SITE PERMIT APPLICATION FOR A LARGE WIND ENERGY CONVERSION SYSTEM

SUBMITTED TO:

MINNESOTA PUBLIC UTILITIES COMMISSION

DOCKET NO. IP7013/WS-19-619

SUBMITTED BY:

BIG BEND WIND, LLC

COTTONWOOD AND WATONWAN COUNTIES, MINNESOTA

NOVEMBER 2020

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ACRONYM LIST

AADT	Annual Average Daily Traffic
ABPP	Avian and Bat Protection Plan
ADLS	Aircraft Detection Lighting System
AMA	Aquatic Management Area
ANSI	American National Standards Institute
Apex	Apex Clean Energy, LLC
Applicant	Big Bend Wind, LLC
Application	Site Permit Application
Area of Interest	A 390-square-mile area including eastern Cottonwood County, southern Brown County, western Watonwan County, and northwestern Martin County that Big Bend Wind, LLC reviewed to identify suitable areas for siting the wind project and routing a transmission line to interconnect with the Lakefield Junction 345 kV transmission line in northwestern Martin County.
AUID	Assessment Unit Identifier
AWWI	American Wind Wildlife Institute
BBCS	Bird and Bat Conservation Strategy
BCC	Birds of Conservation Concern
BGEPA	Bald and Golden Eagle Protection Act
Big Bend	Big Bend Wind, LLC
Big Blue	Big Blue Wind Farm
BMP	best management practice
BOP	Balance of Plant
BWSR	Board of Water and Soil Resources
Cadna-A	Computer Aided Design for Noise Abatement
Commission	Minnesota Public Utilities Commission
CN	Certificate of Need
CREP	Conservation Reserve Enhancement Program
CSAH	County State Aid Highway
CWA	Clean Water Act
CWI	County Well Index
dB	decibels
dB(A)	decibels using the A-weighted scale
DOC	Minnesota Department of Commerce
DOC-EERA	Minnesota Department of Commerce – Energy Environmental Review and Analysis
ECD	Erosion Control Device
ECPG	Eagle Conservation Plan Guidance, Module 1 – Land-based Wind Energy, Version 2
Elm Creek I	Elm Creek I Wind Project

Elm Creek II	Elm Creek II Wind Project
EMF	electromagnetic field
EPA	U.S. Environmental Protection Agency
ESA	Endangered Species Act of 1973
FAA	Federal Aviation Administration
FCC	Federal Communications Commission
FEMA	Federal Emergency Management Agency
FHWA	Federal Highway Administration
FRS	Facility Registry Service
FSA	Farm Service Agency
ft	feet
Grand Meadow	Grand Meadow Wind Farm
GRE	Great River Energy
GW	gigawatt
Hz	hertz
IARC	International Agency for Research on Cancer
IBA	Important Bird Area
ICNIRP	International Commission on Non-Ionizing Radiation Protection
Jeffers Site	Jeffers Petroglyphs
Jeffers Visitors Center	Jeffers Petroglyphs Historic Site Visitors Center
KOPs	key observation points
kV	kilovolt
kV/m	kilovolts per meter
L_{10}	ten percent of an hour
L_{50}	fifty percent of an hour
Lakefield	Lakefield Wind Project
LGU	Local Government Unit
LiDAR	Light Detection and Ranging
LWECS	Large Wind Energy Conversion System
LWECS Application Guidance	Application Guidance for Site Permitting of Large Wind Energy Conversion Systems in Minnesota (Revised July 2019)
m	meters
m/s	meters per second
MBS	Minnesota Biological Survey
MBTA	Migratory Bird Treaty Act
Mbps	megabytes per second
MDH	Minnesota Department of Health
MERRA-2	Modern-Era Retrospective analysis for Research and Applications
MGS	Minnesota Geological Survey
MIAC	Minnesota Indian Affairs Council

MISO	Midcontinent Independent System Operator, Inc.
MN DEED	Minnesota Department of Employment and Economic Development
MNDNR	Minnesota Department of Natural Resources
MNDOT	Minnesota Department of Transportation
MNHS	Minnesota Historical Society
MPCA	Minnesota Pollution Control Agency
MPUC	Minnesota Public Utilities Commission
MW	megawatt
MWFRA	Migratory Waterfowl Feeding and Resting Area
NAC	Noise Area Classification
NASA	National Aeronautics and Space Administration
NHIS	Natural Heritage Information System
NIEHS	National Institute of Environmental Health Sciences
NLEB	northern long-eared bat
NOAA	National Oceanic and Atmospheric Administration
NPC	native plant community
NPDES	National Pollutant Discharge Elimination System
NRCS	Natural Resource Conservation Service
NRHP	National Register of Historic Places
NWI	National Wetlands Inventory
NWR	National Wildlife Refuge
O&M	operations and maintenance
Odell	Odell Wind Farm
PEM	palustrine emergent
PFO	palustrine forested
Phase I ESA	Phase I Environmental Site Assessment
POI	Points of Interconnection
Prairie Rose	Prairie Rose Wind Energy Facility
Project	Big Bend Wind Project
Project Area	The area within the Project boundary identified in Figure 1 of this Application
PSS	palustrine scrub-shrub
PWI	Public Waters Inventory
PWP	Permanent Wetland Preserve
QSI	Quality Services, Incorporated
RCRA	Resource Conservation and Recovery Act
RD	rotor diameter
Red Pine	Red Pine Wind Energy
RFP	Request for Proposal
RIM	Reinvest in Minnesota

RRRRG	Red Rock Ridge Research Group
SCADA	Supervisory Control and Data Acquisition
SCS	Site Characterization Study
SDS	State Disposal System
SDWA	Safe Drinking Water Act
SHPO	State Historic Preservation Office
SNA	Scientific and Natural Area
SOBS	Sites of Biodiversity Significance
SoDAR	Sonic Detection and Ranging
Solar Project	Red Rock Solar Project
SSA	sole source aquifer
SSI	Swedish Radiation Protection Authority
SSM	Swedish Radiation Safety Authority
SWPPP	Stormwater Pollution Prevention Plan
TCP	Traditional Cultural Properties
THPO	Tribal Historic Preservation Officer
TI	Turbulence Intensity
UDP	Unanticipated Discoveries Plan
U.S.C.	United States Code
USACE	U.S. Army Corps of Engineers
USDA	U.S. Department of Agriculture
USGS	U.S. Geological Survey
USFWS	U.S. Fish and Wildlife Service
WCA	Wetland Conservation Act
WEG	Wind Energy Guidelines
WEST	Western EcoSystems Technology, Inc
WHO	World Health Organization
WHPA	Wellhead Protection Area
WIMN	MPCA's *What's in My Neighborhood* Database
Wind Project	Big Bend Wind Project
WMA	Wildlife Management Area
WPA	Waterfowl Production Area
ZVI	Zone of Visual Influence

1.0 APPLICANT INFORMATION

Big Bend Wind, LLC (Big Bend or Applicant), an affiliate of Apex Clean Energy Holdings, LLC (Apex), respectfully submits this application (the Application) to the Minnesota Public Utilities Commission (MPUC or Commission) for a Site Permit to construct and operate the up-to-308 megawatt (MW) nameplate capacity Big Bend Wind Project (the Wind Project or Project). The Project is a Large Wind Energy Conversion System (LWECS), as defined in the Wind Siting Act, Minn. Stat. Ch. 216F. The Project is located in southwestern Minnesota's Cottonwood and Watonwan Counties, and its footprint spans 43,523 acres in portions of Delton, Selma, Carson, and Midway Townships in Cottonwood County and Butterfield Township in Watonwan County (Project Area; see Figure 1 – Project Location).

Big Bend is developing the Project and would be the permittee. Big Bend proposes to connect the Project to the Blue Lake-Wilmarth-Interstate Junction 345 kilovolt (kV) transmission line approximately 10 miles south of the Project Area. Big Bend will need to build approximately 18 miles of 161 kV transmission line to connect to the Blue Lake-Wilmarth-Interstate Junction 345 kV transmission line. Because the proposed transmission line is 161 kV and more than 1,500 feet in length, a Route Permit from the Commission will be required, pursuant to Minn. Stat. Ch. 216E and Minn. R. Ch. 7850. Big Bend's Route Permit application is available in Docket No. IP7013/TL-19-621. Additionally, Apex is also developing the Red Rock Solar Project, an up to 60 MW solar facility, within the Big Bend Project Area (the Solar Project; see Docket No. IP7014/GS-19-620). Together, the Big Bend Wind Project and Red Rock Solar Project represent Minnesota's first potential wind-solar hybrid renewable energy project. As proposed, the renewable energy generation could consist of up to 308 MWs of wind, or a combination of wind and up to 60 MW of solar. In this Application, Big Bend includes environmental analysis for up-to-308 MW of wind; however, should the Solar Project be developed, the Solar Project would be constructed within the proposed Wind Project site boundaries, and the overall size of the Wind Project would decrease.

Apex is an independent renewable energy company based in Charlottesville, Virginia. Since its founding in 2009, Apex has become one of the fastest-growing companies in the industry. More than a dozen Apex-originated wind and solar facilities are now operating around the country, totaling nearly three gigawatts (GWs), with another one GW scheduled to be brought online in the coming months. Operating assets under management have grown to 1.6 GW. Apex has signed contracts for the sale of more than 20 projects totaling over five GW of capacity, and its development portfolio of approximately 20 GW of wind, solar, and storage projects is one of the largest in the United States. Apex's mission-driven team of more than 200 renewable energy experts uses a data-focused approach to create solutions for the world's most innovative and forward-thinking customers.

2.0 RELATED PROCEEDINGS

2.1 Certificate of Need

A Certificate of Need (CN) is required for all "large energy facilities," as defined in Minn. Stat. § 216B.2421, subd. 2(1), unless the facility falls within a statutory exemption from the CN requirements. Because the Project is a generating plant larger than 50 MW, it meets the definition of a large energy facility. Big Bend's CN Application is available in MPUC Docket No. IP-7013/CN-19-408.

2.2 Request for Joint Proceedings

As described above, together, Big Bend and Red Rock are proposing the state's first utility-scale hybrid renewable energy facility and shared transmission line. In addition to this Site Permit Application, Big Bend has applied for a Certificate of Need for the Wind Project in Docket No. IP7013/CN-19-408 and a Route Permit in Docket No. IP7013/TL-19-621. Red Rock Solar has filed a Site Permit Application in Docket No. IP-7014/GS-19-620 and Certificate of Need in Docket No. IP-7014/CN-19-486.

Minnesota Statute section 216B.243, subdivision 4 and Minnesota Rule 7849.1900, subpart 4 permit the Commission to hold joint proceedings for the Certificate of Need, Site Permit and Route Permit in circumstances where a joint hearing is feasible, more efficient, and may further the public interest. Big Bend respectfully requests that the Commission order a joint regulatory review process for the Big Bend Route Permit, Site Permit, and Certificate of Need applications and Red Rock Solar Site Permit and Certificate of Need applications. Holding a joint proceeding is in the public interest because it will make it easier for members of the public to participate in the proceedings, provide a comprehensive record of all benefits, impacts and minimization measures related to this hybrid renewable energy project and improve administrative efficiency.

3.0 STATE POLICY

The contents and treatment of applications for LWECS site permits are governed by Minn. R. Ch. 7854 under the Wind Siting Act (Minn. Stat. Ch. 216F). The Wind Siting Act also requires the Commission to consider the criteria set forth in Minn. Stat. § 216E.03, subd. 7, including effects on land, water and air resources, economic impacts, and other factors. This Application provides information necessary to demonstrate compliance with these criteria and Minn. R. Ch. 7854. This Application has been organized following the Minnesota Department of Commerce – Energy Environmental Review and Analysis (DOC-EERA) Application Guidance for Site Permitting of Large Wind Energy Conversion Systems in Minnesota (Revised July 2019; LWECS Application Guidance).

State policy supports LWECS siting in an orderly manner compatible with environmental preservation, sustainable development, and the efficient use of resources (Minn. Stat. § 216F.03). Big Bend has designed the Project to comply with the Commission's wind turbine setback and siting guidelines. Table 3.0-1 provides a completeness checklist for the Application, identifying the Minnesota Administrative Rules for a LWECS site permit application contents and where each element of those rules is addressed in the Application.

Table 3.0-1
Completeness Checklist

Authority	Required Information	Location
Minn. R. Ch. 7854		
Minn. R. 7854.0500	**SITE PERMIT APPLICATION CONTENTS**	
Minn. R. 7854.0500, subp. 1	**Applicant**. An applicant for a site permit must provide the following background information regarding the applicant:	
A.	A letter of transmittal signed by an authorized representative or agent of the applicant;	*See* Application Filing Letter and Cover Page
B.	The complete name, address, and telephone number of the applicant and any authorized representative;	*See* Application Filing Letter and Cover Page
C.	The signature of the preparer of the application if prepared by an agent or consultant of the applicant;	*See* Application Filing Letter and Cover Page
D.	The role of the permit applicant in the construction and operation of the LWECS;	Section 1.0
E.	The identity of any other LWECS located in Minnesota in which the applicant, or a principal of the applicant, has an ownership or other financial interest;	Section 1.0
F.	The operator of the LWECS if different from the applicant; and	Section 1.0
G.	The name of the person or persons to be the permittees if a site permit is issued.	Section 1.0
Minn. R. 7854.0500, subp. 2	**Certificate of need or other commitment**.	
A.	The applicant shall state in the application whether a certificate of need for the system is required from the	Section 2.1

Table 3.0-1
Completeness Checklist

Authority	Required Information	Location
	commission and, if so, the anticipated schedule for obtaining the certificate of need. The commission shall not issue a site permit for an LWECS for which a certificate of need is required until the applicant obtains the certificate, although the commission may process the application while the certificate of need request is pending before the commission.	
B.	The commission may determine if a certificate of need is required for a particular LWECS for which the commission has received a site permit application.	N/A
C.	If a certificate of need is not required from the commission, the applicant shall include with the application a discussion of what the applicant intends to do with the power that is generated. If the applicant has a power purchase agreement or some other enforceable mechanism for sale of the power to be generated by the LWECS, the applicant shall, upon the request of the commission, provide the commission with a copy of the document.	N/A
Minn. R. 7854.0500, subp. 3	**State policy**. The applicant shall describe in the application how the proposed LWECS project furthers state policy to site such projects in an orderly manner compatible with environmental preservation, sustainable development, and the efficient use of resources.	Section 3.0
Minn. R. 7854.0500, subp. 4	**Proposed site**. The applicant shall include the following information about the site proposed for the LWECS and any associated facilities:	
A.	The boundaries of the site proposed for the LWECS, which must be delineated on a United States Geological Survey Map or other map as appropriate;	Section 4.0 and Figure 1
B.	The following characteristics of the wind at the proposed site: (1) interannual variation; (2) seasonal variation; (3) diurnal conditions; (4) atmospheric stability, to the extent available; (5) turbulence, to the extent available; (6) extreme conditions; (7) speed frequency distribution; (8) variation with height; (9) spatial variations; and (10) wind rose, in eight or more directions;	Section 9.1
C.	Other meteorological conditions at the proposed site, including the temperature, rainfall, snowfall, and extreme weather conditions; and	Section 9.1.11
D.	The location of other wind turbines in the general area of the proposed LWECS.	Section 9.2

Table 3.0-1 Completeness Checklist		
Authority	**Required Information**	**Location**
Minn. R. 7854.0500, subp. 5	**Wind rights**. The applicant shall include in the application information describing the applicant's wind rights within the boundaries of the proposed site.	Section 7.0
Minn. R. 7854.0500, subp. 6	**Design of project**. The applicant shall provide the following information regarding the design of the proposed project:	
A.	A project layout, including a map showing a proposed array spacing of the turbines;	Section 5.1 and Figures 1, 2a – 2c, and 3a-3c
B.	A description of the turbines and towers and other equipment to be used in the project, including the name of the manufacturers of the equipment;	Section 5.2
C.	A description of the LWECS electrical system, including transformers at both low voltage and medium voltage; and	Section 5.3
D.	A description and location of associated facilities.	Section 6.0
Minn. R. 7854.0500, subp. 7	**Environmental impacts**. An applicant for a site permit shall include with the application an analysis of the potential impacts of the project, proposed mitigative measures, and any adverse environmental effects that cannot be avoided, in the following areas:	
A.	Demographics, including people, homes, and businesses;	Sections 8.1 and 8.2
B.	Noise;	Section 8.4
C.	Visual impacts;	Section 8.5
D.	Public services and infrastructure;	Section 8.6
E.	Cultural and archaeological impacts;	Section 8.7
F.	Recreational resources;	Section 8.8
G.	Public health and safety, including air traffic, electromagnetic fields, and security and traffic;	Section 8.9
H.	Hazardous materials;	Section 8.10
I.	Land-based economics, including agriculture, forestry, and mining;	Section 8.11
J.	Tourism and community benefits;	Sections 8.12 and 8.13
K.	Topography;	Section 8.14
L.	Soils;	Section 8.15
M.	Geologic and groundwater resources;	Section 8.16
N.	Surface water and floodplain resources;	Section 8.17
O.	Wetlands;	Section 8.18
P.	Vegetation;	Section 8.19
Q.	Wildlife; and	Section 8.20
R.	Rare and unique natural resources.	Section 8.21

Table 3.0-1
Completeness Checklist

Authority	Required Information	Location
Minn. R. 7854.0500, subp. 8	**Construction of project**. The applicant shall describe the manner in which the project, including associated facilities, will be constructed.	Sections 10.1, 10.2, 10.3, 10.4, and 10.5
Minn. R. 7854.0500, subp. 9	**Operation of project**. The applicant shall describe how the project will be operated and maintained after construction, including a maintenance schedule.	Section 10.6
Minn. R. 7854.0500, subp. 10	**Costs**. The applicant shall describe the estimated costs of design and construction of the project and the expected operating costs.	Section 10.7
Minn. R. 7854.0500, subp. 11	**Schedule**. The applicant shall include an anticipated schedule for completion of the project, including the time periods for land acquisition, obtaining a site permit, obtaining financing, procuring equipment, and completing construction. The applicant shall identify the expected date of commercial operation.	Section 10.8
Minn. R. 7854.0500, subp. 12	**Energy projections**. The applicant shall identify the energy expected to be generated by the project.	Section 10.9
Minn. R. 7854.0500, subp. 13	**Decommissioning and restoration**. The applicant shall include the following information regarding decommissioning of the project and restoring the site:	
A.	The anticipated life of the project;	Section 11.1
B.	The estimated decommissioning costs in dollars;	Section 11.2
C.	The method and schedule for updating the costs of decommissioning and restoration;	Section 11.2
D.	The method of ensuring that funds will be available for decommissioning and restoration; and	Section 11.3
E.	The anticipated manner in which the project will be decommissioned and the site restored.	Section 11.4
Minn. R. 7854.0500, subp. 14	**Identification of other permits.** The applicant shall include in the application a list of all known federal, state, and local agencies or authorities, and titles of the permits they issue that are required for the proposed LWECS.	Section 12.0

4.0 PROJECT DESCRIPTION AND OVERVIEW

4.1 Project Development History

Big Bend initiated development of the Big Bend Wind Project in 2017 by reviewing a 390-square-mile Area of Interest that included eastern Cottonwood County, southern Brown County, western Watonwan County, and northwestern Martin County. This Area of Interest was reviewed to identify suitable areas for siting the wind project and routing a transmission line to interconnect with the Lakefield Junction 345 kV transmission line in northwestern Martin County. The Area of Interest was shaped by considering the available wind resource, proximity to the existing transmission system, Federal Aviation Administration (FAA) airspace, military airspace, coordination on tribal interests, existing wind farms, and landowner interest in hosting Project facilities. In late 2017, Big Bend coordinated with the Minnesota Department of Natural Resources (MNDNR) to determine if any rare species or other significant natural features are known to occur within the Area of Interest by submitting a Natural Heritage Information System (NHIS) request. MNDNR provided a response on December 18, 2017, indicating the Area of Interest included several rare features and natural features including the following:

- Ecologically Significant Areas
    - Prairie Core Areas and Prairie Corridors, as identified in the Minnesota Prairie Conservation Plan. MNDNR recommended the Project avoid Prairie Core Areas and minimize impacts to grasslands within the Prairie Corridor.
    - Minnesota Biological Survey (MBS) identified Sites of Biodiversity Significance (SOBS), which have varying levels of native biodiversity and are ranked based on the relative significance of this biodiversity at a statewide level and include below, moderate, high, and outstanding rankings. Generally, SOBS contain known occurrences of rare native plant communities (NPCs), state-protected plants and animals, and/or federally protected butterflies and plants. MNDNR recommends avoidance of SOBS.
        - There were three SOBS ranked outstanding within the Area of Interest, including Rock Ridge Prairie Scientific and Natural Area (SNA), Jeffers Petroglyphs site (Jeffers Site) managed by the Minnesota Historical Society (MNHS), and The Nature Conservancy's Red Rock Prairie Preserve.
- Over 2,000 acres of NPCs.
- Several tracks of MNDNR-mapped native prairie and two parcels enrolled in the Native Prairie Bank program.
- Calcareous fens, which are rare and distinctive peat-accumulating wetlands that are legally protected in Minnesota.
- Rare species
    - Reptiles and amphibians
        - Blanding's turtle (state threatened) record
        - Great plains toad (state special concern) and western fox snake (Species of Greatest Conservation Need in Minnesota's State Wildlife Action Plan).

- Birds
  - Henslow's sparrow (state endangered) record associated with grassland.
  - Loggerhead shrike (state endangered) record associated with small trees or shrubs in grasslands, old fields, shelterbelts, orchards, or farmyards.
  - Important Bird Areas (IBAs) identified by Audubon Minnesota in partnership with the MNDNR, southwest of the Area of Interest (Heron Lake IBA and Des Moines River IBA). IBAs are voluntary and non-regulatory, but the designation demonstrates the biological value of the surrounding area and indicates potentially higher bird numbers and diversity.
- Prairie-dependent butterflies
  - Poweshiek skippering (federally and state endangered) and Dakota skipper (federally threatened and state endangered) have been documented in the Area of Interest in the 1970s.
  - Phlox moth and regal fritillary (both state special concern) have been documented more recently.
  - MNDNR recommends avoidance of native prairie for which these species depend upon.
- Caddisflies
  - A caddisfly (state threatened) occurs within the Area of Interest.
- Bats
  - NHIS tracks bat roost trees and hibernacula plus some acoustic data, but the information is not exhaustive. Northern long-eared bat, tricolored bat, big brown bat, and little brown bat are all state-listed special concern species that may occur within the Area of Interest.

Big Bend reviewed MNDNR's NHIS comments and recommendations and created a 2018 Project Area of approximately 200 square miles that eliminated southern Brown County and reduced the potential development area in Cottonwood County. This reduction of 190 square miles addressed some of MNDNR's concerns, but not all of them. In particular, the Prairie Core Area and outstanding SOBS associated with the Jeffers Site in northwestern Cottonwood County were still within the 2018 Project Area.

The Jeffers Site, which is a historic site within the state Historic Site Network managed by MNHS Site, "is home to about 5,000 sacred rock carvings, also called petroglyphs, made by the ancestors of today's Native Americans" approximately 7,000 years ago.[1] The 160-acre Jeffers Site is characterized by rock outcrops on which the petroglyphs are located, surrounded by native prairie. Surrounding the Jeffers Site is the Red Rock Ridge, which is a discontinuous ridge of

[1] https://www.mnhs.org/jefferspetroglyphs.

Sioux quartzite outcrops that includes Jeffers Petroglyphs State Historic Site and The Nature Conservancy's Red Rock Prairie Preserve.

Big Bend took a comprehensive approach to communication with the Jeffers Site stakeholders, including Native American tribes, the Red Rock Ridge Research Group (RRRRG), the Minnesota Indian Affairs Council (MIAC), local elected officials, MNHS Jeffers Site staff, and the Minnesota State Historic Preservation Office (SHPO) to actively solicit feedback from all interested parties regarding the potential for the Project to affect the Jeffers Site and the surrounding geologic formation known as Red Rock Ridge.

In July 2018, Big Bend sent invitations to stakeholders for a meeting at the Big Bend Mountain Lake project office in September 2018 to present preliminary project design details and gather initial feedback. At this meeting, feedback received from the Native American tribes, RRRRG, and MNHS Jeffers Site staff centered around visual and auditory impacts, revising the Project boundary to avoid the Jeffers Site, requesting visual simulations of the proposed turbine layout, and cultural and tribal surveys.

Between September 2018 and July 2019, Big Bend continued coordination with tribes and the MNHS while continuing Project development activities, such as land acquisition and wildlife studies. In July 2019, Big Bend hosted another meeting with interested tribes, RRRG, and Jeffers Petroglyphs Historic Site Visitors Center (Jeffers Visitor Center) staff to share Project updates These updates were based on initial feedback from the September 2018 meeting and included confirmation that the Project will be located entirely on private land and information about how the Project boundary was refined to avoid known culturally sensitive areas such as the Jeffers Site and Red Rock Prairie Observatory, as well as MNDNR-identified Prairie Core Areas. Big Bend also expressed its interest in coordinating with tribal representatives to identify culturally-sensitive areas and minimizing impacts on these areas. Big Bend requested that tribes with interest in conducting or participating in cultural resource surveys confirm their interest by early September 2019. Big Bend also provided information about the construction and decommissioning processes, noise, preliminary visual simulations, and a map of the 2019 Project Area and preliminary turbine layout that showed the closest turbine 2.3 miles from the Jeffers Site. Additional feedback received at this meeting included a recommendation that turbines be placed at least five miles from the Red Rock Ridge but specific locations on the ridge were not identified at this meeting, and that no turbines be sited north of Minnesota Highway 30.

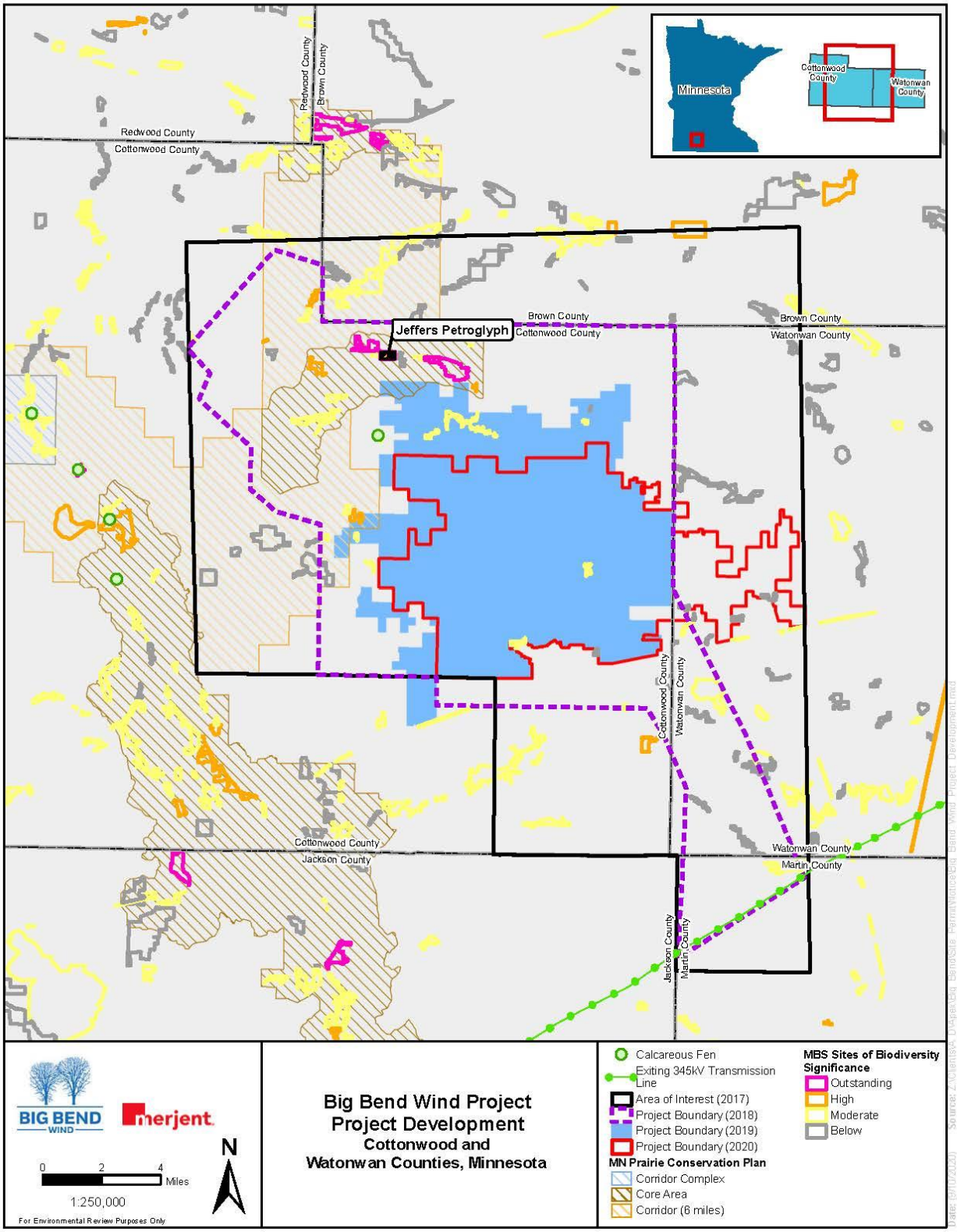
In September 2019, staff from the Minnesota Department of Commerce (DOC) hosted a meeting of stakeholders including the MNHS and SHPO, Big Bend, and Quality Services, Incorporated (QSI), the Project's cultural resource management subconsultant for archaeological surveys and coordination of tribal outreach. This meeting focused on the cultural and tribal resource survey methodology developed by Big Bend in coordination with interested tribes, which both MNHS and SHPO considered appropriate. Archaeological and tribal surveys commenced in October 2019.

Between Fall 2019 and Spring 2020, Big Bend continued Project development activities such as layout modifications, land acquisition, cultural and wildlife surveys, and stakeholder communication. While the 2019 Project Area excluded the Jeffers Site, Big Bend continued to address the potential visual impact concerns of the MNHS and tribes by signing additional easements in Watonwan County. In Spring 2020, Big Bend finalized the Project Area put forth in this Application, updated the visual simulations and completed a visual assessment that demonstrate the Project does not represent a significant impact to the key observation points at

the Jeffers Site (see Section 8.7 (Cultural and Archaeological Resources) and Appendix A – Visual Impact Assessment Report).

The Project development history presented in this section provides a summary of stakeholder input; additional details are provided in Sections 8.7 and 8.20. Image 4.1-1 shows the Project development history specific to MNDNR feedback and the Jeffers Site.

Image 4.1-1: Big Bend Project Development History



4.2 Big Bend Wind Project Overview

The Project Area included in this Application is the result of a comprehensive three-year siting approach that included stakeholder involvement from agencies, non-government units, and Native American tribes. The Project Area is bounded by tribal interests to the north, military airspace on the east, local airport airspace constraints on the west, and existing wind farms on the south. Specific to natural resources and MNDNR comments, the Project Area avoids the Prairie Core Area and Prairie Corridors, SOBS ranked high or outstanding, and calcareous fens; minimizes SOBS ranked moderate or below and native prairie and NPCs; and is 93 percent cultivated crops, thereby limiting habitat for rare species. Specific to the Jeffers Site, the Project Area is south of Minnesota Highway 30, excluding and creating distance from the Jeffers Site. Additionally, Big Bend has initiated cultural resource and tribal surveys, and provided updated visual simulations where the closest turbine is now over five miles from the Jeffers Site (see Section 8.7 for a discussion on the turbine layout related to the Jeffers Site). Big Bend's turbine siting effort within the Project Area is described in Section 5.1.

Big Bend's effort to avoid and minimize impacts to natural and cultural resources resulted in shifting the Project to the south and east away from the Project's initial core group of landowners that own developable private land near the Jeffers Site. Big Bend has 6,688 acres of leased land outside the Project Area between the Project and the Jeffers Site that were initially eligible to host facilities, but are now excluded from the Project Area to minimize visual impact concerns related to the Jeffers Site (see Figure 4 – Land Ownership). Landowners within this buffer zone were critical to initial Project development, and Big Bend has offered ongoing participation to these landowners despite the fact that the land is now outside the Project Area.

The Project Area includes portions of four townships in eastern Cottonwood County and one township in western Watonwan County. The boundary of the Project Area is identified in Figure 1 (Project Location) of this Application. Table 4.0-1 lists the counties, townships, ranges, and sections that are included in the Project Area.

Table 4.0-1
Project Location

County Name	Township Name	Township	Range	Sections
Cottonwood	Delton	107N	35W	25-28, 33-36
	Selma	107N	34W	27-29, 31-36
	Carson	106N	35W	1-2, 10-16, 21-26, 35-36
	Midway	106N	34W	1-32, 34-36
Watonwan	Butterfield	106N	33W	3, 6-11, 15-23, 26, 28-29

The Project Area boundary includes 43,523 acres, of which 34,029 are currently leased or pending leases for the Project (78 percent; of the 34,029 acres, 1,141 acres are "pending participants" where the lease paperwork is underway and in the process of being finalized). Big Bend continues to acquire public and private agreements to construct and operate the Project, including associated wind rights. The Project's aboveground facilities will occupy less than one percent of the Project Area.

The Project will have up to 308 MW of nameplate wind energy capacity. Big Bend is currently proposing three wind turbine models with rated nameplate capacity ranging from 5.5 MW to 5.7 MW, corresponding to between 54 and 55 wind turbines. As described more fully in Section 5.1,

all three turbine models would utilize the same turbine layout (see Figures 3a-3c). Big Bend provides environmental analyses in Section 8.

As described in Sections 5.2, 5.3, and 6.0, the Project's facilities will include:

- up to 55 wind turbines and related equipment;
- new gravel access roads and improvements to existing roads;
- underground and/or aboveground electrical collection and communication lines;
- one operations and maintenance (O&M) facility;
- one Project substation;
- up to one permanent meteorological tower;
- one Sonic Detection and Ranging (SoDAR) or Light Detection and Ranging (LiDAR) unit;
- one laydown area;
- up to four Aircraft Detection Lighting Systems (ADLS) radars; and
- one temporary batch plant area, if needed, for construction of the Project.

As described in this Application, the number and location of certain Project facilities (e.g., permanent meteorological towers and ADLS) may vary based on regulatory approvals, contractor specifications, and landowner input. Accordingly, Big Bend has provided environmental information, anticipated impacts, and proposed mitigation measures for the Project Area and the turbine layout (where applicable) to allow the Commission to consider the potential impacts and evaluate conditions for the LWECS site permit.

5.0 PROJECT DESIGN

5.1 Description of Project Layouts

The proposed layout for the Project optimizes the wind resource and avoids and/or minimizes potential impacts to humans and the environment. As discussed in this section, the interaction among the local topography, the wind resource, regulatory setbacks, landowner input, site control, turbine model, collection-line requirements, and engineering also influences the layout of the Project's facilities. The Project Area contains 43,523 acres, of which 34,029 are currently under or pending lease agreements. Descriptions of the proposed turbine models are provided in Section 5.2.

The Project's layout follows the wind energy conversion facility siting criteria outlined in the Commission's Order Establishing General Wind Permit Standards, Docket No. E,G999/M-07-1102 (January 11, 2008; Commission's General Permit Standards), applicable local government ordinances, and Apex's best practices. In instances when setbacks differ for the same feature, the more stringent setback distance is used. Table 5.1-1 shows turbine setbacks and Figures 2a-2c illustrate the relevant Project setbacks.

Cottonwood and Watonwan Counties have not assumed permitting authority under Minn. Stat. § 216F.08 for an LWECS (see Docket 07-1102). Therefore, Big Bend implemented setbacks described the Commission's General Permit Standards. Table 5.1-1 below describes the setbacks applied to the design of the Big Bend Wind Project. Figures 2a-2c display the turbine layout and constraints for each of the three turbine models under consideration.

Table 5.1-1
Wind Turbine Setback Requirements for the Project

Turbine Setback Requirement	Distance for Setback	Authority	Setback applied to Big Bend Wind Farm
Wind Access Buffer – Prevailing Wind Directions[1]	5 x rotor diameter (RD)	Commission's General Permit Standards	5 x RD
Wind Access Buffer – Non-Prevailing Wind Directions[1]	3 x RD	Commission's General Permit Standards	3 x RD
Residences	500 feet, or the minimum distance required to meet the state noise standard of 50 decibels (dB) using the A-weighted scale (dB(A)), whichever is greater	Commission's General Permit Standards	1,200 feet from residences
Noise Requirements	Distance must meet the state noise standard of 50 dB(A)[2]	Minnesota Pollution Control Agency (MPCA)	Turbines are sited for turbine-only noise to be < 45 dB(A) at non-participating residences and < 47 dB(A) at participating residences[3]

Table 5.1-1
Wind Turbine Setback Requirements for the Project

Turbine Setback Requirement	Distance for Setback	Authority	Setback applied to Big Bend Wind Farm
Public Roads and Trails	Minimum 250 feet	Commission's General Permit Standards	1.1 x total turbine height

[1] See Section 9.1.10 for a discussion on Big Bend's wind access buffer.

[2] Commission's General Permit Standards identify the minimum setback from residences as 500 feet, or the minimum distance required to meet the state noise standard of 50 decibels dB(A), whichever is greater. Big Bend follows the practice of siting turbines at least 1,200 feet from residences or the minimum distance required to meet the state noise standard of 50 decibels dB(A), whichever is greater.

[3] Noise standards are regulated by the MPCA under Minn. R. Ch. 7030. These rules establish the maximum night and daytime noise levels that effectively limit wind turbine noise to 50 dB(A). The MPCA standards require A-weighting measurements of noise; background noise must be at least 10 dB lower than the noise source being measured. Additionally, based on the 2019 LWECS Application Guidance, DOC-EERA staff recommend turbine-only noise to be < 45 dB(A) at non-participating residences and < 47 dB(A) at participating residences. The layouts included in this Application meet this recommendation.

As shown in Table 5.1-1, turbines in Project layouts presented in this Application are sited at least 1,200 feet from residences. Additionally, based on the LWECS Application Guidance, all turbines are sited to meet the recommendation of less than 45 dB(A) turbine-only noise at non-participating residences and less than 47 dB(A) turbine-only noise at participating residences. In doing so, and as described in more detail in Section 8.4 (Noise), the Project complies with the Minnesota Pollution Control Agency (MPCA) limit of 50 decibels (dB) using the A-weighted scale (dB(A)) nighttime L_{50} (the level exceeded for 50 percent of the time) noise level.

Big Bend applied a minimum setback of 1.1x turbine height from all public roads, trails, and other rights-of-way (i.e., powerlines). All turbines will be located a minimum of five rotor diameters (RDs) from non-leased properties in the prevailing wind direction (generally the northern edge of leased areas) and 3 RDs in the non-prevailing wind direction (generally the eastern, western, and southern edge of leased areas) to accommodate disruption of normal wind flow and protect the wind rights of non-participating landowners. Similarly, internal turbine spacing will be at least 5 RD in the prevailing wind direction and 3 RD in the non-prevailing wind direction, with no more than 20 percent of the Project's turbines closer than the prescribed internal setbacks. Table 5.1-2 reflects the differing setbacks based on RD for the types of turbines under consideration for the Project.

Table 5.1-2
Representative Minimum Turbine Setback Distances by Turbine Model

Turbine Description	5 RD[1]	3 RD[1]	1.1x Total Height (including blades)
Nordex N-163	815 m (2,674 ft)	489 m (1,605 ft)	220 m (722 ft)
Vestas V162	810 m (2,658 ft)	486 m (1,595 ft)	220 m (722 ft)
GE-158	790 m (2,592 ft)	459 m (1,506 ft)	205 m (673 ft)

[1] The listed RDs provide the range of rotor sizes; depending on the final turbine selection, the RD may vary from the listed values.

In addition to the regulatory setbacks applied to the Project in Table 5.1-1, Big Bend has designed the layout to minimize shadow flicker to 30 hours or less of shadow flicker per year at non-participating residences. Additionally, both layouts incorporate MNDNR feedback on siting turbines more than 1,000 feet from northern long-eared bat habitat and avoiding permanent and temporary impacts to MNDNR-mapped native prairie, NPCs, and all SOBS.

Additional turbine siting considerations and an approximate schedule for determining these factors are included in Table 5.1-3.

Table 5.1-3
Turbine Siting Considerations and Approximate Schedule

Issue	Expected Resolution Schedule	Siting Consideration
Exclusion areas	At issuance of permit	All exclusion areas in the Application are those proposed by Big Bend and are based on environmental and existing infrastructure constraints. Additional exclusion areas, if any, will be determined through the site permit process.
Setbacks	At issuance of permit	All setbacks in the Application are proposed by Big Bend and are based on the Commission's General Permit Standards (as applicable), as well as Big Bend's other commitments.
Turbine type	Once turbine purchase negotiations are complete	Siting turbines is based on: A) Manufacturer specs and standards B) Turbine interaction within the Project microclimate, etc.
Final leased land boundary	Once final lease and easement negotiations are complete with landowners	Big Bend will not site turbines on unleased properties and will observe a wind rights buffer from unleased property lines.
Title clearance	After site control is complete	Big Bend will site turbines on leased land that has been properly cleared using any necessary Subordination, Non-Disturbance and Attornment agreements and consent forms from appropriate parties. All signed land is to be insured through a title insurance policy. Big Bend will not site any project facilities on non-participating landowner properties.
Energy optimization	After all final leases and setback requirements are complete	Wind energy will be optimized by considering the turbine interaction with the site's microclimate and internal spacing between turbines within the Project.
Geotechnical analysis	After all other field surveys and turbine micrositing are complete	Geotechnical soil borings will be conducted at the location of final turbine placement to determine the soil suitability to support turbine foundations.

