Elk Creek Solar Project
Environmental Assessment

Certificate of Need
&
LEPGP Site Permit

Minnesota Public Utilities Commission
Docket Numbers
IP7009/CN-19-351
IP7009/GS-19-495

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Prepared by
Minnesota Department of Commerce
Energy Environmental Review and Analysis

Preparer
Department of Commerce
Energy Environmental Review
and Analysis
85 7th Place East, Suite 500
Saint Paul, MN 55101-2198

William Cole Storm
Environmental Review Manager
bill.storm@state.mn.us
(651) 539-1844

Applicant
Elk Creek Solar, LLC
7650 Edinborough Way
Suite 725
Edina, MN 55435

Melissa Schmit
Permitting Director
melissa@geronimoenergy.com
(952) 988-9000

Responsible Government Unit
Minnesota Public Utilities Commission
121 7th Place East, Suite 350
Saint Paul, MN 55101-2147

Scott Ek
Energy Facility Permitting
scott.ek@state.mn.us
651-201-2255

Abstract

Elk Creek Solar, LLC (Applicant) is seeking to develop the Elk Creek Solar Project, an up to 80 MW solar PV facility located in eastern Rock County, Minnesota. The Project would interconnect into the Magnolia Substation, which is adjacent to the proposed site. The project's primary components include photovoltaic panels affixed to linear ground-mounted single-axis tracking systems, inverters and transformers housed in electrical cabinets, electrical collection system, project substation, and supervisory control and data acquisition ("SCADA") systems and metering equipment. It also requires fencing, access roads, laydown areas, weather stations, and an operation and maintenance building.

The Project requires a certificate of need (CN) because it meets the definition of a *large energy facility* in Minnesota statute. The Applicant submitted a CN application to the Commission on September 13, 2019.

The Elk Creek Solar Project falls within the definition of a *Large Electric Power Generating Plant* (LEPGP) in the Power Plant Siting Act and, thus, requires a Site Permit from the Commission prior to construction. The Applicant submitted a LEPGP Site Permit application to the Commission on September 13, 2019.

The Commission on December 23, 2019 accepted the applications as complete. The docket numbers for the CN and Site Permit proceedings are IP-7009/CN-19-351 and IP-7009/GS-19-495, respectively.

In Accordance with statute and rule, EERA staff has prepared this Environmental Assessment (EA) for the Elk Creek Solar Project. This EA addresses the environmental review requirements of both the CN and Site Permit provisions.

Persons interested in this project can place their names on the Project Mailing List by contacting the Public Advisor: Charley Bruce at publicadvisor.puc@state.mn.us, 651-201-2251. Documents of interest can be found on the Commission eDockets system at website: mn.gov/puc, select *Search eDockets*, and enter year (*19*) and the docket number (351 *or 495*), and select *Search* and the Department of Commerce Project Website: https://mn.gov/eera/web/project/13739/

Following release of this Environmental Assessment, a public hearing will be held. The hearing will be presided over by an Administrative Law Judge from the Office of Administrative Hearings. Upon completion of the environmental review and hearing process, the record compiled on the CN and Site Permit Application will be presented to the Commission for a final decision. A decision on the CN and Site Permit for the Project is anticipated by November 2020.

ACRONYM LIST

AADT	Annual Average Daily Traffic
AC	alternating current
AIMP	Agricultural Impact Mitigation Plan
Applicant	Elk Creek Solar, LLC
Application	Site Permit Application
AQI	Air Quality Index
Area M	Area M Consulting
ARMER	Allied Radio Matrix for Emergency Response
BCC	Birds of Conservation Concern
BCR	Bird Conservation Region
BGEPA	Bald and Golden Eagle Protection Act
BMPs	best management practices
CAA	Clean Air Act
CO	carbon monoxide
Commission	Minnesota Public Utilities Commission
CON	Certificate of Need
CSAH	County State Aid Highway
CWI	County Well Index
dB	decibels
dBA	A-weighted decibels
DC	direct current
ECS	Ecological Classification System
Elk Creek/Elk Creek Solar	Elk Creek Solar, LLC
EMF	electromagnetic field
EPA	U.S. Environmental Protection Agency
ESA	Endangered Species Act
FAA	Federal Aviation Administration
FEMA	Federal Emergency Management Agency
GAP	Gap Analysis Program
Geronimo	Geronimo Energy, LLC
GPS	Global Positioning System
GIS	Geographic Information System
IPaC	Information for Planning and Conservation
kV	kilovolt

