	15.1	16.7	15.6	15.7	16.4
19	13.8	15.8	17.0	20.9	19.5	16.5	14.4	16.7	15.5	15.7	15.4	15.9	16.3
20	15.4	14.5	16.3	20.0	19.0	15.8	14.4	15.3	15.2	14.7	15.7	15.7	15.9
21	15.0	14.1	15.7	19.4	17.5	14.9	14.0	14.9	14.4	15.8	16.4	15.4	15.7
22	14.2	13.6	15.5	20.3	16.6	14.1	15.8	15.0	15.5	15.9	16.5	15.1	15.7
23	14.2	13.4	16.5	19.9	16.1	15.5	17.1	15.7	14.8	15.6	16.3	16.0	15.9
24	13.9	13.6	16.3	19.2	16.3	16.3	16.3	16.4	14.8	15.2	16.7	15.8	15.9
Mean	13.8	13.7	16.8	19.1	17.5	14.8	14.6	15.5	14.4	15.4	15.7	15.3	15.5

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Good Hours	949	672	744	720	744	720	744	744	720	1115	1435	1449
Missing Hours	539	0	0	0	0	0	0	0	0	373	5	39

10,756 Hours of Good Data   956 Hours Missing   91.8% Data Recovery

Table 3 - Mean Hourly Wind Speed at 40 Meters (Ch3)

MEAN HOURLY WIND SPEEDS

FORT BERTHOLD INDIAN RESERVATION
40M WIND SPEED (CH3) (MPH)

10/01/04 - 01/31/06

Hour	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Mean
01	13.7	13.9	17.6	18.7	17.4	17.9	16.6	16.6	15.5	15.5	16.8	16.5	16.3
02	14.5	14.1	17.4	18.8	17.5	18.3	16.6	16.2	15.3	15.2	16.7	16.0	16.3
03	14.3	14.2	17.1	18.6	17.2	16.9	16.6	16.7	14.8	14.8	15.9	16.4	16.0
04	14.7	13.1	17.0	17.2	16.5	16.7	14.8	16.1	14.5	15.9	16.4	16.6	15.9
05	13.5	13.0	16.7	17.0	17.4	15.5	15.7	16.4	14.4	15.2	15.9	16.1	15.6
06	13.3	12.1	16.8	18.3	17.3	15.0	15.6	15.8	13.9	15.9	15.7	16.7	15.6
07	14.3	11.8	15.6	18.4	16.5	14.4	15.1	15.4	14.4	15.5	16.4	16.0	15.4
08	14.3	12.0	17.3	18.9	15.3	14.1	14.2	15.8	15.2	15.6	15.3	15.7	15.3
09	14.1	13.1	17.7	18.4	15.6	14.1	13.3	14.8	13.9	15.2	15.3	15.1	15.1
10	13.8	13.6	17.6	18.3	17.0	13.5	13.5	14.0	12.9	15.6	15.0	14.9	15.0
11	14.6	13.2	17.5	19.2	18.4	13.1	13.7	14.9	12.9	15.1	15.6	14.3	15.2
12	14.3	13.8	17.0	20.3	18.8	13.4	14.7	15.7	14.6	15.2	15.1	14.5	15.5
13	13.8	14.2	18.6	20.5	18.8	14.5	14.5	16.5	15.6	15.8	16.3	15.1	16.1
14	13.6	14.5	19.1	21.2	20.1	14.5	14.3	16.4	15.5	17.1	16.5	15.4	16.4
15	13.9	16.0	19.1	21.0	20.1	14.7	15.7	16.7	15.9	17.6	17.3	15.7	16.9
16	14.1	17.1	18.9	22.1	20.2	14.3	15.5	17.0	15.9	17.2	17.4	15.7	17.0
17	14.3	17.1	18.5	21.9	19.7	15.4	15.0	16.2	15.9	17.1	17.3	16.4	17.0
18	13.4	16.8	18.3	21.7	20.8	15.6	14.7	16.9	15.2	16.9	16.0	16.3	16.7
19	14.5	16.4	17.5	21.4	19.9	16.8	14.9	17.0	15.8	16.0	16.2	16.4	16.7
20	15.9	15.3	17.0	20.7	19.4	16.2	15.0	15.6	15.8	15.3	16.6	16.4	16.5
21	15.8	15.0	16.5	20.2	18.1	15.6	14.9	15.5	15.4	16.3	17.2	16.0	16.4
22	15.1	14.5	16.4	21.3	17.4	14.8	17.0	15.9	16.5	16.6	17.4	15.7	16.5
23	14.9	14.2	17.3	21.1	16.9	16.2	18.4	16.6	15.7	16.3	17.3	16.7	16.8
24	14.6	14.3	17.0	20.4	17.2	17.3	17.7	17.4	16.0	16.1	17.7	16.5	16.8
Mean	14.3	14.3	17.5	19.8	18.1	15.4	15.3	16.1	15.1	16.0	16.4	15.9	16.1

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Good Hours	975	672	744	720	744	720	744	744	720	1115	1439	1449
Missing Hours	513	0	0	0	0	0	0	0	0	373	1	39

10,786 Hours of Good Data   926 Hours Missing   92.1% Data Recovery

Table 4 – Mean Hourly Wind Speed at 40-Meters (Ch4)

MEAN HOURLY WIND SPEEDS

FORT BERTHOLD INDIAN RESERVATION
40M WIND SPEED (CH4) (MPH)

10/01/04 - 01/31/06

Hour	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Mean
01	13.7	13.8	17.7	18.6	17.4	17.7	16.4	16.5	15.4	15.5	16.8	16.4	16.3
02	14.7	13.9	17.4	18.8	17.4	18.0	16.6	16.0	15.1	15.2	16.7	15.9	16.2
03	14.4	14.1	17.3	18.6	17.0	16.1	16.7	16.6	14.7	14.9	15.9	16.3	16.0
04	14.8	13.1	17.0	17.1	16.0	16.2	14.9	15.9	14.4	16.0	16.4	16.4	15.8
05	13.7	12.9	16.5	16.9	16.7	15.5	15.6	16.5	14.1	15.3	16.0	15.9	15.5
06	13.1	12.1	16.8	18.3	16.9	14.9	15.6	15.8	13.7	15.9	15.6	16.6	15.5
07	14.0	11.5	15.7	18.5	16.0	14.1	15.1	15.3	14.2	15.6	16.2	15.8	15.3
08	14.1	12.1	17.2	18.8	15.0	14.2	14.2	15.7	15.0	15.3	15.3	15.7	15.2
09	14.0	13.0	17.8	18.4	15.4	14.0	13.2	14.7	13.8	15.1	15.4	15.2	15.0
10	13.5	13.4	17.6	18.2	16.9	13.5	13.3	13.9	12.9	15.4	15.0	14.9	14.9
11	14.4	13.2	17.5	19.2	18.3	12.9	13.6	14.8	12.7	15.1	15.7	14.3	15.1
12	14.3	14.0	16.9	20.2	18.7	13.3	14.7	15.8	14.7	15.2	15.1	14.5	15.5
13	13.8	14.3	18.6	20.4	18.5	14.5	14.5	16.7	15.7	15.7	16.3	15.2	16.1
14	13.5	14.6	19.0	21.1	19.9	14.4	14.3	16.5	15.6	17.1	16.4	15.4	16.4
15	14.1	15.9	19.0	20.9	20.0	14.7	15.6	16.9	16.0	17.7	17.3	15.8	16.9
16	14.3	16.9	18.8	21.8	20.1	14.2	15.5	17.2	15.9	17.2	17.3	15.8	17.0
17	14.7	16.9	18.4	21.5	19.6	15.4	14.9	16.3	16.1	17.1	17.2	16.4	17.0
18	13.8	16.6	18.1	21.4	20.8	15.5	14.6	17.0	15.3	17.0	15.9	16.4	16.7
19	15.1	16.3	17.3	21.1	19.8	16.8	14.8	17.0	16.0	16.1	16.1	16.5	16.8
20	16.0	15.3	16.8	20.4	19.3	16.2	15.0	15.6	15.7	15.3	16.5	16.5	16.5
21	15.9	15.0	16.2	20.0	18.1	15.4	15.0	15.6	15.3	16.3	17.1	16.1	16.4
22	15.2	14.5	16.4	21.2	17.2	14.7	16.7	15.9	16.6	16.8	17.5	15.6	16.5
23	15.3	14.3	17.3	21.2	16.6	15.9	18.2	16.7	15.5	16.4	17.3	16.7	16.8
24	14.7	14.2	17.1	20.2	17.1	17.0	17.6	16.9	15.9	16.1	17.7	16.3	16.7
Mean	14.4	14.3	17.4	19.7	17.9	15.2	15.3	16.1	15.0	16.0	16.4	15.9	16.1
Good Hours	970	672	744	720	744	720	744	744	720	1115	1440	1437	
Missing Hours	518	0	0	0	0	0	0	0	0	373	0	51	

10,770 Hours of Good Data   942 Hours Missing   92.0% Data Recovery

Table 5 – Mean Hourly Wind Speed at 50-Meters (Ch 1)

MEAN HOURLY WIND SPEEDS

FORT BERTHOLD INDIAN RESERVATION
50M WIND SPEED (CH1) (MPH)

10/01/04 - 01/31/06

Hour	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Mean
01	14.5	14.6	18.5	19.8	18.2	18.8	17.7	17.9	16.7	16.4	17.8	17.2	17.3
02	15.6	14.8	18.3	19.9	18.3	19.3	18.0	17.1	16.5	16.0	17.8	16.6	17.3
03	15.3	15.1	18.3	19.7	18.0	17.8	18.0	17.6	15.9	15.7	16.9	17.2	17.0
04	15.6	13.9	18.0	18.2	17.2	17.6	16.0	17.0	15.3	16.8	17.3	17.2	16.8
05	14.4	13.9	17.6	18.0	18.1	16.4	16.9	17.7	15.4	16.3	16.9	16.9	16.6
06	14.3	13.0	17.8	19.2	18.3	15.9	16.7	16.8	14.7	16.9	16.5	17.5	16.5
07	15.2	12.5	16.6	19.5	17.2	15.3	16.2	16.4	15.2	16.3	17.1	16.6	16.3
08	15.1	12.9	18.3	19.9	16.0	15.1	15.2	16.8	16.0	16.4	16.2	16.4	16.2
09	14.9	13.9	18.6	19.5	16.2	14.8	14.3	15.7	14.8	16.1	16.4	15.9	15.9
10	14.4	14.4	18.4	19.0	17.3	14.0	14.0	14.2	13.9	16.3	15.8	15.5	15.6
11	15.1	13.7	18.0	19.5	18.5	13.3	14.0	14.9	13.2	15.8	16.6	14.9	15.7
12	15.0	14.3	17.4	20.5	19.0	13.7	14.9	15.9	14.9	15.6	15.7	15.0	15.9
13	14.3	14.6	18.8	20.8	18.8	14.7	14.8	16.8	15.8	16.0	16.6	15.7	16.4
14	14.2	14.8	19.3	21.5	20.2	14.8	14.6	16.6	15.9	17.5	16.7	15.8	16.7
15	14.3	16.1	19.3	21.3	20.3	15.0	15.9	17.0	16.2	18.1	17.5	15.9	17.2
16	14.3	17.1	19.1	22.2	20.4	14.5	15.8	17.3	16.1	17.6	17.6	16.1	17.2
17	14.3	17.1	18.7	22.1	20.0	15.8	15.3	16.4	16.3	17.6	17.6	16.8	17.3
18	13.4	16.8	18.4	21.8	21.1	15.8	14.9	17.2	15.6	17.6	16.4	16.9	17.0
19	15.1	16.7	17.8	21.7	20.3	17.1	15.2	17.2	16.3	16.8	16.8	17.1	17.2
20	16.2	16.0	17.5	21.2	19.9	16.6	15.6	15.9	16.4	16.4	17.2	17.0	17.1
21	16.2	15.8	17.1	21.0	18.7	16.1	15.9	16.3	16.5	17.5	18.0	16.7	17.2
22	15.4	15.2	17.3	22.3	18.2	15.5	18.0	16.8	17.5	17.8	18.4	16.3	17.4
23	15.9	14.9	18.2	22.4	17.6	17.0	19.8	17.7	16.7	17.4	18.4	17.4	17.7
24	15.1	14.9	17.7	21.5	18.0	18.3	19.0	18.4	17.3	17.0	18.7	17.1	17.7
Mean	14.9	14.9	18.1	20.5	18.6	16.0	16.1	16.7	15.8	16.8	17.1	16.5	16.8
Good Hours	944	672	744	720	744	720	744	744	720	1115	1440	1446	
Missing Hours	544	0	0	0	0	0	0	0	0	373	0	42	

10,753 Hours of Good Data   959 Hours Missing   91.8% Data Recovery

Table 6 – Mean Hourly Wind Speed at 50-Meters (Ch2)

MEAN HOURLY WIND SPEEDS

FORT BERTHOLD INDIAN RESERVATION
50M WIND SPEED (CH2) (MPH)

10/01/04 - 01/31/06

Hour	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Mean
01	14.5	14.4	18.5	19.9	18.2	18.9	17.9	18.1	16.6	16.4	17.7	17.3	17.3
02	15.4	14.7	18.3	20.0	18.3	19.4	18.1	17.4	16.4	15.9	17.7	16.7	17.2
03	15.2	14.9	18.3	19.8	18.0	18.0	18.1	17.9	15.8	15.7	16.7	17.3	17.0
04	15.7	13.7	18.0	18.2	17.3	17.7	16.1	17.3	15.3	16.8	17.2	17.3	16.8
05	14.4	13.7	17.6	18.0	18.2	16.5	17.0	17.9	15.3	16.2	16.8	16.9	16.5
06	14.3	12.9	17.8	19.3	18.3	16.0	16.8	16.9	14.7	16.8	16.5	17.6	16.5
07	15.1	12.4	16.6	19.5	17.3	15.3	16.4	16.5	15.1	16.3	17.0	16.6	16.3
08	14.9	12.6	18.3	19.9	16.0	15.1	15.3	17.0	15.9	16.3	16.1	16.5	16.2
09	14.6	13.8	18.6	19.5	16.2	14.8	14.4	16.0	14.9	16.0	16.3	15.9	15.9
10	14.3	14.3	18.4	18.9	17.2	14.0	14.0	14.4	13.8	16.3	15.7	15.5	15.6
11	15.0	13.6	18.0	19.4	18.5	13.3	14.0	15.0	13.1	15.7	16.5	14.9	15.6
12	14.8	14.0	17.3	20.5	18.9	13.7	15.0	15.9	14.8	15.5	15.6	15.0	15.8
13	14.2	14.4	18.8	20.8	18.8	14.7	14.7	16.9	15.7	15.9	16.5	15.7	16.3
14	14.1	14.6	19.3	21.4	20.2	14.7	14.6	16.7	15.7	17.4	16.6	15.7	16.7
15	14.3	16.0	19.3	21.3	20.3	15.0	15.9	17.0	16.1	18.0	17.4	15.9	17.1
16	14.4	17.0	19.0	22.2	20.4	14.5	15.8	17.4	16.0	17.5	17.5	15.9	17.2
17	14.6	17.0	18.8	22.1	19.9	15.7	15.3	16.4	16.2	17.5	17.5	16.7	17.2
18	13.7	16.7	18.4	21.9	21.1	15.9	14.9	17.3	15.5	17.4	16.3	16.7	17.0
19	15.2	16.6	17.8	21.7	20.2	17.1	15.3	17.3	16.2	16.7	16.7	17.1	17.2
20	16.0	15.9	17.5	21.2	19.8	16.7	15.6	16.0	16.3	16.2	17.1	17.0	17.1
21	15.9	15.7	17.2	21.0	18.6	16.2	16.0	16.4	16.4	17.2	17.9	16.7	17.1
22	15.1	15.1	17.4	22.4	18.1	15.6	18.1	17.0	17.4	17.7	18.3	16.3	17.3
23	16.0	14.8	18.2	22.5	17.6	17.1	19.9	18.0	16.6	17.3	18.3	17.4	17.8
24	15.1	14.8	17.8	21.7	17.9	18.4	19.2	18.6	17.2	17.0	18.6	17.2	17.7
Mean	14.9	14.7	18.1	20.5	18.6	16.0	16.2	16.9	15.7	16.7	17.0	16.5	16.8
Good Hours	958	672	744	720	744	720	744	744	720	1115	1440	1449	
Missing Hours	530	0	0	0	0	0	0	0	0	373	0	39	

10,770 Hours of Good Data   942 Hours Missing   92.0% Data Recovery

Table 7 – Mean Hourly Wind Direction at 40-Meters

MEAN HOURLY WIND DIRECTIONS

FORT BERTHOLD INDIAN RESERVATION
40M WIND DIRECTION (DEG)

10/01/04 - 01/31/06

Hour	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Mean
01	234	205	173	157	174	165	152	175	163	174	203	240	189
02	254	223	184	155	168	179	158	188	184	171	204	256	197
03	247	223	188	159	185	174	161	194	191	180	204	271	202
04	256	227	201	197	184	181	185	203	200	180	217	256	210
05	239	227	206	197	199	180	186	196	193	183	208	265	210
06	244	228	214	183	198	196	188	196	186	171	209	270	210
07	245	234	212	187	183	195	192	194	203	176	214	264	211
08	249	253	183	187	198	195	181	200	206	173	225	261	212
09	232	239	228	199	213	203	171	196	187	182	214	252	212
10	252	243	221	190	209	211	202	222	189	187	226	255	219
11	234	229	225	192	190	186	201	214	195	181	226	253	213
12	247	222	215	172	213	196	191	208	210	193	237	255	217
13	236	213	203	173	204	208	192	215	219	212	221	254	216
14	254	231	216	173	212	220	190	227	214	192	237	247	220
15	246	249	219	177	203	208	183	238	210	194	243	248	221
16	257	236	234	190	202	228	190	245	211	194	257	250	227
17	245	234	229	182	202	195	196	248	216	194	255	250	223
18	251	235	203	182	198	185	193	249	209	193	243	247	218
19	241	226	195	167	183	193	181	243	210	193	237	243	213
20	232	192	173	159	179	173	176	244	191	188	225	231	201
21	244	201	185	160	172	187	174	202	170	189	217	235	198
22	247	205	142	163	168	179	159	167	163	180	208	246	191
23	254	200	131	163	148	166	144	178	166	180	204	235	185
24	235	180	157	168	167	162	142	174	160	187	213	235	187
Mean	245	223	197	176	190	190	179	209	194	185	223	251	208
Good Hours	754	629	744	720	744	720	744	744	720	1115	1412	1408	
Missing Hours	734	43	0	0	0	0	0	0	0	373	28	80	

10,454 Hours of Good Data   1,258 Hours Missing   89.3% Data Recovery

Table 8 – Mean Hourly Wind Direction at 50-Meters

MEAN HOURLY WIND DIRECTIONS

FORT BERTHOLD INDIAN RESERVATION
50M WIND DIRECTION (DEG)

10/01/04 - 01/31/06

Hour	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Mean
01	242	224	171	155	184	175	152	185	173	171	206	246	194
02	262	244	171	165	177	165	169	194	183	174	208	262	201
03	257	215	187	169	183	171	159	205	202	190	207	258	204
04	251	204	198	171	171	192	185	214	210	182	220	267	209
05	243	220	219	183	198	190	174	207	204	186	217	263	211
06	252	222	204	193	197	207	200	206	199	181	224	268	216
07	259	255	210	173	195	207	205	206	202	186	217	251	214
08	262	259	196	186	210	206	194	212	205	183	222	254	216
09	243	259	216	198	188	203	183	208	197	192	230	238	214
10	244	263	221	199	195	185	179	221	198	181	241	241	215
11	248	247	201	177	163	194	210	214	204	191	235	258	215
12	235	223	201	168	187	181	200	217	220	186	239	255	213
13	250	228	201	169	178	205	189	225	217	196	229	254	214
14	256	231	225	182	210	206	199	237	223	191	239	244	221
15	259	250	216	186	201	180	192	236	219	195	254	253	223
16	273	251	231	187	188	226	199	254	196	196	267	261	230
17	244	249	238	191	188	180	205	257	224	203	253	243	225
18	254	250	188	178	196	184	202	247	218	202	253	240	220
19	253	240	180	164	193	165	191	240	207	202	222	235	209
20	241	190	182	156	176	183	185	254	200	198	223	235	205
21	241	207	171	144	187	184	172	212	168	183	203	238	195
22	257	196	139	160	177	177	169	176	162	175	194	226	186
23	254	190	151	172	157	164	155	188	154	182	201	235	187
24	260	167	155	177	165	172	153	171	157	183	204	223	186
Mean	252	228	195	175	186	187	184	216	198	188	225	248	209
Good Hours	636	584	744	720	744	720	744	744	720	1115	1413	1406	
Missing Hours	852	88	0	0	0	0	0	0	0	373	27	82	

10,290 Hours of Good Data   1,422 Hours Missing   87.9% Data Recovery

Table 9 – Mean Hourly Ambient Temperature

MEAN HOURLY VALUES

FORT BERTHOLD INDIAN RESERVATION
TEMPERATURE (DEG)

10/01/04 - 01/31/06

Hour	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Mean
01	13.1	19.8	27.2	42.0	48.3	60.5	63.7	61.6	55.2	40.3	31.5	18.7	37.2
02	12.9	18.9	26.4	40.8	47.1	59.4	62.9	60.5	54.0	39.8	30.9	18.6	36.5
03	12.7	18.4	26.0	40.2	45.8	58.5	61.8	59.4	52.7	39.3	30.5	18.3	35.9
04	12.3	17.7	25.4	39.2	44.7	57.8	60.9	58.4	52.0	38.7	30.1	18.2	35.2
05	12.4	17.3	25.0	38.6	44.1	57.2	60.2	58.0	51.2	38.2	29.8	18.2	34.9
06	12.1	17.2	24.7	38.2	43.5	56.7	59.8	57.3	50.7	37.6	29.4	17.8	34.4
07	11.5	17.1	24.2	37.2	42.9	56.2	59.3	56.4	50.1	37.3	28.7	17.6	33.9
08	11.1	16.5	24.1	36.8	43.3	57.0	59.8	56.2	49.4	37.0	28.5	17.5	33.8
09	11.2	16.2	23.8	38.4	45.3	58.5	62.8	58.3	50.5	36.9	27.9	17.4	34.4
10	11.3	16.2	24.7	41.5	48.0	60.8	65.7	61.8	54.1	37.4	27.8	17.1	35.7
11	12.0	17.9	26.5	44.9	50.4	63.4	68.2	65.8	58.1	39.3	29.7	17.6	37.7
12	13.5	20.5	28.8	48.1	52.1	65.3	71.0	69.1	61.8	41.4	32.2	19.1	40.1
13	14.9	22.7	31.4	50.9	53.8	67.1	73.2	71.7	65.1	43.3	34.7	21.0	42.2
14	16.1	25.1	33.2	53.0	55.2	68.6	74.8	73.4	67.3	45.5	36.1	22.1	43.9
15	17.3	26.9	34.7	54.3	56.1	70.2	76.6	74.7	69.1	47.0	37.6	23.1	45.3
16	17.9	27.8	35.9	55.5	57.3	71.7	78.2	76.1	71.0	48.3	38.6	23.9	46.5
17	18.3	28.6	36.6	56.7	58.2	72.2	79.1	76.7	71.5	48.9	39.0	24.0	47.1
18	18.2	28.8	37.0	56.7	58.4	72.0	79.2	77.4	71.3	48.9	38.6	23.5	47.0
19	16.9	28.4	36.4	56.2	57.9	70.9	79.0	77.7	70.2	47.6	36.0	21.9	45.9
20	15.7	25.6	34.6	54.4	57.2	70.1	77.6	76.8	68.2	44.7	33.5	20.8	44.3
21	15.2	23.6	32.1	51.4	56.1	68.9	75.0	73.9	63.1	43.3	32.7	20.1	42.5
22	14.8	22.5	30.7	47.7	53.3	66.3	70.8	67.6	59.8	42.4	32.3	19.3	40.5
23	14.5	21.2	29.9	45.3	51.2	63.6	67.0	64.6	57.8	41.3	31.3	19.0	39.0
24	14.1	20.3	28.4	43.5	49.8	62.1	65.4	62.3	56.3	40.3	30.8	18.9	38.0
Mean	14.1	21.5	29.5	46.3	50.8	64.0	68.8	66.5	59.6	41.9	32.4	19.7	39.7

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Good Hours	1144	672	744	720	744	720	744	744	720	1114	1440	1488
Missing Hours	344	0	0	0	0	0	0	0	0	374	0	0

10,994 Hours of Good Data   718 Hours Missing   93.9% Data Recovery

3.3 Wind Rose

A wind rose, showing the joint frequency of wind speed and wind direction at the 50 meter level is presented in Figure 2. The wind rose for the Ft. Berthold Site reflects the predominant northwest winds that occur in North Dakota. Thirty-six percent (36%) of the time, the wind directions are from the northwest through north. There is a secondary predominant wind direction, south, as 22% of the time the winds are from the south-southeast through the south-southwest. The joint frequency of wind speed and wind direction at the 50-meter level for the period October 2004 – January 2006 is presented in Table 10.