Table 5.1-3
Turbine Siting Considerations and Approximate Schedule

Issue	Expected Resolution Schedule	Siting Consideration
Wetlands	Jurisdictional wetlands and waters within the construction limits of Project facilities will be delineated prior to construction. Necessary state and/or federal permits for unavoidable impacts will be obtained before construction commences in wetlands	Permanent impacts to wetlands/waters subject to state and federal jurisdiction will be avoided or minimized to the extent practicable.
Cultural	Big Bend has coordinated with SHPO, conducted a literature review of the Project Area, and Project Facilities avoid previously identified NRHP listed, eligible, or unevaluated archaeological and historic sites. Big Bend will conduct surveys for previously unidentified cultural resources in fall 2020 based on the survey protocol approved by SHPO.	Cultural resources that are listed, eligible for listing, or that have not yet been evaluated for listing on the National Register of Historic Properties (NRHP) that are identified within the proposed construction areas will be avoided as feasible. If avoidance is not practical, additional investigation of the resource may be needed and further discussion with regulating agencies and tribes, as applicable, would be necessary prior to any direct impact to the resource occurring.

This Application contains one site layout that reflects Big Bend's best effort to maximize the energy production of the Project, follow applicable setbacks, and minimize human and environmental impacts to the land and surrounding community (Figures 3a-3c – Project Area and Facilities). Within the layout, Big Bend selected the proposed turbine locations to minimize the potential land use and environmental impacts from the Project. Big Bend proposes to construct the Project layout presented in this Application but also recognizes that changes to the location of some Project facilities may occur as a result of the Commission's and other permitting processes, further landowner input, and micrositing activities.

5.2 Description of Turbines and Towers

5.2.1 Wind Turbine Design and Operation

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

The tower supports the nacelle, hub, and blades. The tower houses electrical, control, and communication cables and a control system located at the base of the tower. Towers may include lifts for use by Project personnel. Tubular towers are painted a non-glare white or off-white. Electrical equipment at the base of each tower conditions the generated electricity to match

electric grid requirements. The expected tower foundation will be a spread-foundation design. The above-ground portion of the foundation will be approximately 20 feet in diameter.

The wind turbine blades convert linear energy from wind into rotational energy. An anemometer and weathervane located on the turbine nacelle continuously sense wind speed and wind direction.

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

5.2.2 Turbine Model Selection and Types

Big Bend has not yet finalized the specific turbine choice for the Project. The decision will be finalized prior to construction to create the most viable, cost-effective, and optimal design for the Project given the known conditions of the Project Area and the turbines that are commercially available when the Project is constructed. Further, since turbine technology is continually evolving, flexibility in selecting a turbine model will enable the Project to take advantage of the latest technology advancements. The turbines Big Bend is considering for the Project span the energy production range of 5.5 MW to 5.7 MW. Proposed turbine hub heights range from 107.4 to 119 meters (m; 353 to 391 feet) and the RD range from 158 to 163 m (519 to 535 feet). Table 5.2-1 shows the range of characteristics for the three proposed turbines, as well as the number of primary and alternate turbine positions for each of the turbine layouts.

Table 5.2-1
Wind Turbine Characteristics

Characteristic		Turbine		
		Nordex N-163	Vestas V162	GE-158
Nameplate capacity (kilowatts)		5,700	5,600	5,500
Hub height [1]	Meters (m)	108/118	119	107.4
	Feet (ft)	355/388	390	353
Rotor Diameter	m	163	162	158
	ft	535	532	519
Total height[2]	m	189.5/199.5	200	186.4
	ft	622/655	656	612
Cut-in wind speed[3] meters per second (m/s)		3	3	3
Rated capacity wind speed[4] (m/s)		12.5	12.0	13.0
Cut-out wind speed[5] (m/s)		26	24.0	25.0
Wind Swept Area (m^2)		20,867	20,611	19,607
Rotor speed (revolutions per minute)[6]		6-11.8	4.3-12.1	x-10.1
Primary Turbine Positions[7]		47	48	49

Table 5.2-1
Wind Turbine Characteristics

Characteristic	Turbine		
	Nordex N-163	Vestas V162	GE-158
Alternate Turbine Positions	7	7	6

1 Hub height = the turbine height from the ground to the top of the nacelle.
2 Total height = the total turbine height from the ground to the tip of the blade in an upright position.
3 Cut-in wind speed = wind speed at which turbine begins operation
4 Rated capacity wind speed = wind speed at which turbine reaches its rated capacity
5 Cut-out wind speed = wind speed above which turbine shuts down operation
6 The lower range for the GE-158 is not available.
7 The number of primary turbines listed here assumes up to 60 MW of solar will be developed. If the renewable energy generation is only wind, primary and alternate turbine positions would be utilized to reach a net capacity of up to 308 MW.

Turbine

Table 5.2-1 provides details on the hub height, RD, and wind speed operation parameters for the Nordex N-163 wind turbine, the Vestas V162 wind turbine, and the GE-158 wind turbine. The turbines use a bedplate drive-train design where all nacelle components are joined on common structures to improve durability. All three turbine models are capable of operating with adjusted cut-in speeds and full blade feathering.

All proposed turbine models have Supervisory Control and Data Acquisition (SCADA) communication technology to control and monitor the Project. The SCADA communications system permits automatic, independent operation and remote supervision, allowing the simultaneous control of the wind turbines.

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

Other turbine specifications are outlined for the three representative turbine models in Table 5.2-2.

Table 5.2-2
Other Turbine Specifications

Sub-System	Nordex N-163	Vestas V162	GE-158
Pitch Regulation	Electric Motors	Hydraulic Control	Electric
Gearbox	Multi-stage planetary gear + spur gear stage	2-stage planetary	multi-stage planetary/helical
Yaw Control	Four-state planetary gear	Multiple stages planetary gear	Multiple stages planetary gear
Braking System	Main aerodynamic brake (individual blade), mechanical brake on high-speed shaft	Main aerodynamic brake (individual blade), mechanical brake on medium-speed shaft	Main aerodynamic brake (individual blade), mechanical brake
Main Bearing	Spherical roller bearing	Rolling Bearings	Rolling Bearings

All of the turbines being considered also incorporate new technology compared to turbines currently installed on the landscape, including:

- force-flow bedplates (nacelle components joined on a common structure to improve durability);
- new gearbox bearing designs (improving reliability by reducing bending and thrust);
- low-noise trailing edges; and
- SCADA-controlled generation modulation.

Rotor

The rotor consists of three blades mounted to a rotor hub. The hub is attached to the nacelle, which houses the gearbox, generator, brake, cooling system, and other electrical and mechanical systems. Summary technical characteristics for each turbine model can be found in Table 5.2-1.

Tower

The towers are conical tubular in shape with a hub height of 107.4 to 119 m (353 to 391 feet). The turbine tower, where the nacelle is mounted, consists of three to four sections manufactured from certified steel plates. Welds are made with automatically controlled power welding machines and are ultrasonically inspected during manufacturing per American National Standards Institute (ANSI) specifications. All surfaces are sandblasted and multi-layer-coated for protection against corrosion. Access to the turbine is through a lockable steel door at the base of the tower. Within the tower, access to the nacelle is provided by a ladder connecting four platforms and equipped with a fall arresting safety system.

5.3 Description of Electrical and Fiber Optic Communication System

Construction of the Project will include up to 55 wind turbines. At the base of or within the tower section of each turbine, a step-up transformer will be installed to raise the voltage of the electricity generated by the turbine to the power collection line voltage of 34.5 kV. In the Vestas, GE and Nordex turbine models being proposed, the step-up transformer is typically located in the nacelle.

Electrical collection and fiber optic communication systems will connect the Project's wind turbines to the Wind Project Substation and provide communications between the wind turbines, substations, O&M facility, and electrical grid. The collection and fiber-optic systems will be underground, unless unanticipated site-specific conditions require above ground wiring. Where underground, the wires will be placed in the same trench wherever possible and will include a marking system and occasional aboveground junction boxes. All of the collection circuits will connect to a common bus at Big Bend's Project substation, which will have a fiber-optic connection to the O&M facility and a communication system to the grid operator. The power delivered to the Project substation will be converted from 34.5kV to 161 kV. There will then be an approximately 18-mile 161-kV transmission line connecting the Wind Project substation to a step-up substation where the voltage will be stepped up to 345-kV before connecting to the existing Blue Lake-Wilmarth-Interstate Interconnection 345 kV transmission line. The Wind or Wind and Solar Projects will interconnect at the existing Xcel Energy Crandall 345 kV switching station located on the Blue Lake-Wilmarth-Interstate Interconnection 345 kV line. Big Bend's 161 kV transmission line and step-up substation will be addressed in a separate RP application. All grid to Project communications will be specified by the interconnecting utility under a Generator Interconnection Agreement.

6.0 DESCRIPTION AND LOCATION OF ASSOCIATED FACILITIES

A number of facilities will be constructed to support the operation of the wind turbines and facilitate the delivery of the electricity to consumers. Big Bend seeks permitting approval from the Commission through a LWECS site permit for the following associated facilities: permanent meteorological towers and other weather data collection systems, up to four ADLS radars, an electrical collection and communications system, access roads, temporary laydown and staging areas, the Wind Project Substation, and associated equipment, and an O&M facility. The Wind Project Substation will require approximately five acres of land within the Project Area. The O&M facility will be located in the central portion of the Project Area. These facilities have been sited such that the disturbance from installation of the collection system and fiber-optic communications is minimized to the extent feasible. As discussed in Section 5.3 of this Application, Big Bend also proposes to construct an approximately eighteen mile 161-kV transmission line between the Wind Project Substation and the Blue Lake-Wilmarth-Interstate Interconnection 345 kV approximately ten miles south of the Project Area. The proposed transmission line will be permitted under an RP application. A potential location for the Project facilities, including the Wind Project Substation, is shown on Figures 3a-3c (Project Area and Facilities). The description of the associated is included below; construction methods are discussed in Section 10.0.

6.1 Collector Lines and Feeder Lines

Power will run through an underground and/or aboveground collection system to the Wind Project Substation, which will raise the voltage to 161 kV. The electrical collection system will consist of a network of electrical cabling operating at 34.5 kV. Up to 66.5 miles of underground lines will be installed for the Project layout by trenching, plowing, and/or, where needed, directionally boring the cables underground. Generally, the electrical collection lines will be buried in trenches. Additionally, collector system cabling may go aboveground when conflicts with existing underground utilities, other infrastructure, or sensitive environmental conditions such as native prairie remnants cannot be resolved and aboveground cabling will resolve the conflict. Where electrical collectors meet public road right-of-way, the power collection lines will either rise to become aboveground lines (if requested by the road authority or if shallow bedrock, sensitive environmental conditions, or conflicts with underground utility or other infrastructure are encountered) or will continue as underground lines. The collection lines will typically be directionally bored under roads, and, in certain situations, beneath sensitive features such as Public Waters Inventory waterways. The collection lines will require an aboveground junction box when the lines from separate spools need to be spliced together.

Proposed electrical layouts based on the turbine layouts are shown on Figures 3a-3c (Project Area and Facilities).

6.2 Additional Associated Facilities

An O&M facility will be constructed in the Project Area and will provide access and storage for Project O&M. The O&M facility is proposed to be located in the central portion of the Project Area along County State Aid Highway 3 between 590th Avenue and 600th Avenue in Cottonwood County (see Figures 3a-3c). The buildings typically used for this purpose are approximately 3,000 to 5,000 square feet and house the equipment to operate and maintain the Project. The parking lot adjacent to the building is typically approximately 3,000 square feet. Big Bend includes a 5.0-acre area for the O&M facility and associated parking area.

Big Bend proposes to construct one permanent meteorological tower with the potential for a SoDAR and/or a LiDAR unit(s). The met tower will monitor meteorological data. Additionally, Big Bend will install up to two temporary met towers for performance testing during the first six to nine months of operation. The locations of the meteorological towers are shown on Figures 3a-3c (Project Area and Facilities).

Big Bend will coordinate with the FAA on potential implementation of an ADLS radar. Big Bend expects up to four radar units will be needed to provide coverage for the Project. The location of the radar unit(s) will be determined based on participating landowners, environmental conditions, an analysis of radar coverage from an ADLS technology vendor, and, ultimately, a review and approval by the FAA.

Big Bend will also grade one 15.3-acre temporary laydown area to serve both as a parking area for construction personnel and staging area for turbine components during construction. The temporary laydown area is included on Figures 3a-3c (Project Area and Facilities).

The Project may require a concrete batch plant for construction of wind turbine foundations. The potential location of this temporary facility will be determined and permitted locally by the construction contractor.

6.3 Access Roads

The Project will include permanent all-weather gravel roads that provide access to the wind turbines. The primary function of the roads is to provide accessibility to the turbines for turbine maintenance crews. The roads will be low-profile to allow farm equipment to cross. Roads will initially be approximately 150 feet wide to accommodate transportation of heavy construction equipment. Once Big Bend completes construction of the turbines, the roads will be reduced to their permanent width of 16 feet. Total access road length will be up to 17 miles with final lengths determined by civil engineering and the final turbine layout.

Big Bend designed the access road network to efficiently serve the Project, minimize environmental impacts, and reduce overall length as practicable. Big Bend also takes landowner input on road locations into consideration.

6.4 Permitting for Associated Facilities

Big Bend will obtain all permits and licenses that are required to construct and operate the Project following issuance of the LWECS Site Permit.

7.0 WIND RIGHTS

Land rights secured from each landowner vary, and may include, but are not limited to, the rights to construct wind turbines and Project facilities, including access roads, rights to wind and buffer easements, and authorization to construct collection lines in public road right-of-way. Big Bend currently leases or is in the process of finalizing leases for 34,029 acres of the 43,523 acres within the Project Area (78 percent of the Project Area). Big Bend remains in negotiation with multiple landowners within the Project Area and anticipates acreage being added to the Project's leased lands within the Project Area before construction. Figure 4 (Land Ownership) provide maps of the turbine layout and the property lines within the Project Area. Figures 2a-2c depict the Project facilities and underlying parcels required to site the Project following applicable setbacks.

8.0 ENVIRONMENTAL IMPACTS

This section provides a description of the environmental conditions that exist within the Project Area, along with an analysis of the potential impacts of the Project, mitigative measures, and any adverse environmental effects that cannot be avoided. Consistent with Commission procedures on siting LWECS and with applicable portions of the Power Plant Siting Act, various exclusion and avoidance criteria were considered in selecting the Project Area.

Big Bend has defined impacts by their duration, size, intensity, and location. This context is used to determine an overall resource-level impact. Impact levels are described using qualitative descriptors that are not intended as value judgement, but rather as a measure to ensure a common understanding among readers and to compare resource impacts.

- **Minimal** – Minimal impacts do not considerably alter an existing resource condition or function. Minimal impacts may, for some resources and at some locations, be noticeable to an average observer. These impacts generally affect common resources over the short-term.
- **Moderate** – Moderate impacts alter an existing resource condition or function and are generally noticeable or predictable for the average observer. Effects may be spread out over a large area, making them difficult to observe, but can be estimated by modeling or other means. Moderate impacts may be long term or permanent to common resources but are generally short- to long-term for rare and unique resources.
- **Significant** – Significant impacts alter an existing resource or condition or function to the extent that the resource is severely impaired or cannot function. Significant impacts are likely noticeable or predictable for the average observer. Effects may be spread out over a large area making them difficult to observe but can be estimated by modeling. Significant impacts can be of any duration and may affect common and rare and unique resources.

In addition to identifying existing resources and the potential effects on those resources, Big Bend identified measures that can be used to avoid, minimize, or mitigate effects. These actions are collectively referred to as mitigation.

- **Avoid** – Avoiding an impact means that the impact is eliminated altogether by moving or not undertaking parts or all of a project.
- **Minimize** – Minimizing an impact means to limit its intensity by reducing the project size or moving a portion of the project from a given location.
- **Mitigate** – Impacts that cannot be avoided or minimized could be mitigated. Impacts can be mitigated by repairing, rehabilitating, or restoring the affected environment, or compensating for it by replacing or providing a substitute somewhere else.

Big Bend analyzed potential impacts to human and environmental resources based on a specific impact assessment area. The impact assessment area for each resource is the geographic area within which the Project may exert some influence, and is either defined by regulation or is determined in coordination with the regulatory agency. These impact assessment areas vary with the resource being analyzed and the potential impact and are summarized in Table 8.0-1.

The following impact assessment areas will be used:

- **Footprint of Facilities**. The temporary and permanent footprint of facilities for construction and operation of the Project are described below and in Table 8.0-2.
- **One mile**. A distance of one mile from the Project Area is used as the impact assessment area for analyzing potential impacts to rare and unique species. Residences within one mile of the Project Area are included in the impact assessment area for noise and shadow flicker.
- **One and a half Miles.** A distance of one and a half miles from the Project Area is used as the impact assessment area for cultural and archaeological resources, based on early coordination with SHPO.
- **Ten Miles.** A distance of ten miles from the Project Area is used as the impact assessment area for analyzing potential impacts to air traffic and visual resources.
- **Project Counties**. The Project counties are those in which the Project is located and include Cottonwood and Watonwan Counties.

Table 8.0-1
Impact Assessment Area

Impact Assessment Area	Environmental Resource
Footprint of Facilities	Conservation Easements, Public Services and Infrastructure, Recreation, Electromagnetic Fields and Stray Voltage, Hazardous Materials, Land-Based Economies, Topography, Soils, Geologic and Groundwater Resources, Surface Waters and Floodplains, Wetlands, Vegetation, Wildlife
One Mile	Noise, Shadow Flicker and Rare and Unique Natural Resources
One and a half Miles	Cultural and Archaeological Resources
Ten Miles	Air Traffic and Visual Impacts
Project Counties	Demographics, Land Use, Tourism, Local Economies and Community Benefits

Table 8.0-2 summarizes the permanent and temporary footprint for each Project feature for each layout. Big Bend has co-located access roads, collection lines, and crane paths to the extent practicable to minimize the Project's footprint. These footprint assumptions are based on Big Bend's development experience and the size of the turbines.

Table 8.0-2
Summary of Permanent and Temporary Footprint from Project Facilities (acres)

Project Facility	Description of Footprint	Permanent	Temporary
Turbines	50-foot radius for turbine pad	9.9	--
	200-foot radius for construction workspace	--	145.3
Access Roads	16-foot-wide road	31.8	--
	150-foot-wide construction workspace	--	236.7
Crane Paths	120-foot-wide corridor	--	207.2
Collection Lines	75-foot-wide corridor	--	404.3
Met Towers	75-foot by 75-foot workspace	--	0.4

Table 8.0-2
Summary of Permanent and Temporary Footprint from Project Facilities (acres)

Project Facility	Description of Footprint	Permanent	Temporary
Laydown/Staging Areas	Footprint of one laydown/staging areas within the Project Area	--	15.3
Wind Project Substation	Footprint of facility	5.4	--
O&M Facility	Footprint of facility	5.0	--
	Total	**52.1**	**1,009.2**

[1] Big Bend will construct up to four ADLS radars. The number and location of radar unit(s) will be determined based on coordination with the FAA. Temporary workspace associated with ADLS is expected to be similar to the permanent met towers (75-foot by 75-foot workspace), resulting in up to 0.4 acres of temporary impacts. Because the location of the ADLS radar(s) is unknown, they are not accounted for in this table. Big Bend submitted FAA Form 7460-1 for the turbine locations in Q4 2020; Big Bend will initiate FAA review of potential ADLS locations in Q2 2021.

8.1 Demographics

Information about demographics provides important insight into existing human settlement patterns in a given area. LWECS projects have the potential to affect the existing demographics of an area in the short term through an influx of construction personnel which can influence demand for temporary housing. In the long term, addition of personnel to the area for operation of LWECS project could affect area demographics if the total number of personnel is large enough to affect total population, existing population density, demand for housing, or represent a significant change to the ethnicity or race of the local populace. A discussion of demographic information such as per capita income, unemployment rates, and total persons living below the poverty level is presented with the discussion of local economy and community benefits in Section 8.13.

8.1.1 Description of Resources

Demographic information for the Project Area is based on data from the U.S. Census Bureau's QuickFacts and Explore Census Data websites. Data is provided at the county level to characterize the demographics in the Project Area and at the state level for the purpose of comparison. Comparable census data about population, housing, ethnicity, and population density is not available or for towns, cities, or townships with a population of less than 5,000 persons on the U.S. Census Bureau's website; therefore, the demographic information provided is focused on the state and counties in the Project Area. Demographic information is summarized in Tables 8.1-1 and 8.1-2.

The two counties in the Project Area have very small populations compared to the State of Minnesota as a whole, comprising less than one percent of the state's total population (see Table 8.1-1). According to the U.S. Census Bureau's 2019 population estimates, the total population in Minnesota increased by 6.3 percent as compared to 2010 census data, while the population in Cottonwood and Watonwan Counties decreased by an average of 3.5 percent (U.S. Census Bureau, 2019a).

U.S. Census Bureau 2018: American Community Survey 5-year Estimates indicate that the total number of housing units in the counties in the Project Area is 5,435 in Cottonwood County and 5,042 in Watonwan County (U.S. Census Bureau, 2018a). Based on the same 2018 estimates,

the total number of vacant housing units in Cottonwood County is 585 and in Watonwan County 724 vacant housing units (see Table 8.1-1).

The top three industries of employment in the State of Minnesota are education, health, and social services at 25.2 percent, manufacturing at 13.4 percent, and retail trade at 11.0 percent (U.S. Census Bureau, 2018b). The top three industries of employment in the counties within the Project Area vary slightly from the state level, with manufacturing playing a larger role in both Cottonwood and Watonwan Counties (20.0 percent and 22.7 percent, respectively). Employment in the retail trade industry in Cottonwood and Watonwan Counties is similar to the state level. Table 8.1-1 provides the top three industries of employment for Minnesota and the counties in the Project Area.

In Cottonwood and Watonwan Counties, 84.7 and 70.4 percent of the population identifies as white only, not Hispanic or Latino, respectively. The number of persons who identify as white only, not Hispanic or Latino in Cottonwood County is higher than the state level of 79.1 percent, while in Watonwan County the number of persons who identify as white only, not Hispanic or Latino is about 9 percent lower than the state level. Similarly, the percentage of total minority residents in Cottonwood County (15.3 percent) is lower than the state level of 20.9 percent (see Table 8.1-2). In Watonwan County, the percentage of total minority residents is higher than the state level at 29.6 percent. The largest minority group in both Cottonwood and Watonwan Counties is comprised of residents who identify as Hispanic or Latino. Most notably, 26.9 percent of the population in Watonwan County identify as Hispanic or Latino.

Table 8.1-1
Demographics in the Project Area

State and Counties	Population, Census, April 1, 2010[1]	ACS Population Estimates July 1, 2019[1]	Percent Change 2010 - 2019[1]	2018 Estimated Total Housing Units[2]	2018 Estimated Total Vacant Housing Units[2]	Top 3 Industries[3, 4]
Minnesota	**5,303,925**	**5,639,632**	**6.3**	**2,420,473**	**252,672**	**E (25.2%), M (13.4%), R (11.0%)**
Cottonwood County	11,687	11,196	-4.2	5,435	585	E (23.2%), M (20.0%), R (11.5%)
Watonwan County	11,211	10,897	-2.8	5,042	724	M (22.7%), E (21.5%), R (12.0%)

[1] U.S. Census Bureau, 2019a
[2] U.S. Census Bureau, 2018a
[3] U.S. Census Bureau, 2018b
[4] Industries are defined under the 2012 North American Industry Classification System (NAICS) and abbreviated as follows: E = Educational, Health and Social Services; M = Manufacturing; and R = Retail Trade.

Table 8.1-2
Race and Ethnicity of the Population in the Project Area

Location	White Alone, Not Hispanic or Latino (%)	Black or African American Alone (%)	American Indian or Alaska Native Alone (%)	Asian Alone (%)	Native Hawaiian/ Pacific Islander Alone (%)	Two or More Races (%)	Hispanic or Latino (%)	Total Minority (%)[1]
Minnesota	**79.1**	**7.0**	**1.4**	**5.2**	**0.1**	**2.6**	**5.6**	**20.9**
Cottonwood County	84.7	1.3	0.9	4.1	0.4	2.0	8.4	15.3
Watonwan County	70.4	1.2	1.3	1.1	0.1	1.2	26.9	29.6

[1] Total minority percentage equals the total population minus the percentage of white alone, not Hispanic or Latino.
Source: U.S. Census Bureau, 2019a

Based on review of U.S. Census Bureau's QuickFacts data, population densities within five miles of the Project Area boundary range from 18.3 persons per square mile in Cottonwood County to 42.4 persons per square mile in Brown County, which is north of and outside the Project Area (see Table 8.1-3). There are 173 residences within the Project Area (see Figures 3a-3c Project Area and Facilities).

Table 8.1-3
Population Density within Five Miles of the Project Area

Counties and Townships[1]	Total Land Area (sq. mi.)	Population Density per square mile of land area
Minnesota	**79,626.74**	**66.6**
Cottonwood County	638.61	18.3
Watonwan County	434.95	25.8
Brown County	*611.09*	*42.4*

[1] Counties shown in italics are located outside of the Project Area.
Source: U.S. Census Bureau, 2019a; 2019b

8.1.2 Impacts

Construction and operation of the Project will not displace residents and is expected to have a minimal, temporary to long-term impact on the demographics of the Project Area. Approximately 316 personnel will be required at peak employment during construction, and approximately 14 permanent personnel will be required for operation and maintenance of the Project. Big Bend Wind will issue a Request for Proposal (RFP) to qualified Balance of Plant (BOP) contractors and high-voltage contractors to oversee and manage the construction of the Project. In this RFP, Big Bend Wind intends to include a strong preference for bids that utilize local, union construction craft employees to the greatest extent feasible in accordance with the Project's timeline and safety requirements. Big Bend expects that the selected BOP contractors will collaborate with organized labor unions and other stakeholders to develop a workforce and hiring plan that maximizes the local economic benefits of the Project.

If no local contractors are available, the influx of approximately 316 construction personnel would equate to a total population increase of approximately 2.7 percent in Cottonwood County and 2.8 percent in Watonwan County over 2010 census numbers. This would represent a minimal, temporary increase in the total population of the counties in Project Area.

Temporary housing for construction personnel is available in the form of motels and hotels in municipalities near the Project Area such as Windom, New Ulm, Fairmont, and Worthington, all of which are within 30 to 35 miles of the Project Area. Big Bend reviewed the website Hotels.com to identify the number of hotels available in each of these cities. According to the website Hotels.com, there are three hotels in Windom, four hotels in New Ulm, six hotels in Fairmont, and six hotels in Worthington (Hotels.com, 2020). If necessary, construction personnel could also travel to larger municipalities that are between 35 and 50 miles from the Project Area such as, Mankato or Marshall, Minnesota. In addition, as shown in Table 8.1-1, a combined total of 1,309 vacant housing units are available in Cottonwood and Watonwan Counties (U.S. Census Bureau, 2018a). Overall, the demand for temporary housing for construction personnel would represent a minimal, temporary impact on the availability of temporary housing in Cottonwood and Watonwan Counties.

The addition of approximately 14 permanent personnel for the Project would result in a minimal but long-term impact on population levels and housing in the counties in the Project Area. Permanent personnel would likely relocate to the Project Area, which would increase total population and the demand for permanent housing. The addition of 14 persons would represent a population increase of less than one percent in the counties affected by the Project. Furthermore, the availability of 1,309 vacant housing units throughout Cottonwood and Watonwan Counties would be sufficient to house 14 permanent personnel.

Minority populations make up about 15 and 30 percent of the total population in the Cottonwood and Watonwan Counties, respectively. In both counties, persons identifying as Hispanic or Latino represent the largest proportion of minority populations. According to the Minnesota Compass website, 11.9 percent of the population of the City of Mountain Lake identifies as Hispanic or Latino (Minnesota Compass, 2020). Similarly, 11.5 percent of the population in the City of Windom (which is about five miles southwest of the Project Area) identifies as Hispanic or Latino. Minnesota Compass information is not available for the Town of Butterfield, which is directly adjacent to the Project Area, but information about the City of St. James, which is about 7 miles east of the Project Area, indicates that 36.7 percent of the population in St. James identifies as Hispanic or Latino.

As shown in Table 8.1-3, population densities in Cottonwood and Watonwan Counties are generally sparse. There is no indication that any minority or low-income population is concentrated in any one area of the Project (see Table 8.1-2), or that the wind turbines will be placed in an area occupied primarily by any minority population. For this reason, the Project will not have a disproportionate effect on environmental justice communities.

8.1.3 Mitigative Measures

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

8.2 Land Use and Zoning

Information about land use and zoning provides important insight into existing human settlement patterns and future development. Big Bend reviewed land use and county zoning information for Cottonwood and Watonwan Counties to assess the Project's potential to impact existing land uses and to identify any additional siting constraints that should be considered for the development of a wind farm. A discussion of existing land cover types, based on data from the National Land Cover Database, is presented in Section 8.19.

The Project Area is predominantly rural with sparsely scattered rural residences, farmsteads, commercial livestock operations, agricultural support facilities, and commercial business throughout. The Project Area was developed to avoid municipal boundaries; however, the cities of Mountain Lake and Butterfield are adjacent to the Project boundary.

The Project is subject to Minnesota's Wind Siting Act, Minn. Stat. Ch. 216F, for siting of wind energy conversion systems, and the Power Plant Siting Act (Minn. Stat. Ch. 216E). As such, and pursuant to Minn. Stat. § 216F.07, a site permit issued by the Commission, "supersedes and preempts all zoning, building or land use rules, regulations or ordinances adopted by regional, county, local and special purpose governments." Therefore, Big Bend is not required to apply to county zoning authorities for additional permits or approvals for the Project. However, pursuant to Minn. Stat. 216F.081, "[t]he commission, in considering a permit application for LWECS in a

county that has adopted more stringent standards, shall consider and apply those more stringent standards, unless the commission finds good cause not to apply the standards." To assist the Commission in its review of the Project, Big Bend reviewed and incorporated pertinent county zoning requirements for wind energy development in this Application. The results of Big Bend's review are presented in the subsections that follow.

8.2.1 Local Zoning and Comprehensive Plans

A comprehensive plan is a land-use and community-planning tool used to guide the direction and intent of growth for a county or municipality. Generally, comprehensive plans discuss existing and future land uses, population and housing trends, economic development goals and opportunities, and environmental characteristics of the county or municipality. In preparing this Application, Big Bend reviewed and analyzed zoning ordinances and the land use section (and other applicable sections of) the most recently adopted comprehensive plans from the counties within and adjacent to the proposed Project Area. Table 8.2-1 provides an inventory of the zoning ordinances and comprehensive plans that were reviewed.

Table 8.2-1
Comprehensive Plan Inventory for Local Governments within the Project Area

Governing Body[1]	Name of Plan	Year Adopted	Associated Development Plan(s)
Cottonwood County	Cottonwood County Zoning Ordinance	2016	Comprehensive Land Use Plan (2005)
Watonwan County	Watonwan County Zoning Ordinance	2014	Not Available[2]
City of Mountain lake	City of Mountain Lake Code of Ordinances, Chapter 9 Land Use Regulation (Zoning)	Undated	Comprehensive Plan (2006)

[1] Townships in the Project Area are included in the comprehensive plans for their respective counties.
[2] Based on coordination with the Watonwan County Planning and Zoning Department, the County does not have a Comprehensive Plan.

In determining the existing and future land-use and zoning classifications for the proposed Project, the Applicant reviewed the zoning ordinances and comprehensive plans listed in Table 8.2-1 and the official zoning maps for Cottonwood and Watonwan Counties and the City of Mountain Lake. Regarding future land use planning, future planning maps for Cottonwood and Watonwan Counties were not available. Zoning information for the Project Area is displayed on Figure 5 (Zoning Map).

8.2.1.1 Cottonwood County

The Cottonwood County Comprehensive Land Use Plan (2005) states that, similar to other counties in southwestern Minnesota, agricultural production will continue to be the predominant industry in the county. However, the plan lists a number of opportunities for industry diversification that would contribute to future economic growth, including renewable energy development. Specifically, the plan discusses opportunities related to wind power and ethanol and bio-diesel production.

Portions of the Project Area fall within the Floodplain and Shoreland Districts in Cottonwood County, though most of the Project Area is within the Agricultural District, as identified in the Cottonwood County Zoning Ordinance, as amended January 1, 2016 (Cottonwood County, 2016). These districts are defined in the Cottonwood County Zoning Ordinance as follows:

- **Agricultural District**: All unincorporated areas of the County, including unincorporated area of Delft, which are not included in the Floodplain District, Residential District, Commercial District, Industrial District, and the Shoreland District. Siting of wind turbines permitted by the county is conditionally permitted within the Agricultural District according to the Cottonwood County Renewable Energy Ordinance (Cottonwood County, 2016).
- **Floodplain District**: All areas identified as having special flood hazards by the Federal Emergency Management Agency (FEMA) and designated as flood hazard zones A-1 through A-30 and unnumbered A zones on the Cottonwood County Flood Insurance Rate Map (January 2, 1981). Siting of wind turbines in the Floodplain District is prohibited according to the Cottonwood County Renewable Energy Ordinance for turbines permitted by the county (Cottonwood County, 2016).
- **Shoreland District**: Areas within 1,000 feet from the ordinary high-water level of a lake, pond, or flowage greater than 25 acres in size in unincorporated areas, and 300 feet from a river or stream or the landward extent of a floodplain designated by this Ordinance on a river or stream, whichever is greater. Siting of wind turbines in the Shoreland District is prohibited according to the Cottonwood County Renewable Energy Ordinance (Cottonwood County, 2016).

There are a few small pockets of additional zoning categories throughout the Project Area in Cottonwood County, including the 2A Farm Entity 1st Tier, Municipality Property All Other, Rural Vacant Land, and Rural Vacant Non-contiguous categories (see Figure 5). A description of these categories is not available in the Cottonwood County Zoning Ordinance (Cottonwood County, 2016).

8.2.1.2 Watonwan County

According to the Watonwan County Zoning Ordinance (2014) and review of the Watonwan County zoning map (2017), most of the Project Area falls within the Agricultural District. Smaller portions of the Project Area also overlap with the Flood Plain and Shoreland Overlay Districts. Overlay districts impose additional criteria for development in addition to the criteria imposed by the underlying zoning district. These districts are defined in the Watonwan County Zoning District as follows:

- **Agricultural District:** All unincorporated areas of the County which are not included in the Rural Residential District, General Business District, or General Industry District. Siting of LWECS is conditionally permitted within the Agricultural District (Watonwan County, 2014). If present, the provisions of the Flood Plain and Shoreland Overlay Districts must be applied to any development in the Agricultural District, in addition to the provisions of the underlying zoning district.
- **Flood Plain Overlay District:** The Flood Plain Overlay District is applied based on elevations on the regional 100-year flood profile. If 100-year flood elevations are not available, Watonwan County requires a flood plain evaluation (as defined in Section 11, Item D.3 of the zoning ordinance), or an assessment of

hydraulic/hydrologic or site elevation survey data that demonstrates whether an area is within or outside of the flood plain. Siting of wind turbines in the Flood Plain District Overlay is not listed as a permitted or conditional use in Section 11 (Flood Plain Overlay District) or Section 12, Item M (Windpower Management) of the Watonwan County Ordinance (2014).

- **Shoreland Overlay District:** All areas within 300 feet from the ordinary high-water mark of all protected watercourses and 1,000 feet from the ordinary high-water mark of all protected water basins as defined in Section 5, Item B.1 of the Watonwan County Zoning Ordinance. Siting of wind turbines in the Shoreland Overlay District is not listed as a permitted or conditional use in Section 10 (Shoreland Overlay District) or Section 12, Item M (Windpower Management) of the Watonwan County Ordinance (2014).

8.2.1.3 City of Mountain Lake

While the Project Area does not cross the municipal boundary of Mountain Lake, the city is directly adjacent to the southern boundary of the Project Area. The areas directly adjacent to the Project Area are zoned as Residential, Commercial, or Industrial. The City of Mountain Lake has a zoning ordinance and a comprehensive plan that outlines the economic development and land use goals for the city (Mountain Lake, n.d. and 2006). Based on review of the comprehensive plan, economic development and expansion goals are focused on the Commercial District (C-1), which is the downtown area of Mountain Lake. Mountain Lake also has zoning regulations for development of Wind Energy Conversion Systems; wind energy development is a permitted use in the Commercial and Industrial districts but is not allowed in the Residential district.

8.2.2 Impacts

The Project design is consistent with the county zoning ordinances regarding siting of LWECS projects and future economic development goals noted in the comprehensive plan for Cottonwood County. As noted previously, the majority of the Project Area falls within the Agricultural Districts in Cottonwood and Watonwan Counties, and consistent with the purpose of that zoning district, agricultural use of the Project Area will continue after construction of the Project is complete. Big Bend also reviewed the City of Mountain Lake's Comprehensive Plan; however, the Project Area is not located within the municipal boundary of Mountain Lake and the zoning classifications within the city do not apply to the Project.

All turbine models in the Project layout are sited in cultivated cropland; Big Bend will avoid placing turbines within the floodplain, shoreland, and other special protection districts and overlays where siting of LWECS is not permitted by the counties. Figure 5 displays the layout of the Project in relation to zoning districts within Cottonwood and Watonwan Counties.

Overall, the Project is not expected to affect the future land use planning goals of the counties in the Project Area.

8.2.3 Mitigative Measures

The Project is consistent with the comprehensive planning documents and zoning requirements of Cottonwood and Watonwan Counties. No Project facilities would be sited or operated within zoning districts that are not compatible with wind energy project development. Accordingly, no mitigative measures are proposed.

8.3 Conservation Easements

A conservation easement is land that has been sold or leased by the landowner to a federal, state, county, or non-profit agency, who will in turn apply specific development or activity restrictions designed to protect and conserve natural resources. Depending on the governing conservation program, specific restrictions may be applied that would limit or restrict development of LWECS projects. Big Bend reviewed publicly available information to identify existing conservation easements within the Project Area.

8.3.1 Description of Resources

There are several parcels of agricultural land in the Project Area that are enrolled in the Conservation Reserve Enhancement Program (CREP). The CREP is an offshoot of the Conservation Reserve Program which is a land conservation program established by the U.S. Department of Agriculture (USDA) and administered by the Farm Service Agency (FSA) that pays farmers a yearly rental fee for agreeing to take environmentally sensitive land out of agricultural production in an effort to improve environmental health and quality (USDA, 2020). Minnesota implemented the CREP to target state-identified, high-priority conservation resources by offering payments to farmers and agricultural landowners to retire environmentally sensitive land using the Reinvest in Minnesota (RIM) Reserve Program (BWSR, 2020). Both conservation programs are administered by the Minnesota Board of Water and Soil Resources (BWSR).

Additionally, in 2019, a Permanent Wetland Preserve (PWP) easement program was adopted into Minnesota Statutes (103F.516). These easements preserve or restore wetlands on land containing U.S. Fish and Wildlife Service (USFWS) Circular No. 39 (1071 edition) Types 1, 2, 3, 4, 5, or 6 wetlands, public waters wetlands, or public waters.

Enrollment in the CREP, RIM, and PWP programs is voluntary. Based on publicly available data, there are approximately 526 acres (approximately one percent) of the Project Area currently enrolled in CREP, RIM, and PWP easements, which are also shown on Figure 6 (Public Land Ownership and Recreation). CREP and RIM parcels total 497 acres and are only located in the Cottonwood County portion of the Project Area. PWP parcels total 29 acres and are only located in the Watonwan County portion of the Project Area. These CREP and RIM easements are also discussed in Section 8.11.1.

8.3.2 Impacts

Based on publicly available information, the Project design layout avoids impacts to FSA conservation easements, but collection lines and crane paths will temporarily cross about 4.1 acres of conservation easements. Big Bend is coordinating with the Natural Resource Conservation Service (NRCS), BWSR, and MNDNR on the accuracy of the publicly available easement data. Additionally, as part of Project title clearance for participating landowners, Big Bend is actively completing a title search for all Project participants that will also identify any other conservation easements in the Project Area. If additional conservation easements are identified, Big Bend will coordinate with landowner and the agency that administers the conservation easements to identify their trust resources and address any potential impacts.

8.3.3 Mitigative Measures

Big Bend has designed the Project to avoid most conservation easements identified through review of publicly available data. If additional conservation easements are identified during the

title search or in consultation with the NRCS, BWSR, or MNDNR, and impacts to these conservation easements are unavoidable, Big Bend will work with easement holders to obtain all necessary consents to construct and operate the Project. In temporarily disturbed areas, Big Bend will reseed with an appropriate native seed mix free of invasive species; identification and management of invasive species will be detailed in the Invasive Species Management Plan pre-construction filing.

8.4 Noise

Sound level is measured in units of dB on a logarithmic scale. It may be made up of a variety of sounds of different magnitudes, across the entire frequency spectrum. The human ear is not equally sensitive to sound at all frequencies and magnitudes. Some frequencies, despite being the same dB level (that is, magnitude), seem louder than others. For example, a 500 hertz (Hz) tone at 80 dB will sound louder than a 63 Hz tone at the same level. In addition, the relative loudness of these tones will change with magnitude. For example, the perceived difference in loudness between those two tones is less when both are at 110 dB than when they are at 40 dB.

To account for the difference in the perceived loudness of a sound by frequency and magnitude, acousticians apply frequency weightings to sound levels. The most common weighting scale used in environmental noise analysis is the “A-weighting,” which represents the sensitivity of the human ear at low to moderate sound pressure levels. The A-weighting is the most appropriate weighting when overall sound pressure levels are relatively low (up to about 70 dB(A)). The A-weighting de-emphasizes sounds at lower and very high frequencies, since the human ear is less sensitive to sound at these frequencies at low magnitude.