Land Control Area	Approximately 976-acre area of privately-owned land for which Elk Creek Solar, LLC has leases and purchase options to allow siting and construction of the Project
L10	ten percent of any hour
L50	fifty percent of any hour
LGU(s)	local government unit(s)
MBTA	Migratory Bird Treaty Act
MBS	Minnesota Biological Survey
MDH	Minnesota Department of Health
mG	milliGauss
MISO	Midcontinent Independent System Operator
MNDNR	Minnesota Department of Natural Resources
MDA	Minnesota Department of Agriculture
MNDOT	Minnesota Department of Transportation
MPCA	Minnesota Pollution Control Agency
MW	megawatt
NAAQS	National Ambient Air Quality Standards
NHIS	Natural Heritage Information System
NIEHS	National Institute of Environmental Health Sciences
NLEB	northern long-eared bat
NMFP	Nitrogen Fertilizer Management Plan
NO2	nitrogen dioxide
NPCs	native plant communities
NRCS	Natural Resources Conservation Service
NREL	National Renewable Energy Laboratory
NRHP	National Register of Historic Places
NWI	National Wetlands Inventory
NWP	Nationwide Permit
O&M building	operations and maintenance building
O3	ozone
Pb	lead
PEM	palustrine emergent wetland
PM	particulate matter
PPA	Power Purchase Agreement
Preliminary Development Area	Approximate 681-acre area where Elk Creek Solar, LLC proposes to build the Elk Creek Solar Project facilities
Project	Elk Creek Solar Project
PV	photovoltaic

PWI	Public Waters Inventory
SCADA	Supervisory Control and Data Acquisition
SDWA	Safe Drinking Water Act
SHPO	State Historic Preservation Office
SGCN	Species of Greatest Conservation Need
SO2	sulfur dioxide
SOBS	Sites of Biodiversity Significance
SSA	sole source aquifer
SSURGO	Soil Survey Geographic Database
SWAP	State Wildlife Action Plan
SWPPP	Stormwater Pollution Prevention Plan
TEP	Rock County Technical Evaluation Panel
TWh	terawatt hour
USACE	U.S. Army Corps of Engineers
USDA	U.S. Department of Agriculture
USDOT	U.S. Department of Transportation
USFWS	U.S. Fish and Wildlife Service
USG	unhealthy for sensitive groups
USGS	U.S. Geological Survey
VMP	Vegetation Management Plan
WHPA	Wellhead Protection Area
WMA	Wildlife Management Area
WNS	white-nose syndrome

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1 Introduction

This environmental assessment (EA) has been prepared for the Elk Creek Solar Project (Elk Creek Project or Project) proposed by Elk Creek Solar, LLC (Elk Creek or Applicant). This EA evaluates the potential human and environmental impacts of the proposed project and possible mitigation measures. Additionally, it evaluates alternatives to the Project itself.

This EA is not a decision-making document, but rather serves as a guide for decision makers. The EA is intended to facilitate informed decisions by state agencies.

Elk Creek filed two separate applications in support of its proposed 80 megawatt (MW) large electric power generating plant (LEPGP), a solar energy conversion facility to be located in Rock County:

- a certificate of need application for the solar project,[1] and
- a large electric power generating plant solar energy conversion facility site permit application.[2]