Table 10 – Joint Frequency Distribution, Hours of Occurrence for the Ft. Berthold Site

FREQUENCY DISTRIBUTION - Hours of Occurrence 10/15/04 - 01/15/06

Parameter
1: FORT BERTHOLD INDIAN RESERVATION
50M WIND SPEED (CH1) (MPH)

2: FORT BERTHOLD INDIAN RESERVATION
50M WIND DIRECTION (DEG)

	Parameter 1: MPH							
Parm 2 - DEG	0.0 to 10.0	10.1 to 15.0	15.1 to 20.0	20.1 to 25.0	25.1 to 30.0	30.1 to 35.0	35.1 to 50.0	Total
0.0 to 22.5	105	140	228	158	85	74	26	816
22.6 to 45.0	66	102	151	82	25	12	9	447
45.1 to 67.5	77	94	102	49	42	18	4	386
67.6 to 90.0	75	76	93	58	37	20	3	362
90.1 to 112.5	74	63	78	58	0	2	2	277
112.6 to 135.0	69	84	75	96	28	7	2	361
135.1 to 157.5	75	129	118	163	93	24	6	608
157.6 to 180.0	101	152	173	233	127	31	6	823
180.1 to 202.5	80	151	198	220	113	25	16	803
202.6 to 225.0	113	225	202	92	14	9	3	658
225.1 to 247.5	118	159	129	23	7	3	2	441
247.6 to 270.0	136	118	31	9	4	2	0	300
270.1 to 292.5	189	179	74	26	3	1	1	473
292.6 to 315.0	211	236	213	88	23	10	6	787
315.1 to 337.5	174	299	336	181	103	42	26	1161
337.6 to 360.1	153	292	426	332	190	86	50	1529
Total	1816	2499	2627	1868	894	366	162	10232

10,233 Good Hours 759 Hours Missing 93.1% Net Data Recovery

Table 10 (Con't) – Joint Frequency Distribution, Percent Occurrence for the Ft. Berthold Site

FREQUENCY DISTRIBUTION - Percent Occurrence 10/15/04 - 01/15/06

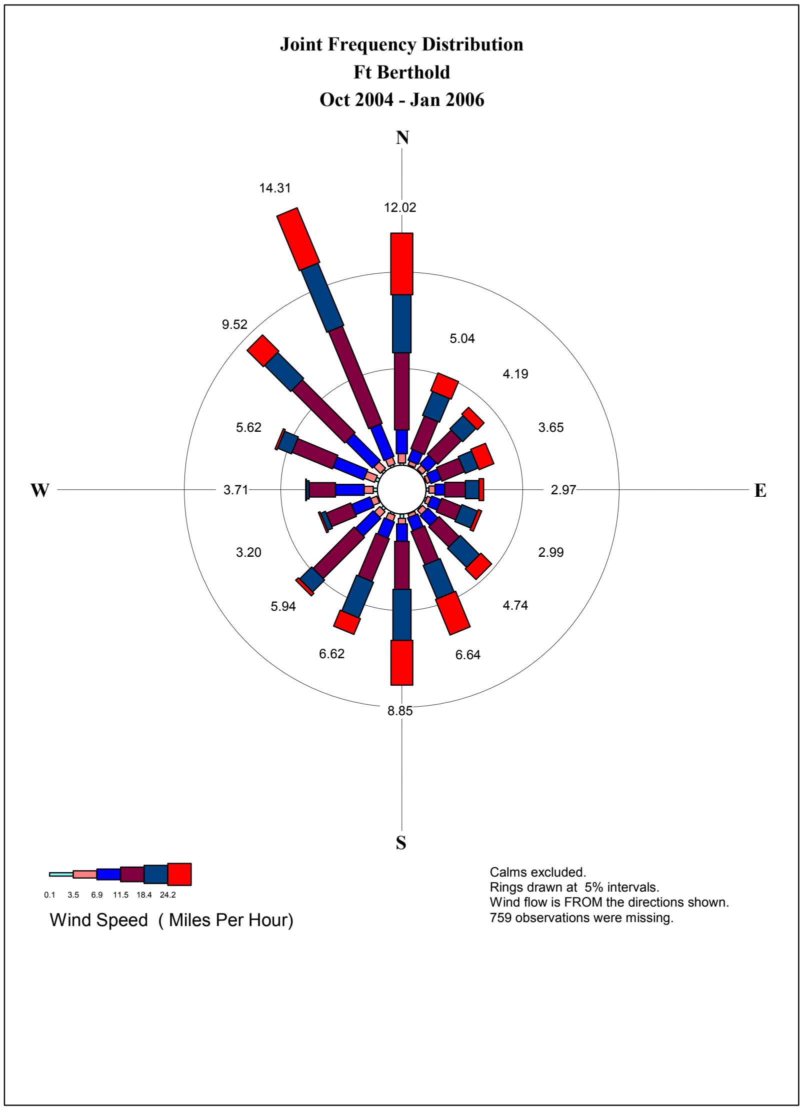
Parameter
1: FORT BERTHOLD INDIAN RESERVATION
50M WIND SPEED (CH1) (MPH)

2: FORT BERTHOLD INDIAN RESERVATION
50M WIND DIRECTION (DEG)

	Parameter 1: MPH							
Parm 2 - DEG	0.0 to 10.0	10.1 to 15.0	15.1 to 20.0	20.1 to 25.0	25.1 to 30.0	30.1 to 35.0	35.1 to 50.0	Total
0.0 to 22.5	1.0	1.4	2.2	1.5	.8	.7	.3	8.0
22.6 to 45.0	.6	1.0	1.5	.8	.2	.1	.1	4.4
45.1 to 67.5	.8	.9	1.0	.5	.4	.2	.0	3.8
67.6 to 90.0	.7	.7	.9	.6	.4	.2	.0	3.5
90.1 to 112.5	.7	.6	.8	.6	.0	.0	.0	2.7
112.6 to 135.0	.7	.8	.7	.9	.3	.1	.0	3.5
135.1 to 157.5	.7	1.3	1.2	1.6	.9	.2	.1	5.9
157.6 to 180.0	1.0	1.5	1.7	2.3	1.2	.3	.1	8.0
180.1 to 202.5	.8	1.5	1.9	2.2	1.1	.2	.2	7.8
202.6 to 225.0	1.1	2.2	2.0	.9	.1	.1	.0	6.4
225.1 to 247.5	1.2	1.6	1.3	.2	.1	.0	.0	4.3
247.6 to 270.0	1.3	1.2	.3	.1	.0	.0	.0	2.9
270.1 to 292.5	1.8	1.7	.7	.3	.0	.0	.0	4.6
292.6 to 315.0	2.1	2.3	2.1	.9	.2	.1	.1	7.7
315.1 to 337.5	1.7	2.9	3.3	1.8	1.0	.4	.3	11.3
337.6 to 360.1	1.5	2.9	4.2	3.2	1.9	.8	.5	14.9
Total	17.7	24.4	25.7	18.3	8.7	3.6	1.6	100.0

10,233 Good Hours 759 Hours Missing 93.1% Net Data Recovery

Figure 2- Wind Rose for the 50-Meter Level, Ft. Berthold, Three Affiliated Tribes



3.4 Wind Shear

Wind shear is the change or increase in wind speed above ground level. The simple wind power law is expressed as:

$$U_2 = U1\ (Z_2/Z_1)^{alpha}$$

Where U_2 and U_1 are the wind speeds at the upper and lower levels, Z_2 and Z_1 are the upper and lower elevations, and alpha is the wind speed power law exponent. The typical value for the wind speed power law exponent is 0.14 (1/7 power law). Depending on terrain and surface roughness, the value may vary between 0.05 and 0.35. The calculated value based on the 20-meter and 80 meter hourly average wind speeds is 0.15.

3.5 Long-Term Adjustment

Wind data are collected at the tower at Ft. Berthold, North Dakota from October 2004 to the present time. The 1-year period from December 2004 through Novemebr 2005 is chosen as the base period for the wind turbine theoretical energy estimates.

To estimate the long-term average wind speed for the site, it is appropriate to adjust the wind speed collected during this 1-year period. The wind data for the National Weather Service (NWS) site in Bismarck, North Dakota are examined. Average monthly wind speeds are obtained for this site for February 2001 – January 2006. The average annual wind speed for the 12-month period December 2004 – November 2005 is compared to the multi-year average for Bismarck. Based on this site, it is concluded that the average wind speeds collected at the Ft. Berthold Tower from December 2004 – November 2005 are 3% above the long term average.

3.6 Projected Hub Height Wind Speeds

The projected hub height wind speed for the project, including the adjustment for the long-tem average wind speeds at the site, is 17.6 mph (7.8 mps).

3.7 Peak Wind Speed at Hub Height

The highest wind speeds at the site are associated with seasonal thunderstorm activity (spring and summer). The peak gusts recorded (1930-1996) at NWS stations in North Dakota are: Bismarck, 84 mph; Fargo, 70 mph; Grand Forks, 72 mph; Minot AFB, 85 mph; Williston, 70 mph. Based on these data, it is estimated that the peak 5-second gust at the Ft. Berthold site at 10 meters agl is 82 mph (36.6 mps). Applying the wind power law with the observed power law exponent of 0.15, the estimated 5-second gust at 80-meters agl is 88 mph (39.3 mps).

3.8 Meteorological Hazards

The meteorological hazards at the Ft. Berthold, North Dakota site are associated with seasonal thunderstorm activity during the spring and summer months. Thunderstorms are associated with lightning, extreme straight-line wind gusts, hail, and tornadoes.

The National Severe Storms Laboratory in Norman, OK prepared maps with the frequency of occurrence of tornadoes (Fig. 3), wind gusts greater than 50 mph (Fig. 4), and 0.25" or larger hail (Fig 5). The Ft. Berthold Site experiences, on average, fewer tornados, fewer days with damaging winds, and fewer days with 0.25" or greater size hail than other locations in the central and southern plains. For example, Figure 3 presents the number of tornado days per year in the Continental US. The highest frequency occurs in NW Colorado, N Texas/S Oklahoma, and Florida. For the Ft. Berthold site, the frequency is small, less than 1 day/yr.

Figure 3 - Number of Tornado Days per Year

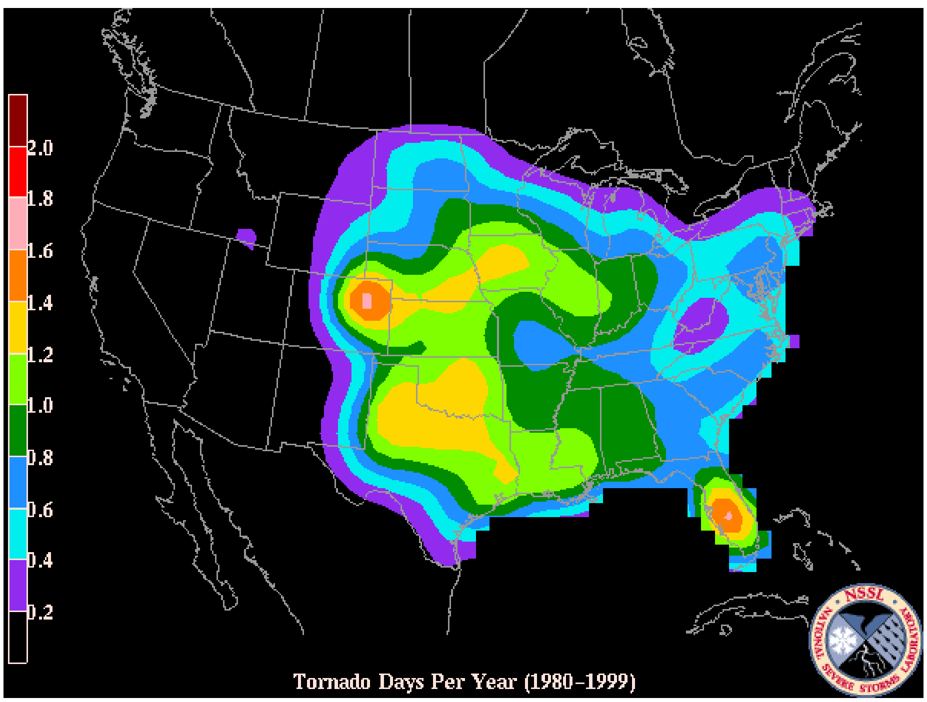


Figure 4 - Number of Days per Year with Wind Gusts in Excess of 50 mph

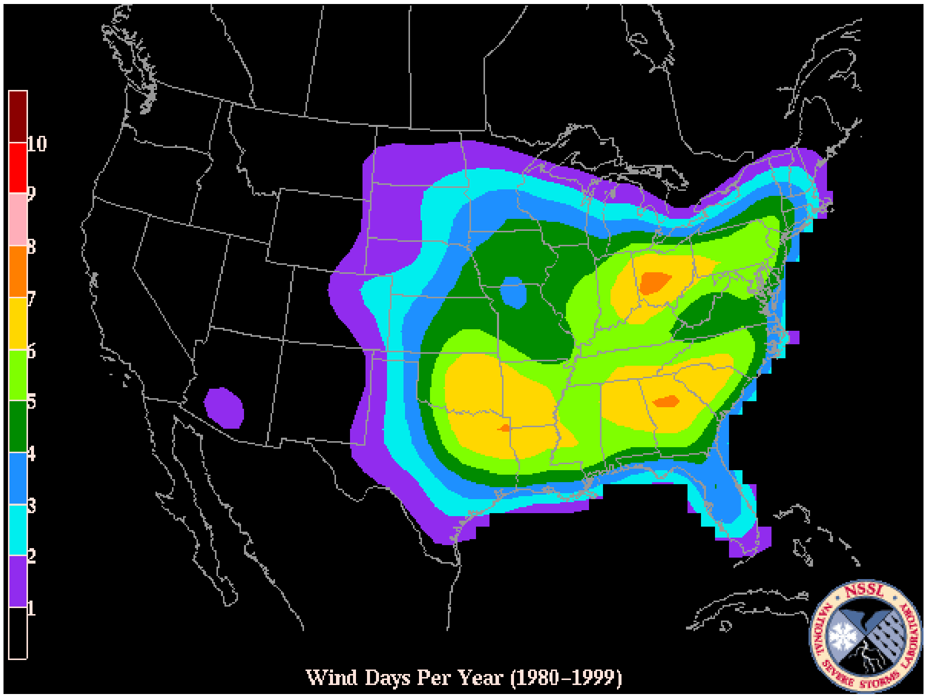
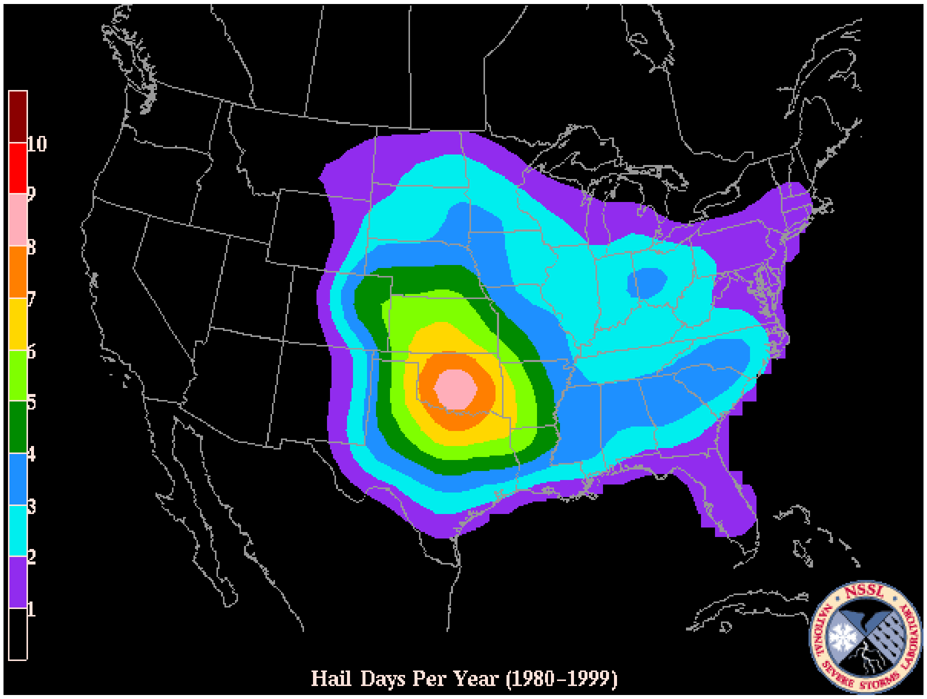


Figure 5 - Number of Days per Year with Hail



3.9 Turbulence Intensity

The Turbulence Intensity (TI) is defined as the standard deviation of the wind speed divided by the mean of the wind speed. The turbulence intensity derived from the hourly average wind speed data at the 50-meter level is presented in Table 11. The critical TI value, based in the existing standards for wind turbine engineering design, is the value at 15 mps.

Table 11 - Turbulence Intensity Summary at 50 Meters

FORT BERTHOLD INDIAN RESERVATION
50M WIND SPEED (CH1)

10/15/04 to 01/15/062

Wind Speed Frequency and Concurrent TI

Wind Speed (mps)	Frequency of Occurrence Hrs	%	Mean Turbulence Intensity
0-2	519	4.8	0.237
3	638	6.0	0.135
4	892	8.3	0.108
5	1109	10.4	0.092
6	1282	12.0	0.079
7	1261	11.8	0.078
8	1246	11.6	0.072
9	982	9.2	0.069
10	820	7.7	0.071
11	695	6.5	0.073
12	443	4.1	0.078
13	322	3.0	0.082
14	182	1.7	0.087
15	145	1.4	0.083
16	76	.7	0.087
17	37	.3	0.089
18	26	.2	0.099
19	16	.1	0.086
20	13	.1	0.095
21	8	.1	0.095
22	0	0.0	*****
23	1	.0	0.128
24	0	0.0	*****
25	0	0.0	*****
26	0	0.0	*****
27	0	0.0	*****
28	0	0.0	*****
29	0	0.0	*****
30	0	0.0	*****
Total Hrs	10713		10713

3.10 Local Climatology

The temperature and precipitation climatology for the site is presented in Table 12 and Table 13. The mean and extreme ambient temperature data and precipitation data by month and the extreme value for the year are shown. The ambient temperature shows a wide range from -40.0 degrees F in the winter to 106 degrees in the summer. Winters tend to be cold and dry while summers are moderately warm and wet.

Table 12 – Climatological Data (Temperature) for NWS Cooperative Observing Station (New Town 4W, ND)

	Monthly Averages			Daily Extremes				Max. Temp.		Min. Temp.	
	Max.	Min.	Mean	High	Date	Low	Date	>= 90 F	<= 32 F	<= 32 F	<= 0 F
	F	F	F	F	dd/yyyy or yyyymmdd	F	dd/yyyy or yyyymmdd	# Days	# Days	# Days	# Days
January	16.7	-3.3	6.7	52	Sep-53	-40	31/1959	0	24.6	30.6	18.6
February	24.7	4.2	14.5	64	25/1958	-37	Jan-59	0	18	27.7	11.5
March	37	15.9	26.4	73	22/1963	-31	Jan-80	0	11	29	4.3
April	54.5	29.5	42	89	20/1980	-5	Feb-54	0	0.7	19.6	0.1
May	67.8	41.1	54.4	95	20/1964	16	Apr-67	0.5	0	4.4	0
June	76.5	50.9	63.7	102	13/1979	29	Dec-69	1.6	0	0.3	0
July	83	56	69.5	102	20/1960	37	Apr-72	6.2	0	0	0
August	82.9	53.9	68.4	106	Sep-58	33	24/1958	6.8	0	0	0
September	70.6	43.7	57.1	98	May-78	19	30/1974	1.3	0	2.5	0
October	59.1	33.8	46.4	95	Jan-53	1	31/1984	0.1	0.6	13.7	0
November	38.3	18.8	28.5	72	Feb-65	-20	29/1964	0	8.9	27.7	2.4
December	25.1	6.2	15.7	62	Apr-79	-34	24/1980	0	19.8	30.8	10.8
Annual	53	29.2	41.1	106	Sep-58	-40	1/31/59	16.5	83.5	186.3	47.7

Source: High Plains Climatic Center
Table updated on Dec 20, 2005

Table 13 - Climatological Data (Precipitation) for NWS Cooperative Observing Station (New Town 4W, ND)

	Precipitation											Total Snowfall		
	Mean	High	Year	Low	Year	1 Day Max.		>= 0.01 in.	>= 0.10 in.	>= 0.50 in.	>= 1.00 in.	Mean	High	Year
	in.	in.	-	in.	-	in.	dd/yyyy or yyyymmdd	# Days	# Days	# Days	# Days	in.	in.	-
January	0.41	1	67	0	61	0.52	Jun-80	4	2	0	0	4.9	11.5	54
February	0.4	1.17	69	0	65	0.54	22/1961	3	1	0	0	4.3	16.9	72
March	0.57	2.77	85	0.07	58	1.97	29/1985	4	2	0	0	3.6	10	72
April	1.31	2.67	70	0	77	1.37	24/1953	6	3	1	0	2.6	16	70
May	2.29	6.4	65	0.1	80	3.07	Jun-65	8	5	1	0	0	1	71
June	3.25	6.09	63	0.49	61	1.98	18/1973	11	8	2	1	0	0	53
July	2.08	6.9	69	0.31	80	1.91	22/1969	8	5	1	0	0	0	53
August	1.82	4.91	74	0.13	79	2.61	21/1966	6	4	1	0	0	0	53
September	1.6	4.77	54	0.06	60	2.4	May-71	6	4	1	0	0.2	5.5	72
October	0.62	2.92	71	0	65	1.1	Feb-71	3	2	0	0	0.5	4	59
November	0.36	1.21	59	0	69	0.41	Apr-59	3	2	0	0	3.7	14	59
December	0.4	1.27	64	0	80	0.49	22/1964	4	2	0	0	5.2	18	72
Annual	15.1	20.75	53	8.24	61	3.07	19650506	68	38	8	2	25.2	67.9	72

Source: High Plains Climatic Center

Table updated on Dec 20, 2005

4.0 Annual Energy Estimate

4.1 Gross Annual Theoretical Energy Estimate

The wind speed frequency distribution is combined with a density adjusted power curve for the nine turbines - GE 77m, Suzlon S88, Vestas V82, Vestas V90, Bonus B23, Gamesa G80, Gamesa G87, and Mitsubishi 1000A - to create the annual theoretical energy estimate for a single turbine. These estimates are presented in Tables 14-19.

4.2 Net Annual Theoretical Energy Estimate

The gross annual theoretical energy output is adjusted by various loss factors to estimate the actual or net energy delivered to the substation. These losses take into account the wind turbine out-of-service time associated with scheduled and unscheduled downtime, electrical line losses from the turbine to the substation, control system losses, array losses due to wake effects between adjoining turbines, and lost power associated with blade icing and blade soiling.

The annual net energy production for a single turbine is calculated using the following formula:

$$AEP_{net} = AEP_{gross} * (1 - EL)$$

where AEP_{net} is the Annual Net Energy Production of the wind facility;

AEP_{gross} is the Annual Gross Energy Production of the wind facility;

EL is the product of individual energy losses (%);

EL is the product of the individual energy losses and is calculated as follows:

$$EL = 1-(1 - L_{array}) * (1 - L_{blade}) * (1 - L_{collect}) * (1 - L_{control}) * (1-Availability)$$

where L_{array} = Array losses

$L_{soiling}$ = Blade contamination losses

$L_{collect}$ = Collection system from turbine to grid

$L_{control}$ = Control, grid, and miscellaneous losses

Availability = Availability is the percentage of calendar time that the turbines are functional and ready to deliver power to the grid.