The A-weighting is the most appropriate weighting for wind turbine sound for two reasons. The first is that sound pressure levels due to wind turbine sound are typically in the appropriate range for the A-weighting at typical receiver distances (50 dB(A) or less). The second is that various studies of wind turbine acoustics have shown that the potential effects of wind turbine noise on people are correlated with A-weighted sound level (Pedersen and Waye, 2008) as well as to the perceived loudness of wind turbine sound. Other researchers found that 51 percent of the energy making up a C-weighted measurement of wind turbine sound is not audible. Thus, it is more difficult to relate the level of C-weighted sound to human perception. That is, two sounds may be perceived exactly alike, but there could be significant variations in the C-weighted sound level depending on the content of inaudible sound in each.

8.4.1 Description of Resources

The term “ambient acoustic environment” refers to the all-encompassing sound in a given environment or community. The outdoor ambient acoustic environment is a composite of sound from varying sources, distances, and directions. Big Bend conducted background sound level monitoring throughout the Project Area to quantify the existing sound levels and to identify existing sources of sound. Monitoring was conducted at five locations distributed throughout the Project Area and at one offsite location. Daytime sound levels throughout the Project Area generally ranged from 36 to 40 dB(A) for 50 percent of the daytime (L_{50}), while nighttime sound levels were generally between 31 and 36 dB(A) (L_{50}). The average daytime L_{50} across the Project Area was 38 dB(A), and the average nighttime L_{50} across the Project Area was 33 dB(A). Common sources of sound included roadway traffic, aircraft overflights, distant trains, distant agricultural operations, and biogenic sources such as birds and occasional dog barking.

Higher sound levels typically exist near roadways and near areas that experience greater human activities such as farming. Agricultural/rural areas with higher wind resources generally experience higher sound levels compared to agricultural/rural areas with lower wind resources. Different communities can experience a wide variety of sound levels within their given ambient acoustic environments, and the variability of sound sources creates their respective spectral content. A comparison of typical noise generators is outlined below in Table 8.4-1.

Table 8.4-1
Decibel Levels of Common Noise Sources

Sound Pressure Level (dB(A))	Noise Source
140	Jet Engine (at 25 m)
130	Jet Aircraft (at 100 m)
120	Rock and Roll Concert
110	Pneumatic Chipper
100	Jointer/Planer
90	Chainsaw
80	Heavy Truck Traffic (at 15 m)
70	Business Office
60	Conversational Speech
50	Library
40	Bedroom
30	Secluded Woods
20	Whisper

Source: MPCA, 2008

The MPCA has the authority to adopt noise standards pursuant to Minn. Stat. § 116.07, subd. 2. The adopted standards are set forth in Minn. R. Ch. 7030. The MPCA standards require A-weighted noise measurements. Different standards are specified for daytime (7:00 AM – 10:00 PM) and nighttime (10:00 PM – 7:00 AM) hours. The noise standards specify the maximum allowable noise levels that may not be exceeded for more than 10 percent of an hour (L_{10}) and 50 percent of an hour (L_{50}), respectively. Household units, including farmhouses, are included in Land Use Noise Area Classification (NAC) 1. Table 8.4-2 shows the MPCA State noise standards. All the land within the Project Area is considered Land Use NAC 1.

Table 8.4-2
MPCA State Noise Standards – Hourly A-Weighted Decibels

Land Use	Code	Day (7:00am – 10:00pm) dB(A)		Night (10:00pm – 7:00am) dB(A)	
		L_{10}	L_{50}	L_{10}	L_{50}
Residential	NAC-1	65	60	55	50
Commercial	NAC-2	70	65	70	65
Industrial	NAC-3	80	75	80	75

8.4.2 Impacts

When in motion, the wind turbines emit audible sound. The level of this sound varies with the speed of the turbine and the distance of the listener from the turbine. Sound is generated from the wind turbine at points near the hub or nacelle and from the blade tips and trailing edges as they rotate. The most stringent noise standards, as regulated by the MPCA under Minn. R. Ch. 7030, is a 50 dB(A) L_{50} limit for nighttime noise levels.

Big Bend proposes siting turbines at least 1,200 feet from residences plus the distance required to comply with the MPCA limit of a 50 dB(A) nighttime L_{50} noise level, if necessary (L_{50} is the median noise level or the level exceeded 50 percent of the time) (MPCA, 2015). The closest turbine to a non-participant residence is 2,277 feet, and the closest turbine to a participating residence is 1,304 feet.

Big Bend incorporated the Project-specific background sound monitoring data with turbine sound modeling using the Computer Aided Design for Noise Abatement (Cadna-A) software program to determine the sound levels at receptors within one mile of the Project Area. The monitoring methodologies and results are detailed in Appendix B - Noise Analysis for the Proposed Big Bend Wind Project. The Cadna-A acoustical analysis software is designed for evaluating environmental noise from stationary and mobile sources and was used to calculate the L_{50} for all three turbine models. Assuming that wind speeds are at the maximum sound power level wind speed for each turbine model and are constant for an entire one-hour period, the L_{50} calculated by Cadna-A was compared to the MPCA L_{50} standard.

The analysis accounted for all noise generating elements associated with the proposed wind turbine models and layout for the Project. All proposed wind turbines (noise sources) were modeled in Cadna-A and Project-related noise levels were calculated at 969 noise-sensitive receptors within the Project Area and a buffer of approximately one mile. Table 8.4-3 presents analysis results. The baseline noise isopleths of turbine-only sound (a line or curve of equal values) are depicted in Figures 7a-7c (Sound/Noise).

Table 8.4-3
Summary of Noise Assessment

Turbine Model	Noise Source	Statistic	Residence Classification		
			dB(A) Levels at All Residences	dB(A) Levels at Participating	dB(A) Levels at Non-Participating
Nordex N-163	Turbine-Only Noise	Avg L_{50} Modeled	32	38	32
		Max L_{50} Modeled	46	46	43
		Min L_{50} Modeled	19	23	19
	Total Sound (Background + Turbine)[1]	Avg L_{50} Modeled	36	39	35
		Max L_{50} Modeled	46	46	44
		Min L_{50} Modeled	33	33	33

Table 8.4-3
Summary of Noise Assessment

Turbine Model	Noise Source	Statistic	Residence Classification		
			dB(A) Levels at All Residences	dB(A) Levels at Participating	dB(A) Levels at Non-Participating
Vestas V162	Turbine-Only Noise	Avg L_{50} Modeled	32	39	32
		Max L_{50} Modeled	46	46	43
		Min L_{50} Modeled	19	24	19
	Total Sound (Background + Turbine)[1]	Avg L_{50} Modeled	36	40	35
		Max L_{50} Modeled	46	46	44
		Min L_{50} Modeled	33	34	33
GE-158[2]	Turbine-Only Noise	Avg L_{50} Modeled	31	37	32
		Max L_{50} Modeled	45	45	42
		Min L_{50} Modeled	18	23	18
	Total Sound (Background + Turbine)[1]	Avg L_{50} Modeled	35	39	35
		Max L_{50} Modeled	45	45	42
		Min L_{50} Modeled	33	33	33

[1] The average Project nighttime sound was monitored at 33 dB(A) (L_{50})
[2] The GE-158 turbine was modeled at the 108 m hub height, which is louder than the 118 m hub height

Maximum calculated sound levels at all residential receptors for all turbine models are below the nighttime L_{50} noise limit of 50 dB(A). The maximum calculated sound level, based on assumptions incorporated into the Cadna-A model and the turbine layout, results in a 46 dB(A) L_{50} at the nearest noise-sensitive receptor (maximum Project-related L_{50} range from 42 to 46 dB(A)). Average Project-related sound levels at residences for all turbine models range from 32 to 39 dB(A), on an hourly L_{50} basis. As depicted in the multi-turbine constraint maps and in Table 8.4-3, all turbine models and layouts comply with MPCA noise guidelines at residential receptors.

8.4.3 Mitigative Measures

Big Bend has sited turbines to minimize noise impacts to residents. In addition, the Nordex N-163 and GE-158 proposed turbine models have sound mitigation built into the turbine blades in the form of low-noise trailing edges. None of the turbine nacelles for any of the three turbine models use noise reduced operations. The modeling assumptions related to these sound mitigation measures are discussed in Appendix B - Noise Analysis for the Proposed Big Bend Wind Project.

Big Bend has incorporated the 2019 LWECS Application Guidance and sited turbines so that turbine-only noise is < 45 dB(A) at non-participating residences and < 47 dB(A) at participating residences. The layouts have been modeled to help ensure cumulative impacts from all wind turbines, and maximum calculated noise levels for all turbine models are below the MPCA's nighttime L_{50} noise limit of 50 dB(A) at residential receptors. To the extent that the sound characteristics of the selected turbine vary, Big Bend will ensure compliance with MPCA noise standards by re-running the noise modeling.

8.5 Visual Resources

LWECS will introduce wind turbines and associated facilities to the landscape and have the potential to alter the existing visual resources where they are most perceptible. Additionally, during construction, visual resources may be interrupted by construction equipment and increased vehicle traffic. Big Bend analyzed potential impacts to visual resources, including public resources, private land, and shadow flicker.

8.5.1 Existing Aesthetics

8.5.1.1 Description of Resources

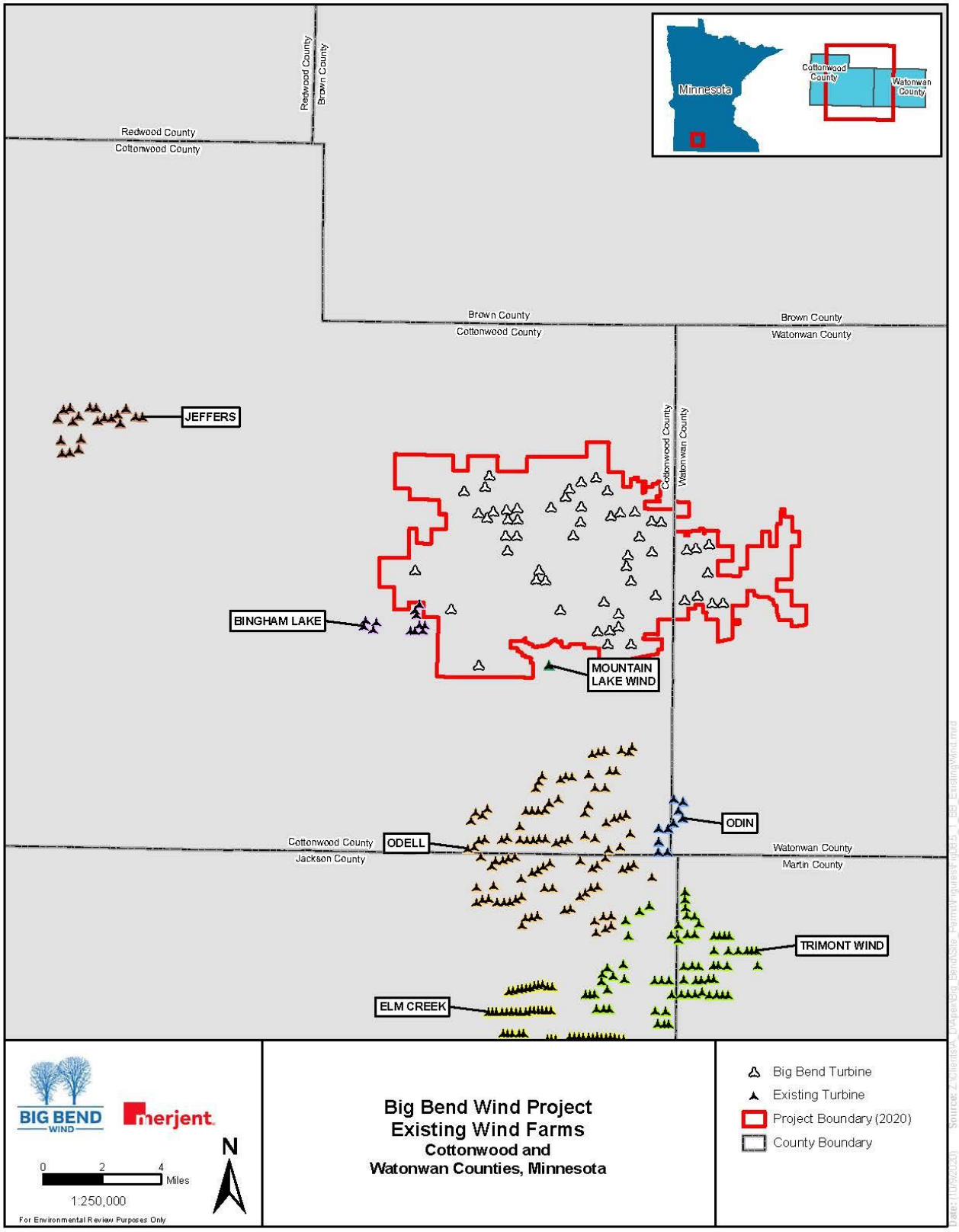
The topography of the Project Area is glaciated, gently rolling plains with elevations ranging from 1,109 to 1,421 feet (338 to 433 m) above sea level. Elevations decrease in a southwest to northeast direction; the highest elevations are in the west/southwest corner of the Project Area. Agricultural fields, farmsteads, and gently rolling topography visually dominate the Project Area. The landscape can be classified as rural open space. Figure 8 (Topographic Map) shows the general topography within the Project Area.

Viewsheds in this area are generally broad and uninterrupted, with only small scattered areas where they are interrupted by trees or topography. The settlements in the vicinity are residences and farm buildings (inhabited and uninhabited farmsteads) scattered along rural county roads. The area is also shaped by a built environment. Horizontal elements, such as highways and county roads, are consistent with the long and open viewsheds in the area. Vertical elements such as wind turbines are visible from considerable distances and are the tallest and often the most dominant visual feature on the landscape. Additionally, numerous electrical distribution lines parallel some unpaved and paved roads that contribute to the existing visual elements.

There are several wind farms that are visible within ten miles of the Big Bend Project Area (see Image 8.5-1), including:

- Mountain Lake Wind – one turbine immediately adjacent to the southern Project Area;
- Bingham Lake Wind – eight turbines immediately adjacent to the southwestern Project Area;
- Farmers' Ridge/Westridge Wind – four turbines within one mile of the southwestern Project Area;
- Odell Wind Farm – 100 turbines located three miles south of the Project Area;
- Odin Wind Farm – 10 turbines located five miles south of the Project Area;
- Trimont Area Wind Farm – 67 turbines located eight miles south of the Project Area; and
- Jeffers Wind Energy Center – 20 turbines located 8.5 miles west of the Project Area.

Image 8.5-1: Existing Wind Farms



8.5.2 Visual Impacts

The introduction of wind turbines and the Wind Project Substation has the potential to alter the existing visual resource where they are most perceptible. During construction, visual impacts associated with the Project facilities would include the removal of existing vegetation and the exposure of bare soils, as well as earthwork and grading scars associated with heavy equipment tracks, trenching, and machinery and tool storage. Other visual effects could result from the removal or alteration of vegetation that may currently provide a visual barrier, or changes that introduce contrasts in visual scale, spatial characteristics, form, line, color, or texture. There are thirteen existing wind turbines that are part of three wind developments immediately adjacent to the southern portion of the Project Area (Mountain Lake Wind, one turbine; Bingham Lake, eight turbines; and Farmers' Coops/Westridge, four turbines). Generally, existing wind development is visually apparent south and west of the Project Area. Other orientations (i.e., north or east) generally lack development in the immediate Project Area, visual scale is uniform, with little contrast in line, form, color, or texture, and no dominant features. Construction in flat terrains would disrupt and dominate foreground and middle ground views with the introduction of equipment, materials, and spoil piles.

During operation, visual impacts associated with wind energy facilities in the Project Area include the presence of wind turbine structures, movement of the rotor blades, shadow flicker, turbine marker lights, and other lighting on control buildings; and other ancillary structures, roads, vehicles, and workers conducting maintenance activities. Visual impacts will vary depending on the viewer's proximity and orientation to the turbines (i.e., a residence within the Project Area vs outside the Project Area and the direction a residence faces relative to wind turbines), obstructions such as tree lines, the viewer's duration in the Project Area (i.e., a resident vs. a car passing through the Project Area), and the viewer's personal preferences. For example, a residence in the eastern portion of the Project Area that also faces east will experience a lesser visual impact than a residence in the western portion of the Project Area that has existing wind turbines in their viewshed.

Additionally, the FAA requires obstruction lighting or marking of structures more than 200 feet above ground to provide safe air navigation, which is synchronized flashing of red lights for wind turbines (FAA, 2005). As described in Section 6.2, Big Bend will coordinate with the FAA on potential implementation of ADLS radar(s).

The turbine models under evaluation for the Project will be similar in appearance to existing wind turbines in the vicinity of the Project Area, with a monopole tower, a single hub, and three blades. The three turbine models are similar in height, rotor diameter, and maximum number of turbines. The three turbine models will have the following RD and number of turbines and are shown in Table 8.5-1.

Table 8.5-1
Rotor Diameter and Number of Turbines

Turbine Model	Rotor Diameter	Rotor Tip Height – Top/Bottom of Rotor Diameter	Maximum Number of Turbines
Nordex N-163	163 m	189.5/27m or 199.5/36.5 m[1]	54
Vestas V162	162 m	200/38 m	55
GE-158	158 m	186.4/28.4 m	55

[1] The Nordex N-163 has two hub heights under consideration: 108 or 118 m

Visual impacts on public resources, private lands, and shadow flicker are described in the sections below.

8.5.2.1 Visual Impacts on Public Resources

The Project will be located within the viewshed of MNDNR-managed Wildlife Management Areas (WMAs), USFWS Waterfowl Production Areas, lands owned by The Nature Conservancy, and the Jeffers Site, as well as other natural areas and may be visible by people using those areas. Figure 6 (Public Land Ownership and Recreation) identifies public resources within the Project's vicinity. Visual impacts specific to the Jeffers Site are discussed in Section 8.7 – Cultural and Archaeological Resources and Appendix A – Visual Impact Assessment Report.

Visual impacts on public resources during construction will be dependent on the construction activity and proximity to the public resource. For example, site clearing and grading would be visible from public resources adjacent to the Project boundary or within one to two miles of the Project's footprint. Other activities, such as turbine erection, would be visible from longer distances due to the height of the crane and towers.

During operation, the wind turbines will impact the visual surroundings of the Project Area and vicinity, but the degree of the visual and unavoidable impact on public resources will vary based upon the distance from the Project, obstructions such as trees between the public resource and Project, a viewer's orientation to the Project (i.e., facing towards or away), and the viewer's personal preferences. For example, a person utilizing Delft WMA approximately 1.2 miles west of the Project Area may see the wind turbines in open areas of the WMA, but not in areas with trees immediately adjacent to the person or when the person is oriented north, west, or south. To the extent public resources are utilized at night, turbine lighting may be visible whether traditional flashing lighting or only when the ADLS system detects aircraft in the vicinity (*see* Section 6.2).

As discussed in more detail in Appendix A - Visual Impact Assessment Report, Big Bend completed a visual assessment of turbines from a number of key observation points, including land owned by The Nature Conservancy, which is located 3.9 miles from the closest turbine. The Visual Assessment concluded that Project turbines sited between 0.5 to five miles from an observation point would be visible, but would not dominate the views and could be somewhat obscured by existing topography and vegetation.

8.5.2.2 Visual Impacts on Private Lands and Homes

The impact of the Project's aesthetics is based on subjective human responses. For some viewers, the Project could be perceived as a visual intrusion; for other viewers, the Project may have positive aesthetic qualities. While people living in or traveling through the area are

accustomed to viewing wind turbines associated with the several existing wind farms west and south of the Project Area, the Project will add to the cumulative visual impacts by adding up to 55 new turbines in the area. This is particularly true for residences in the western and southern portions of the Project Area where the existing wind turbines are more visible than to residences in the eastern and northern portions of the Project Area. Depending on a residence's location and orientation, residences in the southern and western portion of the Project Area may have turbines in multiple viewing angles (i.e., not only south and or west, but also east and/or north).

The placement of turbines in the landscape will have an impact on the existing visual experience of the Project Area to residents and persons traveling along highways in the Project Area and vicinity. Residences with turbines and associated infrastructure closest to their homes are those that are participating in the Project by signing easements. The closest turbine to a non-participant residence is 2,277 feet, and the closest turbine to a participating residence is 1,304 feet. Visual impacts to those traveling on highways in the vicinity will be most evident to people traveling east and west along MN-60 on the south side of the Project and MN-30 on the north side of the Project, and north and south along U.S. Highway 71 approximately three miles west of the Project Area. These highways carry more vehicles on a daily basis (Annual Average Daily Traffic [AADT]) than the county and township roads within the Project Area (MNDOT, 2019).

The Wind Project Substation may be visible to those residents that live within one mile of this facility. The Wind Project Substation will be lower profile than the wind turbines. Access roads have been designed to provide direct access from the public road to the turbine and minimize impacts to the agricultural fields. Where possible, the access roads follow field edges. To the extent possible, Big Bend has collocated linear facilities (access roads, crane paths, and collection lines) to minimize visual impacts. Post-construction, Big Bend anticipates minimal visual impacts from temporary facilities (crane paths, collection lines, and workspace associated with wider access roads and turbines) because all turbines and most associated facilities are sited in cropland and will continue to be farmed during operation (see Section 8.19.2).

8.5.3 Mitigative Measures

Big Bend will implement the following mitigation measures for visual resources:

- Wind turbines will exhibit visual uniformity in the shape, color, and size of rotor blades, nacelles, and towers.
- Collection cables or lines on the site will be buried in a manner that minimizes additional surface disturbance (e.g., collocating them with access roads, where feasible).
- For ancillary buildings and other structures, low-profile structures will be chosen whenever possible to reduce their visibility.
- Turbine foundations and roads have been designed to minimize and balance cuts and fills.
- Facilities, structures, and roads will be located in stable fertile soils to reduce visual contrasts from erosion and to better support rapid and complete regrowth of vegetation.
- Lighting for facilities will not exceed the minimum required for safety and security, and full-cutoff designs that minimize upward light pollution will be selected. Big Bend will install lights that are off until aircraft approach.
- Commercial messages and symbols on wind turbines will be avoided.

Additionally, Big Bend will coordinate with the FAA on potential implementation of ADLS radar(s). With this radar system, turbine lighting (synchronized flashing red lights) is off until the radar detects an aircraft within a prescribed distance to the Project, at which time, the blinking red lights turn on. After the aircraft is safely beyond the Project, the blinking lights are again turned off. Implementation of this radar system will depend on FAA review and approval.

8.5.4 Shadow Flicker

8.5.4.1 Description of Resources

Shadow flicker caused by wind turbines is defined as alternating changes in light intensity at a given stationary location (or "receptor"), such as the window of a home. In order for shadow flicker to occur, three conditions must be met: (1) the sun must be shining with no clouds to obscure it; (2) the rotor blades must be spinning and must be located between the receptor and the sun; and (3) the receptor must be sufficiently close to the turbine to be able to distinguish a shadow created by it (generally 1500 feet because the shadow, at this distance, is sufficiently diffused that it's not seen as a solid obstruction). Shadow flicker intensity and frequency at a given receptor are determined by a number of interacting factors:

- **Sun angle and sun path**: As the sun moves across the sky on a given day, shadows are longest during periods nearest sunrise and sunset, and shortest near midday. They are longer in winter than in summer. On the longest day of the year (the summer solstice), the sun's path tracks much farther to the north and much higher in the sky than on the shortest day of the day (the winter solstice). As a result, the duration of shadow flicker at a given receptor will change significantly from one season to the next.
- **Turbine and receptor locations**: The frequency of shadow flicker at a given receptor tends to decrease with greater distance between the turbine and receptor. The frequency of occurrence is also affected by the sightline direction between turbine and receptor. A turbine placed due east of a given receptor will cause shadow flicker at the receptor at some point during the year, while a turbine placed due north of the same receptor at the same distance will not, due to the path of the sun at Big Bend's latitude.
- **Cloud cover and degree of visibility**: As noted above, shadow flicker will not occur when the sun is obscured by clouds. A clear day has more opportunity for shadow flicker than a cloudy day. Likewise, smoke, fog, haze, or other phenomena limiting visibility would reduce the intensity of the shadow flicker.
- **Wind direction**: The size of the area affected by shadow flicker caused by a single wind turbine is based on the direction that the turbine is facing in relation to the sun and location of the receptor. The turbine is designed to rotate to face into the wind, and as a result, turbine direction is determined by wind direction. Shadow flicker will affect a larger area if the wind is blowing from a direction such that the turbine rotor is near perpendicular to the sun-receptor view line. Similarly, shadow flicker will affect a smaller area if the wind is blowing from a direction such that the turbine rotor is near parallel to the sun-receptor view line.
- **Wind speed**: Shadow flicker can only occur if the turbine is in operation. Turbines are designed to operate within a specific range of wind speeds. If the wind speed is too low or too high, the turbine will not operate, eliminating shadow flicker.

- **Obstacles**: Obstacles, such as trees or buildings, can have a screening effect and reduce or eliminate the occurrence of shadow flicker if they lie between the wind turbine and the receptor.
- **Contrast**: Because shadow flicker is defined as a change in light intensity, the effects of shadow flicker can be reduced by increasing the amount of light within a home or room experiencing shadowing flicker.
- **Local topography**: Changes in elevation between the turbine location and the receptor can either reduce or increase frequency of occurrence of shadow flicker, compared to flat terrain.

Currently, shadow flicker impacts are not regulated by state and federal law.

Shadow flicker modeling for the Big Bend Wind Project incorporated long-term sunshine probability from the Minneapolis-St. Paul weather station through 2015 (Table 8.5-2). Wind speed and direction is displayed in Chart 9.1-4 Big Bend Wind Rose in Section 9.1.10.

Table 8.5-2
Minneapolis-St. Paul Sunshine Probability[1]

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
0.53	0.59	0.57	0.56	0.62	0.67	0.74	0.69	0.62	0.51	0.37	0.38

[1] Defined by NOAA as the total time that sunshine reaches the surface of the earth, expressed as the percentage of the maximum amount possible from sunrise to sunset with clear sky conditions.

8.5.4.2 Shadow Flicker Impacts

Shadow flicker frequency calculations for the Project were modeled for 969 residences (receptors) with WindPRO based on all turbines in each layout. These receptors are those within the Project Area and one-mile buffer that could receive shadow flicker. As demonstrated in Table 8.5-3, all non-participating residences are expected to experience below 30 hours per year of shadow flicker. Figures 9a – 9c (Shadow Flicker) provide a visual representation of shadow flicker across the Big Bend Wind Project for each of the three turbine models. Appendix C shows results of the shadow flicker assessment at the Project.

Table 8.5-3
Summary of Shadow Flicker Assessment

Turbine Model	Shadow Flicker (hr./year)	Participating		Non-Participating		Total	
		No. Receptors	% of Receptors	No. Receptors	% of Receptors	No. Receptors	% of Receptors
Nordex N-163	0	49	43.0%	802	93.8%	851	87.8%
	0-1	0	0.0%	4	0.5%	4	0.4%
	1-10	13	11.4%	39	4.6%	52	5.4%
	10-20	12	10.5%	9	1.0%	21	2.2%
	20-30	17	14.9%	1	0.1%	18	1.8%
	Over 30	23	20.2	0	0.0%	23	2.4%
Vestas V162	0	48	42.1%	804	94.1%	852	87.9%
	0-1	0	0.0%	5	0.6%	5	0.5%
	1-10	13	11.4%	36	4.2%	49	5.0%
	10-20	13	11.4%	9	1.0%	22	2.3%
	20-30	18	15.8%	1	0.1%	19	2.0%
	Over 30	22	19.3%	0	0.0%	22	2.3%
GE-158[1]	0	48	42.1%	806	94.2%	854	88.1%
	0-1	0	0.0%	5	0.6%	5	0.5%
	1-10	15	13.2%	34	4.0%	49	5.0%
	10-20	16	14.0%	10	1.2%	26	2.7%
	20-30	19	16.7%	0	0.0%	19	2.0%
	Over 30	16	14.0%	0	0.0%	16	1.7%

[1] The GE-158 turbine was modeled at the 118 m hub height, which is has more shadow flicker as a result of total turbine height than the 108 m hub height

WindPRO calculates the number of hours per year as well as the maximum minutes per day during which a given receptor could realistically expect to be exposed to shadow flicker from nearby wind turbines. The maximum shadow flicker (hours per year) for each layout is summarized in Table 8.5-4.

Table 8.5-4
Maximum Shadow Flicker (hours/year)

Turbine Model	Maximum Shadow Flicker (hours/year)	
	Participating	Non-Participating
Nordex N-163	59:36	20:31
Vestas V162	59:11	20:19
GE-158	56:07	19:39

The shadow flicker modeling is conservative and does not take in consideration several factors including:

- availability of the turbines (i.e., whether they are operating or not based on meteorological conditions and/or maintenance);
- turbines not operating below cut-in and above cut-out wind speeds;
- obstacles (like trees or buildings) obstructing shadow flicker from a receptor; and
- dust or aerosols in the air which reduce the impact of shadow flicker.

For example, the participating residence modeled to receive the maximum amount of shadow flicker is surrounded by trees that are not accounted for by the model. These trees provide an obstruction to shadows from nearby proposed turbines. There are no non-participating residences which the model calculates will receive more than 30 hours of shadow flicker per year for each of the three turbine models.

At a distance of 1,200 feet or greater (the Project minimum setback for residences), receptors will typically experience shadow flicker only when the sun is low in the sky, and when certain meteorological and operational factors are present. If a receptor does experience shadow flicker, it most likely will be only during a few days per year from a given turbine, and for a total of only a fraction (typically less than one percent) of annual daylight hours.

Shadow flicker from the proposed turbines is not harmful to the health of photosensitive individuals, including those with epilepsy. The Epilepsy Foundation has determined that generally, the frequency of flashing lights most likely to trigger seizures is between five and 30 flashes per second (Epilepsy Foundation, 2013). The frequency of shadow flicker due to wind turbines is a function of the rotor speed and number of blades, and it is generally no greater than approximately 1.5 Hz (i.e., 1.5 flashes per second). Because the frequency of wind turbine shadow flicker is so much lower than the frequency range that can trigger seizures, there is no potential for causing seizures.

8.5.4.3 Shadow Flicker Mitigative Measures

Big Bend has sited turbines to minimize impacts to residences. Based on the results of the Project's shadow flicker modeling, no specific mitigation is currently proposed. To the extent that a residence experiences inordinately more flicker than anticipated by modeling during Project operation, mitigation would be addressed at that time. However, because of the conservative

methods used for the modeling, it is highly unlikely that more flicker than modeled will occur. In order to assess site-specific mitigation measures, flicker occurrences should be documented daily for several consecutive months including location, date, time of day, and duration. Mitigation measures will be considered and implemented based on individual circumstances of residences experiencing shadow flicker, and as a reasonable function of the amount of flicker experienced. Such mitigation measures may include Big Bend taking the following actions:

- Providing education to landowners about how to minimize the effect of shadow flicker.
- Providing indoor screening, such as curtains or blinds in windows, where appropriate and reasonable.
- Providing exterior screening, such as a vegetation buffer or awnings over windows, where appropriate and reasonable.
- Implementing Turbine Control Software programmed to temporarily shut down a specific turbine for a few minutes if conditions are present to create flicker.

8.6 Public Services and Infrastructure

LWECS projects have the potential to impact public services during both construction and operation. This section provides information about public services in the Project Area including emergency services; utilities; roads and railroads; communication systems; television service; and cell towers and broadband service, and discusses whether the Project has the potential to affect these public services. A discussion of potential Project effects on public health and safety is provided in Section 8.9.

Big Bend conducted online research to identify emergency services, existing utilities, roads and railroads, and communication systems within the Project Area. The results of this review and a discussion of potential impacts to these services from construction and operation of the Project is presented below.

8.6.1 Emergency Services

Use of heavy equipment during construction presents the potential for injuries such as falls, equipment-use related injuries, or electrocution. Operation of an LWECS project presents a potential risk to public safety if the wind turbines or Wind Project Substation are damaged by inclement weather or not operated in compliance with safety standards. Injuries as a result of construction or operation of an LWECS project would require use of local emergency services such as police, fire, ambulance, or hospitals and could affect the availability of these services for the local population.

8.6.1.1 Description of Resources

The Project is located in a rural area in southwestern Minnesota (Figure 1 – Project Location). Within the Project Area, local law enforcement and emergency response agencies are available in Cottonwood and Watonwan Counties and nearby communities. Cottonwood and Watonwan Counties have sheriff departments that provide services to their respective counties. Additionally, the Cities of Mountain Lake, Windom, St. James, and Comfrey have local police departments.

Fire services near the Project Area are provided by city and community fire departments, including Mountain Lake, Butterfield, Windom, St. James, Darfur, Comfrey, and Jeffers.

Ambulance response is provided by regional and local ambulance services. The Windom Ambulance Service provides response services to a 200-square-mile region surrounding Windom, Minnesota. The cities of Mountain Lake, St. James, and Jeffers also provide ambulance services (Minnesota Emergency Medical Services Regulatory Board, 2020).

Hospitals near the Project Area include Windom Area Health in Windom (Cottonwood County) and Madelia Community Hospital and Clinic in Madelia (Watonwan County). Smaller medical clinics or medical centers in the area include Sanford Health Mountain Lake Clinic in Mountain Lake, Mayo Clinic Health System in St. James and Comfrey, and various eye clinics, dental offices, and chiropractors.

8.6.1.2 Impacts

Construction and operation of the Project is not expected to impact the availability of emergency services. Big Bend will coordinate with emergency services providers to determine appropriate safety precautions and standards, and develop measures to address these precautions and standards. If emergency services are required during constriction or operation of the Project, the numerous law enforcement, fire departments, ambulance services, and hospitals near the Project Area would be adequate to address Project-related emergency service needs without negatively impacting the availability of these services for the local populace.

8.6.1.3 Mitigation Measures

Because no impacts on emergency services are anticipated, no mitigation measures are proposed. However, as required by Permit Order, Big Bend will prepare an Emergency Action Plan or Emergency Response Plan to be filed with the Commission as part of the pre-construction filings. This plan will address emergency response to residences in the Project Area and any wind project facilities should a response be required. The plan will include information for the site manager, address points of turbine locations, identify haul routes where there will be increased traffic during component deliveries, and identify areas where existing roads and intersections will be updated to facilitate construction of the Project. Big Bend will continue to coordinate with local emergency services throughout construction of the Project and as it enters operation.

8.6.2 Existing Utility and Public Infrastructure

The location of existing utilities and other public infrastructure is an important factor to be considered when siting an LWECS project. Turbines have been sited at least 1.1x the turbine tip height from existing utilities and public infrastructure to avoid potential impacts to existing infrastructure.

8.6.2.1 Description of Resources

South Central Electric Association is the primary electrical provider for the Project Area (Minnesota Geospatial Commons, 2018). Mountain Lake Municipal Utilities service area includes the city of Mountain Lake and areas within approximately half mile of the municipal boundary. Minnesota Energy Resources and CenterPoint Energy provide natural gas service in the Project Area (Minnesota Energy Resources, 2020; CenterPoint Energy, 2020). Water is supplied by the Red Rock Rural Water System (Red Rock Rural Water System, 2019).

The Mountain Lake substation is a distribution substation owned by Great River Energy (GRE) and located at the northwest corner of the intersection of County State Aid Highway (CSAH) 3 and 570th Avenue in Cottonwood County. There is an Alliant Energy 69 kV transmission line that enters the northern portion of the Project Area in Cottonwood County along CSAH 1 traveling south for four miles before turning west along CSAH 3 for half mile and turning south along 575th Avenue for one mile. The transmission line turns west again along 350th Street for four and a half miles before turning south along 530th Avenue and exiting the Project Area. Additionally, there is a half mile segment of 69 kV GRE tap line between the Mountain Lake Substation and Alliant 69 kV transmission line along CSAH 3. In the Watonwan County portion of the Project Area there is a 69 kV GRE transmission line along 650th Avenue, which forms the eastern boundary of the Project Area. There are no pipelines within the Project Area. Infrastructure within the Project Area including existing transmission lines and substations is shown on Figures 3a-3c.

The City of Mountain Lake is building a new wastewater treatment facility adjacent to their current facility. The existing facility is located within the Project Area, north of Mountain Lake between 570th Avenue and 575th Avenue and south of 360th Street. The new facility will be developed east of the existing facility on the east side of 575th Avenue in an area that is currently cultivated cropland.

8.6.2.2 Impacts

Big Bend has sited turbines at least 1.1x the turbine height from exiting utilities, including transmission lines. Other utilities that are common along roads and to residences, such as rural water lines and distribution lines, will be surveyed prior to construction as part of the ALTA survey. The Project will be constructed to avoid impacts to all underground infrastructure as well as overhead transmission lines.

A collocated crane path and collection line will cross the new wastewater treatment facility piping. The new piping will be 7-8 feet below grade. Big Bend's collection lines will be four feet below grade, and, as such, not impacts are anticipated. Additionally, Big Bend has coordinated with the city engineer on the routing of these facilities. The Project design in this location has been approved by the county engineer.

8.6.2.3 Mitigation Measures

Big Bend will conduct a Gopher One Call prior to and during construction to identify the locations of any buried utilities and safety concerns and to prevent possible structural conflicts.

8.6.3 Roads and Railroads

Use of heavy equipment during construction also may damage existing road surfaces and local roadways could experience temporary road and/or lane closures during construction. In addition, the influx of construction contractors could increase traffic volumes on local roadways. In addition, if a wind turbine or Project substation is sited too close to an operating railroad, it could interfere with safe operation of the railroad.

8.6.3.1 Description of Resources

In general, the existing roadway infrastructure in and around the Project Area is characterized by state, county, and township roads that generally follow section lines. Various county and township roads provide access to and throughout the Project Area. Roadway infrastructure throughout the

Project Area also includes two-lane paved and gravel roads. In agricultural areas, many landowners use private, single-lane farm roads and driveways on their property.

The Minnesota Department of Transportation (MNDOT) conducts traffic counts on roads in Minnesota. The functional capacity of a two-lane paved rural highway is in excess of 5,000 vehicles per day, or AADT. Based on 2018 data, the highest existing AADT in the Project Area is 1,700 vehicles per day along CSAH 1 north of Mountain Lake. Traffic volumes along other county and township roads range from 20 to 890 vehicles per day (MNDOT, 2019). Traffic counts are generally higher in proximity to nearby cities.

The Northern Santa Fe Railroad is immediately adjacent to the southern portion of the Project Area between Mountain Lake and Butterfield. No railroads are located within the Project Area.

8.6.3.2 Impacts

During the construction phase, temporary impacts are anticipated on some public roads within the Project Area. Roads will be affected by the transportation of equipment to and from the Project Area between Project facilities. Due to construction equipment and increased traffic over 8 months of construction, there is potential for road surface impacts such as potholes and rutting and improvements such as intersection widening to facilitate equipment and deliveries. Some roads may also be expanded along specific routes as necessary to facilitate the movement of equipment. Construction traffic will use the existing county, state, and federal roadway system to access the Project Area and deliver construction materials and personnel.

Construction activities will increase the amount of traffic using local roadways, and may temporarily affect traffic numbers in the area, but such use is not anticipated to result in adverse traffic impacts. During the construction phase, several types of light, medium, and heavy-duty construction vehicles will travel to and from the Project Area, as well as private vehicles used by construction personnel. Truck access near the Project Area is generally served by Highway 60 on the south side, U.S. Highway 71 on the west side, and 300th Street on the north side of the Project Area. Specific additional truck routes will be dictated by the location required for delivery.

Big Bend estimates the maximum construction workforce is expected to generate approximately 40 large truck (permit loads) trips per day, 200 non-permit concrete truck trips per day, 16 tractor trailer equipment delivery trips per day and up to 510 small-vehicle (pickups and automobiles) trips per day during peak construction periods. The functional capacity of a two-lane paved rural highway is in excess of 5,000 vehicles per day. Currently, the heaviest traffic is on Highway 60 at 5,400 AADT (MNDOT, 2019). Since many of the area roadways have AADTs that are currently well below capacity, the addition of 716 vehicle trips during peak construction would be perceptible, but similar to seasonal variations such as spring planting or autumn harvest.

After construction is complete, traffic impacts during the operations phase of the Project will be minimal. Operation and maintenance activities will not noticeably increase traffic in the Project Area, as these activities tend to be sporadic and spread out within the Project Area. A small maintenance crew driving through the area in pickup trucks on a regular basis will monitor and maintain the wind turbines as needed. There would be a slight increase in traffic for occasional turbine and substation repair, but traffic function will not be impacted as a result. Furthermore, the availability of existing roadways throughout the Project Area will allow access roads to turbines to extend from existing public roads directly to the turbines, thereby minimizing impacts on adjacent agricultural land.

8.6.3.3 Mitigative Measures

Big Bend is currently coordinating with Cottonwood and Watonwan Counties and the townships within the Project Area on the development and execution of a single, cooperative Development, Road Use, and Drainage Agreement to minimize and mitigate impacts on existing roadways. Big Bend will ensure that the general contractor communicates with the road authorities throughout the construction process, particularly regarding the movement of equipment on roads and the terms of the development agreement.

If roadways are impacted by the use of heavy construction equipment (e.g., potholes, rutting), they will be restored per the Development, Road Use, and Drainage Agreement. Additional operating permits will be obtained for over-sized truck movements.

Big Bend has mitigated impacts to existing roadways from operation of the Project by siting wind turbines with a setback of at least 1.1x the total turbine height from all public roads, which exceeds the Commission standard of a 250-foot setback.

8.6.4 Communication Systems

Operation of an LWECS project has the potential to interfere with communication networks such as radio, television, cellular towers, and broadband services. Interference could occur if the placement of wind turbines creates line-of-sight interference with existing communication networks. Big Bend conducted online research to identify local radio, landline telephone service, television, cell towers, and broadband services that could be affected by the Project. The results of this review are presented in Section 8.6.4 through 8.6.6.