1.1 Project

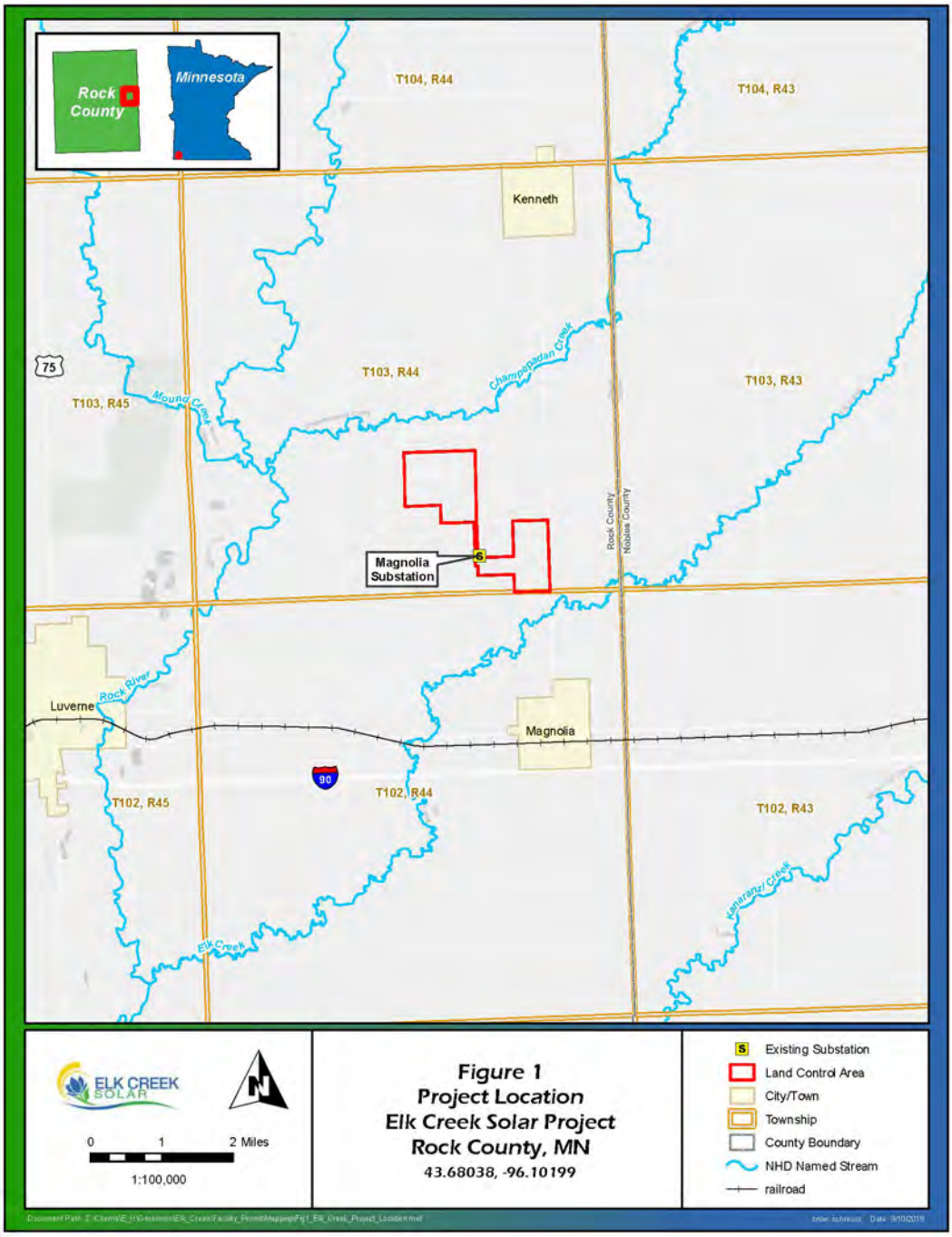
The Applicant is seeking to develop the Elk Creek Solar Project, an up to 80 MW solar PV facility located in eastern Rock County, Minnesota (Diagram 1). The Project would interconnect into the Magnolia Substation, which is adjacent to the proposed site. The project's primary components include photovoltaic panels affixed to linear ground-mounted single-axis tracking systems, inverters and transformers housed in electrical cabinets, electrical collection system, project substation, and supervisory control and data acquisition ("SCADA") systems and metering equipment. It also requires fencing, access roads, laydown areas, weather stations, and an operation and maintenance building.