Table 14 – Theoretical Energy Output for the Gamesa G80

THEORETICAL WIND TURBINE PRODUCTION 12/01/04 - 11/30/05

Wind: 50M WIND SPEED (CH1)
FORT BERTHOLD INDIAN RESERVATION

Wind Speeds Multiplied By 1.04

Turbine: GAMESA EOLICA G80 (2MW) 80M ROTOR 1.18KG

Rated at: 2000 kW at 36.0 MPH
Maximum Output: 2000 kW at 56.0 MPH

Status	MPH	Time hrs	Time %	Production KW-hrs	Production %
Below Cut-in	Under 10.0	1498	17.5		
Cut-in To Rated	10.1-36.0	6898	80.5	6,288,926	94.9
Rated To Cut-out	36.1-56.0	169	2.0	337,780	5.1
Above Cut-out	Over 56.0	0	.0		
Contactor Closed		7067	82.5		

kW-hrs at Capacity / Total kW-hrs 5.1

hrs at Capacity / hrs of Operation 2.4

Mean Wind Speed 17.6 MPH

Energy Produced 6,626,706 kW-hrs

Annual Production Rate 6,777,577 kW-hrs

Capacity Factor .39

8565 hrs of Good Data 195 hrs Missing 97.8% Data Recovery

Table 15 – Theoretical Energy Output for the Gamesa G87

```
THEORETICAL WIND TURBINE PRODUCTION            12/01/04 - 11/30/05

Wind:       50M WIND SPEED (CH1)
         FORT BERTHOLD INDIAN RESERVATION

         Wind Speeds Multiplied By  1.04

Turbine: GAMESA EOLICA G87 (2MW) 87M ROTOR 1.180K

         Rated at:         2000 kW at 36.0 MPH
         Maximum Output:   2000 kW at 56.0 MPH
```

Status	MPH	Time hrs	Time %	Production KW-hrs	Production %
Below Cut-in	Under 10.0	1498	17.5		
Cut-in To Rated	10.1-36.0	6898	80.5	6,946,984	95.4
Rated To Cut-out	36.1-56.0	169	2.0	337,989	4.6
Above Cut-out	Over 56.0	0	.0		
Contactor Closed		7067	82.5		

```
kW-hrs at Capacity / Total kW-hrs     4.6

hrs at Capacity / hrs of Operation    2.4

Mean Wind Speed                      17.6 MPH

Energy Produced                 7,284,974 kW-hrs


Annual Production Rate          7,450,831 kW-hrs

Capacity Factor                       .43


 8565 hrs of Good Data    195 hrs Missing     97.8% Data Recovery
```

Table 16 – Theoretical Energy Output for the GE 1.5 (70.5m) Turbine

```
THEORETICAL WIND TURBINE PRODUCTION           12/01/04 - 11/30/05

Wind:       50M WIND SPEED (CH1)
         FORT BERTHOLD INDIAN RESERVATION

         Wind Speeds Multiplied By  1.04

Turbine: GE 1.5 SL (1500Kw)70M ROTOR 1.18KG/M**2

         Rated at:         1500 kW at 30.0 MPH
         Maximum Output:  1500 kW at 30.0 MPH

                                         Time            Production
    Status                 MPH        hrs      %        KW-hrs     %
    ------                -----       ----    ----      ------   ----

  Below Cut-in       Under 10.0    1498    17.5

  Cut-in To Rated     10.1-30.0    6457    75.4   4,207,295   82.1

  Rated To Cut-out    30.1-56.0     610     7.1     914,736   17.9

  Above Cut-out       Over 56.0       0      .0

  Contactor Closed                 7067    82.5

kW-hrs at Capacity / Total kW-hrs    17.9

hrs at Capacity / hrs of Operation    8.6

Mean Wind Speed                      17.6 MPH

Energy Produced                 5,122,031 kW-hrs


Annual Production Rate          5,238,644 kW-hrs

Capacity Factor                       .40



 8565 hrs of Good Data    195 hrs Missing     97.8% Data Recovery
```

Table 17 – Theoretical Energy Output for a GE 1.5 (77m) Turbine

THEORETICAL WIND TURBINE PRODUCTION 12/01/04 - 11/30/05

Wind: 50M WIND SPEED (CH1)
FORT BERTHOLD INDIAN RESERVATION

Wind Speeds Multiplied By 1.04

Turbine: GE 1.5 SL (1500Kw)77M ROTOR 1.18KG/M**2

Rated at: 1500 kW at 30.0 MPH
Maximum Output: 1500 kW at 30.0 MPH

		Time		Production	
Status	MPH	hrs	%	KW-hrs	%
Below Cut-in	Under 10.0	1498	17.5		
Cut-in To Rated	10.1-30.0	6457	75.4	4,633,905	83.7
Rated To Cut-out	30.1-56.0	610	7.1	903,441	16.3
Above Cut-out	Over 56.0	0	.0		
Contactor Closed		7067	82.5		

kW-hrs at Capacity / Total kW-hrs 16.3

hrs at Capacity / hrs of Operation 8.6

Mean Wind Speed 17.6 MPH

Energy Produced 5,537,346 kW-hrs

Annual Production Rate 5,663,415 kW-hrs

Capacity Factor .43

8565 hrs of Good Data 195 hrs Missing 97.8% Data Recovery

Table 18 – Theoretical Energy Output for the Bonus 2.3 Turbine

THEORETICAL WIND TURBINE PRODUCTION 12/01/04 - 11/30/05

Wind: 50M WIND SPEED (CH1)
FORT BERTHOLD INDIAN RESERVATION

Wind Speeds Multiplied By 1.04

Turbine: BONUS 2.3MW 1.18KG/M**3 04/05

Rated at: 2300 kW at 29.0 MPH
Maximum Output: 2300 kW at 55.0 MPH

Status	MPH	Time hrs	Time %	Production KW-hrs	Production %
Below Cut-in	Under 8.0	881	10.3		
Cut-in To Rated	8.1-29.0	6948	81.1	6,700,105	79.8
Rated To Cut-out	29.1-56.0	736	8.6	1,692,800	20.2
Above Cut-out	Over 56.0	0	.0		
Contactor Closed		7684	89.7		

kW-hrs at Capacity / Total kW-hrs 20.2

hrs at Capacity / hrs of Operation 9.6

Mean Wind Speed 17.6 MPH

Energy Produced 8,392,905 kW-hrs

Annual Production Rate 8,583,987 kW-hrs

Capacity Factor .43

8565 hrs of Good Data 195 hrs Missing 97.8% Data Recovery

Table 19 – Theoretical Energy Output for the Vestas V-82 Turbine

THEORETICAL WIND TURBINE PRODUCTION 12/01/04 - 11/30/05

Wind: 50M WIND SPEED (CH1)
FORT BERTHOLD INDIAN RESERVATION

Wind Speeds Multiplied By 1.04

Turbine: VESTAS V82 1.65MW 06/05 (1.18kg/m**3)

Rated at: 1650 kW at 31.3 MPH
Maximum Output: 1650 kW at 45.0 MPH

Status	MPH	Time hrs	Time %	Production KW-hrs	Production %
Below Cut-in	Under 7.0	677	7.9		
Cut-in To Rated	7.1-31.3	7423	86.7	5,455,339	88.3
Rated To Cut-out	31.4-45.0	440	5.1	726,000	11.7
Above Cut-out	Over 45.0	25	.3		
Contactor Closed		7863	91.8		

kW-hrs at Capacity / Total kW-hrs 11.7

hrs at Capacity / hrs of Operation 5.6

Mean Wind Speed 17.6 MPH

Energy Produced 6,181,339 kW-hrs

Annual Production Rate 6,322,070 kW-hrs

Capacity Factor .44

8565 hrs of Good Data 195 hrs Missing 97.8% Data Recovery

Table 20 – Theoretical Energy Output for the Vestas V-90 Turbine

```
THEORETICAL WIND TURBINE PRODUCTION           12/01/04 - 11/30/05

Wind:      50M WIND SPEED (CH1)
         FORT BERTHOLD INDIAN RESERVATION

         Wind Speeds Multiplied By  1.04

Turbine: VESTAS V-90 3.0 1.18KG/M**3 3/04

         Rated at:        3000 kW at 38.1 MPH
         Maximum Output:  3000 kW at 56.0 MPH
```

Status	MPH	Time hrs	Time %	Production KW-hrs	Production %
Below Cut-in	Under 8.9	1174	13.7		
Cut-in To Rated	9.0-38.1	7285	85.1	8,265,355	96.3
Rated To Cut-out	38.2-56.0	106	1.2	318,000	3.7
Above Cut-out	Over 56.0	0	.0		
Contactor Closed		7391	86.3		

```
kW-hrs at Capacity / Total kW-hrs     3.7

hrs at Capacity / hrs of Operation    1.4

Mean Wind Speed                      17.6 MPH

Energy Produced                 8,583,355 kW-hrs


Annual Production Rate          8,778,773 kW-hrs

Capacity Factor                       .33


 8565 hrs of Good Data    195 hrs Missing     97.8% Data Recovery
```

Table 21 – Theoretical Energy Output for the Suzlon S88 Turbine

THEORETICAL WIND TURBINE PRODUCTION 12/01/04 - 11/30/05

Wind: 50M WIND SPEED (CH1)
FORT BERTHOLD INDIAN RESERVATION

Wind Speeds Multiplied By 1.04

Turbine: SUZLON 2000/88 (2000kW) POWER CURVE 1.18

Rated at: 2100 kW at 31.4 MPH
Maximum Output: 2100 kW at 55.0 MPH

Status	MPH	Time hrs	Time %	Production KW-hrs	Production %
Below Cut-in	Under 9.0	1199	14.0		
Cut-in To Rated	9.1-31.4	6910	80.7	6,442,087	87.1
Rated To Cut-out	31.5-56.0	456	5.3	957,600	12.9
Above Cut-out	Over 56.0	0	.0		
Contactor Closed		7366	86.0		

kW-hrs at Capacity / Total kW-hrs 12.9

hrs at Capacity / hrs of Operation 6.2

Mean Wind Speed 17.6 MPH

Energy Produced 7,399,687 kW-hrs

Annual Production Rate 7,568,156 kW-hrs

Capacity Factor .41

8565 hrs of Good Data 195 hrs Missing 97.8% Data Recovery

Table 22 – Theoretical Energy Output for the Mitsubishi 1000A Turbine

```
THEORETICAL WIND TURBINE PRODUCTION          12/01/04 - 11/30/05

Wind:      50M WIND SPEED (CH1)
         FORT BERTHOLD INDIAN RESERVATION

         Wind Speeds Multiplied By  1.02

Turbine: MWT-1000A 61M ROTOR (SINGLE SPEED) 1.18K

         Rated at:        1000 kW at 29.0 MPH
         Maximum Output:  1000 kW at 29.0 MPH
```

Status	MPH	Time hrs	Time %	Production KW-hrs	Production %
Below Cut-in	Under 10.0	1585	18.5		
Cut-in To Rated	10.1-29.0	6318	73.8	2,726,207	80.5
Rated To Cut-out	29.1-56.0	662	7.7	662,000	19.5
Above Cut-out	Over 56.0	0	.0		
Contactor Closed		6980	81.5		

```
kW-hrs at Capacity / Total kW-hrs    19.5

hrs at Capacity / hrs of Operation    9.5

Mean Wind Speed                      17.3 MPH

Energy Produced                 3,388,207 kW-hrs


Annual Production Rate          3,465,346 kW-hrs

Capacity Factor                       .40


 8565 hrs of Good Data    195 hrs Missing     97.8% Data Recovery
```

The loss factors assumed for this project include 3% for availability, 2% for electrical line losses, 5.0% for array and off-axis wind direction losses, 1% for turbulence and control, and 1% for blade contamination losses. The additive loss factors are 12%; the gross to net ratio is 0.88.

A summary of the gross and net theoretical energy output for the nine different turbine types are presented in Table 23.

Table 23 – Theoretical Energy Projection Summary For Nine Turbines

Turbine	Rotor Diameter (m)	Rating (kW)	Hub Height (m)	Gross Theoretical Energy (kWh)	Net Theoretical Energy (kWh)	Turbine Capacity Factor (Net) (%)	Annual Wind Speed (mps)
Gamesa G80	80	2000	80	6,778,000	5,964,000	34.04%	7.9
Gamesa G87	87	2000	80	7,451,000	6,557,000	37.42%	7.9
GE 1.5	70.5	1500	80	5,239,000	4,610,000	35.08%	7.9
GE 1.5 (77m)	77	1500	80	5,663,000	4,984,000	37.93%	7.9
Bonus 2.3	82	2300	80	8,584,000	7,554,000	37.49%	7.9
Vestas V82	74	1650	80	6,322,000	5,563,000	38.49%	7.9
Vestas V90	90	3000	80	8,779,000	7,725,000	29.40%	7.9
Suzlon S88	82	2100	80	7,568,000	6,660,000	36.20%	7.9
MWT-1000A	61	1000	69	3,465,000	3,050,000	34.81%	7.7

Tribal Renewable Energy
Final Technical Report

Tab 3

Phase One Avian Screening

Project Title: Three Affiliated Tribes Renewable Energy Feasibility Study

Date of Report: May 24, 2006

Recipient Organization: Three Affiliated Tribes of the Ft. Berthold Reservation

Award Number: DE-FG36-04GO14021

Partners: Three Affiliated Tribes of the Fort Berthold Reservation
Distributed Generation Systems, Inc. (cost sharing partner)

Phase One Screening Report:

Fort Berthold Windpower Site

Mountrial and McLean Counties, North Dakota

September 20, 2004

Prepared for:

DISGEN

Prepared by:

Western EcoSystems Technology, Inc.
2003 Central Avenue
Cheyenne, Wyoming 82001

INTRODUCTION:

When exploring prospective windpower sites, knowledge of wildlife and other biological resource issues helps the wind industry identify and avoid potential ecological problems early in the development process. The purpose of this report is not to define impacts of the proposed windpower project, rather, the purpose is to alert project proponents to potential conflicts with wildlife and habitat. WEST, Inc. was asked by DISGEN to evaluate potential wildlife occurrence and habitat issues at a prospective windpower site on the Ft. Berthold Reservation in North Dakota. The area is located within Mountrial and McLean Counties approximately 6 miles south of Parshall, North Dakota. The proposed project area consists of lands owned by the Three Affiliated Tribes: Mandan, Hidatsa, Arikara. Land owned by the Three Affiliated Tribes is not contiguous; hence the project area consists of several divided portions of land (Figure 1). Two project areas are evaluated in this report: a primary project area and a second, alternative area that may also be targeted for development. The area evaluated for potential biological resources includes the project areas and a two mile buffer (evaluation area). This report focuses on the following potential areas of concern:

- Raptors
  1. Identify areas of potentially high nesting density
  2. Identify areas of potentially high prey density
  3. Examine topography to determine the potential for high use and potential nest locations
  4. Determine the species likely to occur in the area
  5. Determine the potential for migratory pathways
- Candidate, Proposed, Threatened, Endangered, and USFWS Birds of Conservation Concern
  1. Identify the potential occurrence of federally listed or state protected species through existing literature and database searches
  2. Evaluate the suitability of habitat at the wind plant site for protected species
- State Wildlife Issues (using existing state wildlife agency information)
  1. Determine if site is considered a critical winter or parturition area or other highly valuable habitat for game and non-game wildlife (birds and bats)
  2. Determine if area is considered a migratory route for game species
  3. Examine habitat during site visits to determine the potential for use by state protected species
- Unique Habitat
  1. Evaluate the uniqueness of the site relative to the surrounding area. For example: wildlife might be attracted to a habitat desirable for wind power development (a rocky bluff) surrounded by less desirable areas (grassland steppe)
- Wetlands
  1. Determine the potential for wetlands at the site through a cursory site visit and examination of available data

- Bats
  1. Determine the proximity to potential feeding sites and hibernacula
  2. Determine species likely to occur in the area
- Avian Migratory Pathways of Passerines, Waterfowl and Shorebirds

METHODS:

Biological resources within the vicinity of the project were evaluated through a search of existing data and a site visit. The project area was examined on June 15, 2004 by foot and vehicle. During the site visit, biological features and potential wildlife habitat including plant communities, topography features, and potential raptor nest structures were identified. A list of wildlife species observed during the site visit was kept.

Several sources of available data were used to identify biological resources within the project area, including requesting data from the North Dakota Game and Fish Department (NDGF), the North Dakota U.S. Fish and Wildlife Service (USFWS), North Dakota Natural Heritage Program, and searching published literature, field guides etc. Letters were received from the USFWS and the NDGF on August 23 and September 3, 2004, respectively (Appendix A).

After biological resources within the project area were identified, we analyzed the potential for conflicts with the potential windpower project based, in part, upon studies conducted at other wind plants throughout the U.S. We also calculated Potential Impact Scores based on the Interim USFWS guidelines for the proposed primary project area and one reference area (See Appendix B for score calculations).

Study Area. The proposed project areas are located on the border of Mountrial and McLean counties from approximately 1 – 6 miles east of Lake Sakakawea and the Missouri River (Figure 1). The elevation of the project areas ranges from approximately 2000 – 2150 ft. The project is located in the Missouri Coteau Slope Ecoregion (Sandra et al. 1998) and tilled agriculture is the dominant land use of the area. Native grassland is present along the westernmost portions of the project areas near Lake Sakakawea and within borders of tilled agricultural fields. Deciduous forest and wetlands are very rare within the project and evaluation areas. The majority of the prairie pothole region occurs approximately 20 miles east of the proposed project areas, and perennial bodies of water are absent within the project boundaries. The project areas are generally flat with little to no discernible topography (Figures 1-2).

RESULTS:

Raptor Issues

Nesting density and species breeding in area. Habitats within the project areas for above ground nesting species are rare. A few shelterbelts are present within the project areas that provide potential nesting habitat. One inactive raptor nest was noted in a shelterbelt in the primary project area. More nesting habitat is present on the western edge of the project and evaluation areas where the topography begins to slope toward the Missouri River. Some potential raptor nesting habitat is present, however, it is unlikely the proposed project or evaluation areas will support extraordinary high densities of breeding raptors due to the overall lack of nesting habitat.

Above ground nesting species most likely to nest within and surrounding the project area include red-tailed hawk (*Buteo jamaicensis*), Swainson's hawk (*Buteo swainsoni*), American kestrel (*Falco sparverius*), and great-horned owl (*Bubo virginianus*) (Stewart 1975). The potential exists for osprey (*Pandion haliaetus*) and bald eagle (*Haliaeetus leucocephalus*) to nest adjacent to Lake Sakakawea. Turkey vulture (*Cathartes aura*) may occur within the project during the breeding season but are unlikely to nest within the project area.

Raptors may also occur within the project area outside of the breeding season including rough-legged hawk (*Buteo lagopus*), red-tailed hawk, American kestrel, Cooper's hawk (*Accipiter cooperi*), and sharp-shinned hawk (*Accipiter striatus*) (Stewart 1975). Bald eagles likely occur on Lake Sakakawea throughout the year, but are much less likely to fly over the project areas.

Potential for prey densities. No obvious signs of colonial rodents were observed due to the preponderance of tilled agriculture in the project area. Prey densities and prey availability of species such as *Peromyscus* may be very high in agricultural fields immediately after harvest as mice forage on leftover seeds.

Overall, it is very difficult to assess potential prey densities during a single site visit. Prey densities can fluctuate rapidly based on habitat and climatic factors. However, overall prey densities are expected to be low in the project area based on the large amount of tilled agriculture in the area.

Does the topography of the site increase the potential for raptor use? The proposed project is located on almost entirely flat agricultural fields that generally lack defined topographic edges. At other windpower facilities located on prominent ridges with defined edges (e.g., rims of canyons, steep slopes), raptors fly along the rim edges, using updrafts to maintain altitude while hunting, migrating or soaring. Turbines are often placed on prominent ridges in order to use higher wind speeds and updrafts that raptors also use. In Wyoming, raptors most often used areas within 50 m of the rim edge (Johnson et al. 2000). Raptor use is not expected to be heavily influenced by the topography in the project area because its general lack of defined ridges and rim edges. The only exception may be the western most portion of section 31 within the alternative development area. The western side of this section borders the bluffs above Lake Sakakawea.

Federal and State Protected Species

In a letter dated August 23, 2004 the U.S. Fish and Wildlife Service described five federally protected species as potentially occurring within the proposed project areas: interior least tern, whooping crane, pallid sturgeon, bald eagle, and piping plover.

Interior Least Tern (Endangered). The USFWS described this species as nesting along midstream sandbars of the Missouri and Yellowstone Rivers. The ND Natural Heritage Program has three records of least terns occurring within the Deepwater Creek Bay approximately 1 – 3 miles south of the alternative development area (Figure 2). The shores of Lake Sakakawea and small islands within the lake provide potential nesting habitat for this species. The proposed project areas are located on a plateau above Lake Sakakawea from approximately 1 – 6 miles from the shores of the Lake. The southwest portion of the alternative development area (sections 4-5 and 31-33) is located closest to potential nesting areas along the shore of Lake Sakakawea.

While no nesting habitat for the least tern occurs within the project boundaries, the potential exists for the species to fly through the project area during migration. Little is known concerning the migration habits of the least tern, and it is not known if the species migrates along major river systems or flies in direct north-south pattern (Sidle and Harrison 1990).

Whooping Crane (Endangered). The whooping crane is a highly endangered bird with a total population of around 194 birds (Wally Jobman, USFWS, pers. comm.). Although one young adult summered in North Dakota in 1989, 1990, 1993, according to the USFWS, most birds migrate through the western and central portions of North Dakota on their way to and from breeding and wintering grounds in Wood Buffalo National Park, Canada and Aransas National Wildlife Refuge, Texas. A correlation may exist between whooping crane stopover sites in North Dakota and the path of the Missouri River (Austin and Richert 1999). The proposed project areas occur from 1 – 6 miles from the Missouri River and the potential exists for whooping cranes to move through the project area during migration. The ND Natural Heritage Program has one record of a whooping crane occurring on the shore of Lake Sakakawea in May of 1981 approximately four miles south of the alternative project area (Figure 2).

The National Wetland Inventory (NWI) shows several wetlands present within the project areas (Figure 3). However, upon field review, no wetlands or waterbodies containing emergent vegetation were present in the project area boundaries. It is likely that wetlands may have been historically present in the project area, but have been tilled under by modern agriculture. It is possible that depressions in the project area may flood during rainy spring and fall seasons, creating temporary non-vegetated pools of water.

Outside of Nebraska, more than 75% of recorded roost observations of whooping cranes between 1943-1999 have been in palustrine wetlands (Austin and Richert 2001). Typically, whooping cranes roost or loaf in shallow water vegetated wetlands and forage in subirrigated wet meadows and/or cultivated ag lands. Four of 644 roost observations used by Austin and Richert (1999) were of whooping cranes that roosted in flooded cropland, while most observations of roosting whooping cranes outside of Nebraska occurred in vegetated wetlands. Of these observations, only 12% occurred in lacustrine or lakeside wetlands. Thus the proposed project areas may provide relatively low quality roosting habitat during wet spring and fall seasons. The project area does provide potential foraging habitat for whooping cranes in the form of grain crops.

Overall the project areas do not contain significant amounts of the dominate habitat utilized by whooping cranes for roosting during the spring and fall migrations, but they do contain some potential foraging habitat in the form of grain crops. Roosting habitat is more common along Lake Sakakawea. Of the observations documenting distances between roost sites and foraging areas, approximately 66% of those groups roosting in palustrine wetlands foraged within 0.5 miles of the roost location and >75% were within one mile of roost locations. Of those foraging < one mile from the roost site, most were found along the Platte River in Nebraska.

The potential exists for whooping cranes to fly through the project area during migration. Whooping cranes generally migrate at 1000-5000 ft, altitudes well above turbine height, (Tom Stehn, USFWS, http://www.learner.org/jnorth/spring1998/jnexpert/CraneAnswer.html), and thus for the most part are unlikely to collide with turbines. However, as whooping cranes ascend and descend during landing, or migrate during inclement weather and as thermal lift decreases whooping cranes may fly at lower altitudes, and may fly within rotor swept areas. Because whooping cranes are so rare, so little is known concerning specific movement patterns and the fact that there is little roosting habitat in the project boundary to draw them to the area, it is very difficult to predict the probability of whooping cranes colliding with proposed turbines.

Pallid Sturgeon (Endangered). The USFWS described the pallid sturgeon as occurring within the Missouri River. The ND Natural Heritage Program has one record of a pallid sturgeon occurring in Lake Sakakawea approximately four miles southeast of the alternative project area. The proposed project is located on the plateau above the Missouri River, and no habitat for the species occurs within the project boundaries.

Piping Plover (Threatened). According to the USFWS, more piping plovers nest in North Dakota than any other state. The species "nests along midstream sandbars of the Missouri and Yellowstone Rivers and along shorelines of saline wetlands." The shores of Lake Sakakawea have been ruled as critical habitat for the piping plover. The ND Natural Heritage Program has seven records of piping plovers occurring with four miles of the proposed project areas. The proposed project areas are located on a plateau above Lake Sakakawea from approximately 1 – 6 miles from the shores of the Lake. The southwest portion of the alternative development area (sections 4-5 and 31-33) is located closest to potential nesting areas along the shore of Lake Sakakawea.

While no nesting habitat for the least tern occurs within the project boundaries, the potential exists for the species to fly through the project area during migration. Little is known concerning the migration habits of the piping, and it is not known if the species migrates along major river systems or flies in a direct north-south pattern.

Bald Eagle (Threatened). The USFWS described the bald eagle as migrating primarily along major rivers through North Dakota**.** The bald eagle also concentrates during the winter along the Missouri River, and may nest in areas with mature forest. No nesting habitat is present within the project boundaries, however, the potential exists for bald eagles to nest near Lake Sakakawea in mature cottonwoods. It is likely that larger numbers of bald eagles occur on Lake Sakakawea during the winter. Because bald eagles feed primarily on fish in North Dakota (Gomes Date Unknown), it is likely the birds will spend the vast majority of their time on Lake Sakakawea. Due to the lack of feeding and roosting areas within the project boundary, bald eagles may only occasionally fly through the project area.

Other species. Most species of migratory birds are protected by the Migratory Bird Treaty Act. The USFWS lists 29 birds as species of concern within the Prairie Potholes Bird Conservation Region (USFWS 2002). These species do not receive special protection, but have been identified as vulnerable to population declines in the area by the USFWS. Some of these species may migrate through the project area, however, only a few are expected to breed or winter within the project area boundaries. Grasshopper sparrows (*Ammodramus savannarum*) were observed during the breeding season within narrow strips of grassland between agricultural fields. Marbled godwits (*Limosa fedoa*) were observed outside of the project areas but within the evaluation area.

Bird species associated agricultural landscapes are expected to make up the breeding bird community in the project areas. Below is a list of species observed during the site visit (Table 1). These species are representative of species most likely to breed within the project area.

Table 1. A list of species observed during the June 15, 2004 site visit within the project and evaluation areas.

Species
Horned lark (*Eremophila alpestris*)
Bobolink (*Dolichonyx oryzivorus*)
Red-winged blackbird (*Agelaius phoeniceus*)
American crow (*Corvus brachyrhynchos*)
American goldfinch (*Carduelis tristis*)
Yellow warbler (*Dendroica petechia*)
Brown-headed cowbird (*Molothrus ater*)
Great blue heron (*Ardea herodias*)
Northern harrier (*Circus cyaneus*)
Eastern meadowlark (*Sturnella magna*)
Barn swallow (*Hirundo rustica*)
Grasshopper sparrow (*Ammodramus savannarum*)[1]
Marbled godwit (*Limosa fedoa*) [1]

[1] Theese species are listed as Birds of Conservation Concern (USFWS 2002).