8.6.4.1 Description of Resources

Big Bend commissioned a communication tower study by Evans Engineering, which identified three communication tower structures in the Project Area (Appendix D). These three tower structures are registered with the Federal Communications Commission (FCC) and are all Land Mobile antennas (see Figure 10 – Microwave Beam Path). There are no microwave, cellular, AM/FM radio, or other types of communication towers in the Project Area. Big Bend notes there may be additional communications antennas within the Project Area, however, because these structures are typically less than 200 feet in height, they are not required to be registered with the FCC.

8.6.4.2 Impacts

Construction and operation of the Project are not expected to impact communication systems, AM/FM radio, and microwave beam paths. Because of their height, modern wind turbines have the potential to interfere with existing communications systems licensed to operate in the United States. The required separation distance based on the characteristics of the communication systems varies depending on the type of communication antennas that are installed on the tower. In general, turbines have been setback at least the fall distance (1.1x turbine height) from a communication tower. Some communication systems, particularly multi-directional transmitting facilities like Land Mobile towers, have a more specific setback of 425 meters (in this case, 425 meters is the distance in which further study is recommended to assess potential interference issues; turbines sited beyond this distance do not require any additional study). At this distance, wind turbines can cause potential interference. Turbines at the Project are sited at least 535

meters (1,755 feet) from a communication tower. As such, impacts to communication systems are not anticipated.

While there are no microwave communication towers in the Project Area, there are portions of three microwave beam paths that bisect portions of the central and southeastern Project Area. Big Bend has sited the Project's turbines in a manner that avoids all identified microwave beam paths and communication systems (see Figure 10 – Microwave Beam Path). As such, impacts to microwave beam paths are not anticipated.

The National Telecommunications and Information Administration stated that no agencies have issues with Project placement in response to a Big Bend letter request from January 17, 2020 (see Appendix E – Agency Correspondence).

Construction and operation of the Project are also not expected to impact landline phone service.

8.6.4.3 Mitigative Measures

If communication interference is identified during or after construction of the Project, Big Bend will address the interference on a case-by-case basis. Big Bend does not propose mitigative measures at this time.

Gopher One Call will be contacted prior to construction to locate and enable avoidance of all underground facilities. To the extent Project facilities cross or otherwise affect existing telephone lines or equipment, Big Bend will enter into agreements with service providers to avoid interference with their facilities. If the Project negatively impacts telecommunication services, Big Bend will provide a specific mitigation plan and take the necessary steps to restore all impacted services at that time.

8.6.5 Television

8.6.5.1 Description of Resources

The Evans Engineering study also identified 35 television stations that have a predicted FCC primary off-the-air service signal over at least a portion of the Project Area (Appendix D). Of these 35 television stations, three are full power TV stations affiliated with major networks. The remaining 32 stations are low power stations or translators. Translator stations are low-power stations that receive signals from distance broadcasters and retransmit the signal to a local audience. These stations serve local audiences and have limited range, which is a function of their transmit power and the height of their transmit antenna.

8.6.5.2 Impacts

Construction of wind turbines has the potential to impact television reception as a result of an obstruction in the line of sight between digital antennas at residences and the television station antennas. Based on the Evans Engineering analysis of licensed television stations that transmit in the Big Bend Wind Project Area, three full-power digital stations and 32 low-power digital stations currently serve the Project Area; these stations may experience reception disruptions related to the Project.

The Evans Engineering study concluded that the Project may result in degraded reception of digital television signals to residences if Project facilities cause obstruction in the line of sight

between the television station antennas and the residence. The true impact of this obstruction is unknown; however, modern digital television receivers have undergone significant improvements to mitigate the effects of signal scattering, which may limit the likelihood that disruptions to digital television would occur. Television reception at residences relying on cable or satellite television service will not be impacted by construction or operation of the Project.

8.6.5.3 Mitigative Measures

If interference to a residence's or business's television service is reported to Big Bend, Big Bend will work with affected parties to determine the cause of interference and, when necessary, reestablish television reception and service.

Big Bend plans to address any post-construction television interference concerns on a case-by-case basis. If television interference is reported to Big Bend, Project representatives will coordinate with landowners on potential options such as relocation of the household antenna to receive better signal, installation of a better outside antenna or one with a higher gain, or installation of satellite or cable tv.

8.6.6 Cell Towers and Broadband Interference

8.6.6.1 Description of Resources

As described in Section 8.6.4 (Communication Systems), there are three land mobile antennas in the Project Area; there are no cellular towers in the Project Area. Cellular service in the Project Area is provided by many carriers including AT&T, DISH network, Sprint, Standing Rock Telecommunications, TerreStar, T-Mobile, and Verizon.

Minnesota is prioritizing border-to-border high-speed internet access throughout the state. The Border to Border Broadband Development Grant Program was created in Minn. Stat. § 116J.395 in 2014. The legislative focus of this grant program is to provide state resources that help make the financial case for new and existing providers to invest in building broadband infrastructure to unserved and underserved areas of the state. Based on data from the Minnesota Department of Employment and Economic Development (MN DEED), the majority of the Project Area is identified as an Unserved Area (no wireline broadband of at least 25 megabytes per second (Mbps) download and three Mbps upload [25M/3M]). A small portion of the Project Area near Mountain Lake (Cottonwood County, Butterfield and Darfur (Watonwan County), and certain sections in Cottonwood County are identified as Underserved Area (wireline broadband of at least 25M/3M but less than 100M/20M) (MN DEED, 2019a and 2019b).

8.6.6.2 Impacts

Big Bend does not anticipate any impacts to cellular services as a result of construction and operation of the Project. Each of the cellular-provider networks in the Project Area is designed to operate reliably in a non-line-of-sight environment. Many land mobile systems are designed with multiple base transmitter stations covering a large geographic area with overlap between adjacent transmitter sites in order to provide handoff between cells. Therefore, any line-of-sight signal blockage caused by placement of the proposed wind turbines would not materially degrade the reception because the end user is likely receiving signals from multiple transmitter locations.

Big Bend also does not anticipate any impacts to land mobile communication systems. As described in Section 8.4.6.2, the closest turbine to a land mobile communication antenna is 535

meters, well beyond the 425-m distance for which further study on potential interference impacts is recommended.

Based on data from the MN DEED, the Project Area is considered an Unserved Area for broadband. As such, impacts to broadband service are not likely or anticipated. Additionally, Big Bend is unaware of potential interference or disruptions to broadband service that could be caused by operation of wind turbines.

8.6.6.3 Mitigative Measures

If cell tower signal or broadband interference is identified during or after construction of the Project, Big Bend will address the interference on a case-by-case basis. Big Bend does not propose mitigative measures at this time.

8.7 Cultural and Archaeological Resources

Cultural resources can be defined as physical evidence or place of past human activity and include archaeological and historic architectural resources that provide important information about the history of human occupation and alteration of the landscape over time. Archaeological resources include prehistoric and historic artifacts, structural ruins, and earthworks or rock art that are typically found either partially or completely below the ground surface. Historic architectural resources include standing structures, such as buildings and bridges, as well as historic districts and landscapes.

To assess potential impacts to cultural and archaeological resources, the 2019 LWECS Application Guidance recommends that applicants, “Consult with the Minnesota SHPO to determine the extent and type of archaeological and cultural resources in and near the project area (within 0.5 miles of the project boundary), provide an interpretation of the results obtained from SHPO results,” and conduct additional surveys if recommended (DOC-EERA, 2019).

Big Bend sent an initial letter to SHPO in November 2017 asking for a record search for the initial proposed Project boundary plus a two-mile buffer. Following a meeting between Big Bend and SHPO in November 2017, SHPO recommended that areas identified with a high probability for cultural resources be identified and field surveyed. Additionally, SHPO recommended Big Bend consult directly with the MNHS regarding appropriate measures to avoid and/or minimize impacts to the Jeffers Site, which was located within the Project boundary at the time. SHPO noted that a viewshed analysis of the Jeffers Site and Red Rock Ridge may warrant management consideration. Through further coordination, in January 2018, SHPO indicated that a 1.5-mile visual area of potential effect around the proposed turbines should be used to assess concerns about National Register of Historic Places (NRHP) eligible or listed structures. Again, further visual impacts analysis and coordination was recommended related to the Jeffers Site, which was within the 2018 Project Boundary (see Image 4.1-1).

The Jeffers Site is an historic site, listed in Minn. Stat. 138.662, subd. 17, and part of the State’s Historic Sites Network. The Jeffers Site was nominated to the NRHP in 1970. The nomination noted that while Southern Minnesota contains many petroglyph sites, the Jeffers Site is the state’s “finest example” of the carvings. In support of the significance of the site, the nomination describes the age, integrity, and distinctive characteristics of the carvings.

To be eligible for the NRHP a site must be at least 50 years old, be historically significant, and have a high degree of integrity. A property has a high level of integrity if it possesses

characteristics that convey its historical significance through its setting, materials, design, location, workmanship, feeling, and association. A property's significance in American history, architecture, archaeology, engineering, and culture is determined by the integrity of the districts, sites, buildings, structures, and objects that are part of the property and its surroundings. To be considered significant, a site must meet at least one of the following review criteria:

A. The property must be associated with events that have made a significant contribution to the broad patterns of our history.

B. The property must be associated with the lives of persons significant in our past.

C. The property must embody the distinctive characteristics of a type, period, or method of construction, represent the work of a master, possess high artistic values, or represent a significant and distinguishable entity whose components may lack individual distinction.

D. The property must show, or may be likely to yield, information important to history or prehistory.

Historic properties can be eligible for NHRP listing because of local, state, or national significance under any of the four criteria. Under criterion A, the applicable history could be local, statewide, or national. Under criterion B, the person could be a local, state, or national figure. Under criterion C, the architectural significance could be local, statewide, or national.

Individual petroglyphs may be historically significant (eligible for NRHP listing) either individually or as a contributing element to a much larger historic district. Not only must a site meet one or more of the NRHP criteria, it must have a high degree of integrity as discussed above. The site must retain, to a significant degree, at least five of the following seven characteristics from its original design:

- Setting—the character of the location and how the site is situated in relationship to other features, such as landforms and characteristics.
- Materials—the elements that were originally combined to construct the site.
- Design—reflects the historic function and technology. Design applies to individual petroglyphs as well as districts.
- Location—the place where the petroglyph was originally placed or where a historic event occurred. Integrity of location can be extremely important.
- Workmanship—evidence of the builder's craft skills and technology.
- Feeling—the expression of the aesthetic or historic sense of a particular time period.
- Association—the direct link between an important historic event or person and the site. Association requires the presence of physical features to convey the relationship.

Through coordination efforts, Big Bend understands that the Jeffers Site and Red Rock Ridge are part of a larger tribal cultural landscape that multiple tribes view as spiritually significant and important. Native American tribes have been creating petroglyphs there for thousands of years. As a sacred site, Red Rock Ridge and Jeffers Site have been utilized historically by numerous tribes as a place of prayer and ceremony. As indicated in Appendix G - Summary of Agency and Tribal Feedback for Jeffers Site and Red Rock Ridge, the Dakota have utilized the Jeffers Site and potentially the Red Rock Ridge in recent historical times to modern times for prayer and meditation.

8.7.1 Phase Ia Literature Review

Big Bend hired QSI to conduct the Phase Ia literature review for the Project Area and 1.5-mile buffer. Background research on known archaeological sites and historic architectural resources was conducted in 2017, 2018, 2019, and 2020 by requesting information from the Minnesota SHPO, reviewing the NRHP and the National Historic Landmark online databases, and visiting the SHPO office and local historical societies to obtain more detailed information. These resources are displayed on Figure 11 (Unique Natural Features).

Data regarding known cultural resources information resulting from previous professional cultural resources surveys was reviewed to identify the types of archaeological sites that may be encountered and landforms or geographic features that have a higher potential for containing significant cultural resources. Table 8.7-1 summarizes the results of the literature review within the Project Area and within 1.5 miles of the Project Area. A copy of Big Bend's Phase Ia literature review is provided in Appendix F.

Table 8.7-1
Previously Recorded Cultural Resources within the Project Area and 1.5-mile Buffer

Resource Type	Project Area	1.5-Mile Buffer
Archaeological Sites	1	3
Total listed in National Register of Historic Places (NRHP)[1]	0	1
Historic Architectural Resources	9	91
Total listed or eligible for listing in NRHP[1]	1	2
Total Previously Recorded Cultural Resources	**10**	**94**
Total Listed or Eligible for Listing in NRHP[1]	**1**	**3**

[1] The number of NRHP-eligible resources shown is a subset of the total number of archaeological sites or historic architectural resources in each category.

One previously recorded archaeological site, eight previously recorded historic architectural resources, and one historic railroad were identified within the Project Area. The previously recorded archaeological site is the Fast burial, a historic burial which has not been evaluated for listing in the NRHP. Of the nine previously recorded historic architectural resources within the Project Area, seven are bridges and one is a farmstead. Six of the seven historic bridges have undergone NRHP evaluation and were determined to be not eligible for listing. The remaining bridge and the previously recorded farmstead have not been evaluated for listing in the NRHP. The historic railroad is the St. Paul & North Pacific Railroad; this railroad is listed in the NRHP.

Within 1.5 miles of the Project Area, three previously recorded archaeological resources were identified during the background literature review. One of the previously recorded archaeological resources is a prehistoric village site that is listed in the NRHP. The remaining two archaeological resources are a prehistoric and historic habitation site and a prehistoric lithic scatter; neither resource has been evaluated for listing in the NRHP.

The background literature review also identified 91 previously recorded historic architectural resources within 1.5 miles of the Project Area. These include 21 farmsteads, 44 residences, two banks, one bandshell, two bridges, five churches, seven commercial buildings, one gazebo, one grain elevator, one highway, one hotel, two municipal buildings, two schools, and Heritage Village (see Section 8.12.1 for a description of Heritage Village). Most of the historic architectural resources are within the cities of Mountain Lake and Delft. Nineteen of the previously recorded

historic architectural resources have been evaluated for the NRHP and determined to be not eligible for listing and 70 have not been evaluated for NRHP listing. One of the previously recorded historic architectural resources, the Isaac I. Bargen House, is listed in the NRHP, and another resource, Heritage Village, is recommended as eligible for listing in the NRHP.

8.7.2 Agency and Tribal Coordination

Big Bend voluntarily initiated coordination with stakeholders including Native American tribes, RRRRG, the MIAC, local elected officials, MNHS, and SHPO to actively generate feedback from all interested parties regarding the Project, including input regarding the Project's location in proximity to the Jeffers Site and the surrounding Red Rock Ridge, which were initially located within the 2018 Project Area. Big Bend's goal in soliciting feedback from these stakeholders was to understand the significance of the Jeffers Site and Red Rock Ridge and to work collectively with the stakeholders to develop appropriate buffers from these areas that provide a balance of limiting impact on these areas while still meeting the economic and operational goals for the Project. A brief summary of this stakeholder coordination is provided below. A full summary of input provided by stakeholders and Big Bend's responses is included in Appendix G.

8.7.2.1 Minnesota State Historical Society and State Historic Preservation Office

As discussed in Section 8.7, Big Bend initiated consultation with SHPO early in 2017 to introduce the Project, present results of the initial Phase Ia literature review (see Section 8.7.1), and discuss additional cultural surveys that would be required as part of the LWECS permitting process (see Section 8.7.3). Based on feedback from SHPO, additional consultation was initiated with MNHS, Jeffers Visitors Center staff, and the RRRRG due to the Project's proximity to the Jeffers Site and the Red Rock Ridge (these areas were within the project boundary at that time).

In April 2019, Big Bend met with MNHS staff at the Jeffers Site to introduce the Project and learn more about the historic site. At this meeting, MNHS requested that the Project design and turbine placement avoid shadow flicker on the petroglyphs because shadow flicker would interfere with the ability to see the petroglyphs clearly. Big Bend agreed to accommodate this request. MNHS staff also attended a July 2019 meeting with Native American tribes at the Big Bend office in Mountain Lake. MNHS did not provide comments specific to the Project or the viewshed analysis during this meeting; however, MNHS staff commented that wind turbines as far as 20 miles away are already visible from the Red Rock Ridge.

In early September 2019, MNHS sent an email to Big Bend providing feedback on the viewshed analysis that was presented at the July meeting where the nearest turbine was two miles from the Jeffers Site (i.e., the July 2019 Project layout), and requested that an additional visual analysis be prepared that considers a buffer of eight miles between the Project and the historic site.

Later in September 2019, and prior to the kickoff of cultural resource field surveys, Big Bend held a meeting with MNHS, SHPO, and DOC-EERA staff to confirm the survey plan for the Project; the SHPO and MNHS agreed with the field survey plan for the Project during the meeting. Also, during the meeting, MNHS reiterated its comment provided in the early September email about the visual simulation presented at the July 2019 meeting and stated that the presence of wind turbines within two miles of the Jeffers Site would represent an adverse impact on the viewshed of the historic site. The SHPO explained that the Jeffers Site is under consideration for National Historic Landmark status and that effects on the viewshed of the Jeffers Site will be a consideration in the decision. MNHS again recommended that additional visual simulations be prepared for consideration that use an eight-mile buffer between the historic site and wind

turbines. MNHS also provided specific vantagepoints that should be included in the revised visual simulation. In October 2019, Big Bend provided copies of meeting notes from the September meeting with MNHS staff and Native American tribes and began Phase I Survey for the Project.

In January 2020, Big Bend hosted another meeting with MNHS and Native American tribes to review Project changes that were made based on feedback received to date (i.e., December 2019 Project layout). At this meeting, Big Bend presented a revised Project design and visual simulation that increased the distance between the Jeffers Site and the nearest turbine to just over 3.25 miles. In addition, Big Bend included the 2019 location of the Red Rock Solar Project in the visual simulations presented at this meeting, using a maximum solar panel height of 20 feet, which represents the maximum potential visual impact from the Solar Project. During the meeting, Big Bend explained the siting constraints for the Project, including legal and physical requirements that affect where wind turbines for the Project can be sited (e.g., wind rights, county setbacks, and wind resource). Increasing the distance between the Project and the Jeffers Site, as shown in the January 2020 visual simulation, required Big Bend to pursue and obtain additional leased land in Watonwan County to meet the Project design of up to 308 MW.

In June 2020, MNHS and Native American tribes attended a virtual meeting hosted by Big Bend to review visual simulations of the revised Project design that incorporates additional feedback received during the January 2020 meeting. The status of ongoing cultural resources investigations for the Project were also discussed at this meeting. The revised Wind Project design presented in the June 2020 visual simulation is the Project Boundary and layout presented in this Application.

On July 29, 2020, Apex staff met virtually with representatives of SHPO, MNHS, and DOC-EERA to share recent changes to Project design, updates on the upcoming cultural/archaeological survey work for the current Project Boundary (as presented in this Application), and recently completed visual simulations that model the Project's visual impact from several key vantagepoints identified by MNHS staff and tribal representatives. At the July 2020 meeting, Big Bend also presented the methodology and results of the visual impacts assessment that had been completed at the request of MNHS and SHPO. The Visual Assessment Report is included in Appendix A.

. Big Bend prepared an updated desktop assessment for the Project and the recommended 1.5-mile buffer on July 16, 2020; the updated Phase Ia literature review will be submitted to SHPO in fall 2020 and is included in this Application as Appendix E. SHPO also recommended that MNHS staff from the Jeffers Site and RRRRG be consulted about the Project and asked for information about Big Bend's coordination with tribal representatives to date. MNHS staff from the Jeffers Site and RRRRG have been included in Big Bend's outreach efforts beginning in early 2018. Furthermore, Big Bend has provided ongoing updates to SHPO and MNHS staff on coordination with Native American tribes and all parties have participated in meetings hosted by Big Bend since 2018. SHPO also requested a visual assessment be conducted for the Project; a copy of Big Bend's Visual Impact Assessment is provided in Appendix A. MNHS requested an additional visual simulation of the Project layout that includes both a five-mile and eight-mile buffer from the Jeffers Site. As noted above, the visual simulation presented at the June 2020 meeting with stakeholders included a five-mile buffer from the Jeffers Site.

8.7.2.2 Tribal Coordination

Big Bend solicited input from Native American tribes due to the proximity of the Project to the Jeffers Site and Red Rock Ridge and the documented cultural and historical significance of these

resources. It is important to note that there is no federal nexus, and, therefore, no Section 106 consultation process for the Project.

Big Bend sent Project introduction letters to 13 Native American tribes in May and June of 2018 to provide information about the proposed Project and solicit their feedback during Project design. The 13 Native American tribes were identified based on their known ties to the Red Rock Ridge area. In July 2018, Big Bend sent invitations to a meeting at Big Bend's Project office in Mountain Lake, that was planned for September 2018, to present preliminary Project design details and gather initial feedback. At this meeting, feedback received from the Native American tribes in attendance centered around including additional Native American tribes that may have interest in the area, visual and auditory impacts, the Project boundary, and surveys. A full summary of input provided by the Native American tribes and Big Bend's response is included in Appendix G.

After the initial meeting, Big Bend provided meeting transcripts to the 13 Native American tribes and to an additional 18 Native American tribes that were identified as potential stakeholders during the meeting (refer to Appendix G). Additional feedback received from the tribes between September 2018 and April 2019 reiterated concerns about potential viewshed impacts from the Project as proposed at that time, recommended consultation with tribal elders to better understand the significance of the Jeffers Site and the surrounding landscape, and requested additional details about Big Bend's decommissioning plan. In May 2019, Big Bend invited the 31 tribes to another meeting to be held in July 2019 to provide Project updates and solicit feedback on issues of importance to the tribes.

In June 2019, Big Bend hired QSI to conduct cultural and archaeological surveys and act as its tribal liaison and to conduct an Oral History Study of the Jeffers Site and the Red Rock Ridge area. QSI consulted with the 31 tribes prior to the planned July 2019 meeting to assess their interest in participating in field surveys of the Project Area and the Oral History Study. At the July 2019 meeting, Big Bend presented visual simulations of turbine layouts under consideration for the Project using photographs taken from points of interest identified through tribal consultation.

Feedback received as a result of QSI's ongoing consultation and at the July 2019 meeting continued to focus on the potential for visual and auditory impacts, the methods and protocols used for cultural resource surveys of the Project Area (e.g., probability modeling, survey transect spacing), methods for identifying and protecting information on Traditional Cultural Properties (TCPs), and concerns that the Project may interfere with continued use of the site and surrounding area for spiritual and ceremonial purposes. The Upper Sioux Community recommended that the Project boundary be adjusted to allow a five-mile buffer between Red Rock Ridge and the wind turbines; additional tribes expressed support for a five-mile buffer area during the July 2019 meeting.

Six tribes expressed interest in participating in the Oral History Study, and 12 tribes expressed interest in participating in field surveys. Big Bend worked with the tribes as well as MNHS, SHPO, and DOC-EERA staff to develop the survey plan for the Project and distributed copies of the plan to all tribes in September 2019. During ongoing consultations in September 2019, some tribes requested the buffer be extended to eight miles from the Jeffers Site and that the visual simulations that were presented at the July 2019 meeting be revised to include the eight-mile buffer. Big Bend also contacted the MIAC in September 2019 to assess their interest in the Project; the MIAC was unable to attend the September 2019 meeting, but a status report of the 2019 Phase I Survey results was provided to MIAC in December 2019 and MIAC attended the July 2020 meeting (see below and Appendix G).

In January 2020, Big Bend met with the Lower Sioux Tribal Council to share the revised Project design and solicit feedback. Lower Sioux Tribal Council requested that Big Bend perform a vibration study and remove a grouping of 12 turbines, most of which were less than 5 miles from the Jeffers Site. A week later Big Bend hosted another meeting with tribal representatives (largely Tribal Historic Preservation Officers [THPOs]) and staff from the Jeffers Site to review revised Project design and visual simulations, and to review the findings of field surveys to date. During the meetings, tribal representatives reiterated their request for regular updates on the status and findings of the field survey and the Project design in general, their concerns regarding the potential for the Project to impact the viewshed of the Jeffers Site, and their desire to consult on site evaluations and the process for responding to unanticipated discoveries. Big Bend provided the vibration study to Lower Sioux on October 14, 2020; to date, no feedback has been received.

To address the requests of tribal representatives, Big Bend committed to providing monthly updates on survey progress and findings to THPOs and including contact information for THPOs in its Unanticipated Discoveries Plan (UDP). In February 2020, Big Bend began drafting its UDP for the Project in consultation with tribes who expressed interest in participating in development of this document. Big Bend provided the first monthly project update to THPOs on March 6, 2020 and has continued to provide monthly updates to date. In addition, in Spring 2020, Big Bend revised the Project design to create a 5-mile buffer area between the Jeffers Site and the nearest wind turbine2. The Project Area presented in this Application reflects these revisions.

Big Bend hosted a virtual meeting with tribal representatives and MNHS in July 2020 to present visual simulations of the revised Project design and an update on the status of ongoing cultural resource investigations. Discussions during the meeting focused on a review of the visual simulations, explanations of other siting constraints to wind turbine placement, and opportunities for tribal involvement in cultural resource investigations and the state permitting process.

Additional field surveys for the Project are planned for fall of 2020. Reports of field survey findings will be provided to the tribes who have expressed interest in the Project, when they are available.

8.7.3 Phase I Survey

During the 2018 meeting, SHPO indicated that areas with high probability for cultural resources would need to be identified and field surveys completed within those areas where ground disturbance was planned. In response, Big Bend hired QSI to develop a predictive model to identify areas with high, medium, and low probability for cultural resources based on a desktop cultural resources review, local research, published history research, historic maps, and various environmental factors.

The Phase Ia literature review report and probability modeling results were provided to SHPO for review in June 2019, and SHPO provided agreement with the probability analysis and recommendations for surveys in July 2019. A survey plan for the Project was then developed by QSI in accordance with the SHPO Manual for Archaeological Projects in Minnesota with input from Native American tribes. The plan was presented to and determined to be appropriate by SHPO and MNHS in September 2019.

[2] Big Bend shifted 9 of the 12 turbines closest to the Ridge, reaching a distance of 5+ miles for all turbines from the Jeffers Site.

Field surveys were conducted in October and November 2019 by a professional archaeologist meeting the Secretary of the Interior's Standards for Archaeology as published in Title 36 Code of Federal Regulations Part 6, and included seven Native American tribes (Lower Sioux Community, Upper Sioux Indian Community, Sisseton-Wahpeton Oyate, Turtle Mountain Band of Chippewa, Rosebud Sioux Tribe, Oglala Sioux Tribe, and Otoe-Missouria Tribe), MNHS staff, and RRRRG. To address tribal concerns regarding TCP information sharing, Big Bend has committed to recording the minimal amount of information necessary for avoidance and protection of any resources identified by the tribes as TCPs during these surveys. Big Bend provided the results of the fall 2019 field surveys to the tribes, MNHS, and SHPO in December 2019 for their review and comment.

Additional field surveys will take place after fall harvest in 2020 and, if necessary, in spring 2021 within the unsurveyed areas of the current Project Area.

8.7.4 Visual Assessment

As requested by SHPO and MNHS, Big Bend conducted a visual assessment for the Project to address feedback received from Native American tribes, MNHS, and RRRRG during early Project outreach. A copy of Big Bend's visual assessment is provided in Appendix A. The state of Minnesota does not have an established methodology for assessing visual impacts to historic sites, and input received from SHPO and MNHS in September 2019 suggested that Big Bend should propose a methodology and conduct an analysis as part of the site permit process.

The determination for the visual assessment analysis area was developed based on the National Park Service's Guide to Evaluating Visual Impact Assessments for Renewable Energy Proposed Projects (Sullivan and Meyer, 2014) and feedback received during early outreach for the Project. Native American tribes, MNHS, and RRRRG provided specific areas of cultural interest along the Red Rock Ridge that were used to further inform and develop the analysis area which includes the Red Rock Ridge including the Jeffers Site and The Nature Conservancy's Red Rock Prairie Preserve. The visual assessment analysis area was defined as an area approximately five miles northwest, north, and east of the 2019 Project boundary.

After the analysis area was established, Big Bend conducted a desktop analysis using GIS to establish a Zone of Visual Influence (ZVI), or the area in which Project turbines may be visible. The ZVI analysis used Environmental Systems Research Institute ArcGIS software to identify locations within the analysis area from which Project turbines might be visible at eye level (i.e., five feet aboveground). In addition, the most recent ZVI analysis assumed the maximum height of the tallest Project feature (i.e., turbines) would be at a total height of 677 feet from the ground to the tip of the extended blade.

The next step in the analysis was to incorporate key observation points (KOPs) that were identified by Native American tribes, MNHS, and RRRRG as areas of particular cultural interest. Each recommended KOP was considered within the ZVI to determine whether Project turbines would be visible from that point. Two of the initial locations, which had been identified for evaluation due to a concern regarding potential viewshed impacts during solstice events were eliminated from further consideration after it was confirmed that Project turbines would not be visible from the first area and were highly unlikely to be visible from the second location (See Appendix A). In the end, seven KOPs were identified where Project turbines may be visible. Each of the seven KOPs were further evaluated to assess potential effects on landscape character, in consideration of different types of views and viewer perspectives. Big Bend visited each of the 7 KOPs to verify areas where

the ZVI map indicated Project turbines would be visible and where they would not be visible. In addition, Big Bend visited other potential KOP locations that were ruled out during the ZVI analysis to confirm the results. Of the seven KOPs where the ZVI analysis indicated Project turbines would be visible, four are within the Jeffers Site, one is within The Nature Conservancy's Red Rock Prairie Preserve, and two are on private land.

To assess the potential visual impacts from the Project, Big Bend applied the impact assessment methodology developed by the Federal Highway Administration (FHWA). The FHWA Visual Impact Assessment methodology (FHWA, 1998) was developed in order to adequately and objectively consider potential visual effects of Federally funded transportation projects on adjacent communities. Using the FHWA method ensures that the information gathered is adequate to contribute to the project decision-making process and that the assessment and descriptions are as objective as possible. Using photographs taken during field visits at the seven KOPs, Big Bend developed photo simulations to show the existing views from each KOP and how the views would change based on various Project layouts under consideration at the time. Using the FHWA methodology Big Bend assigned a score to each of the photo simulations at the seven KOPs. A detailed discussion of the results of the visual assessment at each KOP, including photo simulations of the various Project layouts, are presented in Appendix A.

As described in Sections 8.7.2.1 and 8.7.2.2, photo simulations of the seven KOPs were shared with Native American tribes, MNHS, and RRRRG during meetings in July 2019 and January 2020 and with these groups and SHPO and DOC-EERA in June 2020, and feedback from each of these stakeholders was considered during development of the Project design and layout presented in this Application (Appendix G). Based on the Project layout presented in this Application, the closest turbine to KOPs within the Jeffers Site is 5.2 miles away; the closest turbine to the KOP within The Nature Conservancy's Red Rock Prairie Preserve is 3.9 miles away; and the closest turbine to the two KOPs on private land is 2.2 miles away.

8.7.5 Impacts

LWECS projects have the potential to directly and indirectly impact cultural resources. Archaeological resources could be directly impacted by the disruption or removal of subsurface archaeological materials, structural remains, or earthworks during LWECS construction. They may be indirectly impacted by the placement of a turbine or substation within the established viewshed of an archaeological and/or historic property, which could affect the integrity of the viewshed in a way that decreases the value of the resource.

Information regarding the location of previously documented cultural resources sites was taken into consideration during initial Project design. Big Bend has designed the Project to avoid directly impacting all previously recorded NRHP listed, eligible, or unevaluated archaeological and historic architectural resources either by Project alteration or structure placement. The Project layout presented in this Application considers the input of Native American tribes and MNHS provided during early and ongoing consultation and includes a five-mile turbine buffer from the Jeffers Site. Therefore, no direct impacts on previously documented archaeological or historic architectural resources would occur as a result of the Project.

However, construction and operation of the Project would have an indirect visual impact on the Jeffers Site. As discussed in Section 8.7.4, Big Bend conducted a visual assessment to assess the potential visual impacts on the Jeffers Site from the Project. Throughout development of the visual assessment, and in response to early and ongoing consultation for the Project, Big Bend

has considered and incorporated feedback received from Native American tribes, MNHS, and RRRRG into the Project design and layout presented in this Application. To minimize visual impacts, Big Bend reduced the total number of turbines proposed for the Project and increased the buffer between the Jeffers Site and other KOPs and the Project turbines to address the concerns expressed by these stakeholders.

The Visual Assessment concluded that Project turbines would likely not be visible from two locations identified as culturally significant sites. The Visual Assessment also concluded Project turbines sited between 0.5 to five miles from the KOPs would be visible, but would not dominate views and could be somewhat obscured by existing topography and vegetation. While Project turbines in this area could contrast with the existing landscape character, the severity of contrast would depend on the number of turbines that are visible and the atmospheric and lighting conditions. Project turbines sited greater than five miles from the KOPs would be further obscured by existing topography and vegetation, but would still be visible given the right atmospheric and lighting conditions. However, turbines further than five miles away would be less likely to contrast with the existing landscape character or change the visual quality of the view.

As discussed in Section 8.5.1 (Visual Resources), several existing wind turbines are currently visible from the Jeffers Site (e.g., Jeffers Wind Energy Center [8.4 miles from the Jeffers Site], Bingham Lake Wind [8.4 miles from the Jeffers Site]); see Image 8.5-1. After construction, the appearance of the Big Bend Wind Project would be similar to other wind farms in the surrounding landscape.

As it relates to the Jeffers Site, the wind turbines may draw the eye of visitors to the Jeffers Site because of the movement of the blades and because the turbines are a new, modern visual addition to the landscape. While the turbines may draw the eye, they will be far enough away to be low to the horizon and have a much smaller and narrower profile than if they were in the foreground or middle ground views. Within a majority of the Jeffers Site, the turbines will be behind the viewer, and they will not be noticeable when they are looking down at the petroglyphs.

The wind turbines are also not the only modern infrastructure within the setting of the Jeffers Site. An active aggregate mine, roads, utilities, tree windbreaks, farms, farm fields, residences, and the state historic site visitor accommodations (e.g., paths, deck, and benches) and buildings have changed the area from the open grassland prairie setting to a modern one that is mostly agricultural.

Overall, the visitors to the Jeffers Site will notice the presence of the turbines to the south. However, given all of the other modern developments in the area, the smaller turbine profile due to a distance greater than five miles, and that the park facilities for viewing the petroglyphs draw the person’s attention in directions away from the towers, most casual visitors are expected to dismiss the visual effects. Native American visitors and those seeking a more original feeling from the Jeffers Site may consider the turbines differently. This could especially be the case if movement of the wind turbines provides a distraction during ceremonial activities, or if the visitor is more sensitive to the presence of modern developments.

The presence of the turbines south of the Jeffers Site will only impact two of the seven NRHP historic integrity aspects - setting and feeling - and only then if the viewer is looking south, away from the petroglyphs. The current setting is only minimally similar to what it was during the period when the petroglyphs were created. Meanwhile the aspect of feeling, in general, is more derived from the visual aspects, meaning, and interpretation of petroglyphs themselves, and comes from

the other historical integrity aspects (i.e. workmanship, materials, location, design and association), so is more intact than the setting despite the modern changes currently present and those that would be caused by the turbines. The aspect of feeling could be somewhat diminished if seen from the Native American cultural and ceremonial perspective, although this will likely vary from person to person.

8.7.6 Mitigative Measures

Big Bend understands that additional previously undocumented cultural resources could be present within the Project Area. Archaeological resources would most likely be located on or near elevated landforms near permanent water sources. Historic architectural resources would most likely be located near existing municipalities, farmsteads, and infrastructure such as roads and bridges.

As mentioned in Section 8.7.3, Phase I surveys were initiated in 2019 and are ongoing. The informal results of the 2019 field survey were submitted to Native American tribes for review in December 2019; additional reports of Phase I Survey results will be submitted to SHPO, MNHS, and Native American tribes after additional surveys are completed. If archaeological or historic architectural resources that are determined to be eligible or potentially eligible for listing on the NRHP are identified as a result of field surveys, Big Bend will work with SHPO and Native American tribes to identify measures to avoid or mitigate any effects to these resources.

Avoidance of resources may include minor adjustments to the Project design and designation of environmentally sensitive areas to be left undisturbed by the Project. If archaeological resources are discovered during construction, measures will be implemented in accordance with the Project's UDP and may include halting construction and/or notification of the SHPO and THPOs if appropriate. Additionally, if unanticipated human remains are discovered during construction, they will be reported to the State Archaeologist per Minn. Stat. § 307.08 and construction will cease in that area until adequate mitigation measures have been developed between Big Bend and the State Archaeologist.

Big Bend has mitigated long-term visual impacts on the Jeffers Site through reducing the numbers of turbines from 64 to 55, increasing the buffer between Project turbines and the Jeffers Site from approximately 2.4 miles to more than 5 miles, and proposing the use of ADLS to reduce visual impacts on the night sky. In addition, in response to comments received through early coordination, Big Bend has eliminated potential shadow flicker, noise and vibration impacts to the Jeffers Site. Finally, Big Bend has provided a decommissioning plan, which provides financial surety and detail plans to remove the wind turbines at the end of the Project's life. As such, Big Bend has taken significant and meaningful measures to avoid and minimize the potential for adverse impacts to cultural resources, including at the Jeffers Site.

8.8 Recreation

Construction and operation of the Project has the potential to affect public access to and enjoyment of recreational opportunities in Cottonwood and Watonwan Counties through introduction of a physical, long-term aesthetic change to the predominantly agrarian landscape. The LWECS Guidance suggests an Applicant provide a summary of recreation lands within 10 miles of the Project Area.

8.8.1 Description of Resources

Recreational opportunities near the Project Area include hiking, biking, boating, fishing, camping, swimming, snowmobiling, hunting, golfing, and nature viewing. Figure 6 – Public Land Ownership and Recreation depicts the locations of Aquatic Management Areas (AMAs), WMAs, SNAs, and Waterfowl Production Areas (WPAs); nature viewing areas; golf courses; and snowmobile, water, and state trails within 10 miles of the Project Area. There are no NWRs or state parks within 10 miles of the Project Area.

Minnesota AMAs are managed to protect, develop, and manage lakes, rivers, streams, and adjacent wetlands and lands that are critical for fish and other aquatic life, for water quality, and for their intrinsic biological value, public fishing, or other compatible outdoor recreational uses. The Long Lake AMA is within the southwest portion of the Project Area. AMAs located within 10 miles of the Project Area are included in Table 8.8-1.

Table 8.8-1
Aquatic Management Areas within 10 Miles of the Project Area

Distance from Project Area Boundary (miles)	Distance to Nearest Turbine (miles)	AMA Name	General Location	AMA Area (Acres)
Within	0.9	Long Lake	Southwest	2.4
2.3	3.7	Bingham Lake	Southwest	18.9
5.1	6.3	Warren Lake (multiple parcels)	Southwest	160.5
5.4	5.9	Fish Lake (multiple parcels)	South	5.0
7.9	9.2	Scheldorf Creek	West	9.8

Minnesota WMAs are managed to provide wildlife habitat, improve wildlife production, and provide public hunting and trapping opportunities. These MNDNR lands were acquired and developed primarily with hunting license fees. WMAs are closed to all-terrain vehicles and horses because of potential detrimental effects on wildlife habitat. The MNDNR-owned access road to the Mountain Lake WMA is within the southern portion of the Project Area; the WMA is immediately adjacent to the Project Area. WMAs located within 10 miles of the Project Area are included in Table 8.8-2.

Table 8.8-2
Wildlife Management Areas within 10 Miles of the Project Area

Distance from Project Area Boundary (miles)	Distance to Nearest Turbine (miles)	WMA Name	Direction from Project Area Boundary	WMA Area (Acres)
Adjacent	1.2	Mountain Lake WMA (multiple parcels)	West	70.1
0.5	1.7	Delft WMA	West	351.7
0.8	1.5	Regehr WMA	South	65.0
1.3	4.3	Ewy Lake WMA	East	227.1
1.5	2.7	Little Swan WMA	West	411.8
1.6	2.8	Sulem Lake WMA	South	55.0

Table 8.8-2
Wildlife Management Areas within 10 Miles of the Project Area

Distance from Project Area Boundary (miles)	Distance to Nearest Turbine (miles)	WMA Name	Direction from Project Area Boundary	WMA Area (Acres)
1.9	4.7	Curry WMA	East	111.3
2.0	2.9	Rock Ridge WMA	North	158.1
2.1	3.5	Carpenter WMA	Southwest	60.8
3.0	3.4	Bennett WMA	South	344.2
4.0	4.6	Banks WMA	South	312.2
4.7	5.9	Arnolds Lake WMA	West	123.3
5.0	7.2	Wood Lake WMA (multiple parcels)	North	768.5
5.3	6.8	Farhagen WMA	Southwest	104.2
5.4	8.3	Voss WMA	Northeast	42.9
5.7	8.4	Turtle WMA	Southeast	12.6
5.9	7.5	Fossum WMA (multiple parcels)	South	138.8
6.0	8.3	Mulligan Slough WMA	Northeast	634.3
6.4	7.6	Bashaw WMA (multiple parcels)	North	585.8
6.4	7.6	Wolf Lake WMA	Southwest	55.4
7.0	8.2	Terri WMA	North	74.4
8.4	9.1	Riecks Slough WMA	North	131.2
8.6	9.1	Laurs Lake WMA	South	265.6
9.1	11.9	Rosendale WMA	East	19.1
9.1	10.3	Middle Creek WMA	Northeast	70.9
9.2	10.6	String Lakes WMA	Southwest	298.8
9.4	10.5	Lillegard WMA	Southwest	37.5
10.0	10.8	Vogel WMA	North	166.5

SNAs are areas designated to protect rare and endangered species habitat, unique plant communities, and significant geologic features that possess exceptional scientific or educational values. There are no SNAs within the Project Area. SNAs located within 10 miles of the Project boundary are shown on Table 8.8-3.