1.2 State of Minnesota's Role

In order to build the Elk Creek Solar Project, the Applicant must obtain two approvals from the Public Utilities Commission (Commission)—a certificate of need (CN) and a LEPGP site permit; the Project also requires approvals (permits, licenses) from other state agencies and federal agencies with permitting authority for specific natural resources (as in the waters of Minnesota). Commission site permits supersede and preempt all zoning, building, and land-use regulations promulgated by local units of government.[3]

[1] Elk Creek Solar, LLC, *Application for a Certificate of Need*, September 13, 2019. eDocket ID: 20199-15587-01, -02, -03, -04 [hereinafter CNA].
[2] Elk Creek Solar, LLC, *Application for a LEPGP Site Permit*. September 13, 2019. eDocket ID: 20199-155862-01,-02, -03,and 20199-155860-01 to -08. [hereinafter SPA].
[3] Minnesota Statutes 216E.10

Diagram 1. Elk Creek Solar Project - Location



The Applicant applied to the Commission for a CN and a LEPGP site permit on September 13, 2019. With these two applications, the Commission has before it two distinct considerations:

1. Whether the proposed Project is needed, or whether some other project would be more appropriate for the state of Minnesota, for example, a project of a different type or size, or a project that is not needed until further into the future, and

2. If the Project is needed, whether the solar facility as proposed compatible with environmental preservation, sustainable development, and the efficient use of resources?

To help the Commission with its decision-making and to ensure a fair and robust airing of the issues, the state of Minnesota has set out a process for the Commission to follow in making its decisions. This process requires[4]:

- the development of an EA.
- public hearings before an administrative law judge.

The goal of the EA is to describe the potential human and environmental impacts of the Project ("the facts"); the goal of the hearings is to advocate, question, and debate what the Commission should decide about the Project ("what the facts mean"). The entire record developed in this process—the EA and the report from the administrative law judge, including all public input and testimony—is considered by the Commission when it makes its decisions on the Applicant's CN and LEPGP site permit applications.

1.3 Organization of Environmental Assessment

This EA is based on Elk Creek's certificate of need and LEPGP site permit applications, public comments received during the scoping comment period for this EA, and input from the Commission. This EA addresses the matters identified in the scoping decision for this Project (Appendix A) and is organized as follows:

Chapter 1	Introduction	Provides an overview of the Project, the state of Minnesota's role, and the organization of the document.
Chapter 2	Regulatory Framework	Describes the regulatory framework associated with the project, including the state of Minnesota's certificate of need and site and route permitting processes, the environmental review process, and the permits and approvals that would be required for the project.
Chapter 3	Proposed Solar Facility and System Alternatives	Describes the engineering, design, and construction of the proposed Elk Creek Solar Project and

[4] Minnesota Statutes 216B and 216E

		describes selected System Alternatives, as well as the No Build Alternative.
Chapter 4	Elk Creek Solar Project and Alternatives – Human and Environmental Impacts	Discusses the resources in the project area and the potential human and environmental impacts of the Project and alternatives. Identifies measures that could be implemented to avoid or mitigate potential adverse impacts.
Chapter 5	Application of Siting Factors	Discusses the merits of the Project relative to the routing factors of Minnesota Rules, part 7850.4100

1.4 Describing Potential Impacts and Mitigation

This EA analyzes potential impacts of the Elk Creek Solar Project on various resources. The discussion of the duration, size, intensity, and location of the impacts provides context. This context is used to determine an overall resource impact level. Impact levels are described using qualitative descriptors. These descriptors are not intended as value judgments, but rather as a means to both ensure a common understanding among readers and compare resource impacts between alternatives.

- Minimal - Minimal impacts do not considerably alter an existing resource condition or function. Depending upon the resource and the location, minimal impacts may 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 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.
- Negligible – Negligible means the impacts are so small or unimportant as to be not worth considering; insignificant.

This EA also discusses ways to avoid, minimize, or mitigate specific impacts. These actions are collectively referred to as mitigation.

- Avoid - Avoiding an impact means 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 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 resource elsewhere.

1.5 Sources of Information

The primary sources of information for this EA are the applications for the CN and LEPGP site permit submitted by Elk Creek. Additional sources of information are identified in the footnotes throughout this document. New and additional data has been included from the applicant and from state agencies. Information was also gathered by visits to the project area.