WETLANDS

Information concerning wetlands are based on, field observations, aerial photographs and data from the USFWS National Wetland Inventory (NWI) (Figure 3). Wetlands are rare within the project areas. No large areas of palustrine wetland or major river corridors are present. The project areas are located on a gentle plateau, and contain relatively few creeks or bodies of water. NWI maps indicate a large number of wetlands are present within the project areas, however, field verification indicated that virtually all of these locations are plowed agricultural fields with no wetland vegetation present. Some wetlands are present within the evaluation area on the shores of Lake Sakakawea.

STATE WILDLIFE ISSUES AND UNIQUE HABITAT

Based on correspondence received from the NDGFP dated August 31, 2004 (Appendix A), the NDGF's main concern is the potential impact of the proposed project to native prairies and associated fauna. Within the primary project area, native grassland is limited to small strips (5 – 10' in width) between agricultural fields and areas of grassland within the right-of-way of county roads. A few sections within the alternative project area contain greater amounts of grasslands, and potential impacts to grassland breeding songbirds are greater in this area. Some uncertainty currently exists over the effects of windpower facilities on breeding grassland songbirds. In Minnesota, researchers have found that breeding songbird density on CRP grasslands was reduced in the immediate vicinity of turbines (Leddy et al. 1999), but changes in density at broader scales were not detectable (Johnson et al. 2000).

The proposed project areas are largely dominated by tilled agriculture and contain no unique habitats that would prove an extraordinary attractant to wildlife. The only relatively unique habitat are a few areas of native grassland located within the alternative project area.

BATS

There are ten bat species that can be found in North Dakota including the pale Townsend's big-eared bat (*Plecotus townsendii pallescens*), little brown bat (*Myotis lucifugus*), long-eared bat (*Myotis evotis*), western small footed myotis (*Myotis ciliolabrum*), northern myotis (*Myotis septentrionalis*), silver-haired bat (*Lasionycteris noctivagans*), big brown bat (*Eptesicus fuscus*), red bat (*Lasiurus borealis*), hoary bat (*Lasiurus cinereus*), and long-legged bat (*Myotis volans*) species (USFWS 1995, Grohndal No date). Based on range maps available from Bat Conservation International, a total of six species may occur within the proposed project area, including northern myotis, little brown bat, silver-haired bat, hoary bat, big brown bat and eastern red bat. None of these species receive federal protection, however, they are protected as non-game species by the NDGF.

Potential roosting habitat within the project areas is limited to a few shelterbelts. Due to the lack of topography it is unlikely the project area contains any caves suitable for roosting habitat. Bats may forage over the entire project area, although the extent of use is not known.

Bat casualties have been reported from most windpower facilties where post-construction fatality data are publicly available. Reported estimates of bat mortality at windpower facilities have ranged from 0.07 – 10.0 per turbine per year in the U.S. (Table 2). Most of the bat casualties at windpower facilities to date are migratory species which conduct long migrations between summer roosts and winter hibernacula. Examples of these species commonly found as fatalities at windpower facilities include hoary bats, silver-haired bats and eastern red bats. A recent report of bat fatalities at a windpower facility in West Virginia includes relatively high numbers of red bats, hoary bats, eastern pipistrelle (*Pipistrellus subflavus*) and little brown bat over the course of one year. The West Virginia site is located on a prominent, relatively narrow ridge in the Appalachian Mountains and may be located within a bat migration corridor. The causes of the relatively high number of migratory bat deaths at windpower facilities are not well understood. Some have suggested it may be related to the lack or reduction of echolocation during migration (Johnson 2003). Furthermore, strong field methods to provide quantitative predictions of migratory bat use are lacking.

Due to a lack of information concerning bat migration habits, it is difficult to predict if the proposed project area is located within a bat migration corridor. However, unlike the West Virginia site, the proposed project area is relatively flat and does not appear to contain topographic features that may funnel migrating bats (Figures 1-2).

The proposed project will likely result in the mortality of some bat species, including red bats, hoary bats and silver-haired bats. The magnitude of these fatalities and the degree to which other bats species will be affected is difficult to determine. Bat fatality rates at the proposed project are expected to be within the range of fatality estimates documented at other windpower projects (Table 2).

Table 2. Reported bat fatality estimates for windpower facilities in the U.S from Johnson et al. (2003).

Location	Year	Mean annual mortality	Bat mortalities per turbine	Notes
Buffalo Ridge, MN P1	1999	5	0.07	Adjusted for search biases
Buffalo Ridge, MN P2	1998-2001	289	2.02	Adjusted for search biases
Buffalo Ridge, MN P3	1999-2001	319	2.32	Adjusted for search biases
Wisconsin	1999	34	1.10	Not adjusted for search biases
Foote Creek Rim, WY	1998-2001	138	1.04	Adjusted for search biases
Buffalo Mtn., TN	2001	30	10.0	Not adjusted for search biases
Vansycle, OR	1999	28	0.40	Adjusted for search biases

AVIAN MIGRATORY PATHWAYS

Many species of songbirds and waterfowl migrate at night and may collide with tall man-made structures. Large numbers of songbirds may collide with lighted communication towers and when foggy conditions and spring or fall migration coincide (Avery et al. 1977). Birds appear to become confused by the lights during foggy or low ceiling conditions, flying circles around lighted structures until they become exhausted or collide with the structure. However, relatively large numbers of dead birds have also been recorded following relatively cloudless nights (Avery et al. 1977). To date, no large mortality events on the same scale as those seen at communication towers have been documented at windpower facilities in North America (Erickson et al. 2001). However, turbines used by many wind developers are getting taller and require lighting by the Federal Aviation Administration, potentially increasing the risk of collision by nocturnal migrants with wind turbines.

The proposed project is located on a relatively large, flat plateau 1 - 6 miles north and east of the Missouri River (Figure 1). The Missouri River is a potential migration path for the whooping crane (Austin and Reichert 1999). The extent to which other species follow the Missouri River is not well documented; however, it is likely used as a migration route by other species.

Relatively little stopover habitat for migrating waterfowl in the form of vegetated wetlands or prairie potholes are present within the proposed project area. Some depressions may fill with water in agricultural fields during the spring and fall during wet periods. These wetlands are ephemeral in nature. The project area is largely dominated by tilled agriculture and lacks large bodies of permanent water or palustrine wetlands or large tracts of deciduous forest (Figures 2-3). During especially wet years, the potential exists for several ephemeral, non-vegetated wetlands to form within the project area during migration, increasing use of the project area by migrating waterfowl and waterbirds. Stopover habitat for migrating songbirds is limited to a few shelterbelts within the project area.

DISCUSSION:

Overall, the proposed project area has relatively few issues that may pose a problem (Table 3 and Appendix B). Tilled agriculture and hayfields comprise most of the project areas, and the project areas generally lack stark topography. Because most federally protected species occur within habitats other than tilled agriculture, there is a relatively low risk of impact on these species. The proposed project area contains considerably less amounts of native habitat and topography compared to other windpower projects within the western U.S. The two biggest issues facing the proposed project areas are 1) proximity to the Missouri River and 2) potential for ephemeral wetlands to form in wet years.

Four bird species protected under the Endangered Species Act are associated with the Missouri River in North Dakota: bald eagle, whooping crane, interior least tern and piping plover. In addition to these species, other waterbirds and waterfowl are closely associated with Lake Sakakawea. Although habitat for these species within the project areas are lacking, placing turbines on bluffs adjacent to the Missouri River may increase the potential for collisions with wind turbines as birds fly from feeding, roosting and nesting areas. Most of the primary project area is located greater than four miles from Lake Sakakawea, providing a relatively safer distance between the Lake and proposed turbine locations. However, the southwest most sections of the alternative project area are located close to the Lake and thus may pose more risk to these species. If possible, turbines should be located as far as possible from Lake Sakakawea.

No wetlands were observed within the project area boundaries during the June 15 site visit. However, during wet spring and fall seasons, depressions within project boundaries may fill with water, providing potential roost sites for migrating waterfowl and waterbirds. The presence of potential roost sites and feeding areas within project boundaries may increase use of the project areas by migrating waterfowl and waterbirds, increasing the risk of collision for these species.

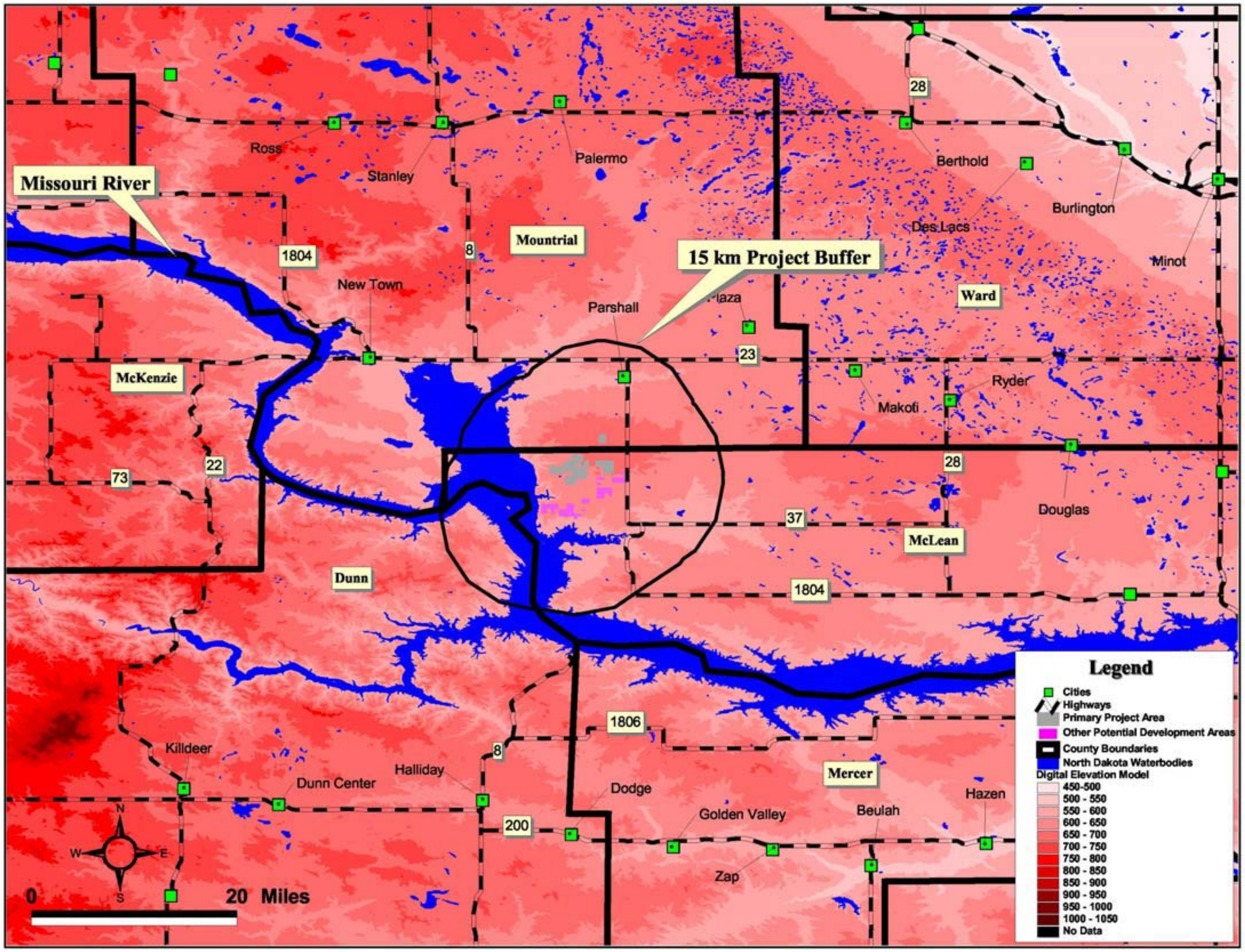


Figure 1. A Digital Elevation Model of the project area. Note the DEM data were obtained from the U.S. Geological Survey.

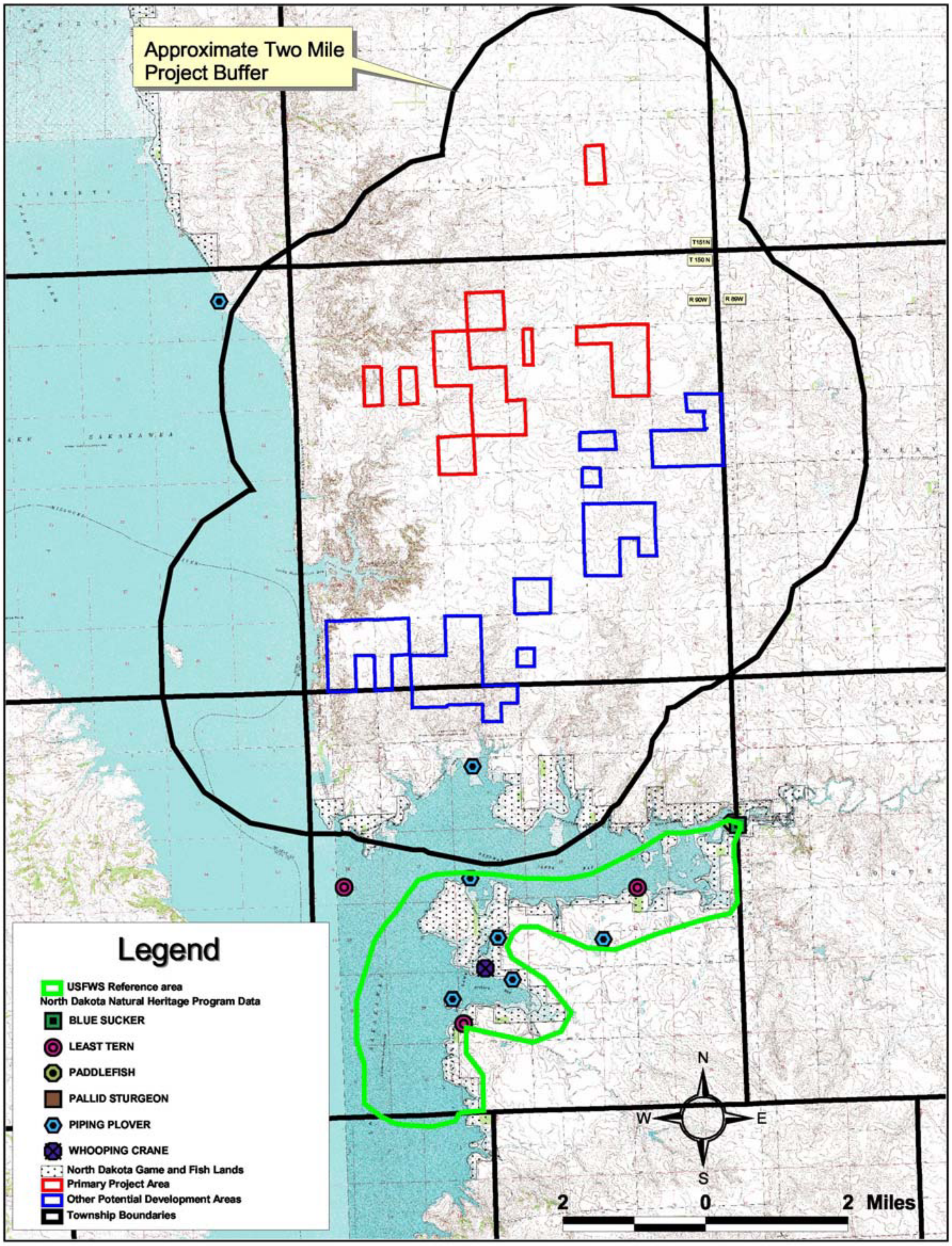


Figure 2. A USGS quad map of the project areas showing the locations of ND Natural Heritage Program records.

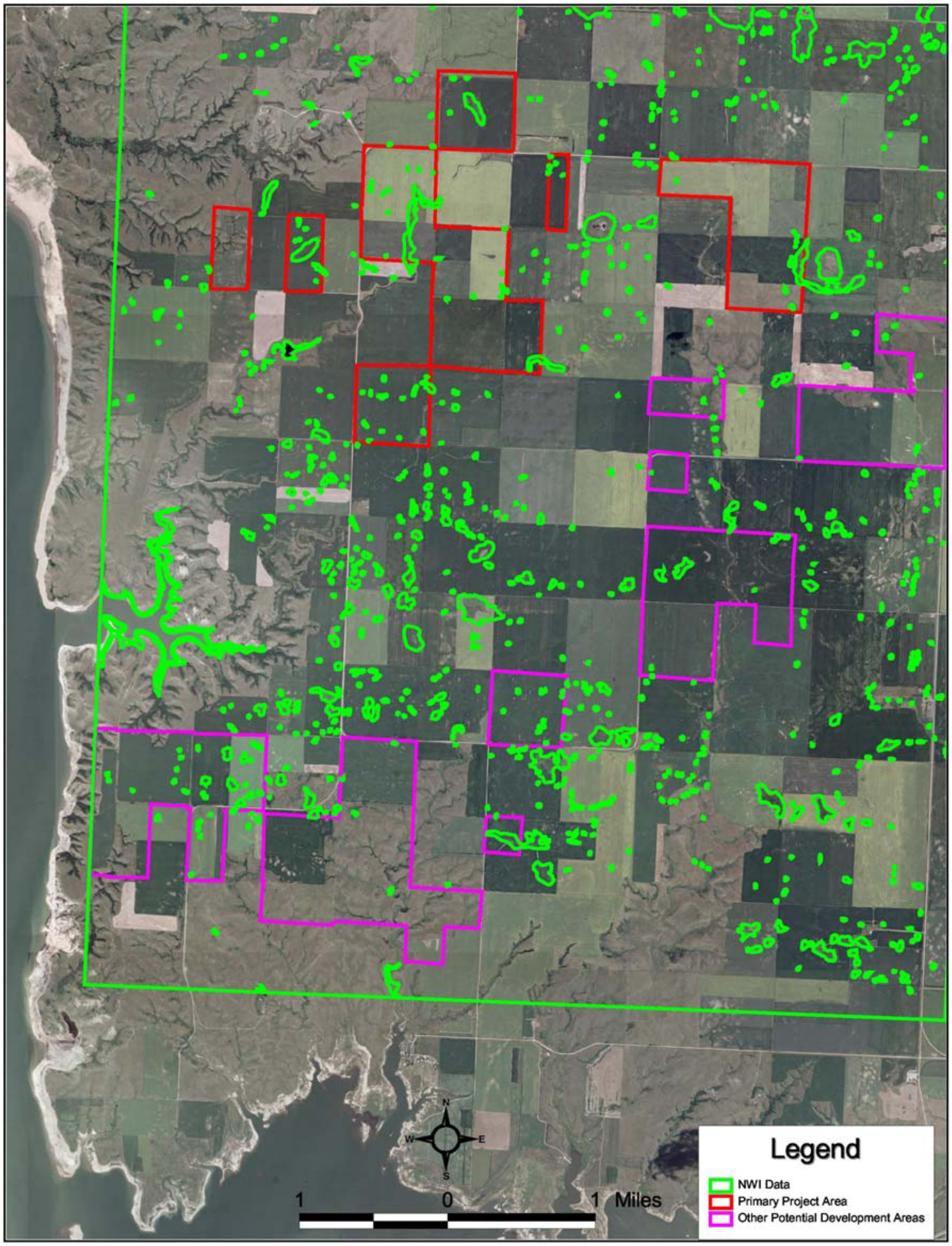


Figure 3. An aerial photo of the project areas showing NWI wetland locations.

Table 2. A summary of the potential for wildlife conflicts in the proposed wind development area[1]. VH = Very High, H = High, M = Medium, and L = Low.

Issue	VH	H	M	L	Notes
Potential for raptor nest sites				✓	A few shelterbelts are present in the project areas. More potential nesting habitat present near Lake Sakakawea.
Raptor flight potential				✓	The general lack of stark topography decreases the potential for concentrated raptor use.
Potential for migratory pathway		✓			Due to the proximity to the Missouri River, migrating birds may be more likely to fly through the project area.
Potential for raptor prey species				✓	Virtually the entire project area is tilled and no signs of colonial rodents were observed.
Potential for protected species to occur			✓		Areas close to Lake Sakakawea have a greater chance for Endangered Species Occurrence.
Potential for State issues				✓	The NDGFP primary concern was impacts to native grasslands, which are rare in the project area.
Uniqueness of habitat at wind plant				✓	Habitat in the project area is not unique to the surrounding landscape.
Potential for rare plants to occur				✓	The lack of native habitat limits the potential for rare plants to occur on the site. Potential highest in those few areas of native habitat.
Potential for use by bats			✓		Difficult to evaluate. Some level of use by migratory and resident bats is expected, but no topography is present that should funnel migrating bats.
Other issues				✓	The project area lacks discernible topography and native habitat.

[1] Summarized for the project area as a whole but the habitat of the project area varies throughout in its ability to support species of concern.

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Appendix A – USFWS and NDGF Correspondence

United States Department of the Interior

FISH AND WILDLIFE SERVICE
Ecological Services
3425 Miriam Avenue
Bismarck, North Dakota 58501

AUG 23 2004

Mr. Rhett E. Good
West, Inc.
2003 Central Avenue
Cheyenne, Wyoming 82001

Dear Mr. Good:

This letter is in response to your August 5, 2004, request for a current list of threatened, endangered, and candidate species on the Ft. Berthold Indian Reservation in McLean County, North Dakota. A list of federally endangered, threatened, and candidate species and designated critical habitat that may be present within the proposed wind development area is enclosed. This list fulfills requirements of the U.S. Fish and Wildlife Service under Section 7 of the Endangered Species Act.

If a Federal agency authorizes, funds, or carries out a proposed action, the responsible Federal agency, or its delegated agent, is required to evaluate whether the action "may affect" listed species. If the Federal agency determines the action "may affect" listed species then the responsible Federal agency shall request formal section 7 consultation with this office. If the evaluation shows a "no effect" determination on listed species, further consultation is not necessary. If a private entity receives Federal funding for a construction project, or if any Federal permit is required, the Federal agency may designate the fund recipient or permittee as its agent for purposes of section 7 consultation.

If you require further information, please contact Terry Ellsworth of my staff at (701) 250-4481, or at the letterhead address above.

Sincerely,

Jeffrey K. Towner
Field Supervisor
North Dakota Field Office

AUG 27 2004

Enclosure

cc: NEPA Coordinator, Denver (MAIL STOP 60120)

FEDERAL THREATENED AND ENDANGERED SPECIES AND DESIGNATED CRITICAL HABITAT FOUND IN MCLEAN COUNTY, NORTH DAKOTA

ENDANGERED SPECIES

Birds

Interior least tern (Sterna antillarum): Nests along midstream sandbars of the Missouri and Yellowstone Rivers.

Whooping crane (Grus Americana): Migrates through west and central counties during spring and fall. Prefers to roost on wetlands and stockdams with good visibility. Young adult summered in North Dakota in 1989, 1990, and 1993. Total population 140-150 birds.

Fish

Pallid sturgeon (Scaphirhynchus albus): Known only from the Missouri and Yellowstone Rivers. No reproduction has been documented in 15 years.

THREATENED SPECIES

Birds

Bald eagle (Haliaeetus leucocephalus): Migrates spring and fall statewide but primarily along the major river courses. It concentrates along the Missouri River during winter and is known to nest in the floodplain forest.

Piping plover (Charadrius melodus): Nests on midstream sandbars of the Missouri and Yellowstone Rivers and along shorelines of saline wetlands. More nest in North Dakota than any other state.

DESIGNATED CRITICAL HABITAT

Birds

Piping Plover - Lake Sakakawea - Critical habitat includes sparsely vegetated shoreline beaches, peninsulas, islands composed of sand, gravel, or shale, and their interface with the water bodies.

"VARIETY IN HUNTING AND FISHING"

NORTH DAKOTA GAME AND FISH DEPARTMENT

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

SEP 3 2004

August 31, 2004

Rhett E. Good
WEST, Inc.
2003 Central Avenue
Cheyenne, WY 82001

Dear Mr. Good:

RE: Potential Windpower Project on the Fort Berthold Indian Reservation, North Dakota

The North Dakota Game and Fish Department has reviewed the proposed project area for wildlife concerns. We do not own any lands within the project area, but do manage the Deepwater Creek Wildlife Management Area which borders this project to the south and west.

Our primary concern is the disturbance of native prairie and subsequent impacts to the species which depend on this diminishing resource. As there is limited research available concerning these possible adverse affects we have little to offer in regards to minimizing them. However, we appreciate being contacted early in the development process and ask that we be updated as the project develops.