Table 8.8-3
Scientific and Natural Areas within 10 Miles of the Project Area

Distance from Project Area Boundary (miles)	Distance to Nearest Turbine (miles)	SNA Name	General Location	SNA Area (Acres)
3.5	5.5	Rock Ridge Prairie SNA	North	198.6
9.4	10.3	Des Moines River SNA	South	245.8

WPAs are managed by USFWS to protect breeding, foraging, and migratory habitat for waterfowl or wading birds, such as ducks, geese, herons, and egrets. WPAs provide opportunities for viewing wildlife and intact ecosystems. There is one WPA adjacent to the Project Area (Mountain Lake WPA), and no WPAs within the Project Area. An additional 11 WPAs are located within 10 miles of the Project boundary and are shown on Table 8.8-4.

Table 8.8-4
Waterfowl Production Areas within 10 Miles of the Project Area

Distance from Project Area Boundary (miles)	Distance to Nearest Turbine (miles)	WPA Name	General Location	WPA Area (Acres)
Adjacent	0.3	Mountain Lake WPA	South	16.3
2.5	3.7	Swan Lake WPA (multiple parcels)	West	146.5
3.0	4.3	Watonwan River WPA (multiple parcels)	West	356.7
4.6	5.9	Cottonwood Lake WPA	Southwest	313.2
5.0	7.3	Wood Lake WPA	North	54.6
5.5	6.7	Harder Lake WPA (multiple parcels)	West	159.9
5.7	6.8	Wolf Lake WPA (multiple parcels)	Southwest	406.6
6.6	7.6	Fish Lake WPA	South	99.3
7.0	7.6	Christiania WPA (multiple parcels)	South	302.3
8.1	9.3	Lake Augusta WPA (multiple parcels)	West	503.7
9.0	10.4	Blixseth WPA	Southwest	161.8
9.0	10.3	Des Moines River WPA (multiple parcels)	West	307.8

Red Rock Prairie, a native prairie site preserved and protected by The Nature Conservancy, is located two miles north of the Project Area. The Nature Conservancy selected this site because tallgrass prairies, such as that present at Red Rock Prairie, are globally endangered. In addition, Red Rock Prairie contains populations of prairie bush clover, a federally listed rare plant.

The MNDNR offers public water access at various waterbodies throughout the state, some access sites allow for carry-in only, while others are equipped with ramps for launching boats by trailer. There are three public water access sites within the Project Area: two associated with Butterfield Lake and one associated with Eagle Lake. Public water access sites are shown on Figure 6 - Public Land Ownership and Recreation.

There are no state trails within 10 miles of the Project Area. There are no state water trails within the Project Area; the closest water trail, a segment of the Des Moines River, is located approximately 6.8 miles southwest of the Project boundary.

As discussed in Sections 8.7 and 8.12, the Jeffers Site is located approximately two miles northwest of the northwest corner of the Project Area. Recreational opportunities include hiking solo or guided tours of prehistoric rock carvings.

There are two snowmobile trails within the Project Area: The Cottonwood and Jackson County Snowmobile Trail, and the Riverside Trail. The Cottonwood and Jackson County Snowmobile Trail runs along both sides of 300th Street on the northern edge of the Project Area boundary and turns south in the center of the Project Area along 580th Avenue through the full length of the Project Area, and includes a small extension that runs east along 360th Street for two miles and then turns south along 600th Avenue for 1.3 miles. The Cottonwood and Jackson County Snowmobile Trail also parallels the southern border of the Project Area along 380th Street, through the City of Mountain Lake until the boundary turns north about three miles west of Mountain Lake. The Riverside Trail runs south along County Road 5, bisecting the east side of the Project Area and then turns west along County Road 105 and then south along Country Road 102 in the southeastern corner of the Project Area around Butterfield Lake. One additional snowmobile trail, a portion of the Brown County Trails, is located 4.5 miles northwest of the Project Area. Snowmobile trails are shown on Figure 6 - Public Land Ownership and Recreation.

The Mountain Lake Golf Course is immediately adjacent to the southern Project Boundary, on the southwest side of Mountain Lake.

8.8.2 Impacts

Construction and operation of the Project is not anticipated to affect public access to or enjoyment of nearby recreational opportunities. Impacts to recreation would mostly be related to Project construction, which will be minimal, temporary, and isolated to specific areas throughout the Project Area. During operations, impacts will be visual in nature and are discussed in Section 8.5.1.2.

While there are several recreation lands within 10 miles of the Project Area, only the Long Lake AMA is within the Project Area and the access road to the Mountain Lake WMA is partially within the Project Area. Big Bend has sited turbines at least 3 RD by 5 RD from the AMA and WMA. The nearest turbine to the AMA is approximately 0.6 miles to the west; therefore, no impacts on public use of the AMA would occur. A collection line and crane path would cross the access road to the Mountain Lake WMA, just south of County Road 9. Temporary interruptions to public access to

the WMA may occur during the period of active construction; however, such interruptions would be temporary and would resolve after construction is complete.

Co-located collection lines and crane paths will cross the Cottonwood and Jackson County Snowmobile Trail in three locations where the snowmobile trail and 580th Avenue are co-located, and in one location where the snowmobile travels along 360th Street, just south of the Wind Project Substation. Collection lines cross the Cottonwood and Jackson County Snowmobile Trail in one additional location along 580th Avenue and along 360th Street; the collection lines are not co-located with crane paths at this crossing. The Riverside Trail will be crossed by one crane path where the snowmobile trail is co-located with County Road 5, north of the Town of Butterfield.

Snowmobile trail crossings by collection lines and crane paths during construction will result in a minimal, temporary impact to the trails, but no permanent impacts to the trails would occur from these activities. As these recreational trails are only used during winter months, potential impacts will depend on the timing of construction. If construction in this area is completed during non-winter months, snowmobilers would not notice an impact. The collection lines will be buried and, as such, no impacts to the snowmobile trail will occur from operation of these facilities.

In addition, three access roads will cross the Cottonwood and Jackson County Snowmobile Trail on the western side of 580th Avenue. Although access roads to the wind turbines will be a permanent feature during operation of the Project, the impact on use of the Cottonwood and Jackson County Snowmobile Trail would be minimal. The access roads would be similar to other residential driveways along 580th Avenue and would not inhibit use of the snowmobile trail.

Introduction of an aesthetic change to the predominantly agrarian landscape in the Project Area could impact public enjoyment of available recreation areas. A detailed discussion of how the Project could impact aesthetics and the measures Big Bend would use to mitigate aesthetic impacts is provided in Section 8.5.

8.8.3 Mitigative Measures

Big Bend has mitigated potential effects on public recreation opportunities in Cottonwood and Watonwan Counties by siting Project facilities to avoid recreation areas. Project turbines and facilities will not be located within public parks, trails, WMAs, or in USFWS lands. Turbines will be set back from public lands based on a minimum of the 3 RD by 5 RD setbacks from all non-leased properties per the Commission siting guidelines (MPUC, 2008).

Big Bend will minimize impacts to the access road to the Mountain Lake WMA by co-locating the collection line and crane path and by using trenchless techniques to install the collection line underneath the road. Big Bend also will obtain a Utility License to Cross Public Lands from the MNDNR for the crossing of this access road prior to the start of construction.

Big Bend will work with the Cottonwood and Jackson County Snowmobile Club and the Riverside Trail to review construction timing, determine if rerouting of the snowmobile trail is needed during construction, and to facilitate any modifications that may be necessary.

8.9 Public Health and Safety

LWECS projects have the potential to affect public health and safety by introducing collection lines carrying electricity from the wind turbines to the Wind Project Substation and their associated electromagnetic fields. Electromagnetic fields have been widely studied for potential health concerns. Additionally, LWECS can introduce air space hazards for aircraft traveling to and from local airports; there is a six-mile buffer from public use airports for which turbines cannot be sited.

8.9.1 Electromagnetic Fields and Stray Voltage

8.9.1.1 Description of Resource

The term electromagnetic field (EMF) refers to electric and magnetic fields that are present around any electrical device. Electric fields arise from the voltage or electrical charges, and magnetic fields arise from the flow of electricity or current that travels along transmission lines, power collection (feeder) lines, substation transformers, house wiring, and electrical appliances. The intensity of the electric field is related to the voltage of the line and the intensity of the magnetic field is related to the current flow through the conductors (wire). EMF can occur indoors and outdoors. However, there are no discernible health impacts from power lines (NIEHS, 1999).

The source of EMF for the Big Bend Wind Project will be from electrical collection lines and wind turbines. EMF from electrical collection lines, transmission lines, and transformers dissipates rapidly with distance from the source (NEIHS, 2002). Generally speaking, higher-voltage electrical lines produce higher levels of EMF at the source before dissipating with distance. There is no federal standard for transmission line electric fields. The Commission, however, has imposed a maximum electric field limit of 8 kV per meter (kV/m) measured at one m (3.28 feet) above the ground. There are presently no Minnesota regulations pertaining to magnetic field exposure.

Stray voltage is often a concern in agricultural areas, particularly dairy farms. Stray voltage is an unintended transfer of electricity between two grounded objects, and is typically caused by improperly grounded electrical equipment in farm buildings or by a faulty utility connection.

8.9.1.2 Impacts

Levels of EMF from the Project will be considerably below accepted guidelines. Project-specific EMF levels were not modeled for the 34.5 kV electrical collection lines; however, several studies have documented EMF exposure of various high voltage transmission lines. The NIEHS provides typical EMF levels for power transmission lines (NIEHS, 2002). For 115-kV transmission lines, the lowest voltage with typical EMF levels reported in the study, electric fields directly below the transmission line were reported at 1.0 kV/m before dissipating to 0.5 kV/m at 50 feet (approximate edge of right-of-way). A Canadian study of collection lines at a wind facility measured EMF (magnetic fields) of the Project's 27.5-kV collection lines, slightly lower voltage than the electrical collection lines proposed for the Big Bend Wind Project. This study found magnetic fields associated with buried electrical collection lines to be within background levels at one m above ground (McCallum et al., 2014). EMF from underground electrical collection lines dissipates very close to the lines because they are installed below ground within insulated shielding. The electrical fields are negligible, and there is a small magnetic field directly above the lines that, based on engineering analysis, dissipates within 20 feet on either side of the installed cable. The closest collection line to a residence is at least 110 feet, well beyond the distance where magnetic fields dissipate to background levels. Similarly, EMF associated with the transformers within each

turbine completely dissipates within 500 feet, so the 1,200-foot turbine setback from residences will avoid any EMF exposure to homes.

Research on the potential influence of EMF on organisms and human health has been conducted over many decades to understand basic interactions of EMF with biological organisms and cells, and to investigate potential therapeutic applications. In the 1970s, questions arose about potential adverse health effects from EMF and health conditions, including cancer. Over the past 40 years, considerable additional research has been conducted to address uncertainties in those studies and to determine if there was any consistent pattern of results from human, animal, and cell studies that would support such an association[3,4,5,6.] The quantity and complexity of the research has led scientific and government health agencies to assemble multidisciplinary panels of scientists to conduct weight-of-evidence reviews and arrive at conclusions about the possible effects associated with EMFs.

Overall, the published conclusions of these scientific review panels have been consistent. None of the panels concluded that either electric fields or magnetic fields are a known or likely cause of any adverse health effect at the long-term, low exposure levels found in the environment. As a result, no standards or guidelines have been recommended to prevent this type of exposure; however, from all the research that has been conducted, it was confirmed that short-term exposure to higher intensities of EMF (above exposure levels of electrical and industrial workers) could produce adverse stimulation of nerves and muscles (WHO, 2018). Although electric and magnetic fields induce voltages and currents in the body, the induced currents directly beneath high-voltage transmission lines are very small compared to thresholds for producing shock and other harmful electrical effects (WHO, 2018).

Big Bend has sited turbines and collection lines away from houses and barns as practical to minimize the electromagnetic field levels that would be present in these areas. There is one dairy farm within the Project Area that is over one mile away from the nearest turbine and 1.25 miles from the nearest underground collection line making it impossible for these dairy cows to be impacted by stray voltage. In fact, cattle in fields that may walk over buried underground collection lines will not be affected by stray voltage because the strength of the electromagnetic field is not high enough to adversely impact the cattle. Additionally, all electrical components in the Project will be grounded in accordance with National Electric Safety Code. Soil resistivity measurements will be taken on site as part of the Project's geotechnical analysis, and that data will be used to

[3] The NIEHS assembled a 30-person Working Group to review the cumulative body of epidemiologic and experimental data and provide conclusions and recommendations to the U.S. government (NIEHS, 1999).

[4] The International Agency for Research on Cancer (IARC) completed a full carcinogenic evaluation of EMF in 2002 (IARC, 2002).

[5] The International Commission on Non-Ionizing Radiation Protection (ICNIRP), the formally recognized organization for providing guidance on standards for non-ionizing radiation exposure for the World Health Organization, published a review of the cumulative body of epidemiologic and experimental data on EMF in 2003. The ICNIRP released exposure guidelines in 2010 that updated their 1998 exposure guidelines. For both guidelines, they relied heavily on previous reviews of the literature related to long-term exposure, but provided some relevant conclusions as part of their update process (ICNIRP, 2010).

[6] The Swedish Radiation Protection Authority (SSI), which became the Swedish Radiation Safety Authority (SSM) in 2009, evaluated current studies in several reports, using other major scientific reviews as a starting point (SSI, 2007 and 2008; SSM, 2009, 2010, 2013, 2014, 2015, 2018).

help design grounding systems. For these reasons, the potential for stray voltage as a result of the Project will be negligible.

8.9.1.3 Mitigative Measures

No impacts due to EMF or stray voltage are anticipated and no mitigation is proposed. Big Bend is committed to siting turbines and associated facilities to avoid conflicts with dairy farmers in the Project Area.

8.9.2 Air Traffic

8.9.2.1 Description of Resource

There is one public airport and one private heliport within 10 miles of the Project Area (Table 8.9-1; AirNav, 2020). The nearest airport is the Windom Municipal Airport, located approximately 4.6 miles southwest of the Project. This airport has runway approaches and restricted airspace for aircraft to approach and take off from. The St. James Medical Center, located approximately 7.8 miles east of the Project Area, has a private heliport for patient transport.

Table 8.9-1
Airports within 10 Miles of the Project Area

Airport Name	City	County	Distance/ Direction[1]	Runway Information[2]	Runway Elevation (feet)[3]
Windom Municipal Airport	Windom	Cottonwood	4.6 SW	Concrete, good	1,410
St James Medical Center[4]	St. James	Watonwan	7.8 E	Heliport	1,077

[1] Distance in miles from the nearest portion of the Big Bend Wind Project boundary.
[2] Runway surface type and condition.
[3] Elevation in feet at the highest point on the centerline of the useable landing surface. Measured to the nearest foot with respect to mean sea level.
[4] Private airport/heliport.

In addition to air traffic to and from the public and private airports/heliports identified above, air traffic may also be present near the Project Area for crop dusting of agricultural fields. Crop dusting is typically carried out during the day by highly maneuverable airplanes or helicopters.

In addition to public and private airports and crop dusting, air space is also used by the military. Big Bend coordinated with the Air National Guard and U.S. Air Force on the presence of military training routes in the Project vicinity.

8.9.2.2 Impacts

The closest public airport to the proposed Project is the Windom Municipal Airport, located approximately 4.6 miles from the Project Area; however, the closest turbine to the Windom Municipal Airport is 6.05 miles, outside the six-mile buffer from public use airports. As such, turbines have been sited to avoid any impacts to restricted airspace.

The installation of wind turbine towers in active croplands will create a potential for collisions with crop-dusting aircraft. However, the turbines would be visible from a distance. Big Bend will notify local airports about the Project including locations of new towers in the area to minimize impacts and reduce potential risks to crop dusters.

Based on coordination with the Air National Guard and U.S. Air Force, there is a military training route near the eastern edge of the Project Area. As such, Big Bend dropped the eastern most-turbine in the layout (formerly Turbine 37) to mitigate military airspace concerns. The turbine layout presented in this Application reflects removal of this turbine.

8.9.2.3 Mitigative Measures

Big Bend will coordinate with the Windom Municipal Airport, the FAA, and MNDOT prior to construction to understand potential impacts. The FAA will review the Big Bend turbine layouts. Turbines over 500 feet tall have a lengthier review timeline, but regardless of turbine height, the FAA approval is a "Determination of No Hazard." Further, Big Bend will appropriately mark and light the turbines to comply with FAA requirements and, as mentioned in Section 8.5.3, Big Bend is coordinating with the FAA on implementing an ADLS. Big Bend will notify local airports about the Project and new towers in the area to reduce the risk to crop dusters. Additionally, Big Bend will coordinate with landowners within and adjacent to the Project regarding crop-dusting activities.

The permanent and performance testing meteorological towers will be freestanding with no guy wires. The existing temporary meteorological towers have supporting guy wires which are marked with alternating red and white paint at the top and colored marking balls on guy wires for increased visibility. The existing temporary meteorological towers will be removed after the Project is operational.

Big Bend mitigated potential conflicts with military airspace by removing a turbine identified by the military as a concern. No further mitigation measures related to military airspace are anticipated.

8.10 Hazardous Materials and Wastes

LWECS projects have the potential to affect known contaminated sites if construction of the project facilities would cause ground disturbance within these sites. In addition, LWECS project construction and operation may utilize petroleum products and other products that could result in site contamination if these materials are not managed and disposed of in compliance with the requirements of applicable laws and regulations.

8.10.1 Description of Resources

Most of the land within the Project Area is rural and used for agricultural production. Potential hazardous materials within the Project Area are associated with agricultural activities, and include petroleum products (fuel and lubricants), pesticides, and herbicides. Older farmsteads may also have lead-based paint, asbestos shingles, and polychlorinated biphenyls in transformers. Trash and farm equipment dumps are common in rural settings.

Big Bend reviewed the U.S. Environmental Protection Agency's (EPA) Facility Registry Service (FRS) to identify sites that are listed on the Comprehensive Environmental Response, Compensation, and Liability Information System (also known as Superfund sites); Resource Conservation and Recovery Act (RCRA) Treatment, Storage, and Disposal; RCRA hazardous

waste generators; the Assessment, Cleanup, and Redevelopment Exchange System; Minnesota Permitting, Compliance, and Enforcement Information Management System; and the Leaking Underground Storage Tank—American Recovery and Reinvestment Act database (EPA, 2020). Big Bend also reviewed the MPCA's What's in my Neighborhood (WIMN) database to identify any potential contaminated sites in the Project Area (MPCA, 2020a).

Review of the FRS and WIMN databases identified 49 licensed feedlots (four of which are inactive), one aboveground tank, four hazardous waste generators (two of which are inactive), one licensed septic installer, one septic system, three active construction stormwater permits and one inactive construction stormwater permit, one active municipal wastewater National Pollutant Discharge Elimination System/State Disposal System (NPDES/SDS) permits, one active petroleum remediation and contaminated soil treatment facility, one inactive underground storage tank, and one active site assessment in the Project Area. No Superfund sites were identified within the Project Area.

In addition to the research described above, and as part of the Project financing process, an ASTM conforming Phase I Environmental Site Assessment (Phase I ESA) will be conducted for the Project Area. The Phase I ESA will identify known recognized environmental conditions or historical recognized environmental conditions that may require additional action prior to or during construction.

8.10.2 Impacts

The Project was designed to avoid known contaminated sites and will therefore not impact them during construction. Spill-related impacts from construction are primarily associated with fuel storage, equipment refueling, and equipment maintenance. To avoid spill-related impacts during construction, Big Bend will develop a Spill Prevention, Control, and Countermeasures Plan that will outline measures to be implemented to prevent accidental releases of fuels and other hazardous substances and describe the required response, containment, and cleanup procedures to be used in the event of a spill.

During operation of the Project, three types of petroleum-product fluids will be used for turbine operation:

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

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

8.10.3 Mitigative Measures

Because any potentially hazardous waste sites identified through online research or the Phase I ESA of the Project Area will be avoided, no mitigative measures are necessary. If any wastes, fluids, or pollutants are generated during any phase of construction or operation of the Project, they will be handled, processed, treated, stored, and disposed of in accordance with Minn. R. Ch. 7045.

8.11 Land-Based Economies

Construction and operation of the Project has the potential to affect land-based economies in Cottonwood and Watonwan Counties through introduction of a physical, long-term presence which could prevent or otherwise limit use of the land for other purposes. The placement of wind turbines, access roads, and Wind Project Substation in cultivated cropland has the potential to interfere with farming operations based on the placement of these facilities in agricultural fields. Interference with farming operations can negatively affect farm income. Additionally, if tree clearing is required for the Project it could affect forestry businesses in the Project Area, if present. Placement of wind turbines, Wind Project Substation, or other associated facilities near mining operations could interfere with access to existing mines and could limit the expansion of the mines. The following subsections present an overview of agricultural, forestry, and mining operations in the Project Area, discuss how the proposed Project may affect these industries, and what measures Big Bend will implement to mitigate Project effects.

8.11.1 Agriculture/Farming

8.11.1.1 Description of Resources

The majority of land use in the Project Area is cultivated crop land (approximately 40,235.2 acres or 92.5 percent), as shown in Figure 12 - Land Cover and discussed in Section 8.19. Pasture/hay lands comprise approximately 435.6 acres (one percent) of the Project Area.

According to the USDA's 2017 Census of Agriculture, the average farm size in the counties in the Project Area was similar, at 498 acres in Cottonwood County and 508 acres in Watonwan County. This is generally larger than the average size of all Minnesota farms, which was 371 acres.

Crop sales account for a larger percentage of total market value of agricultural products compared to livestock sales in Cottonwood County ($194 million vs. $188 million, annually) and in Watonwan County ($146 million vs. $123 million, annually). Corn and soybeans are the top two agricultural crops by acreage in both counties; the third most popular agricultural crop in Cottonwood County is forage, but in Watonwan County vegetables harvested for sale are the third most popular agricultural crop. In Cottonwood County, the most common livestock, based on the total number of farms, are cattle; hogs and pigs; and poultry (layers). In contrast, in Watonwan County hogs and pigs are the most common livestock, followed by cattle, and sheep and lambs and layers. Agricultural statistics for the counties within the Project Area are summarized in Table 8.11-1.

Table 8.11-1
Agricultural Statistics of Counties Within the Project Area

County	Number of Farms	Average Farm Size (acres)	Land in Farms (acres)	Market Value of Agricultural Production (Crops)	Top 3 Crops by Acreage	Market Value of Agricultural Production (Livestock)	Top 3 Livestock Inventories by Farms
Cottonwood	744	498	370,389 (89 % of county)	$194 million (51 %)	Corn, soybeans, forage	$188 million (49 %)	Cattle, hogs and pigs, poultry (layers)
Watonwan	497	508	252,417 (89 % of county)	$146 million (54 %)	Corn, soybeans, vegetable harvested for sale	$123 million (46 %)	Hogs and pigs, cattle, sheep and lambs / poultry (layers)

Source USDA, 2017

Specialty crops typically include nurseries, vineyards, orchards, citrus groves, dairies, aquaculture, and tree farms. To date, no farmland engaged in specialty crop production has been identified in the Project Area. Big Bend will continue to work with individual landowners through the easement process to identify any specialty crops or livestock operations that may be impacted by the Project. If any specialty crops or livestock operations are identified, Big Bend will work with landowners to determine measures to avoid and minimize impacts to these resources.

As discussed in Section 8.3, Conservation Easements, approximately 526 acres of the Project Area within Cottonwood and Watonwan Counties, are currently enrolled in CREP and RIM easements (see also Figure 6 – Public Land Ownership and Recreation). Lands enrolled in these easements are typically pasture/hay, not cultivated cropland.

8.11.1.2 Impacts

Construction of the Project could cause minimal, temporary impacts to farmland from soil compaction and rutting, accelerated soil erosion, crop damage, temporary disruption to normal farming activities, drain tile damage, and introduction of noxious weeds to the soil surface. However, the Project will repair and restore temporary impacts and will not significantly impact use of land for agricultural production. As demonstrated by other wind energy projects in the Midwest, agricultural practices continue during construction and operations.

All turbines in the Project layout are sited in cultivated crop lands. Therefore, operation of the Project will require agricultural land to be taken out of production where the turbines and access roads are sited (approximately 0.5 to one acre per turbine). Additionally, land will also be taken out of agricultural production for the Wind Project Substation and O&M facility, which together would total approximately 8.7 acres of cultivated cropland (the other 1.7 acres for the footprint of these two facilities is classified as developed). Landowners may continue to plant crops near and up to the turbine pads and access roads. In some instances, agricultural practices will be impacted by requiring new maneuvering routes around the turbine structures for agricultural equipment.

The Wind Project Substation and O&M facility would be fenced, but agricultural production would be allowed to continue beyond the fenced area. Agricultural land taken out of production for access roads would be a permanent loss and agricultural production would not be allowed to continue within the footprint of access roads. Access roads are designed in such a way that they do not unnecessarily impede agricultural production beyond the footprint of the access road. For example, an access road is designed either at the field edge or sufficient distance from the field edge to allow agricultural equipment adequate room for operation (i.e., planting, maintaining, harvesting). This allows for continued farming in the area around the access road. Additionally, Big Bend has facilitated review of the layout with each landowner to address any siting concerns, particularly related to agricultural activities.

The loss of agricultural land to the construction of the Project will reduce the amount of land that can be cultivated in the Project Area; however, less than one percent of the Project Area will be converted to non-agricultural land use (i.e., wind turbines, access roads, Wind Project Substation, and O&M facility). This represents an unavoidable yet minimal impact to agricultural land in the Project Area boundary but will not significantly alter agricultural production in the Project Area or Cottonwood and Watonwan Counties.

Turbine and associated facility siting involved discussions with landowners to identify features on their property, including drain tile, which could be avoided, if possible. Damage to drain tile, fences, and gates as a result of construction activities or operation of the LWECS will be repaired according to the lease agreement between Big Bend and the owner. Big Bend will attempt to compensate non-participating landowners for crop damage that is the result of impacts to drain tile on participating landowner's property.

After construction of the Project is complete, farming will be allowed to continue on all land surrounding the turbines, access roads, Wind Project Substation, and O&M facility. The permanent loss of up to 49.5 acres of cultivated crop land (see Table 8.19-2 – Summary of Land Cover Impacts) in the Project Area will not result in the loss of any agriculture-related jobs or a net loss of income.

As noted in Section 8.3, Big Bend has sited the Project layout to avoid permanent impacts on conservation easements held by public agencies or private organizations. However, based on publicly available data, approximately four acres of CREP and RIM conservation easements will be temporarily impacted by installation of collection lines and use of crane paths during construction of the Project. Big Bend is coordinating with the NRCS, BWSR, and MNDNR on the accuracy of the publicly available easement data to confirm the publicly available conservation easement information. Additionally, as part of Project title clearance for participating landowners, Big Bend is actively completing a title search for all Project participants that will also identify any other conservation easements in the Project Area. Big Bend will coordinate with landowner and the agency that administers the conservation easements to identify their trust resources and address any potential impacts. If conservation easements are unavoidable, Big Bend will work with easement holders and agencies to obtain all necessary consents to construct and operate the Project and minimize impacts to landowners engaged in agricultural production.

8.11.1.3 Mitigative Measures

Big Bend has designed the Project layout to minimize impacts to agricultural lands. Revenue lost from the removal of land from agricultural production will be offset by lease payments to landowners hosting the Project facilities.

Big Bend will coordinate with property owners to identify features on their property, including drain tile, in order to avoid permanent, unnecessary impacts. While avoidance of drain tile is ideal, Big Bend recognizes that excavation and heavy equipment operation during construction has the potential to cause damage to known or unknown drain tiles. In the event that there is damage to drain tile as a result of construction activities or operation of the Project, Big Bend will work with affected property owners to repair the damaged drain tile in accordance with the lease agreements between Big Bend and the landowner. Big Bend will attempt to compensate non-participating landowners for crop damage that is the result of impacts to drain tile on participating landowner's property.

As discussed in Section 8.3.2 (Impacts to Conservation Easements), if additional CREP or RIM easements are identified during the title search or in consultation with the BWSR, and impacts to such conservation easements are unavoidable, Big Bend will work with easement holders to obtain all necessary consents to construct and operate the Project.

8.11.2 Forestry

8.11.2.1 Description of Resources

Economically important forestry resources are not found in this region of Minnesota. Forested areas are primarily associated with homes in the form of woodlots, shelterbelts, and along the margins of waterbodies within the Project Area; however, these forested areas are not considered economically important (i.e., used for timber sales).

8.11.2.2 Impacts

No impacts to forestry resources would occur from construction or operation of the Project.

8.11.2.3 Mitigative Measures

No impacts to forestry resources would occur; therefore, no mitigation will be necessary.

8.11.3 Mining

8.11.3.1 Description of Resources

Mining does not comprise a major industry in Cottonwood and Watonwan Counties. Many of the gravel operations that do exist in these counties are inactive, abandoned, or their use is limited to the landowner. Big Bend reviewed topographic maps, MNDOT's Aggregate Source Information System data (MNDOT, 2018), County Pit Maps (MNDOT, 2002 and 2003), and several years of aerial photography to identify mining operations in the Project Area. Review and comparison of these sources indicates that no mining operations are present within the Project Area (see Figure 14 – Site Geology and Depth to Bedrock). The closest mining operation is 2.8 miles north of the northwest corner of the Project Area, immediately south of Jeffers.

8.11.3.2 Impacts

Because there are currently no mining operations in the Project Area, impacts to these resources would not occur.

8.11.3.3 Mitigative Measures

No impacts to mining resources would occur and, as such, no mitigation will be necessary.

8.12 Tourism

Construction and operation of the Project has the potential to affect tourism in Cottonwood and Watonwan Counties through temporary increases of construction vehicles and an introduction of a physical, long-term aesthetic change to the predominantly agrarian landscape.

8.12.1 Description of Resources

Tourism in the Project Area centers around various festivals and activities hosted by the cities near the Project Area, such as Butterfield and Mountain Lake, and outdoor recreational opportunities described in Section 8.8.

Located just outside of the municipal boundary of the City of Butterfield is Voss Park, a community park and campground where most of the public events hosted by the City of Butterfield are held (Butterfieldmn.com, n.d.). Butterfield Summer Sizzler is an annual community event that lasts for three days after the 4th of July holiday. The event is held at Voss Park and includes the Chicken Run (a community fun run), the Butterfield Community Club Auxiliary Flea Market, 1st Lutheran Church's ice cream social, a kid's fishing contest, a scavenger hunt, and various other family friendly events. The Summer Sizzler ends with a firework display over Butterfield Lake, which is directly adjacent to Voss Park. The Butterfield Threshing Bee is held annually at Voss Park in mid-August. The event is hosted by the Butterfield Threshermen's Association, and includes a tractor pull, tractor parade, tractor and horse plowing demonstrations, and live entertainment on the park stage.

While the Project Area boundary does not cross the municipal boundary of Mountain Lake, the city is directly adjacent to the southern boundary of the Project Area. According to their website, the City of Mountain Lake hosts a number of public events annually (Mountainlakemn.com, 2018). Utschtallung (Heritage Fair), held the second Saturday in September, includes public tours, hosted by costumed tour guides, of 21 historic buildings in Heritage Village, an area of early Russian-Mennonite and German-Lutheran settlement on the southwest side of Mountain Lake. Scattered throughout the historic buildings are interpretive displays on early pioneer life in this area of southwestern Minnesota. One of the buildings in the tour is the Minnesota Hall of Fame Telephone Museum, a one-of-a-kind museum in the state.

The City of Mountain Lake also hosts an annual community festival, an event that lasts for five days in mid-June. Activities Includes a parade, tractor pull, animal petting zoo, performances by local artists, and other events. Other tourism opportunities in Mountain Lake include the Island View Campground, and nearby Lawcon Park which boasts a 9-hole disk golf course available for public use during the non-winter months. The Island View Campground and Lawcon Park are both located in the northwest corner of the city, on the opposite side of Mountain Lake from the Project Area boundary.

The Jeffers Site is another tourist attraction in this area of southwestern Minnesota (MNHS, n.d.). The site and associated Visitor Center are located on 160 acres, approximately 2.7 miles north of the Project Area. About 5,000 prehistoric rock carvings are found at this site and visitors can choose between guided or solo tours; field trips for school groups are also available. In addition, 1.2 miles of maintained trails run through the site and are available for public use. The Visitor

Center has interpretive displays and a short video presentation that provides information about Native American culture and prairie ecology, as well as a museum store. The Jeffers Site is open Tuesday through Sunday from late May to early September, Saturdays only between early September and mid-October, then only by reservation for groups of 10 or more for the rest of the year.

As noted in Sections 4.1. 8.5.1, and 8.7.2, Big Bend coordinated with the MNHS and various tribes to assess the potential impacts of the Project on the Jeffers Site. Details about the status of consultations with MNHS and the tribes is presented in Section 8.7.2.

8.12.2 Impacts

Construction and operation of the Project will have minimal impact to tourism opportunities in the Project vicinity. Construction impacts would mostly be related to increased traffic due to construction activities that may be perceptible to persons traveling through the Project Area to visit tourist destinations in Mountain Lake or nearby recreation lands. These impacts will be minimal, temporary, and isolated to specific areas throughout the Project Area.

Because all Project facilities will be located on private lands, and outside of municipal boundaries, there will be no direct impacts to recreational areas, public lands, or other tourism-related activities. Additionally, all recreation lands will be setback from turbines as described in Section 5.1. A detailed discussion of the potential impacts of the Project on the Jeffers Site is presented in Sections 4.1, 8.5, and 8.7.

During operations, introduction of an aesthetic change to the predominantly agrarian landscape in the Project Area could impact public enjoyment of tourist attractions. However, these impacts would be minimal. A detailed discussion of how the Project could impact aesthetics and the measures Big Bend would use to mitigate aesthetic impacts is provided in Section 8.5 and 8.7.

8.12.3 Mitigative Measures

Big Bend has mitigated potential Project effects on tourism opportunities in Cottonwood and Watonwan Counties by siting Project facilities to avoid recreation areas and municipalities where tourism opportunities are available.

8.13 Local Economies and Community Benefits

LWECS projects have the potential to impact the socioeconomic conditions of an area in the short term through an influx of construction personnel expenditures, creation of construction jobs, construction material and other purchases from local businesses, and expenditures on temporary housing and other items by construction personnel. In the long term, LWECS projects provide beneficial impacts to the local tax base in the form of revenues from wind production tax payments and the development of a community fund. Additionally, permanent job creation or relocation of project personnel to the area for operation of a wind project could provide additional tax revenue in the form of income taxes and property taxes.

8.13.1 Description of Existing Socioeconomic Conditions

According to U.S. Census Bureau 2018: American Community Survey 5-year Estimates economic data, the top two industries employing residents in Cottonwood and Watonwan Counties are educational, health, and social services (average of 23.8 percent) and manufacturing (average of

21.4 percent). The third most dominant industry in both counties is retail trade at an average of 11.8 percent (see Table 8.1-1 in Section 8.1). The same data set shows that per capita income in Cottonwood and Watonwan Counties is similar, but approximately $8,500 to $9,000 less than per capita income at the state level, which is $36,245 (see Table 8.13-1).

Table 8.13-1
Existing Economic Conditions in the Project Area

	ACS 2018 Estimates Per Capita Income Level (in 2018 U.S. dollars)	ACS 2018 Estimates Unemployment Rate (%)	ACS 2018 Estimates Persons Living Below the Poverty Level (%)
Minnesota	**$36,245**	**3.9**	**10.1**
Cottonwood County	$27,209	4.1	12.5
Watonwan County	$27,772	2.6	12.7

Source: U.S. Census Bureau, 2018b

Unemployment rates in Cottonwood County are similar to the state level of 3.9 percent, while Watonwan County unemployment rates are 1.3 percent less the state level (*see* Table 8.13-1). The percentage of persons living below the poverty level in Cottonwood and Watonwan Counties (12.5 percent and 12.7 percent, respectively) is higher than the state level of 10.1 percent.

8.13.2 County Economic Development Goals

Cottonwood County has a comprehensive plan that outlines the opportunities and goals for future economic development; Watonwan County does not currently have a comprehensive plan. In the Economic Development section of the Cottonwood County Comprehensive Plan Land Use Plan (2005), renewable energy development (specifically wind power, ethanol, and biofuels) is noted as a potential source of economic growth and diversification for the county.

8.13.3 Impacts

The overall impact of the Project on the local economies and communities of Cottonwood and Watonwan Counties will be positive in both the short term and long term. Community benefits associated with the Project closely correspond with the stated economic development goals of the Cottonwood County Comprehensive Plan Land Use Plan (2005). Development of the Project helps to promote the diversification of economic development in the agricultural sector and promotes efforts to attract additional employment opportunities and tax revenues while retaining and growing the existing business base in both counties.

Approximately 316 construction personnel will be required for construction and approximately 14 permanent personnel will be required for operation and maintenance of the Project. Big Bend Wind expects the BOP contractors to use local contractors and suppliers for portions of the construction process, to the greatest extent feasible. Total wages and salaries paid to construction personnel and permanent Project employees in Cottonwood and Watonwan Counties will contribute positively to the total personal income of the region. Additional personal income will be generated for residents in the county and state by circulation and recirculation of dollars paid out by the Applicant for business expenditures and for state and local taxes. Expenditures made for equipment, fuel, operating supplies, construction personnel lodging, and other products and services benefit businesses in the counties and the state.

Wind-energy harvesting provides a new investment opportunity in Cottonwood and Watonwan Counties. The Project provides landowners and farmers with opportunities for higher agricultural profitability and a more diverse revenue stream. Wind energy is an income-generating opportunity that will provide a long-term, annual benefit to landowners who have chosen to participate in the Project. To date, Big Bend has paid approximately $2 million to landowners who agreed to participate in the Project during early Project development. Landowners having turbines or other Project facilities sited on their land will receive a royalty or lease payment annually for the life of the Project. In addition, landowners adjacent to the Project facilities, but not hosting facilities on their land, will receive annual payments under the Big Bend Good Neighbor Participants program. Finally, landowners who agreed to participate in the Project during early development but now fall within the no-turbine buffer area will receive annual payments, as well. These payments diversify and strengthen revenue generation for the landowners in Cottonwood and Watonwan Counties, which will have a positive impact on the local economy.

Long-term beneficial impacts to the tax base of each county, as a result of the construction and operation of the Project, will have an additional positive impact on the local economy in this area of Minnesota. In addition to the creation of jobs and personal income, the Project will pay a Wind Energy Production Tax to the local units of government of $0.0012 per kilowatt hour of electricity produced, resulting in annual Wind Energy Production tax revenue of approximately $35.7 million over the life of the Project (estimated at 30 years).

Big Bend will form the “Big Bend Community Fund,” a 501(c)(3) organization for the purpose of engaging in and contributing money to the support of charitable activities within the communities near the Project. Assuming the Project is constructed at 308 MW, the Project will contribute $61,600 annually to the Big Bend Community Fund to support charitable activities within the neighboring communities. The Big Bend Community Fund will help ensure that the entire community surrounding the Project, not just the participating landowners, see benefits from construction and operation of the Project. The estimated annual and 30-year total community economic benefits are summarized in Table 8.13-2.

Table 8.13-2
Community Economic Benefits

Community Economic Benefits	Development	Annual	30-Year Total
Wind Energy Production Tax Revenue (County & Townships)	N/A	$1,200,000	$36,000,000
Total Landowner Participants Group Revenue[1]	$2,100,000	$2,320,000	$69,600,000
Buffer Zone Landowner Group Revenue	N/A	$120,000	$3,600,000
Big Bend Community Fund[2]	$62,000	$61,600	$1,848,000
Total Economic Benefit	**$2,162,000**	**$3,702,600**	**$111,048,000**

[1] There is an additional approximately $1,800,000 in one-time payments that will not be distributed more than once.
[2] Big Bend will contribute $200 per MW; data provided here assume 308 MW.

8.13.4 Mitigative Measures

Socioeconomic impacts associated with the Project will be positive with an influx of wages and expenditures made at local businesses during Project construction and an increase in the counties’ tax bases from the construction and operation of the wind turbines. Because the impacts of the Project would be primarily positive, no mitigation measures are proposed.

8.14 Topography

Construction of a wind project has the potential to impact the existing topography with the introduction of new access roads, turbine foundations, Wind Project Substation, and O&M facility. These facilities require a level surface and therefore can require cut and fill of the existing ground elevation to create the level surface.

8.14.1 Description of Resources

The Project is located in the Minnesota River Prairie subsection of the MNDNR's Ecological Classification System (MNDNR, 2000). Subsection boundaries delineate a significant regional change in geology, topography, and vegetation. The Minnesota River Prairie subsection boundaries coincide with large till plains flanking the Minnesota River. This subsection consists of a gently rolling ground moraine about 60 miles wide. Most of the Minnesota River Prairie subsection is covered by up to 400 feet of glacial till.

In the Project Area, elevations range from 1,109 to 1,421 feet (338 to 433 m) above sea level. This elevation change is gradual; there are not areas of significant elevation change in the Project Area. Elevations are higher in the southwestern portion of the Project Area. A topographic map of the Project Area is shown in Figure 8 (Topographic Map).

8.14.2 Impacts

Impacts to topography will be minimal as the Project Area has gently rolling terrain that is currently used for agricultural activities, including large machinery similar to that of which will be required for construction. Additionally, while the Project Area has approximately 300 feet of elevation change, this change is dispersed across the nearly 15-mile wide Project Area and is not localized to a specific area. Therefore, wind turbines and access roads will not require significant excavation or fill beyond that which will be required for turbine foundations or road bases.

8.14.3 Mitigative Measures

Big Bend has designed the Project layouts to minimize the amount of cut and fill; no mitigative measures are necessary.