A number of spatial data sources, which describe the resources in the project area, were used in preparing this EA. Spatial data from these sources can be imported into geographic information system (GIS) software, where the data can be analyzed and potential impacts of the project quantified, (acres of wetland within the anticipated right-of-way).

2 Regulatory Framework

The Elk Creek Solar Project requires two approvals from the Commission – a CN and a LEPGP site permit. The Project will also require "downstream" approvals from other state and federal agencies with permitting authority for actions related to the Project.

2.1 Certificate of Need

The Project requires a certificate of need because it meets the definition of a *large energy facility* in Minnesota statute,[5] which is any electric power generating plant—including one powered by solar energy—with a capacity of 50 MW or more. The Applicant submitted a CN application to the Commission on September 13, 2019.[6] The Commission accepted the application[7] as complete and referred it to the Office of Administrative Hearings (OAH), for an informal review process, to be conducted jointly with the hearings for the LEPGP site permit application, and authorized the Department of Commerce (Department) to conduct environmental review jointly for the CN and the LEPGP site permit applications.

2.1.1 Certificate of Need Criteria

The Commission must determine whether the proposed project is needed or if another project would be more appropriate for the state of Minnesota. Minnesota Rules, part 7849.0120 provides the criteria that the Commission must use in determining whether to grant a CN:

- The probable result of denial would be an adverse effect on the future adequacy, reliability, or efficiency of energy supply to the Applicant, to the Applicant's customers, or to the people of Minnesota and neighboring states.
- A more reasonable and prudent alternative to the proposed facility has not been demonstrated by a preponderance of the evidence on the record.
- The proposed facility, or a suitable modification of the facility, will provide benefits to society in a manner compatible with protecting the natural and socioeconomic environments, including human health.
- The record does not demonstrate that the design, construction, or operation of the proposed facility, or a suitable modification of the facility, will fail to comply with relevant policies, rules, and regulations of other state and federal agencies and local governments.

If the Commission determines that the Applicant has met these criteria, a CN is granted. The Commission's CN decision determines the type of project, the size of the project, and the

[5] Minnesota Statutes 216B.243.
[6] CNA.
[7] Commission Order on Application Acceptance, December 23, 2019. eDocket No. 201912-158561-02.

appropriateness of the project's timing. The Commission could place conditions on the granting of a CN.

Applications for a certificate of need require preparation of an environmental report (ER).[8] An ER contains "information on the human and environmental impacts of the [project] associated with the size, type, and timing of the project, system configurations (combination of generating, transmission, and distribution facilities), and voltage".[9]

The CN decision does not determine the location of the LEPGP; this determination is made in the LEPGP site permit docket for the project.

2.2 Site Permit

The Elk Creek Solar Project falls within the definition of a *Large Electric Power Generating Plant* in the Power Plant Siting Act and, thus, requires a Site Permit from the Commission prior to construction. The Applicant submitted a request to the Minnesota Department of Commerce for a size determination on May 14, 2019, in accordance with Minnesota Statutes Section 216E.021 (2014). Elk Creek is seeking approval of its LEPGP Site Permit Application under the alternative review process provided for under Minnesota Statute 216E.04 and Minnesota Rules 7850.2800-7850.3900; a notification letter was filed with the Commission on August 1, 2019.

Minnesota law provides the commission with two processes to review a LEPGP site permit application. The full permitting process and the alternative permitting process.[10] The full process includes preparing an environmental impact statement and holding a contested-case hearing. The alternative process, which applies to solar projects, requires an EA instead of the more detailed environmental impact statement and a public hearing instead of the more formal contested-case hearing.

An EA contains an overview of the resources affected by the Project, and discusses potential human and environmental impacts and mitigation measures. It also contains information on alternative site locations to the Project if alternative sites were included in the scope.