Sincerely,

Michael G. McKenna
Chief
Conservation & Communication Division

js

APPENDIX B

POTENTIAL IMPACT INDEX CHECKLISTS

PHYSICAL ATTRIBUTE CHECKLIST

Physical Attribute				Site: Ft Berthold	Site: Lake Sakakawea	Site	Site
Topography	Mountain Aspect*	Side	W				
Topography	Mountain Aspect*	Side	E				
Topography	Mountain Aspect*	Side	N				
Topography	Mountain Aspect*	Side	S				
Topography	Mountain Aspect*	Top		X			
Topography	Mountain Aspect*	Foothill	W				
Topography	Mountain Aspect*	Foothill	E				
Topography	Mountain Aspect*	Foothill	N				
Topography	Mountain Aspect*	Foothill	S				
Topography	Valley*				X		
Topography	Pass*						
Topography	Gap*						
Topography	Ridge*						
Topography	Bluff*						
Topography	Butte*						
Wind* Direction	S						
Wind* Direction	N						
Wind* Direction	E						
Wind* Direction	W			X	X		
Wind* Direction	Updrafts*				X		
Migratory* Corridor Potential	Latitudinal (N S)			X	X		
Migratory* Corridor Potential	Longitudinal (E W)						
Migratory* Corridor Potential	Wide Approaches (>30 km)*						
Migratory* Corridor Potential	Funnel Effect*	Horizontal			X		
Migratory* Corridor Potential	Funnel Effect*	Vertical			X		
Site Size (acres) & Configuration*	<640			X	X		
Site Size (acres) & Configuration*	>640 <1000			X	X		
Site Size (acres) & Configuration*	>1000 <1500			X	X		
Site Size (acres) & Configuration*	Turbine Rows not Parallel to Migration						
Infrastructure To Build	Transmission			X	X		
Infrastructure To Build	Roads			X	X		
Infrastructure To Build	Buildings*	Storage		X	X		
Infrastructure To Build	Buildings*	Maintenance		X	X		
Infrastructure To Build	Buildings*	Daily Activity		X	X		
Infrastructure To Build	Substation			X	X		
Increased Activity*				X	X		
			Totals	13	16		

PHYSICAL ATTRIBUTE CRITERIA - 36 categories, max = 36.

Topography - Terrain characteristic within the ecological influence of the proposed wind farm, generally, but not restricted to ± 8 km.

Mountain Aspect - Aspect of topography for site of proposed development. Multiple categories may be checked.

Valley Pass Gap Ridge Bluff Butte

Wind Direction - Compass direction *from* which prevailing winds approach. Multiple categories may be checked.

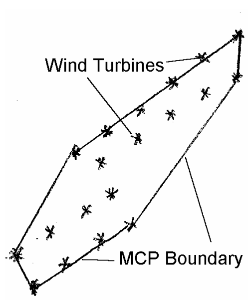
Updrafts - Do updrafts/upslope winds prevail?

Migratory Corridor Potential - Subjective estimate of area to be a potential avian/bat migratory corridor based strictly on topographical characteristics. Multiple categories may be checked.

Wide (>30 km) - Terrain characteristics of approaches to site from each migratory direction, i.e., a large plain, river corridor, long valley. The larger the area that migrant birds/bats are drawn from, the more may be at risk

Funnel Effect - Is the site in or near an area where migrant birds/bats may be funneled (concentrated) into a smaller area, either altitudinally, laterally, or both?

Site Size & Configuration – Size is estimated as if a minimum convex polygon (MCP) were drawn around peripheral turbines.



Successive boxes are checked to convey relationship of larger size = increased impact to birds/bats, *e.g.*, a 700 acre site will have 2 categories checked while a 1200 acre site will have all 3 categories checked.

Configuration of turbine rows is usually perpendicular to prevailing wind direction. Rows aligned perpendicular or oblique to route of migration intuitively presents more risk to birds than rows aligned parallel to movement.

Buildings – Building are categorized by relative size and visitation frequency, *i.e.,* structures that are visited daily are usually larger and present more impact than those that are not. If a "Daily Activity" building is required, all Building categories are checked. If a maintenance structure is required, Storage is also checked.

Increased Activity - Will any type of human activity increase? Sites in urban-suburban or otherwise developed areas (oil, gas, mines) will have less impact on vertebrate wildlife than those in remote or undeveloped areas.

Avian Species of Special Concern Checklist
(Complete prior to SPECIES OCCURRENCE & STATUS CHECKLIST)

	Site											
Birds (*n* = 29)	Ft Berthold			Lake Sakakawea								
Occurrence[1]	**B**	**M/W**	**d**	**B**	**M/W**	**d**	**B**	**M/W**	**d**	**B**	**M/W**	**d**
American Bittern				X	X	2						
Northern Harrier	X	X	2	X	X	2						
Swainson's Hawk	X	X	2	X	X	2						
Ferruginous Hawk												
Peregrine Falcon					X	1						
Yellow Rail												
Solitary Sandpiper					X	1						
Willet				X	X	2						
Upland Sandpiper				X	X	2						
Long-billed Curlew				X	X	2						
Hudsonian Godwit					X	1						
Marbled Godwit	X	X	2	X	X	2						
Sanderling					X	1						
White-rumped Sandpiper					X	1						
Buff-breasted Sandpiper					X	1						
Wilson's Phalarope				X	X	2						
Black-billed Cuckoo												
Burrowing Owl				X	X	2						
Short-eared Owl				X	X	2						
Red-headed Woodpecker	X	X	2	X	X	2						
Loggerhead Shrike												
Sprague's Pipit												
Grasshopper Sparrow	X	X	2	X	X	2						
Baird's Sparrow				X	X	2						
Henslow's Sparrow												
Le Conte's Sparrow												
Nelson's Sharp-tailed Sparrow												
McCown's Longspur												
Chestnut-collared Longspur		X	1	X	X	2						
Subtotals	5	6	11	14	20	34						
Total			11			34						

Avian Species of Special Concern Checklist (29 species, max = 58)

Column totals of this list are added to appropriate cells in the SPECIES OCCURRENCE & STATUS CHECKLIST. Appropriate avian field guides and species accounts should be consulted for confirmation of species distribution and habitat associations.

In addition to species lists (rows), season of occurrence is also indicated (columns). “B” indicates breeding or summer occurrence and “M/W” indicates presence during migration or as wintering species. The USFWS guidelines for windpower development suggests that if occurrence within or in the vicinity (7 km) of a proposed site is confirmed or suspected, an “X” is entered. However, due to sharp differences in habitat and topography within 7 km of the proposed project, and X was only entered if it was likely the species would occur or fly through the project area based on topography and habitat features.

NOTE: These species were selected because they are listed as Birds of Conservation concern by the USFWS (2002) within BCR 11 (Prairie Potholes–U.S. portion only). Determinations of occurrence were based on the geographical location of the project area, habitat and Stewart (1975).

Bat Species Of Special Concern Checklist

(Complete prior to SPECIES OCCURRENCE & STATUS CHECKLIST)

	Site											
Bats (*n* = 4)	Ft. Berthold			Lake Sakakawea								
Occurrence	**B**	**M/W**		**dB**	**M/W**		**dB**	**M/W**		**dB**	**M/W**	d
Long-eared Myotis												
Big-eared Bat												
Long-legged Myotis												
Small-footed Myotis												
Subtotals	0	0	0	0	0	0						
Total			0			0						

Bat Species Of Special Concern Checklist (4 species, max = 8).

Column totals of this list are added to appropriate cells in the SPECIES OCCURRENCE & STATUS CHECKLIST. Appropriate bat field guides and references should be consulted for confirmation of species distribution and habitat associations.

In addition to species lists (rows), season of occurrence is also indicated (columns). "B" indicates breeding or summer occurrence and "M/W" indicates presence during migration or as wintering species. If occurrence within or in the vicinity (7 km) of a proposed site is confirmed or suspected, an "X" is entered.

NOTE: The Four bat species on this list were included because they are were formerly candidates for listing under the Federal Endangered Species Act in North Dakota (USFWS 1995).

SPECIES OCCURRENCE & STATUS CHECKLIST

		Site											
	Species	Ft. Berthold			Lake Sakakawea								
	Occurrence	**B**	**M/W**	d	**B**	**M/W**	d	**B**	**M/W**	d	**B**	**M/W**	d
Threatened & Endangered	Interior Least Tern				X	X	2						
	Whooping Crane												
	Pallid Sturgeon				X	X	2						
	Bald Eagle				X	X	2						
	Piping Plover				X	X	2						
Candidate*													
Special Concern*	Birds (max =58)	5	6	11	14	20	34						
	Bats (max =8)	0	0	0	0	0	0						
Bats*		0	0	0	0	0	0						
	Subtotals	5	6	11	18	24	42						
	Total			11			42						

SPECIES OCCURRENCE & STATUS CHECKLIST (39 categories, max = 78)

Checklist totals for each column in "Avian Species of Special Concern List" and "Bat Species of Special Concern List are inserted in this checklist.

Threatened & Endangered Species - Species include in the Federal List of Endangered and Threatened Species (see attached letter).

Candidate Species - Species being investigated for inclusion in the Federal List of Endangered and Threatened Species. None were described by the USFWS.

Species of Special Concern – Birds of Conservation Concern (USFWS 2002) within BCR 11 were used to generate this list.

Bats (other than bat Species of Special Concern) are included due to generally unknown impacts of wind farms on individual and populations.

ECOLOGICAL ATTRACTIVENESS CHECKLIST

Ecological Attractor			Site: Ft Berthold	Site: Lake Sakakawea		
Migration Route*	Local					
	Continental*	N	x	x		
		S	x	x		
		E				
		W				
Ecological Magnets*	Lotic System					
	Lentic System			x		
	Wetlands			x		
	Native Grassland			x		
	Forest					
	Food Concentrated			x		
	Energetic Foraging			x		
	Vegetation/ Habitat	Unique		x		
		Diverse		x		
Significant Ecological Event*				x		
Site of Special Conservation Status*				x		
Total			2	12		

ECOLOGICAL ATTRACTIVENESS CRITERIA - 16 categories, max = 17.

Migration Route - Indicates predominate direction of movement of seasonal migrations. Multiple categories may be checked.

Local - Some avian populations move only altitudinally & direction may be East-West (sage grouse, owls, bald eagles).

Continental - Some migratory corridors experience mass movements in only one season/direction annually (*e.g*., Bridger Mountains autumn eagle migration).

Ecological Magnets - Special, unique, unusual, or super ordinary habitats or conditions within the vicinity of the site that may attract vertebrate wildlife. Lotic systems include small perennial or seasonal creeks to major rivers. Lentic systems include stock ponds to lakes. Multiple categories may be checked.

Vegetation/Habitat - Unique or exceptionally diverse vegetation or habitat in the vicinity may indicate exceptional diversity and abundance of avian species or bats.

Significant Ecological Event - Special, unique, unusual, or super ordinary events that occur or are suspected to occur in the vicinity of the site, *e.g*., up to one third of the Continental population of Trumpeter Swans visit Ennis Lake, < 4 km from a proposed Wind Resource Area; the Continental migration of shorebirds passes over (many stop) @ Benton Lake National Wildlife Refuge) and up to 2000 golden eagles pass over the Bridger Mountains in autumn. If unknown but suspected a "?" is entered. Specifics regarding the cell are then addressed in the appropriate box of the SITE SPECIFIC COMMENTS sheet to focus follow-up investigation and assist in definition of study objectives.

Site of Special Conservation Status - Any existing or proposed covenants, conservation easements, or other land development limitations intended to conserve, protect, or enhance wildlife or habitat. This criterion is weighted (2 entered if true) because of previous financial or other investment in ecological values. Specifics regarding the easement are then addressed in the appropriate box of the SITE SPECIFIC COMMENTS sheet to focus follow-up attention.

POTENTIAL IMPACT INDEX

	Site							
	Ft Berthold		Lake Sakakawea					
Checklist (*p*)[1]	d	/*p*d	d	/*p*d	d	/*p*d	d	/*p*d
Physical (36 boxes = 36/131 = 0.28)	13	46	16	57				
Species Occurrence & Status (78 boxes = 78 / 131 = 0.59)	11	19	42	101				
Ecological (17 boxes = 17 / 131 = 0.13)	2	15	12	92				
Totals		80		250				

[1]Proportion of total (131) checklist scores.

SITE SPECIFIC COMMENTS

Checklist	Site: Ft. Berthold	Site: Lake Sakakawea
Physical	Relatively Flat with no Topography	Dissected Topography present on bluffs
	Although migration occurs through project area, not likely to be funneled due to lack of topography and habitat	Location adjacent to Missouri River Likely funnels migrants
Species Occurrence	Lack of native habitat precludes most species occurrence	Several federally protected species present
Ecological	Lack of topography and native habitat	Missouri River is a migration route for many species
		The presence of the Missouri River and Lake Sakakawea provides an ecological magnet

Tribal Renewable Energy Final Technical Report

Tab 4

Cultural Assessment

Project Title: Three Affiliated Tribes Renewable Energy Feasibility Study

Date of Report: May 24, 2006

Recipient Organization: Three Affiliated Tribes of the Ft. Berthold Reservation

Award Number: DE-FG36-04GO14021

Partners: Three Affiliated Tribes of the Fort Berthold Reservation
Distributed Generation Systems, Inc. (cost sharing partner)

Distributed Generation Services, Inc
(DISGEN)
Wind Generation Project
(Primary and Secondary Study Areas)

Class I Cultural Resource Records and Literature Survey
Ft Berthold Indian Reservation, North Dakota
(Mandan, Hidatsa, Arikara Nation)
McLean County, North Dakota

prepared for
Distributed Generation Systems, Inc.
"DISGEN"

prepared by
Kent N. Good
Kent Good and Associates

January, 2006

Introduction:

Distributed Generation Systems, Inc. (DISGEN) contracted with Kent N. Good of Kent Good and Associates to complete a Class I – Cultural Resource Records and Literature Survey. Kent Good and Associates completed a records and literature search at the State Historical Society of North Dakota where records and files are located with regard to location and information of cultural resources in North Dakota. Also, the Cultural Resource office, under the direction of Mr. Elgin Crowsbreast was contacted. Mr. Crowsbreast provided consultation services with elders and traditional practitioners. Mr. Crowsbreast provided an e-mail discussing the conversation he had with tribal elders and his recommendations regarding additional cultural resource survey.

Over 4000 acres were considered for the Class 1 study, 1560 acres for the Primary study area and 2760 for the Secondary study area. Areas were located on a general USGS Map, Parshal SW Quad, 1:24000 scale.

Primary Area
T151N – R90W

E½ of the SW¼, Sec. 26

T150 – R90W

NW¼ and the W½ of the SE¼, Sec. 3

SE¼, Sec 4

W½ of the SW¼ and the W½ of the SE¼, Sec. 8

NW¼ and the N½ of the SW¼ and the SE¼, Sec. 9

W½ of the E½ of the NW¼, Sec. 10

E½, Sec. 11

W½ of the NW¼, Sec. 15

NE¼ and the SW¼, Sec. 16

Secondary Area
T150N – R90W (cont)

SE¼ and the SW¼ and the N½ of the NE¼ and the E½ of the NE¼, Sec. 13

N½ of the SW¼, Sec. 14

SW¼ and the SE¼ and the NW¼ of the NW½, Sec. 23

NW¼ and the NE¼ of the NE¼, Sec. 26

SW¼, Sec. 27

W½, Sec. 31

NW¼ and the W½ of the SW¼ and the SE¼, Sec. 32

W½, Sec. 33

NW¼ of the SW¼, Sec. 34

T149N – R90W

N½ of the NE¼, Sec. 5

N½ of the NE¼ and the W½ of the NE¼ and the N½ of the NW¼, Sec. 4

File and Records Search Results:

Since the State Historical Society of North Dakota (SHSND) is the prime repository for files and records in the State of North Dakota regarding cultural resources, the majority of time was spent at its archives. Thirteen manuscripts matching legal locations for the Primary and Secondary study areas are on file at the Historical Society. I believe these represents the most complete information concerning the study areas. Table 1 includes the manuscript number, the completion date, author and the title of the survey/report. As one can see, the earliest survey was 1953 and the most resent was completed in 1996. It should be noted that any survey completed more than 12 years ago, is considered invalid by the State Historic Preservation office. Thus, any survey completed prior to 1994 would need to be re-evaluated. All but two surveys listed on Table 1 could be considered invalid. However, the information contained in the reports does give one an indication of the kinds and numbers of resources in the area. None of the surveys are of great consequence when considering the amount of acres surveyed as most covered a small area.

Thirteen cultural resource sites or cultural resource site leads are on file at the SHSND. Table 2, includes the sites or site leads listed by number, followed by legal location, site type, and site description. Any number containing an "x" indicates a site lead. The number containing the "x" indicates the site may not be located exactly or cultural material may not be the kind or in an amount great enough to consider it a site. The "x" implies that further work may be justified. Five site leads are listed on the table.

Three sites or site leads listed on Table 2 are historic and consist of a recent trash dump, three standing structures and one of household scatter. The only site contain standing structures (32ML331) could be of concern if it is impacted. Ten sites or site leads are archeological and prehistoric in nature. These sites consist of stone features, lithic cultural material scatters, and an eagle trapping depression. All of these sites could be considered important and may require further investigation if they were to be impacted by the wind generating project.

Site Delineation and Map Organization:

Appendix A includes portions of the Parshal SW, USGS maps delineating the location of the Primary and Secondary Project areas. Maps 1 through 3 are of the Primary study area. Aerial photographs of the same area follow the USGS maps. Any cultural site is located on the USGS map by number and is also located, more precisely, on the aerial photograph. Site location on the USGS maps are indicated by a red dot with appropriate site number (example: 32ML289). Site locations on aerial photographs are marked in white along with the last part of the trinomial number system. This number is hand-written on the aerial photographs (example: ML331 or x632). A blank aerial, devoid of cultural site information, but including project legal locations has been included for convenience. Similarly, the Secondary study

TABLE 1

Records Search Information

MS #	Year	Author(s)	Title
4881	1989	Burbidge & Borchert	Sherwood Shoreline Survey Sies Pro Line 305, McLean Co., ND.
5040	1989	Melton	Low Rent Rendezvous: A CRI of 67 Mutual Self-Help Homesites, Ft Berthold Agency, Dunn, McKenzie, McLean, Mercer and Mountrail Counties, North Dakota.
4487	1987	Banks	A CRI of Proposed Farm Breakout on the Ida Beston Allotment, Ft Berthold Agency, McLean County, North Dakota.
112	1953	Metcalf, G. and White	Appraisal of the Archaeological and Paleontological Resources of the Garrison Reservoir, North Dakota, Supplement.
80	1975	Adamczyk	Archaeological Inventory Missouri River Reach Between Fort Benton, Montana and Sioux City, Iowa.
6679	1996	Stine	Spotted Bear Pad #5-11, A Class III CRI, McLean County, ND.
6674	1996	Stine	Rabbit Head 2-15 and Hall 12-23 Well Pads, A Class III CRI, McLean County, ND.
6130	1993	Light	Class III CRI of Duncan Energy Co. Mollie #1 Well, Tank Battery, and Access Road, McLean County, ND.
5345	1991	Borchert	Reliable Exploration CRI of Portions of Seismic Lines for the Coastal Oil Cremerville and Deepwater Creek Prospects, McLean County, ND, UW#1404.
5706	1991	Lueck, Lippincott, Winham, Hannus, Breakenridge, Hughes, Ruple, Sussman	CR Reconnaissance of US Army Corps of Engineers Land Alongside Lake Sakakawea and Audubon Lake in McLean County, ND, Vol 1 & 2.
4650	1988	Banks	Let Their Be Light: A CRI of the Proposed Brochlin Utility Line, Ft Berthold Agency, McLean County, ND.
4539	1988	Banks	A CRI of Four Cluster Low-Rent and Five Prototype Scattered Mutual Self-Help Homesites, Ft Berthold Agnecy, Dunn, McKenzie, McLean, and Mountrail Counties, ND.
3973	1985	Gnabasik	Deep Water Creek Cabin Site Area, CR Survey, Garrison Dam/Lake Sakakawea Project, McLean County, ND.

TABLE 2

Site Number	Legal	¼ ¼ ¼	Type	Description
32ML289	150-90-11	SESWSE	Archaeological	Stone circle, crockery sherds, abrading stone, disturbed by 2-track
32MLx632	150-90-15	NWNENE	Archaeological	Isolate – 2 flakes
32ML326	150-90-33 149-90-04	SESWSE, NENWNE	Archaeological	3 stone circles
32ML715	149-90-04	NENESW	Archaeological	Cairn, hammerstone
32ML716	149-90-04	SSENW	Archaeological	4 stone features
32MLx240	149-90-04	NWNENE	Historical	Historic household trash scatter
32ML884	150-90-23	NENWNW	Archaeological	Lithic scatter
32MLx631	150-90-23	SWNWNW	Archaeological	Isolate – 3 flakes
32ML687	150-90-31	ENWSW	Archaeological	Eagle trapping depression
32MLx446	150-90-31	NENWSW	Archaeological	Isolate – 1 flake
32MLx531	150-90-31	WNESW	Historical	Recent trash dump
32ML331	150-90-32	NSENE	Hist/Architec	3 structures (well, cabin, & cm)
32ML327	150-90-33	SESESW	Archaeological	Cairn

area section of the report contains USGS maps and aerial photographs. These maps are designated Maps 4 and 5. Map 5 has two extra aerial views so that the all legal locations fit a standard 8½ X 11 inch page.

Elder Consultation:

Mr. Elgin Crowsbreast, Cultural Resource Program Director for the Mandan, Hidatsa, and Arikara Nation, interviewed elders and traditionalist from the Ft. Berthold reservation. It does not appear that Mr. Crowsbreast found anyone that had knowledge of anything in the area that had ceremonial [spiritual] use with regard to the study areas. As the project develops and the focus is on a smaller area, spiritual or sacred concerns may surface. However, for this Class I study, DISGEN has fulfilled its obligation for consultation. It is advised, however, that consultation be continued through out the duration of the project. A copy of the email and a copy of the paragraph written by Mr. Crowsbreast is included as Appendix B of this report.

Past Use of the Study Area:

McLean County, in which the wind generating project is located, is part of the Prehistoric, East-Central study area as identified by the State Historical Society of North Dakota – State Historic Preservation Office. The largest number of recorded sites is in this county probably because it contains the Missouri River. At least 150 sites are recorded in McLean County representing at least 20 types and three cultural/temporal groups. Stone rings sites are the most common site type in the county. Cultural material scatters are the next most common followed by earthlodge village, graves, hearths, and other rock features. Other recorded site types include possible earthlodge villages, possible earthworks, bison jumps, mounds, rock art, and miscellaneous. Assignable temporal and cultural affiliations are limited to 41 historic, two Euro-American, and one late Prehistoric. The earthlodge villages and mounds probably represent Plains Village and Woodland occupations, respectively.

Fort Berthold Reservation (Land)

The Fort Berthold Service Unit is located in west central North Dakota and covers approximately 12,284 square miles in 6 counties: McLean, Mercer, Dunn, Mountrail, McKenzie, and Ward. The Missouri River traverses the middle of the reservation and divides the reservation into three separate areas. The total land area of the reservation is 988,000 acres with 457,837 acres in tribal and individual Indian ownership. The land is an integral part of our culture and the economic base of the reservation.The western and southern areas of the reservation are predominately rolling prairie grasslands, occasionally broken by buttes. Erosive effects of the Missouri and Little Missouri Rivers are evident in the scenic Badlands that impinge on the western and southern segments of the reservation. The northern and eastern areas of the reservation are desirable fertile farm land. The Missouri River, flowing through the heartland of the area, is backed up by the Garrison Dam at Riverdale, ND creating Lake Sakakawea. The area's prime bottom lands and timber have been flooded by the lake, which is a prime recreational site containing over 600 miles of shoreline in North Dakota.

Fort Berthold Reservation (History)

The Fort Berthold reservation is home to three Tribes: the Mandan, Hidatsa, and Arikara. The Hidatsa and Mandan lived permanently in the present area since 1845. Prior to 1845, they lived in villages at the mouth of the Knife River. After their move to this area, they helped build and eventually settled around a fur trading post for the American Fur Company. The post was built on a bend of the Missouri called by the Tribes "Like-a-Fishook-Village." The Arikara later moved up the river and joined with Mandan and Hidatsa Tribes around 1862.The original reservation was established for the three Tribes by the Fort Laramie Treaty of 1851. A large tract of land was ceded by the Fort Berthold Agreement of 1866. In 1868 an Executive Order reduced the reservation by 98,645 acres. In 1870 an investigation showed that the Fort Laramie Treaty had never been ratified by Congress, therefore, no reservation existed for the three Tribes. An Executive Order of April 12, 1870, established a reservation that was much smaller than the area described in the Fort Laramie Treaty. In July 13, 1880, an Executive Order took that portion of the reservation required to fulfill a grant made by Congress to the Northern Pacific Railway. Additional acres and cedings brought the reservation down to about 1,000,000 acres and the external boundaries now recognized.On July 31, 1947, the history of the reservation was dramatically changed. Federal legislation was enacted that provided for the taking of reservation lands for the Garrison Reservoir. Thirty miles downstream from New Town, North Dakota is the Garrison Dam. Begun in 1946 and completed in 1956, the dam inundated 155,000 acres of prime agricultural land of the reservation. Not only did this federal project take many acres, it also disrupted tribal social and economic patterns. The reservoir, now known as Lake Sakakawea, divided the reservation into five segments now identified as districts. Communication between these segments is difficult because only one bridge at the northern end of the reservation crosses the lake. Central transportation is nonexistent. To reach the southern segment, one must travel over 100 miles around the lake. The overall infrastructure that was to replace the old fell short of tribal expectations and federal-tribal agreements.

The Allotment Act of 1888 allotted Indian lands into 160-acre lots to adult male heads of household and 80 acre lots to adult males to further divide the nation. The Act and subsequent foreclosures due to illegal taxation and land sales and numerous Homestead Acts have further reduced individual and tribal land holdings on the reservation today to about one-half their original size prior to 1880.