8.15 Soils

Project construction will temporarily disrupt soils by compaction and erosion, which, if unmitigated, can affect agricultural activities and water quality, respectively. Soils categorized as prime farmland and farmland of statewide importance are protected under the Farmland Protection Policy Act because of their value for agricultural production, and a significant or irreversible loss of these high-quality farmlands could have local economic impacts for the agricultural industry.

8.15.1 Description of Resources

Four soil associations are found within the Project Area (Table 8.15-1, Figure 13 - Soils). A soil association has a distinctive pattern of soils, relief, and drainage. Each is a unique natural landscape consisting of one or more major soils and other minor soils. The association is named after its major soils.

Table 8.15-1
Soil Associations in Project Area

Soil Association	Area (acres)
Webster-Nicollet-Glencoe-Crippin-Canisteo (s3557)	27,752
Delft-Clarion (s3558)	10,213
Webster-Nicollet-Glencoe-Clarion-Canisteo (s3569)	5,114
Webster-Nicollet-Clarion-Canisteo (s1750)	444
Total	**43,523**

The Webster-Nicollet-Glencoe-Crippin-Canisteo Association is a complex of five soil types. The Webster series consists of very deep, poorly drained, moderately permeable soils formed in glacial till or local alluvium derived from till on uplands with slopes ranging from zero to three percent. The Nicollet series consists of very deep, somewhat poorly drained soils that formed in calcareous loamy glacial till on till plains and moraines and have slopes ranging from zero to five percent. The Glencoe series consists of very deep, very poorly drained soils that formed in loamy sediments from till with slopes ranging from zero to one percent. The Crippin series consists of very deep, somewhat poorly drained, moderately permeable, calcareous soils formed in glacial till on uplands. This series' slope ranges from zero to three percent. The Canisteo series consists of very deep, poorly, and very poorly drained soils that formed on rims of depressions, depressions, and flats on moraines or till plains and have slope ranges from zero to two percent (Soil Survey Staff, 2020).

The Delft-Clarion Association is a complex of two soil types. The Delft series consists of very deep, poorly drained, and somewhat poorly soils that formed on till plains and moraines with slopes ranging from zero to four percent. The Clarion series consists of very deep, moderately well drained soils on uplands. These soils formed in glacial till with slopes ranging from one to nine percent (Soil Survey Staff, 2020).

The Webster-Nicollet-Glencoe-Clarion-Canisteo Association is a complex of five soil types. The Webster series consists of very deep, poorly drained, moderately permeable soils formed in glacial till or local alluvium derived from till on uplands with slopes ranging from zero to three percent. The Nicollet series consists of very deep, somewhat poorly drained soils that formed in calcareous loamy glacial till on till plains and moraines and have slopes ranging from zero to five percent. The Glencoe series consists of very deep, very poorly drained soils that formed in loamy sediments from till with slopes ranging from zero to one percent. The Clarion series consists of very deep, moderately well drained soils on uplands. These soils formed in glacial till with slopes ranging from one to nine percent. The Canisteo series consists of very deep, poorly, and very poorly drained soils that formed on rims of depressions, depressions, and flats on moraines or till plains and have slope ranges from zero to two percent (Soil Survey Staff, 2020).

The Webster-Nicollet-Clarion-Canisteo Association is a complex of four soil types. The Webster series consists of very deep, poorly drained, moderately permeable soils formed in glacial till or local alluvium derived from till on uplands with slopes ranging from zero to three percent. The Nicollet series consists of very deep, somewhat poorly drained soils that formed in calcareous loamy glacial till on till plains and moraines and have slopes ranging from zero to five percent. The Clarion series consists of very deep, moderately well drained soils on uplands. These soils formed in glacial till with slopes ranging from one to nine percent. The Canisteo series consists of very deep, poorly, and very poorly drained soils that formed on rims of depressions, depressions,

and flats on moraines or till plains and have slope ranges from zero to two percent (Soil Survey Staff, 2020).

In addition to the soil associations, the USDA, NRCS identifies areas that are important to agricultural use, such as prime farmland and farmland of statewide importance. Prime farmland is land that has the best combination of physical and chemical characteristics for producing food, feed, forage, fiber, and oilseed crops and is available for these uses. It could be cultivated land, pastureland, forestland, or other land. Important farmlands consist of prime farmland, unique farmland, and farmland of statewide or local importance (Soil Survey Staff, 2020). As shown in Table 8.15-2, 89 percent of the soils in the Project Area are classified as prime farmland, including those soils identified as prime farmland if the limiting factor is mitigated. Soils are mapped on Figure 13 (Soils).

Table 8.15-2
Prime Farmland Within the Project Area (acres)

Prime Farmland Classification	Acres	Percent of Project Area
Prime Farmland[1]	38,743.0	89
Farmland of Statewide Importance	2,601.7	6
Not Prime Farmland	2,178.4	5
Total	**43,523.1**	**100**

[1] This includes soils classified as prime farmland or prime farmland if the limiting factor is mitigated.

8.15.2 Impacts

Construction activities such as clearing, grading, foundation excavation, and backfilling, as well as the movement of construction equipment within the construction workspace, may result in impacts to soil resources. Potential impacts to soil resources include soil erosion, soil compaction, reduction of soil fertility, and changes to other soil characteristics. Clearing removes protective cover and exposes soil to the effects of wind and precipitation, which may increase the potential for soil erosion and movement of sediments into sensitive environmental areas such as wetlands. Grading and equipment traffic may compact soil, reducing porosity and percolation rates, which could result in increased runoff potential. These impacts will be temporary and localized to the footprint of facilities.

Construction of the wind turbines, access roads, Wind Project Substation, and O&M facility will convert prime farmland to industrial uses. The Project layout would impact 50.3 acres of prime farmland, which is less than one percent of the prime farmland in the Project Area.

Table 8.15-3
Summary of Permanent Impacts to Prime Farmland (acres)

Prime Farmland Classification	# Turbines[2]	Acres[3]
Prime Farmland[1]	51	50.3
Farmland of Statewide Importance	4	1.4
Not Prime Farmland	0	0.4
Total	**55**	**52.1**

[1] This includes soils classified as prime farmland or prime farmland if the limiting factor is mitigated.

Table 8.15-3
Summary of Permanent Impacts to Prime Farmland (acres)

Prime Farmland Classification	# Turbines[2]	Acres[3]

[2] Number of turbines includes the highest possible number of turbines from the three turbine models under consideration.

[3] Acreage of impacts includes all permanent facilities (turbines, access roads, Wind Project Substation, and O&M facility).

8.15.3 Mitigative Measures

Big Bend will obtain a NPDES permit to discharge stormwater from construction facilities from the MPCA. Under this permit, best management practices (BMPs) will be used during construction of the Project to protect topsoil and adjacent resources and to minimize soil erosion. Practices may include containment of excavated material, protection of exposed soil, and stabilization of restored material. A Stormwater Pollution Prevention Plan (SWPPP) will be developed prior to construction that will include Erosion Control Devices (ECDs) such as silt fencing, revegetation plans, and management of exposed soils to prevent erosion. Because the Project will impact more than 50 acres, Big Bend will submit the SWPPP to the MPCA for review prior to finalizing.

Access roads will be placed away from steep slopes to the degree possible to minimize the amount of grading and soil disturbance. Additionally, access roads, collection lines, and crane paths are co-located to the extent practicable to minimize the footprint of facilities and reduce soil disturbance. Geotechnical soil borings will be conducted at wind turbine foundation locations prior to construction to determine the soil suitability to support turbine foundations; this information will help dictate final design parameters of the turbine and structure foundations.

Furthermore, Big Bend would use the following BMPs and mitigation measures to minimize soil impacts:

- During construction, certain activities may be suspended in wet soil conditions to avoid rutting and mixing of topsoil and subsoil. The contractor will cease work until Big Bend determines that site conditions are such that work may continue without damage. Big Bend's construction management personnel will ultimately decide if wet weather shutdown is necessary in a given location.
- Big Bend will strip topsoil in upland areas as specified in the Project plans, commitments, and/or permits. Excavated topsoil and subsoil will be stockpiled separately in the approved construction workspace, stored in such a way that the area subject to erosion is minimized, and then reestablished post construction.
- Temporary ECDs, such as slope breakers, sediment barriers (e.g., silt fences, straw bales, bio-logs), stormwater diversions, trench breakers, mulch, and revegetation will be installed following soil disturbance and maintained until site is restored. The contractor will maintain erosion and sediment control structures as required in the Project construction documents and as required by all applicable permits. Non-functional ECDs will be repaired, replaced, or supplemented with functional materials within 24 hours after discovery, or as otherwise specified in Project permits.
- Temporary ECDs installed across the travel lane may be removed during active daytime construction; however, ECDs will be properly reinstalled after equipment

has passed, or activities in the area are completed for the day. These ECDs will also be repaired and/or replaced prior to forecasted inclement weather.

- Once construction is complete, Big Bend will backfill graded and excavated areas with the stored native material and reestablish the original grade and drainage pattern of the construction workspace to the extent practicable.
- During site restoration, Big Bend will decompact subsoil within the construction workspace, temporary access roads, and crane pathways. The contractor will implement ECDs, including seeding the site with weed-free native plants in accordance with landowner or local agency requests.
- During operations, Big Bend will regularly inspect access roads, utility and transmission line corridors, and tower site areas for damage from erosion, washouts, and rutting. Big Bend will initiate corrective measures immediately upon evidence of damage.

8.16 Geologic and Groundwater Resources

Due to their size, wind turbines must be sited in areas that are geologically stable. Certain geological environments, such as karst, can present turbine siting challenges due to its instability and erodibility. Similarly, presence of groundwater resources can create unstable foundations. These resources are described below.

8.16.1 Description of Resources

8.16.1.1 Surficial Geology

Surficial geology of the Project Area consists of glacial deposits associated with the Des Moines Lobe. This Project Area is part of a high glacial landform occupying Southwestern Minnesota topped by Buffalo Ridge (1,995 feet above sea level) in northern Pipestone County. The high elevation is caused by thick deposits of pre-Wisconsin age glacial till (up to 800 feet thick). The underlying bedrock is covered by100 to 400 feet of glacial till, which consists of calcareous loamy sediment (MNDNR, 2000).

The Altamont moraine makes up the quaternary geology of the Project Area and southcentral Minnesota (MGS, 2007). The Altamont moraine is sufficiently clayey making it good agricultural land.

8.16.1.2 Bedrock Geology

The bedrock underlying the glacial material in the Project Area consists of undifferentiated Cretaceous rocks from the Mesozoic Era and Sioux Quartzite from the Paleoproterozoic. The undifferentiated Cretaceous rocks are a conglomerate, sandstone, mudstone, shale, marlstone, siltstone, and minor lignite from the Mesozoic Era (MGS, 2011). This Cretaceous undifferentiated rock consists of largely gray shale and friable sandstone. Most sandstone is quartzose, light gray to pale brown or yellow, and fine-to medium-grained. Dark gray to black, lignitic organic matter is common in both the sandstone and shale. The Sioux Quartzite contains quartzite, mudstone, and local conglomerate of fluvial and marine origin. The depth to bedrock in the Project Area is up to several hundred feet (Figure 14 – Site Geology and Depth to Bedrock).

8.16.1.3 Aquifers and Wells

Minnesota is divided into six groundwater provinces based on bedrock and glacial geology. The aquifers within these provinces occur in two general geologic settings: bedrock, and unconsolidated sediments deposited by glaciers, streams, and lakes. The Big Bend Wind Project is within the Western Province, which is characterized by clayey glacial drift overlying Cretaceous and Precambrian bedrock. In this province, fractured bedrock is usually buried deeply beneath glacial sediments and is only locally used as an aquifer (MNDNR, 2001).

Big Bend reviewed the Project Area for EPA designated sole source aquifers (SSA), wells listed on the Minnesota County Well Index (CWI), and Minnesota Department of Health (MDH) Wellhead Protection Areas (WHPAs).

The EPA defines a SSA or principal source aquifer area as one that supplies at least 50 percent of the drinking water consumed in the area overlying the aquifer, where contamination of the aquifer could create a significant hazard to public health, and where there are no alternative water sources that could reasonably be expected to replace the water supplied by the aquifer (EPA, 2016). There are currently no EPA-designated SSAs in the Project vicinity (EPA, 2017).

Homes and farms in the Project Area typically use private wells and septic systems for their household needs. According to the MDH's Minnesota Well Index online database, there are 122 located wells within the Project Area that are generally associated with residences (MDH, 2019a).

Under the Safe Drinking Water Act (SDWA), each state is required to develop and implement a Wellhead Protection Program to identify the land and recharge areas contributing to public supply wells and prevent the contamination of drinking water supplies. The SDWA was updated in 1986 with an amendment requiring the development of a broader-based Source Water Assessment Program, which includes the assessment of potential contamination to both groundwater and surface water through a watershed approach. A WHPA encompasses the area around a drinking water well where contaminants could enter and pollute the well.

Public and non-public community water supply source-water protection in Minnesota is administered by the MDH through the Wellhead Protection program. The purpose of the Wellhead Protection Program is to prevent contamination of public drinking water supplies by identifying water supply recharge areas and implementing management practices for potential pollution sources found within those areas (MDH, 2019b). The Mountain Lake Wellhead Protection Area is partially within the southern portion of the Project Area (4,271 acres).

8.16.2 Impacts

Big Bend does not anticipate any impacts to bedrock during construction or operation of the Project as bedrock within the Project Area is at depths greater than proposed foundation depths of four-to-six feet deep. Similarly, Big Bend does not expect any impacts to groundwater resources as the aquifers are also at depths deeper than the excavation for the turbine foundations and permanent Project facilities are not located near previously identified wells.

Water use during construction will provide dust control and water for concrete mixes. One temporary batch plant may be needed to supply concrete for construction of the Project. The batch plant may be able to use rural water service, but is more likely to require well water. The water source will be determined prior to construction when a contractor is selected to construct the Project.

The O&M facility will likely require a new private well water supply. Water usage during the operating period will be similar to household volume; less than five gallons per minute. Use of water for operations will be negligible. The Project will not require the appropriation of surface water or permanent dewatering. Temporary dewatering may be required during construction for specific turbine foundations and/or electrical trenches.

There is one turbine within the Mountain Lake Wellhead Protection Area. Construction and operation of the wind turbine within the Wellhead Protection Area will not introduce contaminates because excavation depth is four to six feet, well above the depth to the aquifer (100-400 feet). As such, no impacts to the Mountain Lake Wellhead Protection Area are anticipated.

8.16.3 Mitigative Measures

Because impacts are not expected to geologic resources during the Project construction and operation, mitigation measures are not anticipated. Big Bend will obtain a well permit for the O&M facility from Minnesota Department of Health prior to construction. The batch plant operator will obtain the local permits and access to water supply and will address supply and drawdown issues in those permits. If temporary dewatering is required, Big Bend will obtain a permit from MNDNR.

During construction, Big Bend will use BMPs to ensure there are no contaminates in the Wellhead Protection Area and the Project Area as a whole. Vehicles and equipment will be maintained and inspected for equipment leaks. Additionally, refueling will only occur in designated areas, likely the O&M facility or temporary laydown area that will be used for staging.

8.17 Surface Water and Floodplain Resources

Construction and operation of a LWECS can impact surface waters by creating crossings with access roads or temporary facilities such as crane paths and collection lines. Construction activity can also make soil erosion more prevalent, which can impact water quality. Siting permanent facilities within a floodplain can impact its flood storage capacity. These resources are discussed below.

8.17.1 Description of Resources

Surface water and floodplain resources for the Project Area were identified by reviewing U.S. Geological Survey (USGS) topographic maps, Minnesota Public Waters Inventory (PWI) maps, and National Hydrography Dataset. The Project Area occurs entirely within the Watonwan River watershed (MNDNR, 2017a, Figure 15 – Surface Waters). Named streams within the Project Area include Watonwan River and Butterfield Creek. There are no trout streams within the Project Area; the nearest trout stream is Scheldorf Creek, located approximately seven miles west of the Project Area (MNDNR, 2018). Similarly, none of the waterbodies within the Project Area are identified as Outstanding Resource Value Waters under Minn. R. 7050.0335, subp. 3. Figure 15 - Surface Waters shows the locations of surface waters, federal Clean Water Act (CWA) 303(d) impaired waters, and Minnesota PWI waters within the Project vicinity, all of which were downloaded from the Minnesota Geospatial Commons.

8.17.1.1 Minnesota Public Waters Inventory

Public waters are all waters that meet the criteria set forth in Minn. Stat. § 103G.005, subd. 15 that are identified on PWI maps authorized by Minn. Stat., § 103G.201 (MNDNR, 1984). Public water wetlands include all type III, IV, and V wetlands (as defined in USFWS Circular No. 39,

1971 edition) that are 10 acres or more in size in unincorporated areas, or 2.5 acres or more in size in incorporated areas. These watercourses are regulated as public waters under the MNDNR's Public Waters Permit Program. There are 16 PWI watercourses and five PWI basins in the Project Area that are listed as MNDNR PWI public waters. There are no PWI wetlands in the Project Area. The waters shown on the PWI maps and located at least partially within the Project Area are presented in Table 8.17-1.

Table 8.17-1
Public Waters Inventory

PWI Type	PWI Feature Name
PWI Watercourse	Watonwan River (M-055-076-003-B005)
	Unnamed Stream (M-055-076-003-037-017-003)
	Unnamed Stream (M-055-076-003-041-001)
	Watonwan River (M-055-076-003-B002)
	Unnamed Stream (M-055-076-003-043)
	Watonwan River (M-055-076-003-B004)
	Unnamed Stream (M-055-076-003-037-017)
	Butterfield Creek (M-055-076-003-034-001)
	Unnamed Stream (M-055-076-003-041)
	Watonwan River (M-055-076-003-B006)
	Watonwan River (M-055-076-003-B001)
	Unnamed Stream (M-055-076-003-034-001-008)
	Unnamed Stream (M-055-076-003-041-001-001)
	Watonwan River (M-055-076-003-B003)
	Unnamed Stream (M-055-076-003-052)
	Watonwan River (M-055-076-003)
PWI Basin	Eagle Lake
	Long Lake
	Butterfield Lake
	Mountain Lake
	Barish Lake

8.17.1.2 Impaired Waters

Section 303(d) of the CWA requires each state to review, establish, and revise water quality standards for all surface waters within the state. Waters that do not meet their designated beneficial uses because of water quality standard violations are considered impaired. According to the 2018 Impaired Waters List, there are eight 303(d) impaired waters within the Project Area, three basins and five watercourses. The waters shown on Figure 15 – Surface Waters and located at least partially within the Project Area are presented in Table 8.17-2.

Table 8.17-2
Impaired Waters Inventory

Water Type	Feature Name	AUID [1]	Impairment
Watercourse	Unnamed creek (Mountain Lake Inlet)	07020010-505	Aquatic macroinvertebrate bioassessment
	Unnamed creek	07020010-549	Fishes bioassessments; Aquatic macroinvertebrate bioassessment
	Unnamed creek	07020010-583	Fishes bioassessments; Aquatic macroinvertebrate bioassessment
	Butterfield Creek	07020010-516	Escherichia coli; Fishes bioassessments; Aquatic macroinvertebrate bioassessment; Turbidity
	Watonwan River	07020010-566	Fecal coliform; Fishes bioassessments; Aquatic macroinvertebrate bioassessment; Turbidity; Mercury in fish tissue
Basin	Mountain	17-0003-00	Fishes bioassessments; Mercury in fish tissue
	Eagle	17-0020-00	Nutrient/eutrophication biological indicators
	Butterfield	83-0056-00	Nutrient/eutrophication biological indicators

[1] AUID = Assessment Unit Identifier

Source: MPCA, 2020. MPCA creates a list of impaired waters that do not meet water quality standards every two years.

8.17.1.4 Wildlife Lakes in and Adjacent to Project Boundary

The MNDNR commissioner may formally designate lakes for wildlife management under the authority of Minn. Stat. § 97A.101, subd. 2. This designation allows the MNDNR to temporarily lower lake levels periodically to improve wildlife habitat and regulate motorized watercraft and recreational vehicles on the lake. There are no MNDNR designated wildlife lakes in the Project Area; the closest wildlife lake is Sulem Lake located approximately 1.4 miles south of the Project Area in Watonwan County (MNDNR, 2014).

8.17.1.5 Migratory Waterfowl Feeding and Resting Lakes

Migratory Waterfowl Feeding and Resting Areas (MWFRA) protect waterfowl from disturbance on selected waters of the state by prohibiting motors on these lakes during waterfowl season. These lakes are nominated by a petition process and approved or denied by the MNDNR after public input is received. There are no migratory waterfowl feeding and resting lakes in Cottonwood or Watonwan Counties (MNDNR, 2014).

8.17.1.6 Federal Emergency Management Agency Floodplains within Project Area

FEMA-designated floodplains are digitally available for the Cottonwood portion of the Project Area (FEMA, 2019). Floodplains in Watonwan County were digitized based on the FEMA-FIRM panel (FEMA, 1985). There are approximately 1,578 acres of 100-year floodplains within the Project Area in Cottonwood County that are associated with the Watonwan River and an Unnamed Tributary to the Watonwan River. In Watonwan County, there are approximately 73 acres of 100-year floodplains within the Project Area that are associated with Butterfield Creek (see Table 8.17-3 and Figure 16 – FEMA Floodplain).

Table 8.17-3
FEMA Floodplains in the Project Area

County	Associated Streams	Acres
Cottonwood	Watonwan River and Unnamed Tributary to Watonwan River	1,578.1
Watonwan	Butterfield Creek	73.3
	Total	**1,651.4**

8.17.2 Impacts

The Project will have minor, mostly short-term effects on surface water resources. Project facilities have been designed to avoid impacts on surface water resources to the extent practicable. Wind turbines will be built on uplands to avoid surface water resources in the lower elevations. Access roads have been designed to avoid crossing streams and other surface waters. Some collection lines and crane paths will cross streams during construction of the Project.

Construction of Project facilities (such as underground electrical collector lines, access roads, crane paths, turbine pads, substation, and the O&M facility) will impact land, and therefore could potentially impact surface water runoff within the Project Area. Ground-disturbing construction activities also have the potential to cause sedimentation. These impacts are expected to be minimal and would only occur during construction.

The Project layout, which includes turbines, access roads, met towers, the Wind Project Substation, and the O&M facility, will not permanently impact floodplain areas.

8.17.3 Mitigative Measures

Turbines will be constructed on relatively high elevation portions of the Project Area to maximize the wind resource, and as such are likely to avoid direct impacts to surface waters and floodplains, which tend to be in lower topographical positions. Access roads and substations will be designed to minimize impacts on surface waters. Temporary impacts associated with crane paths will also be minimized. Installation of underground utilities is expected to avoid impacts by boring under surface water features as necessary.

Big Bend will obtain an MNDNR License to Cross Public Waters for all facilities (crane paths, collection lines) that cross these watercourses. Big Bend has co-located these facilities at PWI crossings to minimize the number of crossings.

Because there are impaired waters within the Project Area, the NPDES permit and SWPPP will require additional BMPs for potential runoff to these waters. As part of the NPDES permit process, Big Bend will design BMPs for the entire Project, including near impaired waters. The MPCA will review the SWPPP prior to finalizing.

Big Bend will permit collection lines and crane path crossings of waterbodies (waters of the U.S.) with the U.S. Army Corps of Engineers (USACE) and Local Government Unit (LGU) under the Wetland Conservation Act (WCA). Crane path crossings of surface waters will be matted to minimize impacts on the waterbody.

The Project layout avoids permanent impacts to floodplains; therefore, no mitigation is proposed.

8.18 Wetlands

Similar to surface waters, construction, and operation of a LWECS can impact wetlands with crossings of access roads, crane paths, or collection lines. Construction activity can also make soil erosion more prevalent, which can impact water quality.

8.18.1 Description of Resources

Wetlands are areas with hydric (wetland) soils, hydrophilic (water-loving) vegetation, and wetland hydrology (inundated or saturated much of the year). Wetlands are part of the foundation of water resources and are vital to the health of waterways and communities that are downstream. Wetlands detain floodwaters, recharge groundwater supplies, remove pollution, and provide fish and wildlife habitat. Wetlands are also economic drivers because of their key role in fishing, hunting, agriculture, and recreation. Wetland types include marshes, swamps, bogs, and fens. Wetlands vary widely due to differences in soils, topography, climate, hydrology, water chemistry, vegetation, and other factors.

Wetlands within the Project Area were identified using Minnesota’s update to the National Wetlands Inventory (NWI). Some of the wetlands are associated with creeks and unnamed intermittent streams within the site and some of the wetlands are isolated basins. The Cowardin Classification System wetland types and their acreage within the Project Area are presented in Table 8.18-1.

Table 8.18-1
National Wetlands Inventory in the Project Area

NWI Wetland Type	Acres[1]
Palustrine Emergent Wetland (PEM)	543.9
Freshwater Pond/Lake	370.2
Palustrine Forested Wetland (PFO)	113.6
Riverine	104.8
Palustrine Scrub-shrub Wetland (PSS)	5.0
Wetland Total	**1,137.5**

[1] Wetland acreage is calculated using Minnesota's Update to NWI data.

There are approximately 1,137.5 acres of NWI-mapped wetlands in the Project Area, which constitutes less than one percent of the Project Area. About 48 percent (543.9 acres) of the NWI wetland acreage is mapped as palustrine emergent wetlands (PEM). Freshwater pond/lake comprise 33 percent (370.2 acres) of the NWI wetland acreage. Palustrine forested wetlands (PFO) comprise 10 percent (113.6 acres) of the NWI wetland acreage. Riverine wetlands comprise 9 percent (104.8 acres) of the NWI wetland acreage. The remaining less than one percent is palustrine scrub-shrub wetlands (PSS; 5.0 acres). Additionally, there are a total of 283.0 acres of PWI basins that are located within the Project Area, which may overlap with NWI. *See* Figure 17 – Wetlands Inventory Map for locations of wetlands within the Project site. There are no calcareous fens, a rare and unique wetland type, within the Project Area.

8.18.2 Impacts

Project impacts on NWI-mapped wetlands are summarized in Table 8.18-2. Turbines and meteorological towers will be constructed on higher ground within the Project Area to maximize the wind resource, and as such, will not permanently impact wetlands. Based on preliminary design, access roads, the O&M facility, and Wind Project Substation are also designed to avoid permanent impacts on wetlands. Based on review of the NWI data, temporary impacts on wetlands may occur from the use of access roads and crane paths, installation of collection lines, and workspaces used during turbine construction. None of the wetlands that would be temporarily impacted during construction are MNDNR-designated PWI wetlands. All mapped water features will be field verified and final impact calculations will vary based on the results of the field delineation. Based on review of the field data, Project facilities may undergo minor shifts so as to avoid wetland features where possible.

Table 8.18-2
Summary of NWI-mapped Wetland Impacts (acres)

NWI Wetland Type	Permanent	Temporary
Palustrine Emergent Wetland (PEM)	--	2.8
Palustrine Forested Wetland (PFO)	--	0.6
Riverine	--	0.6
Total	**0.0**	**4.0**

Temporary impacts associated with the use of access roads and crane paths will be minimized by the use of matting during construction. Installation of underground utilities is expected to

minimize impacts to wetlands or where possible make them coincident with other impacts (e.g., crane paths).

8.18.3 Mitigative Measures

Formal wetland delineations of the Project Area will be completed prior to construction, and the layout will be refined to further avoid and minimize wetland impacts, if necessary. If wetland impacts cannot be avoided, Big Bend will submit a permit application to the USACE for dredge and fill within Waters of the United States under Section 404 of the CWA, to the LGU for Minnesota WCA coverage, and the MPCA for Water Quality Certification under Section 401 of the CWA prior to construction.

Big Bend will minimize impacts to wetlands during construction by protecting topsoil, reducing soil erosion, and protecting adjacent wetland resources. Practices may include containing excavated material, use of silt fences, protecting exposed soil, stabilizing restored material, and re-vegetating disturbed areas with non-invasive species.

8.19 Vegetation

Construction of a LWECS will temporarily disturb vegetative cover. Operation of the Project will remove the permanent footprint of facilities from a vegetative to impervious surface (i.e., gravel). The various vegetative communities within a Project Area can influence the wildlife species present.

8.19.1 Description of Resources

8.19.1.1 Land Cover

The Project Area is in both the Minnesota River Prairie and Coteau Moraines subsections of the North Central Glaciated Plains Section in the Prairie Parkland Province, as defined by the ECS of Minnesota (MNDNR, 2000). Historically, tallgrass prairie covered most of this area and wet prairies covered a smaller proportion of the landscape. Forest was similarly restricted to floodplains along the Minnesota River and other streams. As a result of settlement in the mid-1800s, the area was converted to farmland, with only a few remnants of pre-settlement vegetation remaining (MNDNR, 2000).

Based on review of aerial photographs and land use/land cover database information, Big Bend determined that the majority of the land area at the site is cultivated crops (refer to Table 8.19-1 and Figure 12 – Land Cover). Corn and soybeans are the top two agricultural crops by acreage in both counties; the third most popular agricultural crop in Cottonwood County is forage, but in Watonwan County vegetables harvested for sale are the third most popular agricultural crop (USDA, 2017). The relative abundance of land cover types in the Project Area are shown in Table 8.19-1 (Yang et al., 2018).

Table 8.19-1
Land Cover Types and their Relative Abundance in the Project Area

Land Cover	Acres	Percent of Project Area
Cultivated Crops	40,235.2	92.5
Developed (all categories)	1,584.7	3.6

Table 8.19-1
Land Cover Types and their Relative Abundance in the Project Area

Land Cover	Acres	Percent of Project Area
Hay/Pasture	435.6	1.0
Emergent Herbaceous Wetlands	380.5	0.9
Herbaceous	249.7	0.6
Deciduous/Mixed Forest	224.4	0.5
Woody Wetlands	15.2	< 0.1
Barren Land	37.8	0.1
Open Water	358.6	0.8
Shrub/Scrub	1.3	< 0.1
Total	**43,523.1**	**100**

Source: Yang et al., 2018

Forested areas in the Project Area are primarily surrounding residences as windbreaks and riparian areas along the Watonwan River and associated tributaries. Hay/Pasture and herbaceous lands are present primarily in areas near the margin of waterbodies in the Project Area. Wetlands are generally associated with streams, and there are several lakes and ponds present in the Project Area as well. The hay/pasture and herbaceous areas at the site may contain potential remnant native prairie areas. Native prairie is discussed in Section 8.21.2 and may be present within the Project Area.

8.19.2 Impacts

The primary impact from construction of the Project would be the cutting, clearing, and removal of existing vegetation within the construction workspace. The degree of impact would depend on the type and amount of vegetation affected, the rate at which the vegetation would regenerate after construction, and whether periodic vegetation maintenance would be conducted during operation. Secondary effects from disturbances to vegetation could include increased soil erosion, increased potential for the introduction and establishment of invasive and noxious weed species, habitat fragmentation and edge effects, and a local reduction in available wildlife habitat.

Cultivated cropland comprises over 96 percent of the permanent and temporary impacts. A summary of vegetation impacts is provided in Table 8.19-2. Vegetation will be permanently removed and replaced by wind turbines, access roads, and substation and O&M Facility components. Temporary vegetation impacts will be associated with crane walkways, the installation of underground collection lines, workspace around turbines, wider access roads, and contractor staging and laydown areas. The turbines and access roads are sited to avoid forests and groves to maximize turbine output and avoid tree removal. Impacts on surface waters and wetlands are discussed in Sections 8.17.2 and 8.18.2, respectively. Less than one percent of the Project Area will be permanently converted to sites for wind turbines, access roads, and facilities.

Table 8.19-2
Summary of Land Cover Impacts (acres)

Land Cover Type	Permanent	Temporary
Cultivated Crops	49.5	977.8

Table 8.19-2
Summary of Land Cover Impacts (acres)

Land Cover Type	Permanent	Temporary
Developed (all categories)	2.6	28.3
Emergent Herbaceous Wetlands	--	1.8
Hay/Pasture	<0.1	0.7
Herbaceous	--	--
Deciduous/Mixed Forest	--	0.4
Barren Land	--	<0.1
Open Water	--	0.2
Total	**52.1**	**1,009.2**

8.19.3 Mitigative Measures

Big Bend will begin restoring disturbed soils and vegetation as soon as possible after construction activities are complete. Big Bend will restore areas of disturbed soil in non-cropped areas using weed-free native grasses, forbs, and shrubs. In cropped areas, a temporary cover crop may be planted to stabilize soils depending on the timing of construction completion and the next growing season.

The following measures will be used to avoid and minimize impacts on existing land use in the Project Area during siting, construction, and operation to the extent practicable:

- Prioritize turbine, access road, and Wind Project Substation siting on cultivated cropland.
- Avoid disturbance of wetlands during construction and operation of the Project. If jurisdictional wetland impacts are proposed, Big Bend will obtain the applicable wetland permits (*see* Section 8.18).
- Design the Project to minimize the need to clear existing trees and shrubs.
- Prepare a construction SWPPP and obtain a NPDES Permit.
- Use BMPs during construction and operation of the Project to protect topsoil and adjacent resources and to minimize soil erosion. Practices may include containing excavated material, protecting exposed soil, and stabilizing restored material, revegetating non-cropland with wildlife conservation species, and (wherever feasible) using a seed mix that matches the surrounding impacted areas (i.e., roadside mix, grazing mix, etc.) in cooperation with landowners.

8.20 Wildlife

8.20.1 General Wildlife

8.20.1.1 Description of Resource

Regulatory Environment and Agency Guidance

Migratory Bird Treaty Act

The Migratory Bird Treaty Act (MBTA) of 1918 (16 United States Code [U.S.C.] 703-712) regulates the taking, selling, transporting, and importing of migratory birds, their nests, eggs, parts, or products. The MBTA protects more than 800 species of birds that occur within the United States. A list of federally protected migratory birds may be found in 50 Code of Federal Regulations Part 10.13. Most birds within the Project Area would be afforded protection under this Act.

USFWS Land-Based Wind Energy Guidelines

On March 23, 2012, the USFWS issued the Land-Based Wind Energy Guidelines (WEGs; USFWS, 2012). The WEGs provide a structured, scientific process for addressing wildlife conservation concerns at all stages of land-based wind energy development. They also promote effective communication among wind energy developers and federal, state, and local conservation agencies. The WEGs are founded upon a tiered approach for assessing potential impacts to wildlife and their habitats. The tiered approach is an iterative decision-making process for collecting information in increasing detail, quantifying the possible risks of proposed wind energy projects to wildlife and habitats, and evaluating those risks to make siting, construction, and operation decisions. Subsequent tiers refine and build upon issues raised and efforts undertaken in previous tiers. At each tier, a set of questions is provided to help the developer identify potential problems associated with each phase of a project, and to guide the decision process. The tiered approach is designed to assess the risks of project development by formulating questions that relate to site-specific conditions regarding potential species and habitat impacts. The tiers are outlined briefly as:

- Tier I: Preliminary evaluation or screening of sites (landscape-level screening of possible project sites; generally based on readily available public information).
- Tier II: Site characterization (comprehensive characterization of one or more potential project sites; generally based on consulting with the appropriate agencies/authorities and one or more reconnaissance level site visits by a wildlife biologist).
- Tier III: Field studies to document site wildlife conditions and predict project impacts (site-specific assessments at the proposed project site; quantitative and scientifically rigorous studies; e.g., acoustical monitoring, point count avian surveys, raptor nest surveys, lek surveys, etc.).
- Tier IV: Post-construction mortality studies (to evaluate direct impacts from project operation).
- Tier V: Other post-construction studies (to evaluate direct and indirect effects of adverse habitat impacts, and assess how they may be addressed; not done for most projects; e.g., post-construction displacement and/or use studies, curtailment effectiveness studies, etc.).

This tiered approach allows developers to determine whether they have sufficient information, whether and/or how to proceed with development of a project, or whether additional information gathered at a subsequent tier is necessary to make those decisions. The WEGs indicate that wind energy developers who voluntarily adhere to these guidelines will be undertaking a robust level of wildlife impact analysis and have a shared responsibility with the USFWS to ensure that the scientific standards of the guidelines are upheld and used to make wise development decisions.

It is important to note that not all of the five tiers are recommended or necessary for all projects.

At each tier, potential issues associated with developing or operating a project are identified and questions formulated to guide the decision process. The guidelines outline the questions to be posed at each tier and recommend methods and metrics for gathering the data needed to answer those questions. If sufficient data are available at a particular tier, the following outcomes are possible based on analysis of the information gathered:

- The project is abandoned because the risk is considered unacceptable.
- The project proceeds in the development process without additional data collection.
- An action, or combination of actions, such as project modification, mitigation, or specific post-construction monitoring, is identified or implemented.

If data are deemed insufficient at a tier, more intensive study is conducted in the subsequent tier until sufficient data are available to make a decision to abandon the project, modify the project, or proceed with and expand the project (USFWS, 2012).

Results of Tier 1 and 2 Process

The Tier 1 and 2 Site Characterization Study (SCS) is incorporated into the Project's Bird and Bat Conservation Strategy (BBCS; Appendix H). Based on the results of the SCS, Tier III studies are completed or in progress for the Project. This decision was reached by answering the following questions from the USFWS guidelines:

Are there known species of concern present on the proposed site, or is habitat (including designated critical habitat) present for these species?

Two federally-listed and nine state-listed threatened and endangered species, as well as 17 birds of particular concern have the potential to occur within Cottonwood and Watonwan counties, Minnesota. No federally or state-designated critical habitat occurs within the current Project Area.

The federally threatened northern long-eared bat (*Myotis septentrionalis*; NLEB) has the potential to occur in the Project Area. The federally threatened prairie bush clover (*Lespedeza leptostachya*) is unlikely to occur in the Project Area due to limited suitable habitat (tallgrass prairie). State-listed species with potential to occur in the Project Area include burrowing owl, loggerhead shrike, Henslow's sparrow, king rail, Poweshiek skipperling, Dakota skipper, eastern spotted skunk, Blanding's turtle, and Wilson's phalarope. Each of these species has potential to occur in the Project Area due to their range; however, habitat suitability for these species is limited due to the predominance of cultivated crops and limited amount of native prairie and wetlands.

Bald eagles occur locally throughout the year, but are more common in winter and spring, with use primarily associated with the town of Mountain Lake (eBird, 2002-2017). Use of the Project Area is expected to be consistent with eagle use in the region. Golden eagle (*Aquila chrysaetos*) use is unlikely as the Project Area is outside this species range (eBird, 2017).

Does the landscape contain areas where development is precluded by law or designated as sensitive according to scientifically credible information? Examples of designated areas include, but are not limited to: areas of scientific importance; areas of significant value; federally-designated critical habitat; high-priority conservation areas for NGOs; or other local, state, regional, federal, tribal, or international organizations.

There are few protected areas within the Project Area: an access road to a WMA and a 2.4-acre AMA. There will be no impacts to these protected areas, and setbacks from the Project will result in a minimum buffer of 3 RD by 5 RD between these resources and any turbines.

Are there plant communities of concern present or likely to be present at the site(s)?

There are only 16.5 acres of MNDNR-mapped native prairie and NPCs in the Project Area. There are four SOBS in the Project Area: two moderate (totaling 16.5 acres) and two below (totaling 46.6 acre). The moderate SOBS overlap with the MNDNR-mapped native prairie and NPCs; the below areas are associated with stream corridors.

Are there known critical areas of congregation of species of concern, including, but not limited to: maternity roosts, hibernacula, staging areas, winter ranges, nesting sites, migration stopovers or corridors, leks, or other areas of seasonal importance?

There are no known hibernacula or maternity roosts within the Project Area, with the nearest NLEB hibernacula is located approximately 50 miles northeast of the Project Area. Bald eagles may potentially use the habitat in and around the Project Area for nesting. Additionally, the open waterbodies within the Project Area may be used as stopover habitat for migrating waterfowl.

Are there large areas of intact habitat with the potential for fragmentation, with respect to species of habitat fragmentation concern needing large contiguous blocks of habitat?

Species of habitat fragmentation concern that may occur in the Project Area include grassland-dependent species (e.g. Henslow's sparrow) and forest-dependent bat species (e.g. NLEB) but the majority of the Project Area is highly fragmented with 96 percent of the Project Area being cultivated crops or developed.

Which species of birds and bats, especially those known to be at risk from wind energy facilities, are likely to use the proposed site based on an assessment of site attributes?

Bald eagles, along with a variety of other raptor species, will likely occur within the Project Area. Waterfowl, waterbirds, and passerines are also likely to occur, especially during migration, but generally have low risk profiles with wind energy facilities. The Project Area is highly fragmented with 96 percent being cultivated crops or developed, limiting habitat for a variety of species that utilize grassland, woodlands, and wetlands.

Seven species of bats have the potential to occur within the Project Area and have known risk during fall migration, including: hoary bat (*Lasiurus cinereus*), big brown bat (*Eptesicus fuscus*), little brown bat (*Myotis lucifugus*), eastern red bat (*Lasiurus borealis*), silver-haired bat (*Lasionycteris noctivagans*), tri-colored bat (*Perimyotis subflavus*) and NLEB (Solick et al., 2019).

Is there a potential for significant adverse impacts to species of concern based on the answers to the questions above?

The potential for significant impacts to species of concern is low based on available data. Although the Project Area is likely to be used by bald eagles and has potential to be used by other sensitive bird and bat species, limited habitat is available and is unlikely to support any concentration of these species and therefore significant adverse impacts to these species is unlikely.

Summary of Tier 1 and Tier 2 Process

Big Bend initiated Tier 3 studies in November 2017 to provide baseline avian and bat use data. The Tier I and II questions identified limited types of wildlife habitats including native prairie, NPCs, Mountain Lake WMA, conservation easements, and SOBS ranked as moderate within and adjacent to the Project Area. All turbines are sited in cultivated crops; turbines will not be sited in native prairie, NPCs, SOBS (any rank), conservation easements, or any natural resource lands.

Baseline avian and bat data have been incorporated into the BBCS (see Appendix H). Big Bend will continue to coordinate with USFWS, MNDNR, and DOC-EERA on Tier III data and the BBCS.

Tier 3 Studies

Based on the results of the Tier 1 and 2 reviews, coordination with USFWS and MNDNR, and MNDNR's approval of the Big Bend Biological Study Plan, Tier 3 surveys were designed and completed throughout the Project area and vicinity to understand wildlife usage, evaluate risk, and inform siting and operational protocols. A summary of the completed and ongoing avian and bat studies are listed in Table 8-20.1.

Table 8.20-1
Avian and Bat Monitoring and Survey Efforts for the Big Bend Wind Project

Study Type	Study Period
Avian Use Surveys – Year 1	November 2017- October 2018
Avian Wetland Use Surveys	March 15 – June 15, 2018
Raptor Nest Survey	April 2018
Eagle Nest Monitoring Survey	May 2018 - July 2018
General Acoustic Bat Survey	May 2018 – August 2018
Avian Use Surveys – Year 2	November 2018 – February 2020
Aerial Eagle Nest Survey	May 2019
Northern Long-eared Bat Habitat Assessment	May 2019 – May 2020
Raptor Nest Surveys	March 2020
Eagle Nest Monitoring Survey	March 2020 – August 2020
Avian Wetland Use Surveys (Watonwan County)	March 2020 – June 2020
Native Prairie Habitat Assessment	June 2020
Avian Use Surveys (Watonwan County)	March 2020 – February 2021

Birds

No federally threatened or endangered bird species were observed during surveys. One state-listed endangered species, Henslow's sparrow, a species that is often recorded at wind energy facilities in southwestern Minnesota, was recorded during Year 1 avian use surveys. However, no Henslow's sparrow fatalities at wind energy facilities have been reported in publicly available data, so risk is anticipated to be relatively low (Foo et al., 2019). No state-listed species were recorded during Year 2 avian use surveys. Three birds of particular concern (bald eagle, black tern, red-headed woodpecker) were observed in the Project Area during surveys at comparatively low levels during Year 1 and one bird of particular concern (Franklin's gull) was observed incidentally. Two birds of particular concern were recorded during Year 2 (bald eagle, Franklin's gull). Approximately 96% of the Project Area consists of cultivated crops and developed areas, leaving limited preferred herbaceous (0.5 percent) and open water (0.9 percent) habitat available to species of concern. The majority of species of concern were recorded infrequently and in low numbers, suggesting low use of the Project Area.

Bald eagles were observed using the Project Area during all seasons in Year 1 avian use surveys and in fall, winter, and spring during Year 2 avian use surveys. Overall bald eagle use was not concentrated in a specific portion of the current Project area, although higher use was generally associated with areas in close proximity to rivers and lakes. A bald eagle nest was discovered within the Project Area during 2020 aerial nest surveys. This bald eagle nest is located 0.6-mile from the nearest turbine.

Bats

The Project Area is within the range of the federally threatened NLEB; however, no known hibernacula or maternity colonies exist within the Project Area, and the nearest known hibernacula is approximately 50 mi northeast. Potential NLEB habitat does exist within the Project Area, and it is likely that tree-roosting migratory bat species will utilize the Project Area, including NLEB and other state-listed species of concern. During bat acoustic surveys, the following seven bats were detected, listed in order of abundance: big brown bat, hoary bat, eastern red bat, silver-haired bat, *Myotis* species (NLEB and little brown bat), and tri-colored bat. The bat acoustic software classified eight calls as potential NLEB calls; however, after qualitative review, none were confirmed to display characteristics indicative of typical NLEB call structures.

Eagle Conservation Plan Guidelines

Wind energy developers and wildlife agencies have recognized a need for specific guidance to help make wind energy facilities compatible with eagle conservation and the laws and regulations that protect eagles. The USFWS has developed the Eagle Conservation Plan Guidance, Module 1 – Land-based Wind Energy, Version 2 (ECPG; USFWS, 2013). Similar to the WEGs for wildlife in general, the ECPG have a tiered approach to assessing a Project's risk to eagles. Stage 1 is a preliminary site evaluation which characterized eagle use of the Project and the expected level of risk, following the classifications outlined in the ECPG and publicly available data. Stage 2 involves site-specific surveys. Baseline wildlife studies were designed to collect information about wildlife species and behavior within and near the Project to aid assessment of potential risks to species or habitats of concern, including bald and golden eagles in alignment with Stage 2 of the ECPG. Studies at the Project collected information about eagle use rates and breeding territories in and around the proposed Project Area. Eagle use data has been collected at the Project since 2017 and nest surveys were conducted for the Project in 2018, 2019, and 2020.

Preliminary Site Evaluation (Stage 1)

Information on seasonal and spatial patterns of bald eagle abundance near the Project is limited. Based on relatively low abundance in eBird reports, spring and fall migration data from a Hawkwatch site located 55 miles away, and Audubon Christmas Bird Count data, the Project appears to be low to moderate expected risk as described in the ECPG. For golden eagles, the Project appears to be a low risk site as defined in the ECPG. However, the preliminary site evaluation is inconclusive and more detailed site-specific (Stage 2) information is needed to determine eagle risk at this site.

Site-Specific Surveys (Stage 2)

The preliminary site assessment indicated the Project would likely pose a low-moderate risk for bald eagles due to the altered landscape, scarcity in recorded observations, and minimal prey-based habitats. However, based on site-specific surveys, the Project appears to be moderate expected risk for bald eagles as described in the ECPG. The Stage 1 assessment suggested bald eagle observations peak during migration seasons; however, Stage 2 surveys showed that this species also overwinters and breeds within and near the Project and is likely to be observed at the Project throughout the year. During the first year of eagle use surveys bald eagles were observed in every season; however, only two eagle observations were recorded in each summer and winter. During the second year of eagle use surveys, more eagles were observed in winter (13 observations) than other seasons; no eagle observations were recorded in summer. During 2020 eagle nest surveys, one bald eagle nest was recorded in the Project Area.

The nest within the Project Area is located 0.6 mi from the closest proposed turbine; nest monitoring studies were completed to assess flight path patterns. Nest monitoring studies were conducted during spring and summer 2020 to further determine how and where the eagles moved around the nest. Data collected from late March until August shows eagle activity concentrated near the nest. Flight paths have been documented in the vicinity of four proposed turbines located southeast of the nest; however, upon review of aerial imagery, no prey resources appear to be located near these turbines. No other bald eagle nests are within two miles of proposed turbines.

No golden eagles were observed during site-specific surveys. Golden eagles may occur at the Project occasionally; however, the Project is expected to be low risk to golden eagles as described in the ECPG.

Other Wildlife

In addition to birds and bats, other wildlife that may occur in the Project Area include land-based mammals, reptiles and amphibians, and insects; each are described more below.

Mammals

Mammals that may occur in the Project Area use the food and cover available from agricultural fields, grasslands, farm woodlots, wetland areas, and wooded ravines. Mammals that may occur in the Project Area include white-tailed deer, red fox, Virginia opossum, striped skunk, white-tailed jackrabbit, eastern cottontail, raccoon, thirteen-lined ground squirrel, and coyote (MNDNR, 2020b).

Reptiles and Amphibians

Reptile and amphibian species that may be present in the Project Area include Great Plains toad, northern leopard frog, and plains garter snake (MNDNR, 2020b). These species are typical of agricultural landscapes and grasslands.

Fish

Fish may be present in the streams that traverse the Project Area or in one of the lakes. Fish species typical of streams in the southwest portion of the state include the bullhead, channel catfish, and long-nose gar (MNDNR, 2020b).

Insects

Pollinator insects may be present in the Project Area including native bees, butterflies, and moths and non-native honeybees. Other insect groups that may occur in the Project Area include mayflies and katydids (MNDNR, 2020b).

8.20.1.2 Impacts

Development of the Project, including the construction and operation, is expected to produce a minimal impact to wildlife. Based on studies of existing wind power projects in the United States and Europe, the impact to wildlife would primarily occur to avian and bat populations. Although Big Bend preconstruction surveys are ongoing, it can be expected that, similar to other wind developments, there is a high likelihood that individual bird and bat fatalities will occur at the Project. However, it is unlikely that Big Bend will affect species at the population level.

Project survey results indicate that development of the Project Area is unlikely to adversely impact small or large bird populations, including diurnal raptors or species of concern. Most species observed are prevalent and abundant, and their populations are therefore at low risk of adverse impacts from the Project. Analysis of data collected during raptor and eagle surveys suggests there is minimal potential for the Project to create instability in local or regional nesting diurnal raptor populations.

Although NLEB were not documented as occurring within the Project Area during the acoustic bat surveys, Big Bend will implement best management practices recommended by USFWS and MNDNR to minimize take for all bat species (Baerwald et al., 2008, Arnett et al., 2010, Good et al., 2011), including siting turbines more than 1,000 ft (305 m) from suitable NLEB habitat, minimizing tree removal to the greatest extent possible and focusing any necessary tree removal to winter, and locking or feathering blades up to manufacturer's cut-in speed from April 1 to October 31 for the life of the Project.

Recent post-construction data are available from the following wind facilities in southern Minnesota with comparable landscapes to Big Bend from which to draw correlative inferences about potential impacts on birds and bats from Project operations:

- Odell Wind Farm (Odell) in Cottonwood, Jackson, Martin and Watonwan Counties, Minnesota;
- Red Pine Wind Energy Facility (Red Pine) in Lincoln County, Minnesota;
- Lakefield Wind Project (Lakefield) in Jackson County, Minnesota;

- Elm Creek I Wind Project (Elm Creek I) in Jackson County, Minnesota;
- Elm Creek II Wind Project (Elm Creek II), in Jackson and Martin Counties, Minnesota;
- Prairie Rose Wind Energy Facility (Prairie Rose) in Rock County, Minnesota;
- Big Blue Wind Farm (Big Blue) in Faribault County, Minnesota;
- Grand Meadow Wind Farm (Grand Meadow) in Mower County, Minnesota; and
- Oak Glen Wind Farm (Oak Glen) in Steele County, Minnesota.

Data from post-construction avian and bat studies at these facilities suggest the types and levels of impacts that may be realized at Big Bend (Table 8.20-2):

Table 8.20-2
Bird and Bat Post-Construction Fatality Estimates at Wind Facilities with Geographic Proximity and Similar Land Cover to the Project

Facility	Survey Timeframe (month/year)	Bird (#/MW)	Bat (#/MW)	Comments
Odell[1]	12/2016-12/2017	4.69	6.74	• Most avian fatalities were in September and October • Bat fatalities were primarily July through September • Seasonality suggests most fatalities were fall migrants • Most common bat species was hoary bat
Red Pine[2]	3/2018-11/2018	4.47	11.35	• Fatality estimates were for cleared plot surveys and road and pad surveys, respectively • Most common bird species were ruby-crowned kinglet, marsh wren, red-eyed vireo, and sedge wren • Bat species were hoary, big brown, eastern red, and silver-haired
		2.68	18.74	
Lakefield[3]	4/2012-11/2012	2.75	19.97	• Fifteen species of birds documented • Documented bat species were hoary, big brown, eastern red, and little brown • No fatalities were federal- or state-listed or special concern
	6/2014-10/2014	1.07	20.19	• Most of the bat fatalities (65 percent) were solitary tree roosting bats (eastern red bat, hoary bat) • Bat fatalities were during fall migration (last week of July through mid-September)
Elm Creek I[4]	2009-2010	2.32	1.49	• This report is not publicly available; only summary data are provided in the BBCS
Elm Creek II[4]	2011-2012	8.73	2.81	• This report is not publicly available; only summary data are provided in the BBCS

Table 8.20-2
Bird and Bat Post-Construction Fatality Estimates at Wind Facilities with Geographic Proximity and Similar Land Cover to the Project

Facility	Survey Timeframe (month/year)	Bird (#/MW)	Bat (#/MW)	Comments
Prairie Rose[5]	4/2014-6/2014	0.44	0.41	• Estimates provided are per study period (i.e., 8 weeks during spring migration and 10 weeks during fall migration) • An operational shut-down from August 18 through August 28, 2014 may have affected fatality rates
	8/2014-10/2014			
Big Blue, Grand Meadow, & Oak Glen[6]	7/2013-10/2013	--	3.1-6.3	• Systematic avian surveys were not conducted • Fatality rates are the range for the three facilities • Bat fatalities peaked twice: in late July/early August and in late August/early September. • Bat fatalities were primarily tree-roosting bats

1 Chodachek and Gustafson, 2018
2 Trana et al., 2019
3 Westwood Professional Services, 2015
4 *see* Appendix H - BBCS
5 Chodachek et. al, 2015
6 Chodachek et al., 2014

Overall, adjusted fatality rates for all bird species vary between three to six birds/MW/year for the majority of post-construction fatality studies nationwide. Fatality estimates are relatively constant across the country except for in the Great Plains, where there appears to be lower avian fatality rates, and the Pacific region, where there may be slightly higher fatality rates. Most avian fatalities due to wind turbines are small passerines, about 60 percent of avian fatalities in publicly available reports in the United States. Fatality rates of migratory passerines increase in the spring and fall during migration (AWWI, 2017). The majority of avian species have a low risk of impacts at the population level (Allison et al., 2019). Based on the post-construction fatality studies outlined above, national averages for post-construction fatalities, and AWWI's conclusions about geographic trends, Big Bend anticipates that unavoidable avian fatalities due to collision will be at or below the national average and may result in limited localized impacts to some groups of birds, such as small passerines.

Potential unavoidable impacts from the Project on bats are expected to be similar to the post-construction fatality rates at the above wind facilities, based on the similar land uses within the Project Area, geographic proximity of the projects, and similarities in species composition. Migratory tree-roosting bats (e.g., hoary bat, silver-haired bat, and eastern red bat), which were detected during the Project's pre-construction studies, may have the highest risk of collision based on previous bat fatality studies (AWWI, 2017). Unlike birds, wind facilities may present a risk to populations of migratory tree-roosting bats; in addition, although impacts from wind facilities on cave-roosting bats are typically low, even a small impact can be a risk to populations already impacted by white-nose syndrome (Allison et al., 2019). Overall, risk of mortality to bats in the Project Area is likely to be greatest on nights during fall migration, when the number of bats moving through the area are the highest. During the fall migration, weather conditions that are

most conducive to higher mortality rates occur with warm temperatures (greater than 50 degrees Fahrenheit) and low wind speeds (less than 6.5 m/s or 14 miles per hour) (Baerwald and Barclay, 2009; Arnett et al., 2011; Good et al., 2011; Cryan and Brown, 2007). In addition, risk may be higher on the first night following the passage of a low-pressure system when the prevailing wind shifts from a southerly to a northerly direction (Cryan and Brown, 2007; Good et al., 2011). Additional impacts may include a small reduction in the available habitat that some wildlife uses for forage or cover; however, operation of the Project will not significantly change the existing land use. Based on bat fatality data from Elm Creek I and II and Odell, which are within ten miles of Big Bend (see Image 8.5-1), bat fatalities are expected to range from 1.49 to 6.74 bats/MW/year (Table 8.20-2).

As described in detail in the BBCS, Big Bend initiated coordination with MNDNR and USFWS on the Project in November 2017. Since that time, Big Bend has met several times with the wildlife agencies on rare and unique resources, surveys, and survey results. Big Bend has incorporated turbine-siting avoidance of rare and unique resources and potential habitat for threatened and endangered species into the Project layout. All turbines are sited in cultivated cropland and the layout avoids permanent and temporary impacts to MNDNR-mapped native prairie, NPCs, and SOBS.

8.20.1.3 Mitigative Measures

Big Bend will implement the following measures to the extent practicable to minimize and/or avoid potential impacts to wildlife in the Project Area during Project design, construction, and operation:

- Prioritize turbine siting in cultivated cropland.
- Avoid siting turbines in mapped native prairie, NPCs, and SOBS (all ranks).
- Maintain, at a minimum, the three by five times the RD setback from adjacent WMAs to reduce risk to waterfowl/waterbirds and grassland-associated birds when siting turbines in the Project Area.
- Avoid siting turbines within a 1,000-foot habitat connectivity buffer of forested areas for NLEB.
- Avoid or minimize disturbance to individual wetlands or drainage systems during Project construction. Field delineations will be conducted prior to construction to identify the limits of wetland and other WOUS boundaries in the vicinity of Project activities.
- Conduct a minimum of one year of post-construction Project monitoring to assess operational impacts to birds and bats.
- Protect existing trees and shrubs by avoiding tree removal for turbines, access roads, and underground collector lines. These will be identified based on aerial photos and during field surveys.
- Maintain sound water and soil conservation practices during construction and operation of the Project to protect topsoil and adjacent resources and to minimize soil erosion. To minimize erosion during and after construction, BMPs for erosion and sediment control will be used. These practices include silt fencing, temporary seeding, permanent seeding, mulching, filter strips, erosion blankets, grassed waterways, and sod stabilization.

- Construct wind turbines using tubular monopole towers.
- Light turbines according to FAA requirements, which may include ADLS radar.
- Revegetate non-cropland and pasture areas disturbed during construction or operation with an appropriate native seeding mix.
- Inspect and control noxious weeds in areas disturbed by the construction and operation of the Project.
- Prepare and implement a BBCS during construction and operation of the Project. A draft BBCS is attached to this Application as Appendix H. This BBCS consists of Apex's corporate standards for minimizing impacts to avian and bat species during construction and operation of wind energy projects. The BBCS has been developed in a manner that is consistent with the guidelines and recommendations of the USFWS WEG (USFWS, 2012). It includes Big Bend's commitments to wind project siting and transmission route suitability assessments, construction practices and design standards, operational practices, permit compliance, and construction and operation worker training. It also includes additional avoidance and minimization measures that may be implemented in consultation with the USFWS and MNDNR if avian and bat mortalities exceed an acceptable level.
- Prepare a draft Eagle Management Plan to proactively address potential eagle impacts resulting from construction and operation of the Project (Appendix I).

Big Bend is committed to minimizing wildlife impacts within the Project Area. Big Bend has designed the layout to minimize avian impacts by siting all turbines in cultivated crops and avoiding high use wildlife habitat (woodlands adjacent to farmsteads), using tubular towers to minimize perching, placing electrical collection lines underground as practicable, and minimizing infrastructure. Big Bend continues to consult with DOC-EERA, USFWS, and MNDNR regarding appropriate mitigation measures for wildlife impacts.

8.20.2 Migratory Waterfowl Feeding and Resting Areas

8.20.2.1 Description of Resources

MWFRA were authorized by the Minnesota legislature in 1969 to protect migratory waterfowl from disturbance. During the waterfowl season, electric motors are either prohibited or limited in size, depending on the MWFRA. In 2011, 30 MWFRAs were designated across the state. MWFRA are typically nominated by local conservation groups for the MNDNR to consider and approve or deny (MNDNR, 2020c).

8.20.2.2 Impacts

No MWFRAs are within or adjacent to the Project Area, and thus Big Bend anticipates no impacts.

8.20.2.3 Mitigative Measures

No mitigative measures are necessary related to MWFRAs because there are no MWFRAs within or adjacent to the Project Area.

8.20.3 Important Bird Areas

8.20.3.1 Description of Resources

IBAs are created under a voluntary, non-regulatory, international conservation effort that identifies critically essential habitats for birds, designates these habitats as IBAs, monitors the IBAs for changes in avian distribution and abundance, and conserves IBAs to protect birds in the long-term (MNDNR, 2020d). In Minnesota, the IBA program is led by the MNDNR's Nongame Wildlife Program and Audubon Minnesota.

8.20.3.2 Impacts

No IBAs are within or adjacent to the Project Area, and thus Big Bend anticipates no impacts.

8.20.3.3 Mitigative Measures

No mitigative measures are necessary related to IBAs because there are no IBAs within or adjacent to the Project Area.

8.21 Rare and Unique Natural Resources

8.21.1 Rare and Unique Natural Resources

8.21.1.1 Description of Resources

Federal Regulations

Endangered Species Act

Section 7 of the Endangered Species Act of 1973 (ESA; 16 U.S.C 1531-1544) requires that all federal agencies consider and avoid, if possible, adverse impacts to federally listed threatened or endangered species or their critical habitats, which may result from their direct, regulatory, or funding actions. USFWS is responsible for compiling and maintaining the federal list of terrestrial threatened and endangered species. Section 7 of the ESA also prohibits the taking of any federally listed species by any person without prior authorization. The term "taking" is broadly defined at the federal level and explicitly extends to any habitat modifications that may significantly impair the ability of that species to feed, reproduce, or otherwise survive. While the prohibition of "taking" federal species applies to anyone, the prohibition of the destruction or adverse modification of designated critical habitat only applies to federal agencies.

Bald and Golden Eagle Protection Act

The Bald and Golden Eagle Protection Act (BGEPA) of 1940 (16 U.S.C. 668-668d) protects and conserves bald eagles and golden eagles from intentional take of an individual bird, chick, egg, or nest (including alternate and inactive nests) without a permit. Unlike the MBTA, BGEPA prohibits disturbance that may lead to biologically significant impacts, such as interference with feeding, sheltering, roosting, and breeding or abandonment of a nest (USFWS, 2007).

State Regulations

Minnesota's endangered species law (Minn. Stat. § 84.0895) and associated rules (Minn. R. Chs. 6212, 1800, 2300, and 6134) regulate the taking, importation, transportation, and sale of state endangered or threatened species. The MNDNR administers the state list of rare, threatened, and endangered species. The MNDNR also identifies and develops a list of species of special concern; species of special concern are not protected by the state endangered species law.

Federal and State Listed Species

Big Bend reviewed the USFWS's Information for Planning and Conservation website (USFWS, 2020) for federally listed species, candidate species, and designated or proposed critical habitat that may be present within the proposed Project Area (Table 8.21-1). Big Bend also reviewed the MNDNR's NHIS for documented occurrences of federally listed species, state listed species, and state species of concern within one mile of the Project Area (MNDNR, 2020e). The MNDNR maintains the NHIS database through their Natural Heritage Program and Nongame Game Research Program. The NHIS is the most complete source of data on Minnesota's rare, endangered, or otherwise significant plant and animal species, plant communities, and other rare natural features. Although these reviews do not represent a comprehensive survey, they provide information on the potential presence of rare and unique species and habitats (refer to Table 8.21-2). Big Bend requested NHIS information from MNDNR for the Project Area and one-mile buffer on September 28, 2020. A copy of this request is included in Appendix F.

Table 8.21-1
Federally Listed Species with the Potential to Occur in the Project Area [1]

Species	Counties of Occurrence	Federal Status
Northern Long-eared Bat (*Myotis septentrionalis*)	Cottonwood, Watonwan	Threatened
Prairie Bush-Clover (*Lespedeza leptostachya)*	Cottonwood	Threatened

1 USFWS, 2020

Table 8.21-2
Federal and State Listed Species Documented within One Mile of the Project Area[1]

Type	Federal Status[2]	State Status[2]	Scientific Name	Common Name	NHIS Records within the Project Area (#)	NHIS Records within one Mile of Project Area (#)	Year of Most Recent Observation
Mammal	--	SPC	*Perognathus flavescens*	Plains Pocket Mouse	1	0	1952
Insect	E	E	*Oarisma poweshiek*	Poweshiek skipperling	1	0	1974
	--	SPC	*Catocala abbreviatella*	Abbreviated Underwing	1	0	1967

Table 8.21-2
Federal and State Listed Species Documented within One Mile of the Project Area[1]

Type	Federal Status[2]	State Status[2]	Scientific Name	Common Name	NHIS Records within the Project Area (#)	NHIS Records within one Mile of Project Area (#)	Year of Most Recent Observation
	--	T	*Ironoquia punctatissima*	A Caddisfly	0	1	2000
Plant	--	T	*Asclepias sullivantii*	Sullivant's Milkweed	0	1	1992
	--	SPC	*Buchloe dactyloides*	Buffalo Grass	0	1	2009
	-	T	*Rhynchospora capillacea*	Hair-like Beak Rusk	0	1	2019

1 MNDNR, 2020e
2 E=Endangered, T=Threatened, SPC=Species of Special Concern, W=Watchlist

Acoustic surveys to determine presence/absence for the northern long-eared bat were conducted in the Project Area during April – October 2018. The results indicated a lack of species presence based on a qualitative review of acoustic software results. Subsequently, the northern long-eared bat is considered likely absent from the Project Area. Surveys are considered complete, and no further action is recommended to confirm the species absence, according to the 2019 Range-Wide Indiana Bat Summer Survey Guidelines (USFWS, 2019).

One federally listed species has been documented within the Project Area, a 1974 record of the Poweshiek skipperling. This species is also state endangered. Poweshiek skipperlings are small butterflies that occur in native tallgrass prairie habitat. Approximately four percent of tallgrass prairie habitat remains in the United States, and the majority of remaining parcels are small and isolated (USFWS, 2014). Based on the age of the record and the absence of the Poweshiek skipperling on the USFWS species list for the Project Area, the Poweshiek skipperling is not likely to occur in the Project Area. If individuals were present, they would be associated with the native prairie remnants. As noted in Section 8.21.2 (Native Prairie), there is approximately 16.4 acres of MNDNR-mapped native prairie in the Project Area.

Based on Big Bend's review of the NHIS, there are records of one special status mammal (plains pocket mouse), one federal and state-listed insect (Poweshiek skipperling), and one special status insect (abbreviated underwing) historically occurirng within the Project Area. Additionally, there is one state-threatened insect (a caddisfly), two state-threatened plants (Sullivan's milkweed and hair-like beak rush) and one special status plant (buffalo grass) within one mile of the Project Area. Generally, NHIS species records are associated with MNDNR special status habitats such as native prairie, NPCs, and/or SOBS. Special status species, including species of special concern and watchlist species, do not have a legal or protected status but are tracked by the MNDNR.

8.21.1.2 Impacts

Records of federal and state endangered and threatened species documented within the Project Area include one NHIS record of Poweshiek skipperling (a federal- and state-endangered species) from 1974. Big Bend has designed the Project to avoid any impacts to MNDNR-mapped native prairie, NPCs, and SOBs, which may provide suitable habitat for this species. Furthermore, the Powershiek skippering was documented in the Project Area in 1974 over 45 years ago; subsequently, the likelihood of the species occurring in the Project Area during Project construction and operations is very low. Additionally, the closest turbine to mapped native prairie is over one mile away (5,493 feet); the closest collocated crane path and collection line are 128 feet away from a different mapped prairie parcel and in cultivated crops. Therefore, Big Bend should avoid impacts on the Poweshiek skipperling, a native prairie obligate.

Project-specific acoustic surveys for bats, including northern long-eared bats, confirmed species absence in 2018. As described in Section 8.20.1.2, Big Bend will implement best management practices recommended by USFWS and MNDNR to minimize take for all bat species including siting turbines more than 1,000 ft (305 m) from suitable habitat, minimizing tree removal to the greatest extent possible and focusing any necessary tree removal to winter, and locking or feathering blades up to manufacturer's cut-in speed from April 1 to October 31 for the life of the Project.

As discussed in Section 8.20.1, one state listed endangered bird, Henslow's sparrow, was observed during Project-specific avian surveys. This species is grassland-dependent. Project design avoids permanent impacts to areas classified as herbaceous and has 0.1 acre of temporary impact to herbaceous areas (*see* Table 8.19-2). As such, impacts to this species are not anticipated.

8.21.1.3 Mitigative Measures

Big Bend will implement the following measures to the extent practicable to avoid potential impacts to federal and state-listed species and rare and sensitive habitat in the Project Area:

- Avoid placement of turbines in MNDNR-mapped native prairie, NPCs, and SOBS.
- Pursuant to Minn. Stat. § 84.02, subd. 5, Big Bend will complete a Native Prairie Protection Plan in coordination with MNDNR and DOC-EERA .
- Big Bend has conducted a native prairie desktop assessment and will field verify these areas prior to construction.
- Avoid or minimize disturbance of individual wetlands or drainage systems during Project construction.
- Setback the turbines from the WMAs in adjacent properties by at least 3x5 RD.
- Prepare and implement a BBCS during construction and operation of the Project.

8.21.2 Native Prairie

8.21.2.1 Description of Resources

In addition to rare and sensitive species, the MNDNR also maps rare and unique plant communities that may include relatively rare habitats (e.g., prairie) or higher quality or good

examples of more common plant communities (e.g., wet meadow). Although most NPCs have no legal protection in Minnesota, these areas may have the potential to contain undocumented populations of rare plant species, which may be protected under Minnesota's state endangered species law (Minn. Stat. § 84.0895). These native prairies and NPCs may also provide essential habitat for rare species of fauna, such as those listed in Table 8.21-2 above.

Native prairies are typically untilled plant communities that are comprised primarily of native grasses and sedges along with a variety of broad-leaved forbs and scattered shrubs (MNDNR, 2011). Approximately 250,000 acres of native prairies ranked good to excellent remain in Minnesota (MNDNR, 2017b). Based on MNDNR's native prairie database, three records of Dry Hill Prairie (Southern) have been documented in the Project Area (Figure 11 – Unique Natural Features). The acreages of the three records are 0.1, 1.6, and 14.7 acres, totaling 16.4 acres of native prairie within the Project Area.

The MNDNR's railroad rights-of-way prairies program includes native prairie remnants that occur along railroad rights-of-way. The railroad rights-of-way program was instituted in 1997 by the Minnesota legislature in the Prairie Parkland and Eastern Broadleaf Forest ECS Provinces (MNDNR, 2020f). There are no railroad prairie rights-of-way in or adjacent to the Project Area.

8.21.2.2 Impacts

Big Bend has sited all turbines in cultivated cropland; the layout avoids permanent and temporary impacts from all Project components (e.g., turbines, access roads, permanent met towers, Wind Project Substation, O&M facility, collection lines, and crane paths) on MNDNR-mapped native prairie.

8.21.2.3 Mitigative Measures

Big Bend will continue to coordinate with MNDNR on native prairie. Big Bend will, in consultation with DOC-EERA and MNDNR, prepare a Native Prairie Protection Plan. The plan will be submitted to the DOC-EERA and MNDNR after issuance of the site permit and prior to construction. The plan shall address steps to be taken to identify native prairie within the Project Area, measures to avoid impacts to native prairie, and measures to minimize and mitigate for impacts if unavoidable. Wind turbines and all associated facilities, including foundations, access roads, underground cable, and transformers, shall not be placed in native prairie unless addressed in the Native Prairie Protection Plan. Measures to be taken to mitigate unavoidable impacts to native prairie will be agreed to by the Applicant and MNDNR.

Big Bend will implement the following measures to the extent practicable to avoid and minimize potential impacts on MNDNR-mapped native prairie in the Project Area during Project development and operation:

- Avoid placement of turbines on MNDNR-mapped prairie.
- Avoid permanent and temporary impacts from other Project components (e.g., turbines, access roads, permanent met towers, Wind Project Substation, O&M facility, collection lines, and crane paths) on MNDNR-mapped prairie.
- Conduct a field assessment for native prairie identified as potentially occurring through the desktop assessment.

8.21.3 Native Plant Communities and Sites of Biodiversity Significance

8.21.3.1 Description of Resources

The MBS assesses and maps the distribution and status of Minnesota's fauna, flora, NPCs, and SOBS.

Native Plant Communities

NPCs are assemblages of native plants that have not been substantially impacted by non-native species or human activities. NPCs are formed and classified by hydrology, soils, landforms, vegetation, and natural disturbance regimes such as floods, wildfires, and droughts. NPCs are named by their dominant or characteristic species and/or natural features (MNDNR, 2020g). NPCs may include native prairie. The MNDNR has classified NPCs within the state using plant species, soils, and other site-specific data from vegetation plots. The current NPC classification covers most of the wetland and terrestrial vegetation in the state and was completed in 2003. It is a six-level hierarchical classification that accounts for vegetation structure and geology, ecological processes, climate and paleohistory, local environmental conditions, canopy dominants, substrate, and environmental conditions (Aaseng et al., 2011).

Three NPC records of Dry Hill Prairie (Southern) have been documented in the Project Area. They are the same parcels of native prairie documented in the MNDNR's native prairie database and are described in Section 8.21.2 (Figure 11 – Unique Natural Features).

Sites of Biological Significance

The MBS is an assessment of Minnesota landscapes for NPCs, rare animals, rare plants, and animal communities through desktop review and follow-up field survey. MBS designates and assigns rankings to SOBS based on landscape context, presence of NPCs, and occurrence of rare species populations. The MBS groups and ranks SOBS for each of Minnesota's system subsections for the purpose of designating and cataloguing the state's most notable examples of NPCs and rare species. A site's biodiversity rank is based on the presence of rare species populations, the size and condition of NPCs within the site, and the landscape context of the site (MNDNR, 2009; MNDNR 2019g). Both native prairie and NPCs may also be designated as SOBS. There are four biodiversity significance ranks: outstanding, high, moderate, and below:

- "Outstanding" sites contain the best occurrences of the rarest species, the most outstanding examples of the rarest NPCs, and/or the largest, most ecologically intact or functional landscapes.
- "High" sites contain very good quality occurrences of the rarest species, high-quality examples of rare NPCs, and/or important functional landscapes.

- "Moderate" sites contain occurrences of rare species, moderately disturbed NPCs, and/or landscapes that have strong potential for recovery of NPCs and characteristic ecological processes.
- "Below" sites lack occurrences of rare species and natural features or do not meet MBS's standards for outstanding, high, or moderate rank. These sites may include areas of conservation value at the local level, such as habitat for native plants and animals, corridors for animal movement, buffers surrounding higher-quality natural areas, areas with high potential for restoration of native habitat, or open space.

Table 8.21-3 presents the number and acreage of MBS's SOBS that occur within the Project Area and their Biodiversity Significance Rank. SOBS are also displayed on Figure 11 – Unique Natural Features.

Table 8.21-3
Sites of Biodiversity Significance within the Project Area

Site of Biodiversity Significance Rank	Number of Sites Within Project Area	Acres
Below	2	46.6
Moderate	2	16.5
High	0	0
Outstanding	0	0
Total	**4**	**63.1**

8.21.3.2 Impacts

Big Bend has sited all turbines in cultivated cropland; the layout avoids permanent and temporary impacts from all Project components to NPCs and SOBS.

8.21.3.3 Mitigative Measures

The Project avoids impacts to NPCs and SOBS; as such, no mitigative measures are included.

9.0 SITE CHARACTERIZATION

9.1 Site Wind Characteristics

Big Bend initiated its wind resource assessment campaign in 2018 and has 10 temporary meteorological towers monitoring weather data in the Project Area. Based on data collected on-site, the mean annual wind speed at 58 m above ground level is 7.39 m/s.

9.1.1 Interannual Variation

Interannual variation is the expected variation in wind speeds from one year to the next. There is a very strong correlation between Big Bend's meteorological tower data and the long-term reference data sets available through the National Aeronautics and Space Administration's (NASA's) Modern-Era Retrospective analysis for Research and Applications (MERRA-2) reanalysis program and the weather monitoring stations available at airports in the vicinity. Based on analysis of reference datasets in the vicinity of the Project, annual wind-speed variation is expected to be 3.25 percent.

9.1.2 Seasonal Variation

Seasonal variation is represented by the shift in wind speeds from one month to the next. Table 9.1-1 shows the estimated average seasonal variation based on long-term correlations with meteorological data collected in the Project Area. The months of September through April are expected to generally have the highest wind speeds, while the months of July and August are expected to have the lowest wind speeds.

Table 9.1-1
Average Wind Speed at Hub Height of Proposed Turbines

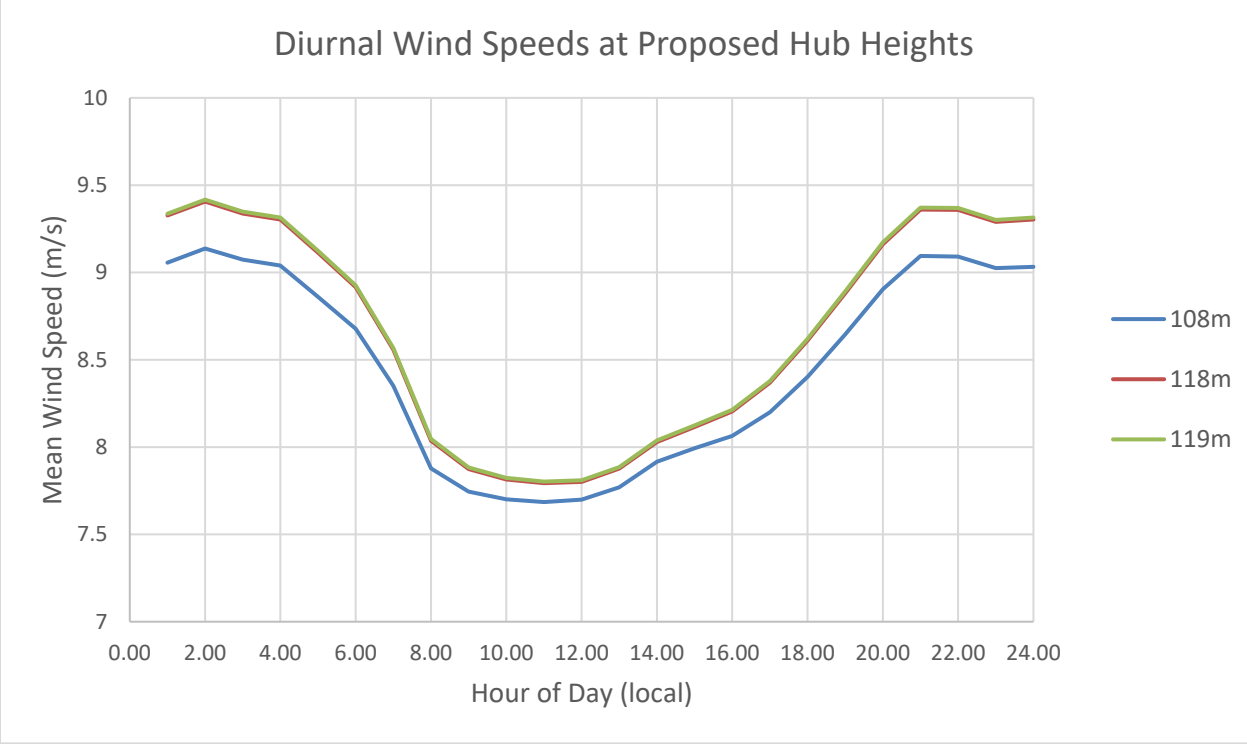
	Wind Speed (m/s)		
Month	**108m**	**118m**	**119m**
January	9.18	9.38	9.39
February	9.35	9.57	9.58
March	8.87	9.08	9.09
April	8.73	8.91	8.92
May	8.51	8.69	8.70
June	7.66	7.82	7.83
July	7.20	7.38	7.39
August	6.91	7.11	7.11
September	8.20	8.43	8.44
October	8.84	9.06	9.07
November	9.32	9.53	9.54
December	8.76	8.97	8.98
Annual Mean	8.46	8.66	8.67

9.1.3 Diurnal Conditions

Diurnal variation occurs through the shift in day and nighttime weather patterns. Chart 9.1-1 shows the expected variation in wind speeds at the Project Area at hub height for each of the

three proposed turbines. On average, the wind speeds are higher in the evening and nighttime hours, and lower in the morning and at midday.

Chart 9.1-1: Diurnal Wind Speeds



9.1.4 Atmospheric Stability

The atmospheric stability is defined by lateral fluctuation of the wind, or sigma theta. A stability level of sigma theta of 0 to 2.5 degrees is characterized as stable, 2.5 to 7 as moderately stable, 7 to 9 as neutral, 9 to 15 as moderately unstable, and greater than 15 degrees as very unstable (Slade, 1968). The atmospheric stability based on the Big Bend meteorological tower sites at the 60-m level is 6.5 degrees, or moderately stable.

9.1.5 Hub Height Turbulence

The Turbulence Intensity (TI) is defined as the measured standard-deviation of wind speed over an hour, divided by the mean for the same time period. For 15 m/s wind speeds, the average TI is 6.4 percent at 108 meters, 6.1 percent at 118 meters, and 6.0 percent at 119 meters. Representative TI accommodates the natural variation in TI associated with the variability of wind speed by being the normal TI plus 1.28 standard deviations of the TI at 15 m/s second.

9.1.6 Extreme Wind Conditions

The maximum hourly wind speed measured at the Big Bend meteorological tower sites for hub heights 108 m, 118 m, and 119 m were 29, 30.5, and 32.5 m/s, respectively. Table 9.1-2 provides the 20- through 100-year maximum means and gusts for the Project Area based on the data collected by meteorological towers in the Project Area. To extrapolate from the three-year data record at the Project Area to the longer periods in the table, a Gumbel distribution was fit to the

observed maximum wind speeds in each year of the Project data record (Harris, 1999). The result is a plot of the wind speed versus the probability of exceedance; the return period is the inverse of the probability of exceedance (i.e., a one percent probability of exceedance translates to a 100-year return period).