Recommendations:

Both the Primary and Secondary Study Areas have medium to high potential to contain important cultural resources. Past surveys, although small in size, located a variety of cultural sites in both the primary and secondary study area. The primary area is smaller in size and contains fewer cultural sites than does the secondary study area. The secondary area also tends to be closer to the Missouri river and holds a greater potential for cultural remains. Which ever area is selected, both need to be pedestrian surveyed. Block survey, although more expensive initially, is a better planning tool than spot surveys. If wind generators need to be aligned in a particular manner, surveying their individual location might clear one location, while another could contain important resources. If particular alignment is not critical this may not be a critical consideration.

Mr. Crowsbreast indicated, "because of such a large area that DISGEN is researching, a closer look at the area for each wind turbine, when selected, would need to be surveyed more. This would be to insure the best possible site that would reflect avoidance of Cultural Resources in the project area when the project begins in the future." Mr. Crowsbreast is suggesting individual turbine site survey. Again, this might be the most economical method initially, however, if site are discovered and locations for the turbines need to be changed after the fact, then cost in both time and money could exceed that expended during a block type survey.

Tribal Renewable Energy
Final Technical Report

Tab 5

Transmission Review and Market Study

Project Title: Three Affiliated Tribes Renewable Energy Feasibility Study

Date of Report: May 24, 2006

Recipient Organization: Three Affiliated Tribes of the Ft. Berthold Reservation

Award Number: DE-FG36-04GO14021

Partners: Three Affiliated Tribes of the Fort Berthold Reservation
Distributed Generation Systems, Inc. (cost sharing partner)

TRANSMISSION ASSESSMENT

for

THE MANDAN, HIDATSA, ARIKARA NATION,
THE THREE AFFILIATED TRIBES OF NORTH DAKOTA

submitted on

17 January, 2005

by

Distributed Generation Systems, Inc. (Disgen)
Author: Krista Jo Gordon, Manager of Engineering

Table of Contents

Introduction

In July, 2004 Distributed Generation Systems, Inc. (Disgen) signed an Energy Services Contract with the Mandan, Hidatsa, Arikara Nations (Tribe) to explore and develop the Tribe's renewable energy resources. Shortly after, Disgen applied to the Department of Energy (DoE) for funding for the development of its renewable resources, specifically wind, hydro, biomass, and solar. A meteorological ("met") tower was installed at the selected site in October, 2004. At the time of writing, 14 months of wind data had been collected. This Transmission Assessment will discuss the distribution line that passes by the project area as well as the local transmission system required for export of power from a wind project to a buyer elsewhere.

The met tower is located approximately eight miles south of Parshall and three miles west of State Highway 37. It is on a site selected by a professional meteorologist as having good potential for a wind project. The wind turbines will be sited in close proximity to the met tower. The entire project footprint will be within the boundaries of the MHA Nation Reservation on the Mountrail – McLean County border. Lake Sakakawea is approximately four miles west and seven miles south of the met tower. The Tribe's DOE funding was for the development of a 30MW wind project, though there is enough land to support a much larger project. For purposes of this report, 30MW will be considered the project size. A description of the project area has been included in Appendix 1.

The nature of the wind resource will not be addressed in this Assessment since Disgen was contracted to perform this Transmission Assessment regardless of the economic viability of a wind power project.

Transmission System

The Tribe has designated 30MW as the project size. This report will explore the feasibility of interconnecting 30MW in two different ways. Both thermal limits and voltage drops will be considered in this report to determine if upgrades are necessary to accommodate 30MW and their extent if they are necessary. There are many factors that determine the feasibility of interconnecting a new generator to an existing transmission system. Chief among these are equipment voltages, size ratings, other regional loads and generators, transfer capability from one region to another, and market. All of these will be discussed herein. However, it is worth noting that this report is *not* an official interconnection study since it has not been written or reviewed by any transmission agency, although it was written with input and interviews with relevant regional utilities.

From Disgen's conversations with Mountrail-Williams Electric Cooperative (MWEC) Disgen has learned that there are multiple conductor sizes in the Parshall area. One of them is 1/0 ("one aught"), one is #2, and the last is #4. (1/0 is largest and #4 is the smallest.) All of them are Aluminum Conductor Steel Reinforced (ACSR). The current-carrying capacity of conductors is measured in terms of ampacity. The ampacity of 1/0 line is 200 Amperes ("Amps"), #2 line is 150 Amps, and #4 line is 115 Amps. (Maps of the electric power system in the Parshall area and a one-line drawing of the Parshall Substation have been included in Appendix 2.) The south and west distribution lines are #4, the east distribution line is 1/0, and the north distribution line is #2. The line-to-line voltage of the line going south out of the Parshall Substation is 12.47kV. Transmission goes north out of the Substation to Finstead Corner at 69kV on 1/0 line and distribution goes out in all four cardinal directions. The south feeder is one of these distribution lines and is configured in a wye connection. The 69kV line going north is configured in a delta connection. The south feeder connects to the 69kV line by way of a transformer rated at 25MVA with 6.72% impedance. Both the 69kV transmission line and the south feeder are pole-mounted.

There are ten line miles between the Parshall Substation and the point where the south feeder crosses the Mountrail County – McLean County line. There may be a short (1 – 3 mile) feeder to connect the wind project to the south feeder, but for purposes of this report ten miles will be used as the circuit distance.

If normal atmospheric conditions are assumed for the project, and no conductor replacements or voltage increases take place then the south feeder will have a thermal limit of less than 3MW. Therefore, the project must decide whether to provide substantial upgrades to this line or build a dedicated feeder to the Parshall Substation to interconnect.

There are currently at least twenty-one taps on the south feeder between the Parshall Substation and the County Line. If modifications are made to the south feeder, those taps will be affected. If re-conductoring takes place and the conductor size increases dramatically, the structural integrity of the poles may diminish. If the south feeder is re-charged at a higher voltage, there must be added insulators and the line spacing will likely increase. Given all of these modifications, it is likely that building a dedicated feeder will be the preferable option.

Voltage drop is another consideration for the project. It is a function of conductor size, length, and current flow. The relationship is given by:

$$CMA = \frac{\sqrt{3} * K * I * L}{V_D}$$

where CMA is the conductor area in circular mils, V_D is the allowable voltage drop, K is the specific resistance of the conductor, I is the current in Amperes, and L is the length in feet. It will be assumed that both the voltage and the conductor size will increase. In this case, the nominal voltage will be 24.9kV. To calculate the required ACSR conductor size for the 30MW project:

- L = 52800 feet (10 miles)
- I = 696 Amperes
- K = 21.1 for ACSR
- V_D = 1,245 Volts (5% of 24.9kV)

The minimum required CMA is therefore 1,078,125 circular mils which corresponds to a conductor size of either 1000kcmil or 1250kcmil. Using the same method, a voltage of

41.6kV would require 645,320 circular mils (600kcmil or 750kcmil ACSR) and a voltage of 69kV would require 389,062 circular mils (350kcmil or 400kcmil ACSR). Given that it will be impossible to connect 30MW to the south feeder in its existing state and that it will be difficult to maintain reasonable voltage performance without either large conductors or a high voltage, Disgen recommends that the project build a dedicated 69kV feeder to the Parshall Substation and connect directly to the high voltage (69kV) bus there.

Another reason to build a dedicated 69kV feeder rather than improving the south feeder is that the transformer at the Parshall Substation is rated at 25MVA and would have to be replaced to accommodate a 30MW wind project.

In addition to a ten-mile 69kV feeder, the project will have to build a small substation at the project area to step the voltage up from the collection system voltage (assume 34.5kV) to 69kV. Some work may also be necessary at the high side of the Parshall Substation. The actual extend of the work at Parshall will be determined by MWEC. Using approximate figures taken from other distribution and transmission projects, Disgen estimates that the total cost of interconnection will be approximately $1.5 – 1.8 million. This assumes no network upgrades are necessary elsewhere on the transmission system. This also assumes minimal right-of-way fees for the 69kV line.

Once connected to the 69kV system, the project will have access to the Wabek and Makoti Substations to the east and the New Town Substation to the West. To the north is the change in ownership from MWEC to Montana-Dakota Utilities (MDU) near Stanley. Western Area Power Administration is accessible directly to the east or by way of McKenzie Electric Cooperative to the west. (McKenzie is another electric cooperative served by Basin.)

The City of Parshall has approximately 1000 year-round residents. There is some irrigation load in the outlying areas, but the amount depends largely on water levels in Lake Sakakawea. Over the last decade the region has seen a drought, so irrigation load has not grown. Conversations with MWEC indicate that the area may see an increase in electric load due to increased irrigation activity now that water levels are rising. However, potential increases in irrigation are unlikely to affect the overall minimum system load at Parshall. It is estimated that the minimum load is approximately 500kW, so the wind project will not be able to count on local load to consume much of the project's output locally before transferring onto the transmission system.

Transmission charges ("wheeling") are very important factors to consider in selecting an interconnection point. It can be cripplingly expensive to connect to one utility, wheel power through that utility, and then sell power to a different utility. Transmission charges vary by type of service, regional reliability council, and individual utility. The basic types of transmission service include firm point-to-point, non-firm point-to-point, and network energy service.

Since the wind project under consideration will connect to the MWEC system. Therefore, the simplest way to avoid wheeling charges would be to sell the output directly to Basin as MWEC's supplier of energy. However, if a Power Purchase Agreement (PPA) cannot be signed with Basin then the project would have to pay transmission charges to Basin in order to get the power to another transmission owner's system. As of early 2005, Basin's charge for firm point-to-point service was $1.14/kW-month. (In other words, a 30,000kW project would pay $34,200 every month of operations for a firm path from the project area into the buyer's service area.)

In addition to paying for firm point-to-point service, the project may be asked to account for Basin's real power loss rate of 1.33% to get energy from Parshall to a non-Basin power purchaser. The loss rate is uniform regardless of the actual distance traveled on Basin's system. Therefore, the project would have to adjust its net output to account for the losses in order to sell 98.7% of net output to a non-Basin purchaser.

Interconnection Procedure

Once the Tribe receives its final wind assessment report from Disgen and if it decides that it wishes to pursue a wind power project, it will be appropriate to file an Interconnection Request with Basin. A blank Interconnection Request form is included as Appendix 3. It is important to know many technical aspects of the generator(s) selected for interconnection when this form is completed.

The typical *official* study process for interconnecting a new generator to the grid is fairly standard from one utility to the next as long as they are both governed by the Federal Energy Regulatory Commission (FERC). This is a three-tiered process that ends with the Interconnection Agreement. It is separate from the process to request and obtain transmission service.

The submittal of the Interconnection Request form, along with a $10,000 deposit required by the utility, sets the interconnection study process in motion. The deposit is meant to cover any charges associated with the Feasibility Study. The purpose of the Feasibility Study is to satisfy an Interconnection Customer's curiosity about moving a project forward or not. It essentially provides a "thumbs up" or "thumbs down" on proceeding with it. The Feasibility Study typically takes 45 days.

Once the Feasibility Study is complete, the Customer (in this case the Tribe and/or its representative) meets with the utility (Transmission Service Provider or TSP) to discuss its results and make plans for the second study. This study is called the System Impact Study and it typically takes 90 days to complete. A deposit of $50,000 is required buy the utility. This study will make an in-depth examination of all power flow, short circuit, and system stability analysis. The power flow analysis covers the basic thermal results of interconnecting the new generator. An analogy might be to think of the transmission system as a network of pipes, valves, pumps, etc. As additional water is inserted into the pipe network, an examination must be conducted to ensure that the existing elements are not overstressed. A typical analysis would include "system intact" as well as "N-1" conditions. System intact means that all elements are in service and functioning properly.

N-1 means that one element is not working, so the other parts must work harder to maintain the same system performance. This one element could be any element: transmission line, transformer, circuit breaker, etc.

The purpose of the short circuit analysis is to see what happens when a fault occurs. This is different than N-1. Whereas in N-1 something is simply taken out of service, in a short circuit situation current flows where it is not supposed to go. This generally means it will either flow from one phase to another (from one wire to another) or from one or more phases to ground. This can result in severe interruption of proper flows, so care must be taken to address these potential faults. Since local faults are typically the focus of this portion of the study, and since fault current contribution varies from one generator to the next, it is important that the specific wind turbine model be chosen no later than at this stage.

The system stability analysis addresses the behavior of the wind project when there are faults on other parts of the transmission system. For example, if there is a fault on a line 200 miles away, will the wind project stay on-line or trip off-line? It will be at the discretion of the TSP to decide whether it is desirable for the project to ride through a fault or briefly go off-line.

When the System Impact Study is complete, the TSP and Customer will have another scoping meeting to review its results and prepare for the Facilities Study. This is the stage of the study process where the TSP makes estimates for the Customer as to the new or upgraded facilities required to interconnect the generator. This study also takes approximately 90 days. The estimates will include both those facilities to be provided and owned by the Customer and those to be provided and owned by the TSP. The cost estimates will be within +/- 20%. The deposit for this study is $100,000.

Following the completion of the Facilities Study, negotiations will begin on the Interconnection Agreement. If following the FERC guidelines, this is a standard form called the Large Generator Interconnection Agreement (LGIA) and can be found on most major utilities' websites.

It is important to note that the three deposits required for the three tiers of study are simply initial down payments and do not necessarily reflect actual costs. The actual costs may vary up or down depending on the size and complexity of the wind project as well as the efficiency of the utility carrying out the studies.

Markets

It is commonly beneficial to connect to the same utility that will buy the output of the project. The wind project will connect to the MWEC system. As MWEC currently buys its generation from Basin Electric Cooperative ("Basin") by way of Upper Missouri G&T (UMGT) the first option to consider for the sale of the project's output would be Basin in order to avoid wheeling charges. Basin has a program called PrairieWinds Generation under which it buys wind power on its system for $25/MWh. This price includes both the actual electricity as well as the Renewable Energy Credit (REC). The price has been adjusted more than once since the met tower was installed south of Parshall, so it is conceivable that it will change again before a power contract could be negotiated with Basin for the project. (It is worth noting that the adjustments have been increases, not decreases.)

Basin Electric utilizes approximately 136MW of wind power on its system from projects in North and South Dakota. The projects are located in Minot, Chamberlain, Rosebud, Pipestone, Kulm, Edgeley, and Highmore. Most of that total is from three projects developed by Florida Power & Light. Basin has recently become a vocal supporter of wind, so it is presumable that it will contract for more on its system over the coming years. Additionally, a large amount of the Basin region includes excellent wind sites, so it is likely that they will receive a large number of proposals to buy wind energy over the coming years.

Absent the injection capability of either of these two transmission lines, the anticipated cost of Customer-owned facilities must be taken into account. The interconnection studies will be done with a certain purchaser in mind, but if the Tribe requests that multiple purchasers be considered, then the studies will produce comparative costs to interconnect and possibly upgrade transmission resources elsewhere on the system. If one set of upgrades is substantially more than another, then the Tribe may want to reconsider whether that utility is a good candidate for a PPA or not.

Other Generators

The Dakotas area is extremely rich in coal and hydropower generation. Coal is typically used as a base load resource rather than a system regulator or peaker, so by itself it is not adept at managing fluctuating levels of wind resource. However, hydro is adjustable on a short-term basis and as such is an excellent regulator of wind projects. Drought conditions can affect the operations of a hydropower facility, but in general the Dakotas generation and transmission system should be sufficiently capable of including 30MW of wind on the Three Affiliated Tribes Reservation.

Additionally, a high-level study was recently conducted by the Western Area Power Administration on available transmission capacity in the Dakotas for the integration of wind projects. The general conclusions are that there is ample non-firm transmission capacity that can be utilized for wind projects. A copy of the study is available at http://www.wapa.gov/ugp/study/DakotasWind/Default.htm. One of the zones given attention in the study is in the immediate vicinity of the MHA Nation wind project.

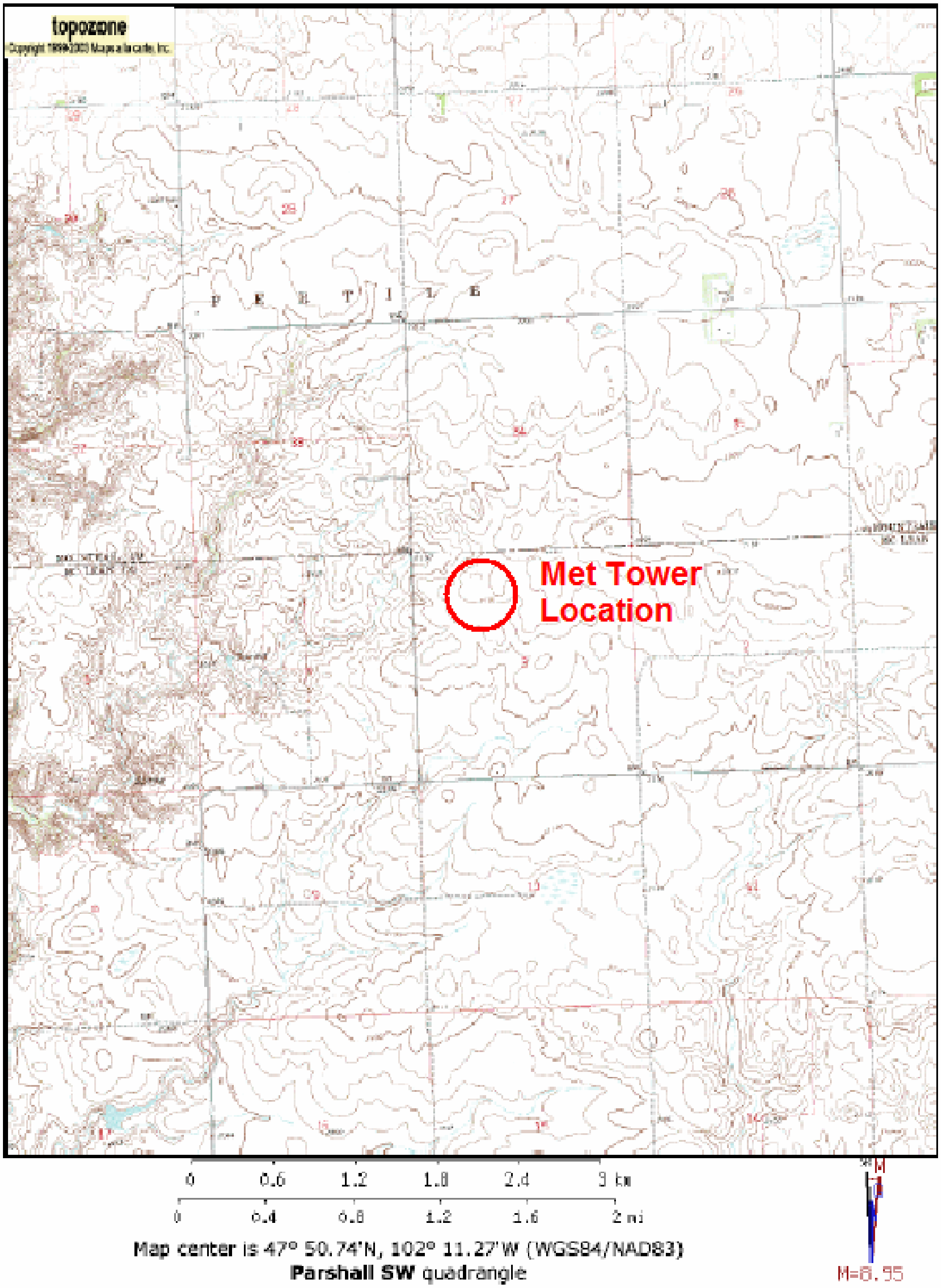
Conclusion

From this initial transmission analysis, it is considered to be feasible to build a 30MW wind project south of Parshall, ND and interconnect it to the existing electric power system. However, it is recommended that the project build an 8-mile 69kV feeder line to the Parshall Substation owned by Mountrail-Williams Electric Cooperative and interconnect there rather than to the distribution line that passes within three miles of the current met tower. Interconnection studies will be necessary, and an official Interconnection Request should be placed with Basin Electric Cooperative once the Tribe is satisfied with the various project feasibility tasks and wishes to move onto the project development phase. Basin should also be considered for a Power Purchase Agreement to avoid the excessive transmission charges that would be required to reach other utilities' service areas.

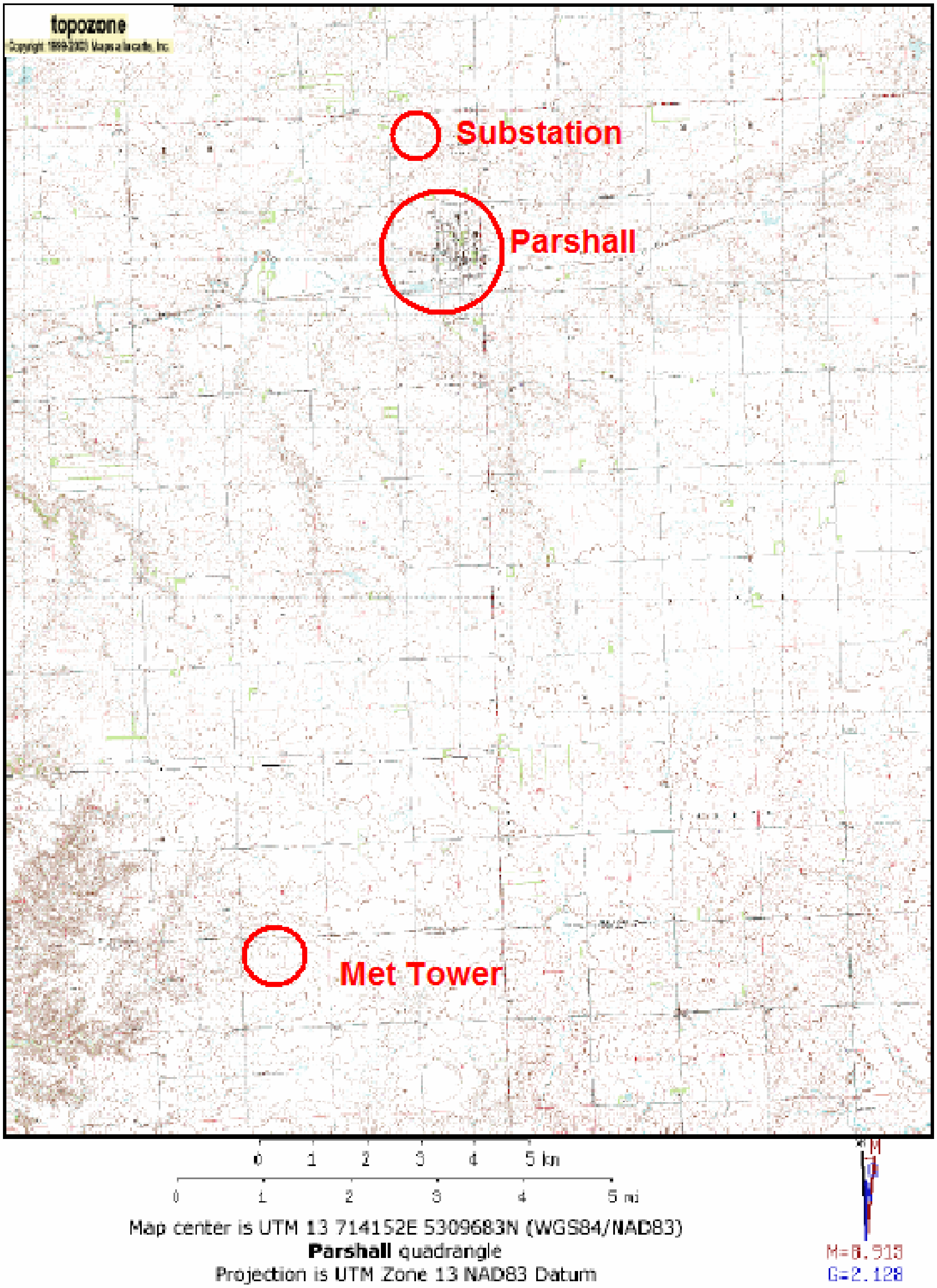
In order for progress to continue on the interconnection of a 30MW wind project, a total of $160,000 in study deposits ($10,000 plus $50,000 plus $100,000) would be required by the utility. (Actual costs may vary depending on the complexity of the studies.) A more precise estimate for the cost of the interconnection facilities will be provided in the interconnection studies, but at this time it appears that the cost to interconnect will be approximately $1,500,000.

Disgen is confident of its abilities to guide the Tribe deftly and efficiently through the complicated interconnection studies and Interconnection Agreement negotiations and thus help make a wind project for the MHA Nation a rapidly-approaching reality.