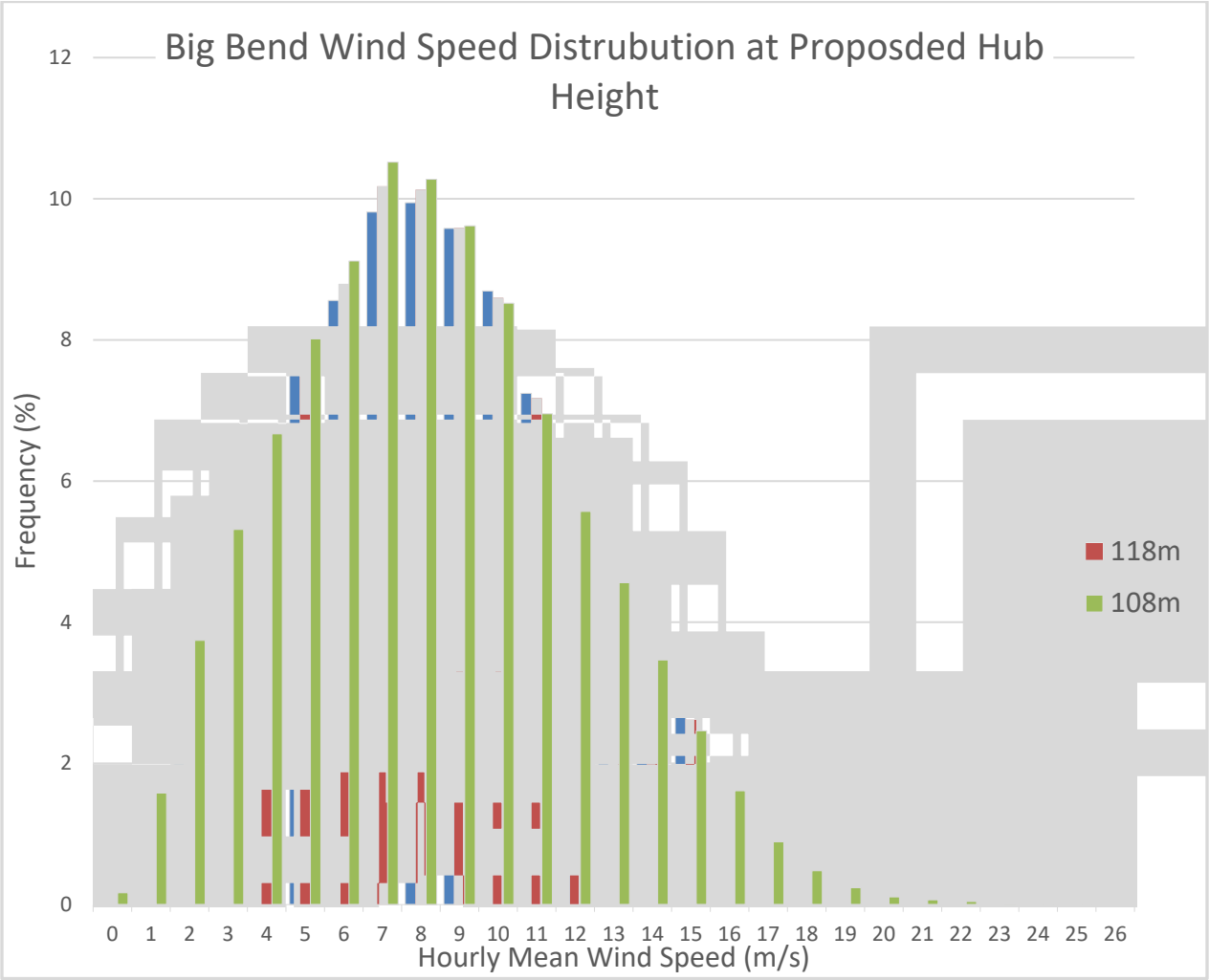
Table 9.1-2
Extreme Wind Events at Proposed Hub Heights (89m, 105m, and 125m)

	Extreme Wind Speed (m/s) at 89m		Extreme Wind Speed (m/s) at 105m		Extreme Wind Speed (m/s) at 125m	
Period (yr.)	10 min means	Gust	10 min means	Gust	10 min means	Gust
20	24.7	55.3	25.3	55.8	25.5	55.9
50	25.5	56.1	26.1	56.6	26.2	56.7
100	26.0	56.8	26.6	57.1	26.8	57.2

9.1.7 Wind Speed Frequency Distribution

Chart 9.1-2 shows the wind speed frequency distribution calculated from hourly 50-m data at the nearest member grid point of the NASA Modern Era Retrospective Analysis for Research and Applications dataset (Rienecker, et al., 2011). A majority of the winds occur between three m/s and 13 m/s. The characteristics of this distribution are consistent with wind regimes observed elsewhere in Minnesota.

Chart 9.1-2: Wind Speed Frequency Distribution



9.1.8 Wind Variation with Height

Wind shear is the relative change in wind speed as a function of height. Wind shear is calculated using a power function based upon the relative distance from the ground. The general equation used for calculating wind shear is S/So = (H/Ho)α , where So and Ho are the speed and height of the lower level and α is the power coefficient. The power coefficient can vary greatly due to terrain roughness and atmospheric stability. The power coefficient will also change slightly with variation in height. The vertical variation with height or shear coefficient, based on the meteorological tower measurements, is approximately 0.21.

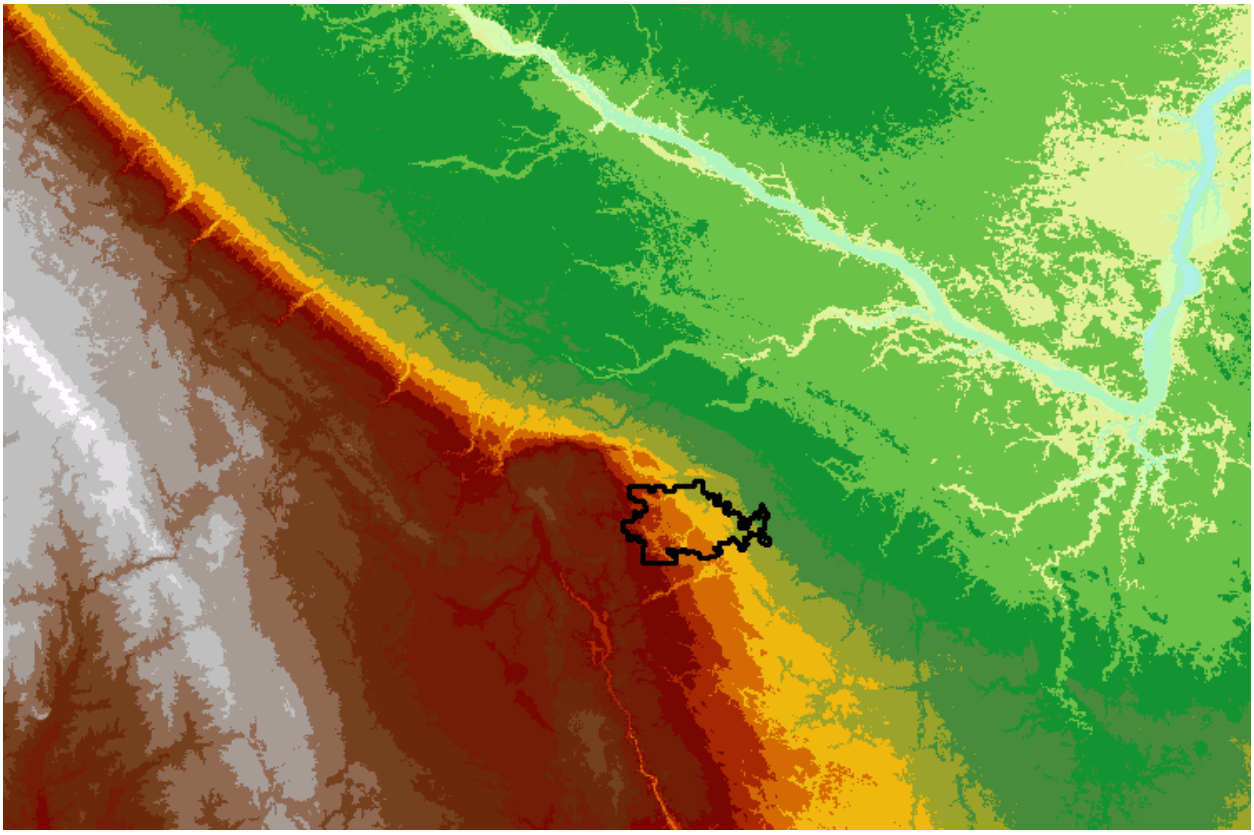
9.1.9 Spatial Wind Variation

Based on Big Bend's onsite meteorological data, the spatial variation in wind speed across the Project Area is between 8 and 9 m/s.

9.1.10 Wind Rose

A wind rose is a graphical representation of wind speeds based on the direction the wind comes from and the frequency it comes from each direction. Wind speed and direction is in part a function of topography and a project's location. Image 9.1-3 below is a color scaled elevation image, highlighting the location of the Big Bend Wind Project. From west to east across the Project, there is a drop in elevation of approximately 250 feet.

Image 9.1-3: Elevation Change at Big Bend Wind Project



As a result of the Big Bend Wind Project location and change in elevation across the Project Area, wind direction is predominately from the northwest. Chart 9.1-4 shows a composite wind rose from the 10 Big Bend meteorological tower locations and corresponding energy production. Energy production estimates combine the direction information with the windspeeds that come from those directions. Therefore, the directions with the higher energy numbers correspond to the higher wind speeds for energy production. Based on Big Bend's wind rose, which reflects over two years of site-specific data, Big Bend's 3 RD by 5 RD wind access buffer is displayed in Image 9.1-5 below.

Chart 9.1-4: Big Bend Wind Rose and Energy Production

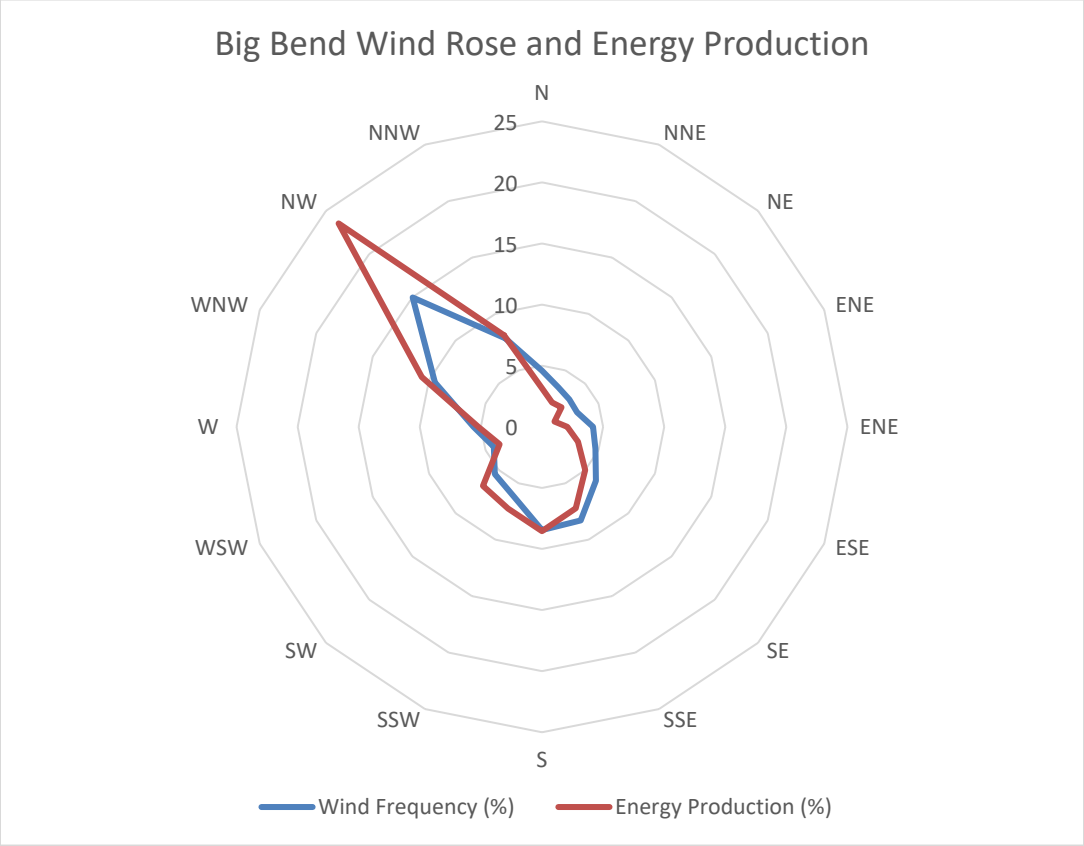
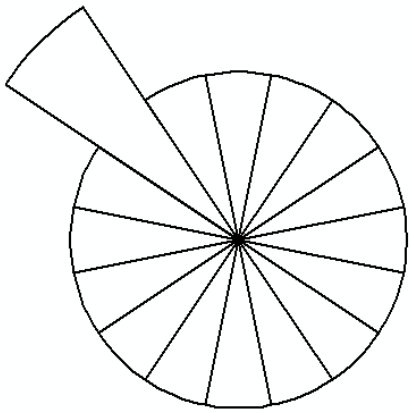


Image 9.1-5: Wind Access Buffer for the Big Bend Wind Project



In Minnesota, it is more common to have bimodal wind directions. However, Project-specific data from over two years of wind speed data collected by 10 meteorological towers placed throughout the Big Bend Project Area demonstrates a dominate singular wind direction based on topography. Therefore, Big Bend incorporated this data into the wind access buffer.

9.1.11 Other Meteorological Conditions

9.1.11.1 Average and Extreme Weather Conditions

Long-term average temperatures and precipitation were evaluated from the National Centers for Environmental Information Climate at a Glance for Cottonwood County. The average minimum temperature in the Project Area ranges from 2.2 degrees Fahrenheit in January to 59.7 degrees in July; the average maximum temperature ranges from 21.2 degrees in January to 83.6 degrees in July. Average precipitation in the Project Area ranges from 0.65 inches in January to 4.21 inches in June.

Extreme weather events for the Project Area include thunderstorms, tornadoes, hail, heavy snow and ice, extreme cold, heat waves, flash floods/floods, heavy rain, lightning, and drought. Tornadoes, thunderstorms, and extreme winds strike occasionally. The state of Minnesota experiences approximately 15 to 20 tornadoes per year (NOAA, National Climatic Data Center, 2019).

National Climatic Data Center records in and near the Project Area include 278 thunderstorms, 56 high wind events, and 69 tornadoes from January 1950 to May 2019. Such storms are usually of short duration and localized, leading to damage in small geographic areas. Wind turbines are built to withstand hail and lightning, but are not designed to survive tornado-force winds of 89+ m/s (200+ miles per hour).

Turbines proposed for this Project are capable of withstanding most of the extreme weather conditions that occur in the area. All turbines being considered have lightning protection systems, turbine blades that “feather” into the prevailing wind direction during high wind events to minimize the risk of damage, and turbines that shut down above the cut-out wind speed (generally 45-55 miles per hour).

During the winter, there is potential for icing events to result in ice accumulation on turbine blades with variable frequency. Although the turbines are not equipped with specific ice-sensing equipment, the turbine will stop turning if significant ice accumulation causes an imbalance. Mechanical safeguards and turbine setbacks mitigate the potential hazards associated with ice throw, and minimize the potential that ice thrown from turbine blades could reach public roads and residences. Additionally, GE Renewable Energy, a manufacture for one of the three proposed turbine models at the Big Bend Wind Project, includes setback recommendation to mitigate ice throw is 1.1x the turbine tip height (GE Renewable Energy, 2018). Big Bend has sited turbines at least 1.1x the tip height from residences, public roads, and trails (see Tables 5.1-1 and 5.1-2). As such, ice throw is not expected to be a hazard for this Project.

9.2 Location of Other Wind Turbines within 10 Miles of Project Boundary

Based on the U.S. Wind Turbine database (USGS, 2020), there are 149 existing wind turbines associated with six wind farms within 10 miles of the Project Area. These include:

- Odell Wind Farm: 100 turbines
- Trimont Area Wind Farm: 19 turbines
- Bingham Lake Wind Farm: 12 turbines
- Odin Wind Farm: 10 turbines
- Jeffers Wind Energy Center: 7 turbines
- Mountain Lake Wind: 1 turbine

Note that some of these wind farms have more turbines than are included in the 10-mile buffer from the Project Area. For example, Trimont Area Wind Farm includes 67 turbines, 10 of which are within 10 miles of the Big Bend Wind Project. Figure 18 shows the location of existing wind turbines and wind energy projects. As displayed on Figure 18, there are several more existing wind turbines up to 20 miles south and southwest of the Project.

10.0 PROJECT CONSTRUCTION

Land will be graded for the turbine pads, access roads, laydown yards, Wind Project Substation, and the O&M facility. Storage areas, a concrete batch plant, shop facilities, and associated access roads will be installed or utilized on site, if necessary, to fully accommodate all aspects of the construction, operation, and maintenance of the Project. These four temporary facilities will be permitted locally by the contractor.

Several activities must be completed prior to the proposed commercial operation date. The majority of the activities relate to equipment ordering lead-time, as well as design and construction of the Project. Below is a preliminary schedule of activities necessary to develop the Project. Preconstruction, on-site construction, and post-construction activities for the Project include:

- Order all necessary components including towers, nacelles, blades, foundations, transformers, etc.
- Finalize turbine micrositing
- Complete survey to finalize locations of structures and roadways
- Complete soil borings, testing, and analysis for proper foundation design and materials
- Complete construction of access roads, to be used for construction and maintenance
- Construct aboveground or underground collection and feeder lines and communication cables
- Design and construct the metering station adjacent to the interconnection substation
- Design and construct the step-up substation
- Install tower foundations
- Place towers, set wind turbines, and install ADLS technology
- Complete Project acceptance testing
- Commence commercial production

Big Bend and its engineering contractor will perform or manage all development activities. Specifically, Big Bend will:

- Perform site resource analysis
- Complete site-specific environmental studies
- Obtain specific permits and licenses for the Project

Under the oversight of Big Bend's staff, the engineering and construction contractors will:

- Perform civil engineering for access roads and turbine foundations
- Construct foundations, towers, and transformers
- Assemble and install turbines
- Install the communication system, including telephone and fiber-optic cable, and SCADA software and hardware
- Construct the Project Wind Project Substation
- Construct the electrical feeder and collection system
- Construct radial interconnection

10.1 Roads and Infrastructure

During the construction phase, several types of light, medium, and heavy-duty construction vehicles will travel to and from the Project Area, as well as private vehicles used by construction personnel. The Applicant estimates that there will be 256 large truck trips per day and up to 510 small-vehicle (pickups and automobiles) trips per day in the area during peak construction periods. That volume will occur when the majority of the foundation and tower assembly is taking place. Prior to construction, the Applicant will coordinate with local jurisdictions (counties and townships) to obtain the necessary road access and overwidth/overweight permits. At the completion of each construction phase, this equipment will be removed from the Project Area or reduced in number.

Improvements to existing access roads may include re-grading and filling of the gravel surface to allow access in inclement weather and widening of select intersections to accommodate truck traffic. No asphalt or other paving is anticipated. Big Bend will coordinate with the county and the townships road authorities to execute a development agreement prior to construction.

10.2 Access Roads

Constructing the Project will require approximately up to 17 miles of gravel access roads, depending on the size of turbine selected and final design. They will be located to facilitate both construction access (cranes) and access by operation and maintenance crews while inspecting and servicing the wind turbines. The access roads will be between towers, with one road required for each string of wind turbines. The roads will be approximately five m (16 feet) wide and of low profile to allow cross-travel by farm equipment.

Big Bend will work closely with landowners to locate access roads to minimize land-use disruptions. Siting of access road connections to public road right-of-way will be completed in accordance with state and local requirements. Siting roads in areas with unstable soil will be avoided whenever possible. All roads will include appropriate drainage and culverts and will allow for farm equipment crossing.

The roads will be approximately five m (16 feet) wide and will be improved with class-5 (gravel) cover, which is adequate to support the size and weight of maintenance vehicles. The specific turbine locations will determine the amount of roadway that will be constructed for this Project. In addition, an up to 15.2-m (50-foot) diameter gravel work area will surround each turbine base.

The roads will consist of graded dirt overlaid with geotechnical fabric or other suitable sub-base (if needed) covered with gravel. To facilitate crane movement and equipment delivery, an additional 1.0 to 3.7 m (3.5 to 12 feet) of gravel roadway may be temporarily installed on either side of the permanent roadway (12.1 m [40 foot] total width).

Long term, access roads will be maintained at a 5-m (16 foot) width. Once construction is completed, the access roads will be regraded, filled, and dressed as needed.

Big Bend will repair or replace any existing fences or gates that are impacted during construction, and will coordinate with participating landowners to provide suitable fencing or gates if access roads cross into existing pastures.

10.3 Associated Facilities

10.3.1 Collector Lines

The collection system lines will be installed in trenches or plowed into place at a depth of at least four feet below grade. During trench excavation the topsoil and subsoil will be removed and stockpiled separately. Once the cables are laid in the trench, the area will be backfilled with subsoil followed by topsoil. Final engineering and procurement will help determine the construction method for the electrical collection system.

10.3.2 Operation and Maintenance (O&M) Facility

An O&M facility will be constructed in the Project Area and will provide access and storage for Project maintenance and operations. Such buildings are typically 3,000 to 5,000 square feet and house the equipment to operate and maintain the Project. The parking lot adjacent to the building is expected to be approximately 3,000 square feet. Big Bend anticipates that a new well will provide water service for the O&M facility, and that an on-site septic system will provide for sanitary needs.

10.3.3 Wind Project Substation

The Wind Project Substation will consist of switch gear, metering, transformers, electrical control and communications systems, and other high-voltage equipment needed to convert the electricity generated by the Project from 34.5 kV to 161 kV. Final specification of the substation will be determined by the agreements the Project has with MISO, as well as the transmission owner and power purchaser. The Wind Project Substation will be approximately five acres including the graded area, which may be larger than the area actually fenced.

10.3.4 Laydown and Staging Areas

One temporary laydown and staging area will be disturbed and used during construction of the Project. It will be the primary location for construction and delivery activities for the Project as well as provide office space for the construction management team. Big Bend proposes one 15.3-acre temporary laydown area to serve both as a parking area for construction personnel and staging area for turbine components during construction (see Figures 3a-3c). The area will be comprised of gravel pads and will have geotextile fabric placed in between the gravel and the soil on the site to increase the ease of site restoration.

10.3.5 Meteorological Towers

Big Bend also proposes to install up to one permanent meteorological tower to maintain the performance of the Project, and three temporary met towers to conform to grid integration requirements and validate wind turbine power curves. Additionally, Big Bend plans to install up to four ADLS radar units, pending FAA review and approval.

10.4 Turbine Site Location

Construction of the turbines will include temporary impacts of approximately an additional 12 to 15 feet (3.6 to 4.6 m) of gravel roadway on either side of the permanent roadway (48 feet [14.6 m] total width), an 80-foot-by-120-foot (24.4-m-by-36.6-m) gravel crane pad extending from the roadway to the turbine foundation which will be graded to a minimum of one percent, and a

component laydown and rotor assembly area centered close to the turbine foundation which will be graded to a minimum of five percent. The component laydown area will range from approximately 260 feet by 260 feet to 335 feet by 335 feet (79 m by 79 m to 102.1 m by 102.1 m), depending on the turbine size selected. In addition to the disturbances associated with temporary travel roads for cranes, it is possible that temporary impacts could occur when cranes move cross-country between strings of turbines.

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

10.4.1 Foundation Design

The wind turbines' freestanding tubular towers will be connected by anchor bolts to a concrete foundation. Turbine foundations will use a pad-and-pier tower mounting system consisting of top and bottom templates. These templates consist of anchor bolts and reinforcing steel bar (rebar); they are placed within the excavated portion of the turbine footing and filled with concrete. The anchor bolts protrude from the concrete pad surface and the turbine base is fastened to these bolts. The excavated portion of the concrete turbine pad ranges from approximately 291 to 737 cubic yards depending on soil requirements and turbine size. The turbine pad dimensions are approximately 20 feet in above-ground diameter and typically range in depth from four to six feet; An approximate height of two to three feet of the turbine pad remains above grade. Geotechnical surveys, turbine tower load specifications, and cost considerations will dictate final design parameters of the foundations.

In addition, turbine assembly will require an 80 by 120 foot gravel crane pad extending from the access road to the turbine foundation, which will be graded to a maximum of one percent, and an approximate 260 by 260 feet to 335 by 335 feet area for component laydown and rotor assembly centered close to the turbine foundation, which will be graded to a maximum of five percent.

10.4.2 Tower

The towers are conical tubular steel with a hub height of 89 m to 125 m (292 to 410 feet). The turbine towers, where the nacelle is mounted, consist of four to six sections manufactured from certified steel plates. Welds are made in automatically controlled power welding machines and are ultrasonically inspected during manufacturing per ANSI specifications. All surfaces are sand-blasted and multi-layer-coated for protection against corrosion. Access to the turbine is through a lockable steel door at the base of the tower. Access to the nacelle is provided by a ladder connecting four internal platforms and equipped with a fall arresting safety system.

10.5 Post Construction Clean-up and Site Restoration

After construction, temporary construction areas, such as crane pads adjacent to the turbine pad and access road additional width areas, will be restored. The temporary disturbance areas will be graded to natural contours and soil will be loosened and seeded in non-cropland areas. Once construction is completed, the permanent access roads will be regraded, filled, and dressed as needed. Although few, if any, temporary roads will be constructed with the Project, all temporary roads, staging areas, batch plant and the laydown area will be decommissioned and restored

upon completion of construction of the Project. Erosion control methods will depend on the contours of the land, as well as requirements of the general contractor and relevant permits. Big Bend anticipates that the post-construction clean-up and site restoration process will last approximately 30 days.

10.6 Operation of Project

Each wind turbine in the Project will communicate directly with the SCADA system for performance monitoring, energy reporting, and troubleshooting. The SCADA system will also provide the overall control of the Project.

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

10.6.1 Project Control, Management, and Service

In addition to providing Project control, the SCADA system offers access to wind turbine generation or production data, availability, and meteorological and communications data, as well as alarm and communication error information. The SCADA system allows for control of individual turbines and any combination of turbines should turbine operations need to be adjusted (i.e., curtailment). Performance data and parameters for each machine (generator speed, wind speed, power output, etc.) can be viewed, and machine status can be changed. There is also a snapshot facility that collects frames of operating data to aid in diagnostics and problem troubleshooting.

The primary functions of the SCADA are to:

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

General Maintenance Duties

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

- Maintenance on the wind turbines and on the mechanical, electrical power, and communications system
- Performance of all routine inspections
- Maintenance of all oil levels and changing oil filters

- Maintenance of the control systems, all structures associated with the Project, access roads, drainage systems, and other facilities necessary for the operation of the Project
- Maintaining all O&M field maintenance manuals, service bulletins, revisions, and documentation for the Project
- Maintaining all parts, price lists, and computer software
- Maintenance and operation of interconnection facilities
- Providing all labor, services, consumables, and parts required to perform scheduled and unscheduled maintenance on the Project, including repair and replacement of parts and removal of failed parts
- Assisting as needed with avian, bat, and other environmental studies and compliance activities
- Management of lubricants, solvents, and other hazardous materials as required by local and/or state regulations
- Maintenance of all appropriate levels of spare parts in order to service equipment
- Obtaining all necessary equipment including the rental of industrial cranes for removal and reinstallation of turbine components
- Hiring, training, and supervising a work force necessary to meet Project general maintenance requirements
- Maintaining site security

Maintenance Schedule

Equipment will be monitored by local O&M staff and remotely by the Applicant's operations and power scheduling desk, which is staffed 24 hours a day. When needed during off hours, local personnel will be dispatched to the site by the remote monitoring staff. Performance testing is done during the early months of operation to see that the Project is operating within expected parameters. Maintenance schedule is subject to change based on many factors such as turbine model and new industry trends or technology.

Project inspection and maintenance is performed on the following intervals:

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

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

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

D. **Two-Year Service Inspection.** The two-year service inspection consists of the annual inspection, plus checking and tightening of electrical terminal connectors.

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

10.7 Costs

10.7.1 Capital and Operational Costs

The total Project-installed capital costs are estimated to be approximately $408 million, including wind turbines, associated electrical and communication systems, and access roads. Ongoing O&M costs and administrative costs are estimated to be approximately $2.7 million per year, including payments to landowners for wind lease and easement rights.

10.7.2 Site and Design Dependent Costs

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

10.8 Schedule

10.8.1 Land Acquisition

Big Bend will be responsible for all land acquisition and will obtain the necessary easements, leases, or purchase agreements from landowners. Big Bend may either lease, secure easements or purchase the necessary parcels for the substation, O&M facilities, and temporary laydown and staging areas. The expected timeline for land acquisition completion is 4th quarter 2020.

10.8.2 Equipment Procurement, Manufacture and Delivery

Big Bend is in the process of procuring turbines for the Project. Turbines will be allocated to the Project after meteorological and economic studies are completed to achieve the best match of turbines for the Project. Turbines could arrive on site as early as 2nd quarter 2022.

10.8.3 Construction

Big Bend personnel will oversee the primary contractors performing onsite Project construction, including, but not limited to, roads, wind turbine assembly, electrical, and communications work. The construction will take approximately 8 months to complete; however, depending upon seasonal or weather-related constraints (i.e., minimal work would occur during winter months) it may take less time.

10.8.4 Construction Financing

The Applicant will be responsible for financing all predevelopment, development, and construction activities. The Applicant anticipates financing the cost of all predevelopment activities through internal funds. Construction will be financed with internal funds or a combination of internal funds and third-party sources of debt and equity capital.

10.8.5 Permanent Financing

Permanent financing will be provided with the Applicant's internal funds or a combination of internal funds and third-party sources of debt and equity capital.

10.8.6 Expected Commercial Operation Date

The Applicant anticipates that the Project would begin commercial operation by the end of the 4th quarter 2022. The commercial operation date is dependent on the completion of the interconnection process, permitting, and other development activities.

10.9 Energy Projections

10.9.1 Proposed Array Spacing for Wind Turbines

Wind turbines will be placed on lands in the Project Area that are leased by Big Bend. The turbines will be installed in relatively high elevation areas to access the best wind resource in the Project Area. The proposed internal array spacing for the Project's turbines is a minimum of 3 RD in a crosswind spacing (non-prevailing direction) and a minimum of 5 RD in a downwind spacing (prevailing direction), with up to 20 percent of the turbines spaced closer to each other. The internal turbine spacing is dependent upon the selected equipment and the site topography. Big Bend developed the Project to maximize the wind resource and minimize array wake losses. Big Bend will file a Wake Loss Study prior to construction.

10.9.2 Base Energy Projections

The Project will have a nameplate generation capacity of up to 308 MW and a currently estimated net capacity factor of between 41 to 44.5 percent. Big Bend estimates an average annual output of between approximately 1129 and 1225 GWh hours. Annual energy production output will depend on final design, site specific features, and the equipment selected for the Project. Gross to net calculations take into account, among other factors, energy losses in the gathering system, mechanical availability, array losses, and system losses. An industry-wide estimate of energy losses ranges from 10 to 12 percent of maximum output.

11.0 DECOMMISSIONING AND RESTORATION

The Project decommissioning and restoration plan is developed in accordance with the requirements of Minn. R. 7854.0500, subp. 13, and incorporates the considerations of Cottonwood County Zoning Ordinance Section 25, and Watonwan County Zoning Ordinance Section 12-M. Big Bend's draft decommissioning plan is provided in Appendix J and will be updated in response to comments received during the permitting process. At the end of commercial operation, Big Bend will be responsible for removing wind facilities and removing the turbine foundations to a depth of four feet below grade. Big Bend reserves the right to extend operations instead of decommissioning at the end of the site permit term. If it chooses to continue operations beyond the end of the site term, Big Bend will apply for an extension of the LWECS Site Permit to continue operation of the Project. In this case, a decision may be made on whether to continue operation with existing equipment or to retrofit the turbines and power system with upgrades based on newer technologies.

11.1 Anticipated Life of the Project

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

11.2 How the Project Will be Disconnected from the Grid

The 161 kV transmission line connects the Project substation to the voltage step-up substation at the point of interconnection south of the Project. All poles, conductors, switches, and lines associated with this interconnection link will be removed and hauled off-site to a recycling facility or disposal site. Underground infrastructure such as pole foundations will be removed down to four feet below grade. Most transmission line poles are direct burial, so there are no foundations remaining after removal. Pole foundation holes will be filled with a suitable clean compactable material. Topsoil will be applied and the areas and re-vegetated to pre-construction conditions. The interconnection substation will continue to be owned by the transmission line owner.

11.3 Description of Component Removal

Decommissioning includes several phases and activities such as:

- Preparation of crane paths to accommodate movement of large industrial cranes to and from each turbine location;
- Preparation of crane pads for removal of turbine components;
- Removal of above-ground components (turbines, transformers, met towers, substation(s), and potentially the O&M facility);
- Removal or abandonment in place of underground collection system and fiber optic cables;
- Removal of access roads (unless the landowners request the roads to remain) and crane paths;
- Reclamation, re-grading, and restoration of disturbed areas including top soil reapplication and decompaction of soils;

- Application of necessary sediment and erosion controls during and following decommissioning; and
- Repair of public roads and culverts to pre-decommissioning conditions.

A detailed description of decommissioning and removal activities is included in Appendix J.

11.4 Decommissioning, Abandonment, and Removal Conditions

The Project or any turbines in the Project will be abandoned and decommissioned if they aren't producing electricity in a twelve-month period. Additionally, under the terms of Big Bend's standard wind lease, Big Bend must remove all Project facilities, to a depth of four feet below grade, within 12 months from the date the lease expires or terminates. If Big Bend were to fail to remove the facilities within that timeframe, the lease allows the lessor to remove and dispose of the facilities. Big Bend is responsible for reimbursing the lessor for the costs of removal, less any salvage value received. Big Bend must also maintain any security for removal of the Project that is required by any applicable permits or governmental rules or regulations, if any.

11.5 Site Restoration Objectives

Big Bend will restore and reclaim the site to its pre-Project topography and topsoil quality using BMPs consistent with those outlined by 2012 USFWS Land-Based Wind Energy Guidelines. Big Bend will also have a Native Prairie Protection Plan that will provide further BMPs to be used in areas where native prairie, as defined by Minn. Stat. § 84.02, subd. 5, based on specific site data collected in the Project Area. In non-cropland areas, the goal of decommissioning will be to restore natural hydrology and plant communities to the greatest extent practical while minimizing new disturbance and removal of native vegetation. The decommissioning BMPs that will be employed on the Project to the extent practicable with the intent of meeting this goal include:

1. Minimize new disturbance and removal of native vegetation to the greatest extent practicable and limit the duration that disturbed soils are exposed.
2. Remove foundations to four feet below surrounding grade, and cover with soil to allow adequate root penetration for native plants, and so that subsurface structures do not substantially disrupt ground-water movements.
3. Segregate topsoil that is removed during decommissioning and use as topsoil during restoration. Once decommissioning activity is complete, restore topsoils to assist in establishing and maintaining pre-construction contours to the extent possible, consistent with landowner objectives.
4. Decompact subsoil and topsoil similar to match surrounding soil conditions after decommissioning activities are complete.
5. Any drain tile lines damaged during decommissioning activities will be repaired to ensure drainage is maintained.
6. Stabilize soils by re-vegetating with a cover crop in cropland areas or a local seed mix in non-cropland areas using seed mixes approved by the local FSA, Soil and Water Conservation District, or NRCS.
7. Restore surface water flows to pre-disturbance conditions, including removal of stream crossings, roads, and pads, consistent with storm water management objectives and requirements.

8. After decommissioning, install erosion control measures in all disturbance areas where potential for erosion exists, consistent with storm water management objectives and requirements.
9. Remove access roads unless the landowner requests the road be left in place.
10. Remediate any petroleum product leaks and chemical releases prior to completion of decommissioning.

Decommissioning and restoration activities will be completed within 8 months after the date the Project ceases to operate.

11.6 Cost to Decommission

Big Bend will be responsible for all costs to decommission the Project and associated facilities. The estimated decommissioning cost in current dollars is expected to be $185,400 per turbine, excluding salvage value. Including resale and salvage values, the estimated decommissioning cost in current dollars is expected to be around $102,400 per turbine after salvage value, including associated facilities. The cost to decommission will depend upon the prevailing equipment and labor costs. Big Bend anticipates that a portion of the decommissioning costs will be offset by the salvage value of the project components; salvage rates are volatile and difficult to predict many years into the future.

Because of the uncertainties surrounding future decommissioning costs and salvage values, Big Bend will review and update the cost estimate of decommissioning and restoration for the Project every five years after Project commissioning. This revised cost estimate of decommissioning and salvage value will be submitted to the Commission for review and comment.

11.7 Method and Schedule for Revising Cost Estimates

This cost estimate was prepared: (1) in current dollars; (2) with the salvage value of equipment or materials calculated separately. The estimate includes: (i) an analysis of the physical activities necessary to implement the approved reclamation plan, with physical construction and demolition costs based on applicable MNDOT unit bid prices and RS Means material and labor cost indices; (ii) the level of effort or number of crews required to perform each of the activities; and (iii) an amount to cover contingencies above the calculated cost. Appendix J contains an estimate shown on a total-cost and on a per-turbine basis. The Project decommissioning cost will be reassessed every five years and updated if necessary.

11.8 Decommissioning Assurance

The Project decommissioning cost will be reassessed every five years and updated if necessary. In year 10 following the Project's commercial operation date, Big Bend will establish a financial surety in the form of escrow, bond, letter of credit, etc. to ensure that decommissioning funds are available at the time of decommissioning. Cottonwood and Watonwan Counties will be the beneficiaries of the financial surety.

12.0 IDENTIFICATION OF OTHER POTENTIAL PERMITS

Big Bend will be responsible for undertaking all required environmental review and will obtain all permits and licenses that are required following issuance of the LWECS Site Permit. The permits or approvals identified in Table 12.0-1 may be required for the construction and operation of the Project. Copies of agency correspondence to date are provided in Appendix E.

Table 12.0-1
Potential Permits and Approvals

Administering Agency	Permit, Approval, or Consultation	Status and Applicability to the Project
Federal		
U.S. Army Corps of Engineers	Wetland Delineation Approvals	Wetland delineations will be completed prior to construction; Big Bend anticipates impacts will be within the either Nationwide Permit or Minnesota Regional General Permit thresholds.
	Jurisdictional Determination	
	Federal Clean Water Act Section 404	
U.S. Fish and Wildlife Service	Review for Threatened and Endangered Species	Based on coordination with USFWS, an incidental take permit is not anticipated for the Project.
Environmental Protection Agency (Region 5) in coordination with the Minnesota Pollution Control Agency (MPCA)	Spill Prevention Control and Countermeasure Plan	Big Bend will develop a Spill Prevention Control and Countermeasure Plan for use during construction and operation of the Project to minimize risk of site contamination.
Federal Aviation Administration	Form 7460-1 Notice of Proposed Construction or Alteration (Determination of No Hazard)	Big Bend submitted FAA Form 7460-1 for the turbine locations in Q4 2020; Big Bend will initiate FAA review of potential ADLS locations in Q2 2021.
	Notice of Actual Construction or Alteration (Form 7460-2)	After construction is complete, Big Bend will submit Form 7460-2 for the turbine locations.
State of Minnesota Approvals		
Board of Water and Soil Resources (BWSR)	Wetland Conservation Act approvals	Big Bend has conducted a desktop review of wetlands and potential impacts with the MNDNR update to NWI data. Based on this desktop data, the Project will fall under the impact threshold for either a Nationwide Permit or Minnesota Regional General Permit. Prior to construction, Big Bend will conduct wetland delineations to confirm wetland boundaries and impacts based on final design.
Minnesota Public Utilities Commission	Certificate of Need	Submitted concurrent with this Site Permit Application.
	Site Permit for Large Wind Energy Conversion System	Submitted November 6, 2020.
	Route Permit for electric transmission line	Submitted concurrent with this Site Permit Application.
Minnesota State Historic Preservation Office (SHPO)	Cultural and Historic Resources Review and Review of State and	Big Bend has coordinated with SHPO, conducted a literature review of the Project Area, and Project Facilities avoid previously identified NRHP listed, eligible, or unevaluated archaeological and historic sites.

Table 12.0-1
Potential Permits and Approvals

Administering Agency	Permit, Approval, or Consultation	Status and Applicability to the Project
	National Register of Historic Sites and Archeological Survey	Big Bend will conduct surveys for previously unidentified cultural resources in fall 2020. Big Bend will coordinate with SHPO and the THPOs on any potential mitigation.
MPCA	Section 401 Water Quality Certification	Concurrent with Section 404, Clean Water Act – Big Bend will meet the Minnesota conditions
	National Pollutant Discharge Elimination System Permit – MPCA General Stormwater Permit for Construction Activity	After the Site Permit is Ordered by the Commission, Big Bend will submit NPDES Permit application. The permit is required to be submitted within 30 days of the start of construction. The NPDES permit will cover the transmission line and wind project.
	Very Small Quantity Generator License – Hazardous Waste Collection Program	To be obtained prior to construction.
	Aboveground Storage Tank Notification Form	To be obtained prior to construction.
Minnesota Department of Natural Resources	License to Cross Public Waters	Big Bend will submit its License to Cross Public Waters, if applicable based on a final Project design.
	General Permit for Water Appropriations (Dewatering)	To be obtained prior to construction, if applicable.
	Public Waters Work Permit	To be obtained prior to construction, if applicable.
Minnesota Department of Health	Well Construction Permit	To be obtained prior to construction of a low-volume well at the O&M facility,
Minnesota Department of Transportation (MNDOT)	Utility Permits on Trunk Highway Right-of-way (Long Form No. 2525)	To be obtained prior to construction.
	Oversize/Overweight Permit for State Highways	To be obtained prior to construction.
	Access Driveway Permits for MNDOT Roads	To be obtained prior to construction.
	Tall Structure Permit	To be obtained prior to construction.
Local Approvals		
Cottonwood and Watonwan Counties	Right-of-way permits, crossing permits, driveway permits for access	Big Bend will enter into a Development, Road Use, and Drainage Agreement prior to construction.

Table 12.0-1
Potential Permits and Approvals

Administering Agency	Permit, Approval, or Consultation	Status and Applicability to the Project
	roads, oversize/overweight permits for County Roads	
Townships	Right-of-way permits, crossing permits, driveway permits for access roads, oversize/overweight permits for township roads	Big Bend will enter into a Development, Road Use, and Drainage Agreement prior to construction.

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