APPENIDX 1
SITE MAPS



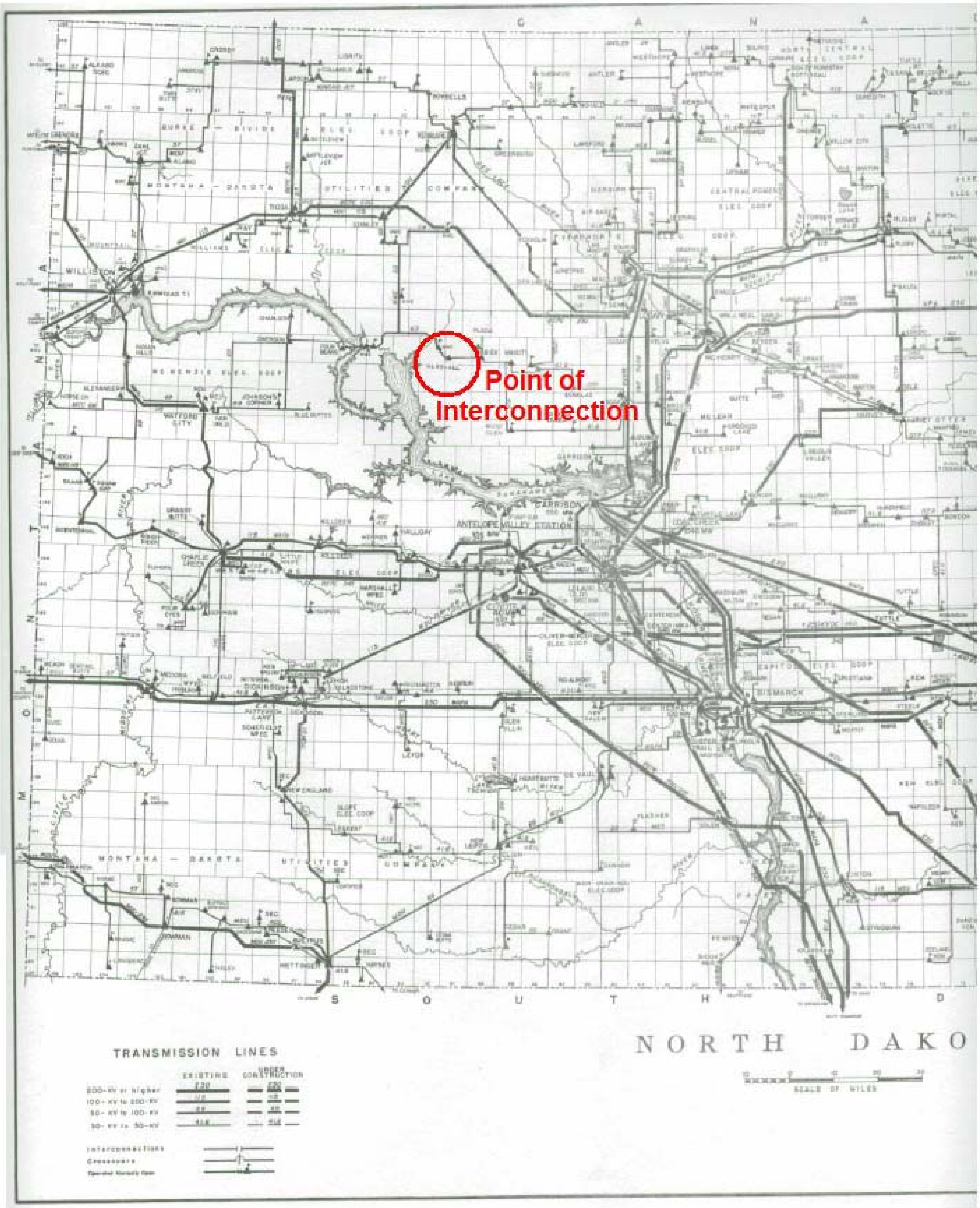
Map center is 47° 50.74'N, 102° 11.27'W (WGS84/NAD83)
Parshall SW quadrangle
Projection is UTM Zone 13 NAD83 Datum



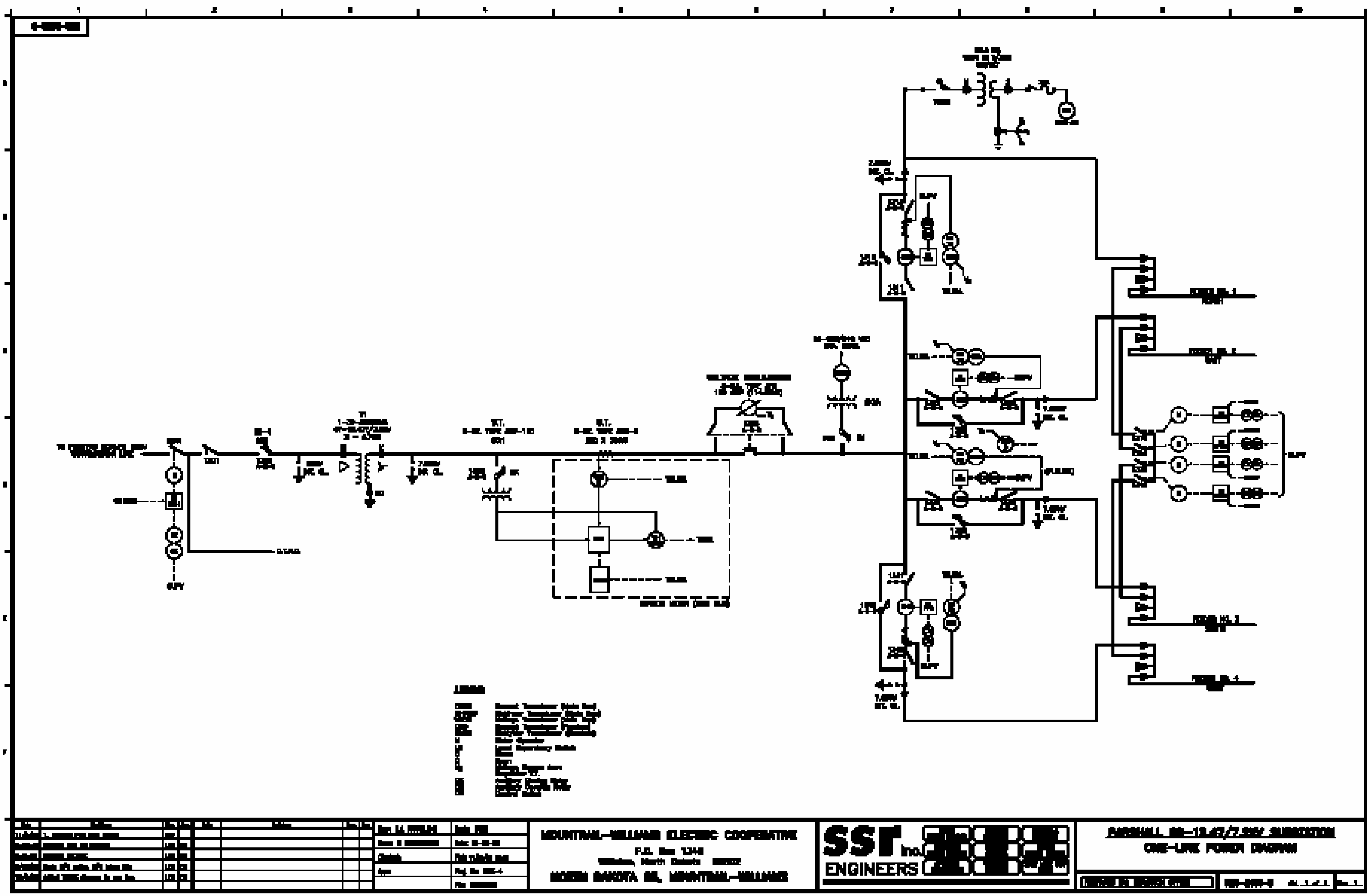
Map center is UTM 13 714152E 5309683N (WGS84/NAD83)
Parshall quadrangle
Projection is UTM Zone 13 NAD83 Datum

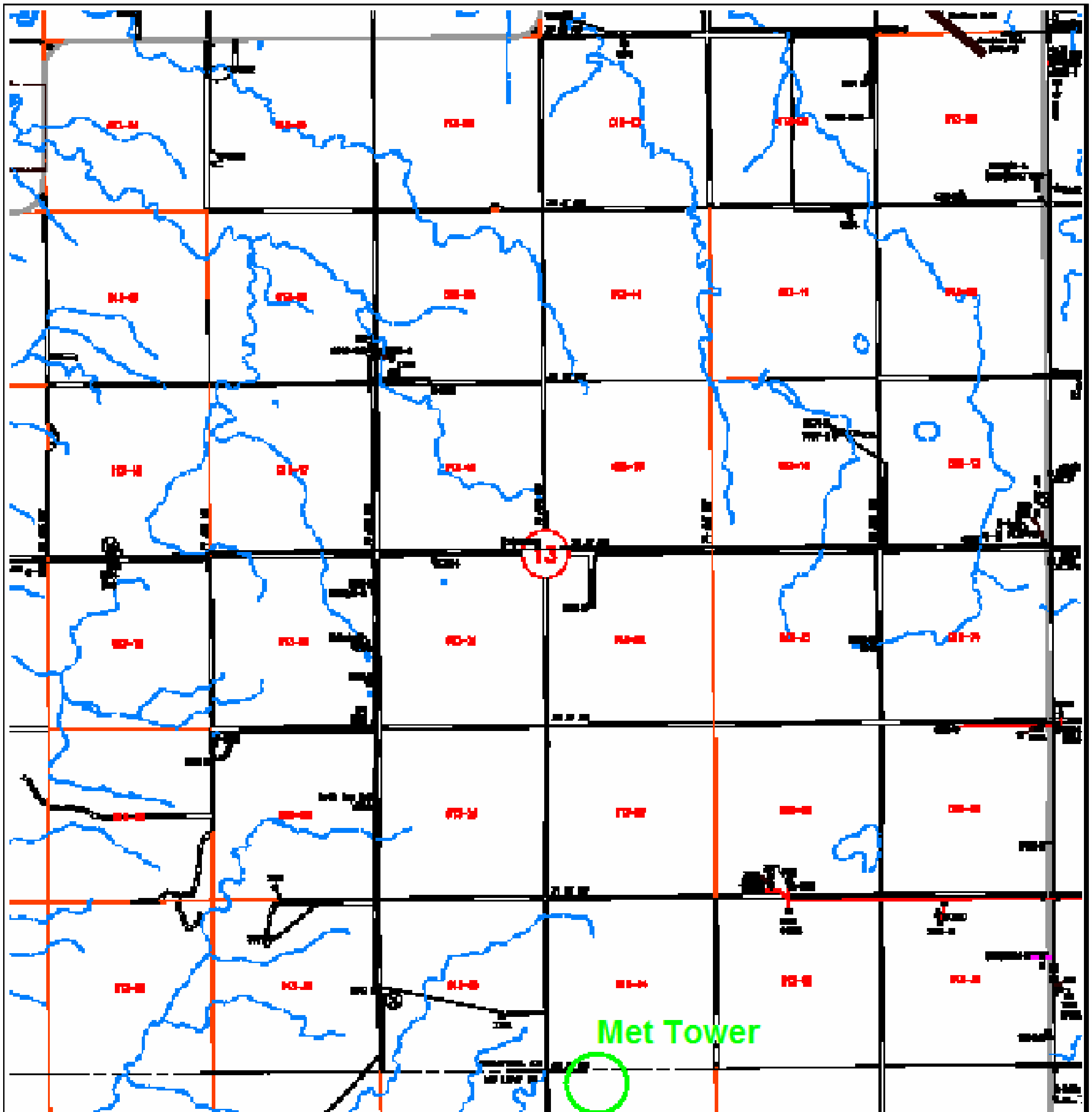

Town of Parshall
Met Tower

APPENDIX 2
TRANSMISSION MAPS



Point of Interconnection
NORTH DAKO
TRANSMISSION LINES
EXISTING
UNDER CONSTRUCTION
SCALE OF MILES
WILLISTON
WATFORD CITY
GARRISON
ANTELOPE VALLEY STATION
BISMARCK
DICKINSON
MONTANA – DAKOTA UTILITIES COMPANY


6-0000-000
MOUNTRAIL–WILLIAMS ELECTRIC COOPERATIVE
ENGINEERS
ONE-LINE POWER DIAGRAM

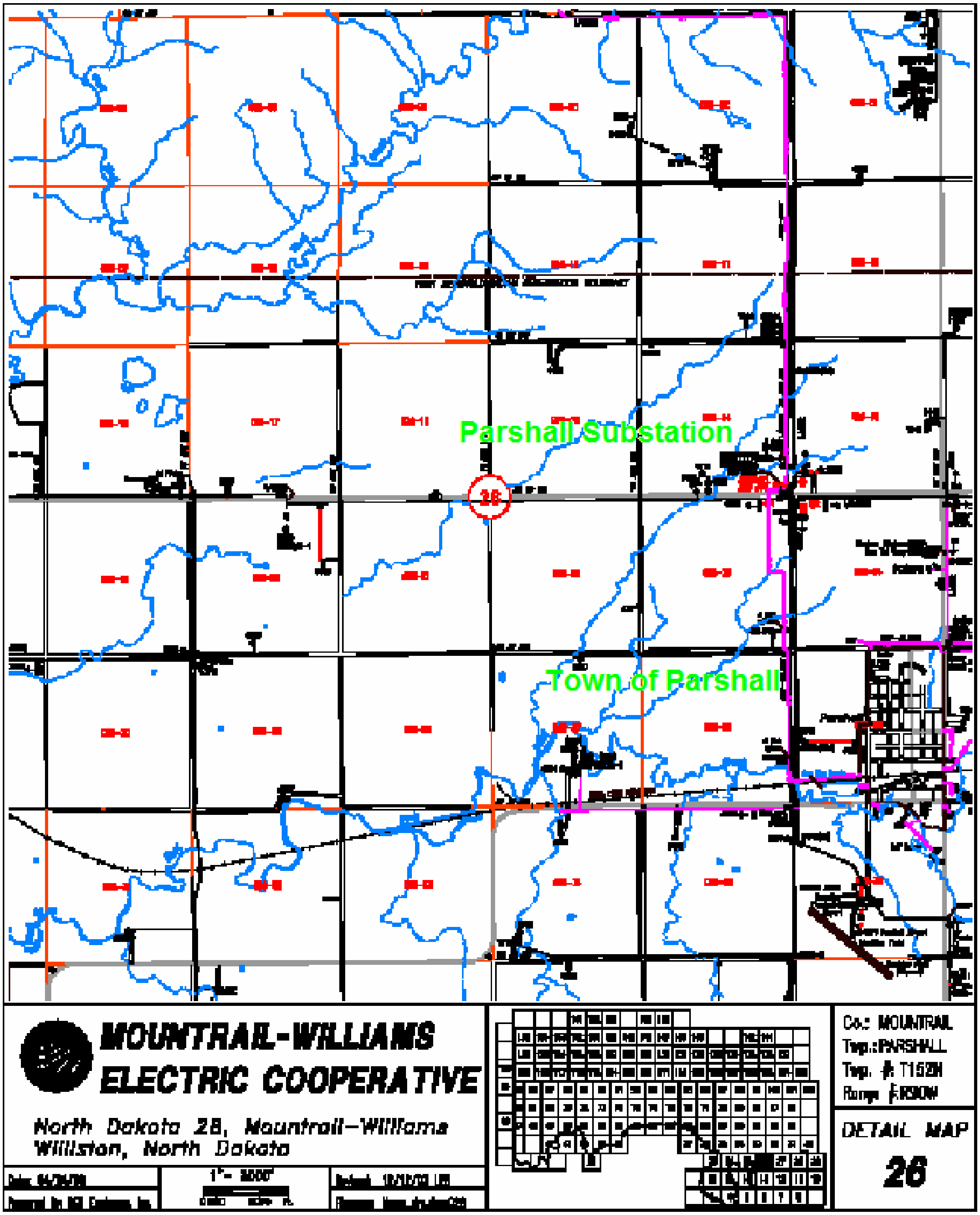


MOUNTRAIL-WILLIAMS ELECTRIC COOPERATIVE

North Dakota 28, Mountrail-Williams
Williston, North Dakota

Co.: MOUNTRAIL
Twp.: FERTILE
Twp. #: T151N
Range #: R90W

DETAIL MAP
13


Parshall Substation
26
Town of Parshall
MOUNTRAIL-WILLIAMS
ELECTRIC COOPERATIVE
North Dakota 28, Mountrail-Williams
Williston, North Dakota
Co.: MOUNTRAIL
Twp.: PARSHALL
DETAIL MAP
26

Tribal Renewable Energy
Final Technical Report

Tab 6

Project Economics

Project Title: Three Affiliated Tribes Renewable Energy Feasibility Study

Date of Report: May 24, 2006

Recipient Organization: Three Affiliated Tribes of the Ft. Berthold Reservation

Award Number: DE-FG36-04GO14021

Partners: Three Affiliated Tribes of the Fort Berthold Reservation
Distributed Generation Systems, Inc. (cost sharing partner)

PRELIMINARY

PROJECT ECONOMICS FOR WIND FACILTY

For

The Mandan, Hidatsa, and Arikara Nation on the Fort Berthold Indian Reservation

Summary

Distributed Generations Systems, Inc has been working on a financial model for the MHA Nation to provide them.

Disgen has provided a set of preliminary project economics for a 30MW facility to be interconnected to the Mountrail-Williams Electric Cooperative system as a baseline to the economic viability of this proposed project. This model assumed a Tribally owned project on Tribal trust lands, without using the existing production tax credit, and using no loans. It also assumed no property taxes being paid to the state North Dakota and Federal Government and no landowner payments to the MHA Nation. The breakeven energy sales price is 5.00 cents per kWh to make this propose wind project to work. If the Tribe chooses to take on a private investment partner who needs to utilize the existing Production Tax Credit, and negotiates a 3.5% landowner payment, the rate of return and price per kWh can only improve. Disgen is able to deliver the scenarios at the Tribes request.

Sources and Uses of Funds

Ft. Berthold Model
Tribal Ownership, No Debt

SOURCES		Unit Price	Units	Percent	Amount	
	Senior Loan			0.0%		
	Other Debt			0.0%		
	Equity			100.0%	45,850,725	
	Total Sources			100.0%	45,850,725	
USES						
1.0	**Wind Turbine Cost**					
1.01	Wind Turbines and Towers	2,125,000	15	69.5%	31,875,000	
1.02	Wind Turbine Contingency	-	15	0.0%	0	
1.03	Shipping and Packing	100,000	15	3.3%	1,500,000	
1.04	Turbine Warranty (Years 3-5 total)	90,000	15	2.9%	1,350,000	
1.05	Sales Tax	0	15	0.0%	0	
	Subtotal			75.7%		34,725,000
2.0	**Balance of Construction**					
2.01	Base Construction Cost	525,000	15	17.2%	7,875,000	
2.02	Dynamic VAR Comp	-	1	0.0%	0	
2.03	Substation	2,000,000	1	4.4%	2,000,000	
2.04	O & M Building	-	1	0.0%	0	
2.05	Construction Interest			1.6%	741,963	
2.06	Construction Contingency			0.6%	296,250	
2.07	Sales Tax			0.0%	0	
	Subtotal Construction			23.8%		10,913,213
3.0	**Working Capital and Initial Operating Expenses**					
3.01	Working Capital Funding			0.1%	34,387	
3.02	Spare Parts			0.0%	-	
3.03	First Half -Year Insurance Premium			0.3%	118,125	
3.04	Initial Operations and Management Fee			0.0%	-	
3.05	Other Initial Operating Expense			0.0%	-	
	Subtotal Working Capital and Initial Operating Expenses			0.3%		152,512
3.0	**Lender Transaction Expenses**					
3.01	Legal Expenses			0.0%	-	
3.02	Construction Loan Fee			0.0%	-	
3.03	Permanent Loan Fee			0.0%	-	
3.04	Lender Consulting Expenses			0.0%	-	
3.05	Other Lender Costs			0.0%	-	
3.06	Title Insurance			0.0%	5,000	
3.07	Other			0.0%	-	
3.08	Initial Debt Reserve Funding			0.0%	-	
3.09	First Year Agency Fee			0.0%	-	
	Subtotal Lender Transaction Expenses			0.0%		5,000
4.0	**Equity Financing and Other Expenses**					
4.01	Equity Consulting Expenses			0.0%	-	
4.02	Development Costs			0.0%	-	
4.03	Legal Expenses			0.1%	50,000	
4.04	Organizational Costs			0.0%	5,000	
	Subtotal Equity Financing and Other Expenses			0.1%		55,000
5.0	**Development Costs and Fees**					
5.01	Developer Development Cost Reimbursement			0.0%	-	
5.02	Other Development Cost Reimbursement			0.0%		
5.03	Base Development Fee			0.0%	-	
5.04	Additional Development Fee			0.0%	-	
5.05	Project Construction Management			0.0%	-	
5.06	Land Owner Installation Fee ($/MW)	0	31.5	0.0%	-	
5.07	Substation Installation Fee			0.0%	-	
5.08	Development Contingency			0.0%	-	
	Subtotal Development Costs and Fees			0.0%		-
	Total Budget			100.0%		45,850,725

Ft. Berthold Model
Tribal Ownership, No Debt

Project Assumptions

Turbine Manufacturer		Suzlon S-88	
Turbine Type		2100	
Number of Turbines		15	
KW Rating	kW	2,100	
Capacity Installed	MW	31.50	
Turbine Price (including tower)	$	2,125,000	
Gross Annual kWh per Turbine	kWh	7,568,000	
Net Output as Percent of Gross	%	90.0%	
Net Annual kWh per Turbine	kWh	6,811,200	
Availability	%	98.0%	
Annual Production to Meter per Turbine	kWh	6,674,976	
Total Annual Production to Meter	MWh	100,125	
Net Capacity Factor	%	36.28%	Capacity Factor Calculator
Annual Decrease In Availability	%	0.00%	Net Capacity Factor: 36.28%
			Gross Output: 7,566,971
Project Life	years	30	
1st Year of Operation	yyyy	2008	
1st Month of Operation	number	12	
1st Year Percent for Operating Costs	%	8.3%	
1st Year Percent for kWh Production	%	3.0%	
Base Year for Capital Costs	yyyy	2008	
Construction Loan Closing	mm/dd/yy	07/01/08	
Permanent Loan Closing	mm/dd/yy	12/01/08	
Initial Spare Parts	$	-	
Initial O&M/Mgt. Payment	no. of mo.	3	
Percent of 1st Year Interest	%	8.3%	
Base Construction Cost per Turbine	$	525,000	525,000 $250 / kw
Construction Contingency	%	3%	

First Year in Financial Model	2008
Final Year in Financial Model	2037

Electricity Purchaser	Begin	End
IOU Purchaser	12/1/2008	11/30/2028
Avoided Cost Purchaser	12/1/2028	11/30/2038

Contract Term yrs 20

IOU Purchaser			PRODUCTION PER CONTRACT TERM	
			Begin	End
Phase 1	%	50%	2008	2027
Phase 2	%	25%	2008	2027
Phase 3	%	25%	2008	2027

need to fix production %: **cannot be = 0% as currently modeled**

Levelized Cost of Energy over Project Life

		cents
Constant Currency - Base Yr	2008	0.000
Constant Currency - Op Yr 1	2008	0.000
Levelized Nominal Currency	2008	0.000

Nominal Discount Rate 9.00%

Ft. Berthold Model
Tribal Ownership, No Debt

Energy Sale Prices

20 yr After Tax ROR: 9.1%

Base Energy Prices

	Begin Yr.	End Yr.	Contract Pricing	Avoided Cost	
Tranche 1	2008	2028	5.00	3.00	cents/kWh
Tranche 2	2029	2038	0.00	3.00	cents/kWh
Tranche 3	2039	2039	0.00	0.00	cents/kWh
Capacity Payment	2040	2040	0.00	0.00	$/kW-yr

Escalation of Contract Energy Prices

Tranche 1	Yrs Starting:	2008	2028	2038
	Rate	2.0%	2.0%	2.0%
Tranche 2	Yrs Starting:	2008	2028	2038
	Rate	2.0%	2.0%	2.0%
Tranche 3	Yrs Starting:	2008	2028	2038
	Rate	2.0%	2.0%	2.0%
Capacity Payment	Yrs Starting:	2008	2028	2038
	Rate	2.0%	2.0%	2.0%

Escalation of Avoided Cost Energy Prices

Tranche 1	Yrs Starting:	2008	2028	2038
	Rate	2.0%	2.0%	2.0%
Tranche 2	Yrs Starting:	2008	2028	2038
	Rate	2.0%	2.0%	2.0%
Tranche 3	Yrs Starting:	2008	2028	2038
	Rate	2.0%	2.0%	2.0%
Capacity Payment	Yrs Starting:	2008	2028	2038
	Rate	2.0%	2.0%	2.0%

Base Year (EOY) 2008

Debt Financing

Senior Loan

		Amortized	Cover. Ratios - Senior Debt	
% Debt (if amort) or Coverage Ratio		0%	Minimum	Average
Fixed Interest Rate		5.00%	0.00	0.00
Amortization Period (Years)		20		
Interest Only Period (Years)				
			Average Life (Years)	
Total Term		20	N/A	

Variable Coverage Ratio	Yrs Starting:	2008	2007	2010
	Percent			

Initial Loan Fee	1.00%
Annual Agency Fee	$ -

Other Debt

	Amortized	Cover. Ratios - Total Debt	
% Debt (if amort) or Coverage Ratio	0%	Minimum	Average
Interest Rate	8.25%	0.00	0.00
Term (Years)	15		
Interest Only Period (Years)	1		
Total Term	16	Average Life (Years)	
		N/A	

Debt Service Reserve

Debt Service Reserve (% of Annual)	50%
Initial DSR (% of 1st Year Debt Service)	50%
% of Cash Flow to Fund Reserve	50%

Construction Debt

Construction Loan?	(Yes/No)	Yes
Amount	% of Cost	100%
Interest Rate	%	5.3%
Commitment Fee on Unused Funds	%	0.5%
Initial Loan Fee	%	0.0%

Operations and Maintenance Expenses

Base Year		2008	
Operations & Maintenance Fee Options			
Cents/kWh (escalating)	cents	0.00	
Fixed Annual Pmt (escalating)	$		
Fixed Annual Pmt per Turbine (escalating)	$	25,000	
Percent of Revenues	%	0.00%	
% of Total O&M Subordinated	%	0.00%	
1st Year/Month Fees Begin		2008	12
Landowner Pymt Options			
Fixed Annual Pymt	$		(Landowner electric bill reimbursement)
Per kW (esc)	$		
% of Revenues (fixed)	%	0.00%	
% of Revenues (variable)		Year	Percent
Applied to Yrs Starting		2008	
Applied to Yrs Starting		2020	
Applied to Yrs Starting		2026	
Minimum Annual Pymt	$/Turbine		
Standby Electric Rate (escalating)	$/kWh	0.060	
Standby Electric Consumption	kWh	50,000	
Interconnect Fee to Utility (fixed $/KW-yr)	$	-	
Insurance/kW (escalating)	$	7.50	
Administration (esc)	$	20,000	
Audit/Legal/Miscellaneous (esc)	$	20,000	
Management Oversight Expense (esc)	$	20,000	
Other Expense (esc)	$	-	
Other Expense (% of rev)	%	0.0%	
Other Expense (constant)	$		
Other Expense Subordinated (esc)	$	-	
Developer Subordinated Fee (% of rev)	%	0.0%	
Interest Rate (Income) on Debt Resv/Cash		2.0%	
Accrued Interest as a % of Cash Interest Pymt		100%	
Working Capital Requirement as % of 1st Year Expenses		5.0%	
Capital Costs & General Inflation	(all years)	2.0%	
Operating Expense Escalation	(all years)	2.0%	
Book Life of Project	years	30	
Amortization Period for Intangible Assets	years	5	

Ft. Berthold Model
Tribal Ownership, No Debt

Income & Other Taxes

Income Taxes

	Federal	CO		
Tax Rates	0.00%	0.00%	Yr Placed in Service	2008
			Short first yr?	No
At-Risk Limitations?	No	No	1st Year Percent	8.3%
Utilize Tax Losses?	Yes	Yes		

	Depr Methods Code	Type		Yrs or DB%	DB/SL Yrs	Book Life	D/A
Facility Costs	1	MACRS	42,338	5		30	D
Interconnect Costs	2	SL	2,000	20		30	D
Loan Expenses	3	SL	5	20		20	A
Organizational Costs	4	SL	5	5		5	A
			44,348				

1st Yr PTC	cents/kWh	-
PTC Base Year	yyyy	2008
Last Year of PTC	yyyy	2018
PTC Annual Escalation	%	1.5%

PTC Escalator	
1.8	2003
1.827	2004
1.854405	2005
1.882221075	2006
1.910454391	2007
1.939111207	2008

Property Taxes

Cost of Equipment	45,638,213	Total Wind Turbine Costs (budget)	34,725,000
Assessed Value as Percent	29.0%	Total Balance of Plant Costs (budget)	10,913,213
Mil Rate ($ per $1000)	-	TOTAL COST OF EQUIPMENT	45,638,213
Decr in Prop Value/Yr	5.0%		
Min. Mil Rate (% of orig.)	20%		

Sales Taxes

Rate	0.00%

Ft. Berthold Model
Tribal Ownership, No Debt

Internal Rates of Returns/Development Fees

Internal Rates of Return

	Returns		ApproxUnleveragedReturns
Years	**Pre-tax**	**After-tax**	**Pre-tax**
5+			
10+	1.2%	1.2%	1.2%
15+	6.9%	6.9%	6.9%
20+	9.1%	9.1%	9.1%
25+	9.7%	9.7%	9.7%
30+	10.1%	10.1%	10.1%

Development Fees

Base Development Fee	% of cost	0.0%	of first	200	MW
Additional Development Fee	% of cost	0.0%	all over	200	MW

Income Statement

Ft. Berthold Model
Tribal Ownership, No Debt

	Closing	2008	2009	2010	2011	2012	2013	2014
		1	2	3	4	5	6	7
Operating Revenue								
Capacity Sales								
Electricity Sales		150	5,106	5,208	5,313	5,419	5,527	5,638
Total Revenues		150	5,106	5,208	5,313	5,419	5,527	5,638
Operating Expenses								
Operations & Maintenance		31	383	390	398	406	414	422
Landowner Payments		-	-	-	-	-	-	-
Interconnect and Electricity Consumption		0	3	3	3	3	3	3
Insurance		20	241	246	251	256	261	266
General and Administrative		2	20	21	21	22	22	23
Audit, Legal, Miscellaneous		20	20	21	21	22	22	23
Property Taxes		-						
Management		2	20	21	21	22	22	23
Lender Agency Fee		-	-	-	-	-	-	-
Other		-	-	-	-	-	-	-
Total Operating Expenses		75	688	701	716	730	744	759
NET OPERATING INCOME		76	4,419	4,507	4,597	4,689	4,783	4,879
Depreciation		123	1,478	1,478	1,478	1,478	1,478	1,478
Amortization		0	1	1	1	1	1	0
Subordinated Expenses								
Interest Income		(0)	(44)	(45)	(46)	(47)	(48)	(49)
Interest Expense								
PRETAX INCOME		(47)	2,984	3,073	3,164	3,257	3,352	3,449
Production Tax Credit								
Tax Provision								
NET INCOME		(47)	2,984	3,073	3,164	3,257	3,352	3,449

Income Statement

Ft. Berthold Model
Tribal Ownership, No Debt

	2015	2016	2017	2018	2019	2020	2021	2022
	8	9	10	11	12	13	14	15
Operating Revenue								
Capacity Sales								
Electricity Sales	5,751	5,866	5,983	6,103	6,225	6,349	6,476	6,606
Total Revenues	5,751	5,866	5,983	6,103	6,225	6,349	6,476	6,606
Operating Expenses								
Operations & Maintenance	431	439	448	457	466	476	485	495
Landowner Payments	-	-	-	-	-	-	-	-
Interconnect and Electricity Consumption	3	4	4	4	4	4	4	4
Insurance	271	277	282	288	294	300	306	312
General and Administrative	23	23	24	24	25	25	26	26
Audit, Legal, Miscellaneous	23	23	24	24	25	25	26	26
Property Taxes								
Management	23	23	24	24	25	25	26	26
Lender Agency Fee	-	-	-	-	-	-	-	-
Other	-	-	-	-	-	-	-	-
Total Operating Expenses	775	790	806	822	838	855	872	890
NET OPERATING INCOME	4,976	5,076	5,177	5,281	5,386	5,494	5,604	5,716
Depreciation	1,478	1,478	1,478	1,478	1,478	1,478	1,478	1,478
Amortization	0	0	0	0	0	0	0	0
Subordinated Expenses								
Interest Income	(50)	(51)	(52)	(53)	(54)	(55)	(56)	(57)
Interest Expense								
PRETAX INCOME	3,548	3,648	3,751	3,855	3,962	4,071	4,182	4,295
Production Tax Credit								
Tax Provision								
NET INCOME	3,548	3,648	3,751	3,855	3,962	4,071	4,182	4,295

Income Statement

Ft. Berthold Model
Tribal Ownership, No Debt

	2023	2024	2025	2026	2027	2028	2029	2030
	16	17	18	19	20	21	22	23
Operating Revenue								
Capacity Sales								
Electricity Sales	6,738	6,872	7,010	7,150	7,293	4,463	4,553	4,644
Total Revenues	6,738	6,872	7,010	7,150	7,293	4,463	4,553	4,644
Operating Expenses								
Operations & Maintenance	505	515	525	536	546	557	568	580
Landowner Payments	-	-	-	-				
Interconnect and Electricity Consumption	4	4	4	4	4	4	5	5
Insurance	318	324	331	337	344	351	358	365
General and Administrative	27	27	28	29	29	30	30	31
Audit, Legal, Miscellaneous	27	27	28	29	29	30	30	31
Property Taxes								
Management	27	27	28	29	29	30	30	31
Lender Agency Fee	-	-	-	-	-	-	-	-
Other	-	-	-	-				
Total Operating Expenses	907	926	944	963	982	1,002	1,022	1,042
NET OPERATING INCOME	5,830	5,947	6,066	6,187	6,311	3,461	3,531	3,601
Depreciation	1,478	1,478	1,478	1,478	1,478	1,478	1,478	1,478
Amortization	0	0	0	0	0	0		
Subordinated Expenses								
Interest Income	(58)	(59)	(61)	(62)	(63)	(35)	(35)	(36)
Interest Expense								
PRETAX INCOME	4,410	4,528	4,648	4,771	4,896	2,018	2,088	2,159
Production Tax Credit								
Tax Provision								
NET INCOME	4,410	4,528	4,648	4,771	4,896	2,018	2,088	2,159

Income Statement

Ft. Berthold Model
Tribal Ownership, No Debt

	2031	2032	2033	2034	2035	2036	2037
	24	25	26	27	28	29	30
Operating Revenue							
Capacity Sales							
Electricity Sales	4,737	4,831	4,928	5,027	5,127	5,230	5,334
Total Revenues	4,737	4,831	4,928	5,027	5,127	5,230	5,334
Operating Expenses							
Operations & Maintenance	591	603	615	628	640	653	666
Landowner Payments							
Interconnect and Electricity Consumption	5	5	5	5	5	5	5
Insurance	373	380	0	0	0	0	0
General and Administrative	32	32	33	33	34	35	36
Audit, Legal, Miscellaneous	32	32	33	33	34	35	36
Property Taxes							
Management	32	32	33	33	34	35	36
Lender Agency Fee	-	-	-	-	-	-	-
Other							
Total Operating Expenses	1,063	1,084	719	733	748	763	778
NET OPERATING INCOME	3,673	3,747	4,209	4,293	4,379	4,467	4,556
Depreciation	1,478	1,478	1,478	1,478	1,478	1,478	1,478
Amortization							
Subordinated Expenses							
Interest Income	(37)	(37)	(42)	(43)	(44)	(45)	(46)
Interest Expense							
PRETAX INCOME	2,232	2,306	2,773	2,858	2,945	3,033	3,124
Production Tax Credit							
Tax Provision							
NET INCOME	2,232	2,306	2,773	2,858	2,945	3,033	3,124

Cash Flow Statement

Ft. Berthold Model
Tribal Ownership, No Debt

		2008	2009	2010	2011	2012	2013	2014
PRETAX INCOME		(47)	2,984	3,073	3,164	3,257	3,352	3,449
Increased by:								
Book Depreciation		123	1,478	1,478	1,478	1,478	1,478	1,478
Book Amortization		0	1	1	1	1	1	0
Subordinated Expenses								
Accrued Interest Expense								
Cash Flow before Debt Service, Reserves & Taxes		76	4,463	4,552	4,643	4,736	4,831	4,927
Decreased by:								
Interest Payments		0	0	0	0	0	0	0
Principal Payments		0	0	0	0	0	0	0
Cash Flow before Reserves & Taxes		76	4,463	4,552	4,643	4,736	4,831	4,927
Debt Reserve Releases (Additions)								
Equity Investment	(45,851)							
PRETAX CASH FLOW	(45,851)	76	4,463	4,552	4,643	4,736	4,831	4,927
Production Tax Credit		0	0	0	0	0	0	0
Income Tax Benefit (Payment)								
AFTER-TAX CASH FLOW	(45,851)	76	4,463	4,552	4,643	4,736	4,831	4,927

Cash Flow Statement

Ft. Berthold Model
Tribal Ownership, No Debt

	2015	2016	2017	2018	2019	2020	2021	2022
PRETAX INCOME	3,548	3,648	3,751	3,855	3,962	4,071	4,182	4,295
Increased by:								
Book Depreciation	1,478	1,478	1,478	1,478	1,478	1,478	1,478	1,478
Book Amortization	0	0	0	0	0	0	0	0
Subordinated Expenses								
Accrued Interest Expense								
Cash Flow before Debt Service, Reserves & Taxes	5,026	5,126	5,229	5,333	5,440	5,549	5,660	5,773
Decreased by:								
Interest Payments	0	0	0	0	0	0	0	0
Principal Payments	0	0	0	0	0	0	0	0
Cash Flow before Reserves & Taxes	5,026	5,126	5,229	5,333	5,440	5,549	5,660	5,773
Debt Reserve Releases (Additions)								
Equity Investment								
PRETAX CASH FLOW	5,026	5,126	5,229	5,333	5,440	5,549	5,660	5,773
Production Tax Credit	0	0	0	0	0	0	0	0
Income Tax Benefit (Payment)								
AFTER-TAX CASH FLOW	5,026	5,126	5,229	5,333	5,440	5,549	5,660	5,773

Cash Flow Statement

Ft. Berthold Model
Tribal Ownership, No Debt

	2023	2024	2025	2026	2027	2028	2029	2030
PRETAX INCOME	4,410	4,528	4,648	4,771	4,896	2,018	2,088	2,159
Increased by:								
Book Depreciation	1,478	1,478	1,478	1,478	1,478	1,478	1,478	1,478
Book Amortization	0	0	0	0	0	0		
Subordinated Expenses								
Accrued Interest Expense								
Cash Flow before Debt Service, Reserves & Taxes	5,889	6,006	6,126	6,249	6,374	3,496	3,566	3,637
Decreased by:								
Interest Payments	0	0	0	0	0	0	0	0
Principal Payments	0	0	0	0	0	0	0	0
Cash Flow before Reserves & Taxes	5,889	6,006	6,126	6,249	6,374	3,496	3,566	3,637
Debt Reserve Releases (Additions)								
Equity Investment								
PRETAX CASH FLOW	5,889	6,006	6,126	6,249	6,374	3,496	3,566	3,637
Production Tax Credit	0	0	0	0	0	0	0	0
Income Tax Benefit (Payment)								
AFTER-TAX CASH FLOW	5,889	6,006	6,126	6,249	6,374	3,496	3,566	3,637

Cash Flow Statement

Ft. Berthold Model
Tribal Ownership, No Debt

	2031	2032	2033	2034	2035	2036	2037
PRETAX INCOME	2,232	2,306	2,773	2,858	2,945	3,033	3,124
Increased by:							
Book Depreciation	1,478	1,478	1,478	1,478	1,478	1,478	1,478
Book Amortization							
Subordinated Expenses							
Accrued Interest Expense							
Cash Flow before Debt Service, Reserves & Taxes	3,710	3,784	4,251	4,336	4,423	4,511	4,601
Decreased by:							
Interest Payments	0	0	0	0	0	0	0
Principal Payments	0	0	0	0	0	0	0
Cash Flow before Reserves & Taxes	3,710	3,784	4,251	4,336	4,423	4,511	4,601
Debt Reserve Releases (Additions)							
Equity Investment							
PRETAX CASH FLOW	3,710	3,784	4,251	4,336	4,423	4,511	4,601
Production Tax Credit	0	0	0	0	0	0	0
Income Tax Benefit (Payment)							
AFTER-TAX CASH FLOW	3,710	3,784	4,251	4,336	4,423	4,511	4,601

Tribal Renewable Energy
Final Technical Report

Tab 7

Other Energy Assessment

Project Title:	Three Affiliated Tribes Renewable Energy Feasibility Study
Date of Report:	May 24, 2006
Recipient Organization:	Three Affiliated Tribes of the Ft. Berthold Reservation
Award Number:	DE-FG36-04GO14021
Partners:	Three Affiliated Tribes of the Fort Berthold Reservation Distributed Generation Systems, Inc. (cost sharing partner)

Tribal Renewable Energy
Final Technical Report

Tab 8

Hybrid System

Project Title:	Three Affiliated Tribes Renewable Energy Feasibility Study
Date of Report:	May 24, 2006
Recipient Organization:	Three Affiliated Tribes of the Ft. Berthold Reservation
Award Number:	DE-FG36-04GO14021
Partners:	Three Affiliated Tribes of the Fort Berthold Reservation Distributed Generation Systems, Inc. (cost sharing partner)

PRELIMINARY REVIEW
ELECTRIC HYDRO POWER
PUMPED-STORAGE SYSTEM

For

The Mandan, Hidatsa, and Arikara Nation on the
Fort Berthold Indian Reservation

By
Distributed Generation Systems, Inc

Submitted on
25 May, 2006

Summary

This preliminary study is to review the capability for constructing a pumped-storage hydropower system on the Fort Berthold Indian Reservation. The Mandan, Hidatsa, and Arikara Nation (MHA Nation) reside on the Fort Berthold Indian Reservation. This study is one of several energy options reviewed for the MHA Nation under a Renewable Energy Feasibility Study grant provided by Department of Energy, DOE Award Number: DE-FG36-04GO14021 for consideration by MHA Nation.

Pumped-storage hydropower is an energy storage system that is generally used to store off-peak power generation from other power sources. That off-peak generation is then used to meet peak load needs or to provide emergency power injection to the grid when a plant goes offline. When the demand for electricity is low, pumped storage facility stores energy by pumping water from a lower reservoir to an upper reservoir.

Given that three required consideration are needed for a pumped-storage system to function is net effective head (elevation difference of reservoirs), water flow and the need for satisfy an electrical load. The areas around MHA Nation lands near the Lake Sakakawea has a very limited geographical attributes to support a commercially viable pumped storage system, so further studies should not be implemented.

- The net effective head is limited approximately 200 feet for the proposed project area which severely limited the energy production from any hydro turbine.
- The amount of water need to be drawn from the Lake Sakakawea would very substantial in relation to the amount of produce electrical energy.
- Environmental and permitting concerns for an “open” pumped storage system would be very difficult to permit and very time consuming. This open system would require a substantial amount of land to be flooded to get minimal amount of generation.

Background and Proposed Project Description

MHA Nation retained Distributed Generation Systems, Inc. in 2004 to conduct a preliminary review of constructing a pumped storage hydropower system on the MHA Nation land as an energy resource for Tribal use along with conducting a wind resource feasibility study under a DOE Grant Award Number: DE-FG36-04GO14021

Pumped Storage Hydropower System Description

Pumped hydropower is an energy storage system that is used to store off-peak power generation from other power sources. That off-peak generation is then used to meet peak load needs or to provide emergency power injection to the grid when a plant goes offline. When the demand for electricity is low, pumped storage facility stores energy by pumping water from a lower reservoir to an upper reservoir. During periods of high electrical demand, the water is released back to the lower reservoir to generate electricity as shown in Figure 1.

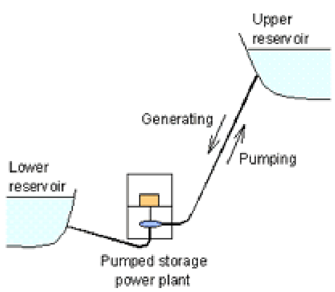


Figure 1 Pumped storage scheme configuration

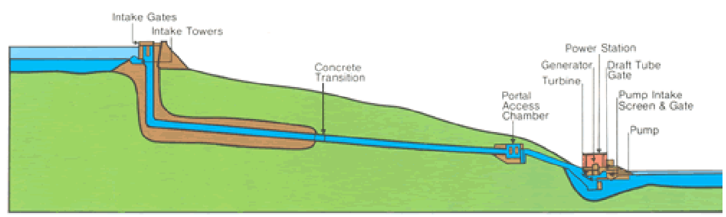


Figure 1b Pumped storage scheme configuration

Technical

Location and History

Areas along the eastern banks of the Lake Sakakawea closest to the Parshall site were reviewed. The project area needs to have a high elevation and be capable of storing large amounts of the water. The physical limitation for the net effective head is the difference of the lowest elevation and the highest elevation. The lowest elevation is Lake Sakakawea, shoreline elevation is approximately between 1854 and 1870, mean = 1862 ft. The highest elevation around the project area is approximately 2100 ft. The elevation difference is the most available effect head which is 238 ft.

Hydropower

Maximum Net Effective Head Available

To utilize the available net effective head of 238 ft a tank or upper reservoir would have to be constructed on the top of the highest ridge and the hydro turbine located at the Lake Sakakawea elevation. Its believed that using Lake Sakakawea as the lower reservoir would not be allowed due to the regulatory and environmental constraints. The Army Corps of Engineer will require an extensive environmental review to allow raw water to be discharged into Lake Sakakawea. Discussion was initiated with the Army Corp of Engineers regarding the pumped storage system. The Corp recommended that a closed pumped storage system is more acceptable by the regulatory agencies such as FERC and EPA. A closed pumped storage systems means using 2 reservoirs, upper and lower, *without* having to discharge into Lake Sakakawea, thereby eliminating possible of cross contamination. The lower reservoir would have to be constructed above the lake's elevation of 1,862 ft which reduces the net effective head.

The highest elevation point would be at ridges along the banks. The top of these ridges are at an elevation of 2100 ft. Unless large tanks were built at these high elevation points, the available net head would have to be reduced. Most of the project areas capable of holding large amounts of water are at the elevation of 2050 ft.

Therefore, a new lower reservoir will have to be constructed above Lake Sacajawea at the approximate elevation level of 1870 ft and the highest elevation level would be at 2080 ft so the assumed net effective head of 210 ft will be used for this analysis.

A make up water system would have to be installed and draw water from the actual lake to makeup the loss of due the evaporation of the pumped storage reservoirs which would require another pumping system.

Hydro Turbine

A hydro turbine such as one provided from the Gilkes Company would suffice for this analysis. The hydro turbine performance rating is as follows: Rated power output of 544 kW, 200 ft net head, with flow at 35 cubic feet per second (cfs) or 262 gallons per minute (gpm), 900 RPM, 90.9% efficiency.

Amount of Water Storage Required

Given the performance of the hydro turbine and required net effective head of 210 ft with a flow rate of 35 cfs or 262 gpm, the minimum amount of storage water needed for a given amount of time can now be determined. Table 1 show the minimum amount of water needed to flow through a single turbine at the required head to produce the electrical power.

*Water Storage needed = flow rate * 60 min/hr * demand period hr*

Demand Period (hours)	Water Storage Needed (gallons)	Water Storage Needed (acre-ft)	Water Storage Needed (cubic feet)
4	3,769,920	11.57	504,000
6	5,654,880	17.35	756,000
8	7,539,840	23.14	1,008,000
10	9,424,800	28.92	12,600,000

Table 1

Now that the minimum volume of water storage needed for one hydro turbine has been determined, the next item to select is to select the reservoir sites.

As previously mentioned, a tank could be installed at the highest elevation to serve as the upper reservoir source. By taking the minimum volume of water needed for the turbine to work, we can determine the minimum tank size. We will use volume calculated for the 6 hour period. The tank size for the minimum amount of water to operate the hydro turbine for a 6-hour period of time show in the following table:

Demand Period Of 6 hours	*Tank Radius* **At the following depth.**		
Depth	**20 ft**	**30 ft**	**40 ft**
1 turbine	*110 ft*	*90 ft*	*78 ft*
3 turbines	*190 ft*	*155 ft*	*134 ft*
10 turbines	*347 ft*	*283 ft*	*245 ft*
19 turbines	*478 ft*	*390 ft*	*338 ft*

For one turbine to operate, the required tank size would be at least 90 ft in diameter and 30 ft tall.

The same principle would be applied to an open aired reservoir.

Demand Period Of 6 hours (rated kW)	*Reservoir Surface Area (acre)* **At the following depth.**		
Depth	**20 ft**	**30 ft**	**40 ft**
1 turbine (544kW)	*.87*	*.58*	*.43*
3 turbines (1632 kW	*2.60*	*1.74*	*1.30*
10 turbines (5440 kW)	*8.68*	*5.79*	*4.34*
19 turbines (10,336 kW)	*16.49*	*10.99*	*8.24*

For one turbine to operate at the rated output, the upper and lower reservoirs would each be at a minimum size at 0.58 surface acres at 30 ft depth.

Energy required in pumping water from lower reservoir to upper reservoir

As the system name implies, after the water is discharge from the upper reservoir, energy is then needed to pump the water from the lower reservoir to the upper reservoir. The amount of electrical energy needed is about 26% more than generated. So the energy generated by a single hydro turbine generating at 544 kW for 6 hours is equal to 3,264 kWh. 4,411 kWh would then be needed to recharge the uppers reservoir.

Conclusion

Most hydroelectric pumped-storage system are designed and built in markets that need to address a very high demand requirement such as industrial zone and remote sites. The proposed project area in the Fort Berthold reservation does not have high demand period. Using the pumped-storage concept may work combined with a wind farm but in this case the net effective head is not substantial enough help offset a firm requirement.

Tribal Renewable Energy
Final Technical Report

Tab 9

Tribal Economic Development Options

Project Title: Three Affiliated Tribes Renewable Energy Feasibility Study

Date of Report: May 24, 2006

Recipient Organization: Three Affiliated Tribes of the Ft. Berthold Reservation

Award Number: DE-FG36-04GO14021

Partners: Three Affiliated Tribes of the Fort Berthold Reservation
Distributed Generation Systems, Inc. (cost sharing partner)

ECONOMIC DEVELOPMENT

For

The Mandan, Hidatsa, and Arikara Nation on the
Fort Berthold Indian Reservation

Summary

The proposed 30MW wind farm, if constructed will provide Tribal jobs during a construction period of at least 180 days. After the construction, 2 to 4 full-time operations and maintenance jobs will be required. The O&M jobs will be of manufacturing quality and will be required for the life of the facility, which is expected to be 25 years. A single administrative person will required for reporting on project performance and accounting functions. For the first few years, there will be a need for post-construction monitoring of environmental impacts, particularly in recording bird strikes, if any.

Other value added economic opportunities exist during the construction period. Concrete and aggregate will be needed to supply the wind turbine base and roads leading to the wind site. Construction workers will need to feed and housed in the local community areas.

The Tribe selected a representative to learn and build its' capacity for any energy development activities. Terry Fredericks learn the following items during this activity of the feasibility study that included wind Resource Assessment Capabilities, energy assessment, and energy project management.

Other evaluated resources such as solar, biomass and hydropower that was evaluated for this study cannot provide the economic stimulus that a wind energy facility can produced.