2.2.1 Site Permit Decision Criteria

If the commission determines the project is needed, it must determine where it will be located. Minnesota Statutes 216E.03 lists considerations that guide the study, evaluation, and designation of LEPGP site permits. Minnesota Rule 7850.4100 lists the factors the commission must consider when making a site permit decision; they are:

[8] Minnesota Rule 7849.1200.
[9] Minn. R. 7849.1500.
[10] Minnesota Rule 7850.1700, and Minnesota Rule 7850.2900.

- Effects on human settlement, including, but not limited to, displacement, noise, aesthetics, cultural values, recreation, and public services.
- Effects on public health and safety.
- Effects on land-based economies, including, but not limited to, agriculture, forestry, tourism, and mining.
- Effects on archaeological and historic resources.
- Effects on the natural environment, including effects on air and water quality resources and flora and fauna.
- Effects on rare and unique natural resources.
- Application of design options that maximize energy efficiencies, mitigate adverse environmental effects, and could accommodate expansion of transmission or generating capacity.
- Use or paralleling of existing rights-of-way, survey lines, natural division lines, and agricultural field boundaries.
- Use of existing large electric power generating plant sites.
- Use of existing transportation, pipeline, and electrical transmission systems or rights-of-way.
- Electrical system reliability.
- Costs of constructing, operating, and maintaining the facility which are dependent on design and route.
- Adverse human and natural environmental effects which cannot be avoided.
- Irreversible and irretrievable commitments of resources.

The commission is also guided by the "state's goals to conserve resources, minimize environmental impacts, minimize human settlement and other land use conflicts, and ensure the state's electric energy security through efficient, cost-effective power supply and electric transmission infrastructure".

The Commission is charged with making a final decision on a LEPGP site permit within 1 year after finding the LEPGP Site Permit application complete. The Commission may extend this time limit for up to 3 months for just cause or upon agreement of the applicant.

The commission may not issue a LEPGP site permit for a project that requires a certificate of need until a certificate has been approved by the commission, though these approvals may occur consecutively at the same commission meeting.

2.2.2 Joint Proceedings

When there are multiple applications before the Commission for a single project, the environmental review required for each application may be combined. The Commission authorized the Department

to combine the environmental review required for the certificate of need and site permit;[11] therefore, these applications will be processed jointly using Minnesota Rule 7829.1200 and Minnesota Rule 7850.2800 to 7850.3900.

Department staff prepared an EA in lieu of an ER, which means the analysis of issues typically reviewed for a LEPGP site permit in an EA and system alternatives otherwise studied in an ER were combined into a single document.

2.3 Environmental Review

An EA is intended to facilitate informed decision-making by entities with regulatory authority over a project. It also assists citizens in providing guidance to decision-makers regarding the project. An EA describes and analyzes the potential human and environmental impacts of a project and possible mitigation measures, including alternatives to the project. It does not advocate or state a preference for a specific alternative. Instead, it analyzes and compares alternatives so that citizens, agencies, and governments can work from a common set of facts.

Before the Commission makes final decisions regarding Elk Creek's CN and LEPGP site permit applications, it must determine whether the environmental review document(s) is adequate.[12]

2.3.1 Environmental Assessment

Scoping is the first step in the development of the EA for a project. The scoping process has two primary purposes:

1. Gather public input as to the impacts, mitigation measures, and alternatives to study in the EA.
2. Focus the EA on those impacts, mitigation measures, and alternatives that will aid in the Commission's decisions on the certificate of need and LEPGP site permit applications.

Department staff gathered input on the scope of the EA through a public meeting and an associated comment period. Commission and Department staff held a joint public information and EA scoping meeting on January 13, 2020, in the city of Luverne. Approximately 20 people attended the meeting and 3 people provided comments at the meeting.[13]

[11] Commission Order on Application Acceptance, December 23, 2019. eDocket No. 201912-158561-02.
[12] Minnesota Rules 7850.3900, Subpart 2, and Minnesota Rules 7849.1800, Subpart 2.
[13] Comments (oral and written) from January 13, 2020, Public Information and EA Scoping Meeting, eDockets Number 20201-159824-01.

During the scoping meeting these individuals covered a variety of questions and comments; topics ranged from general support to specifics concerning finance (ownership, funding, tax credits), operations (capacity factors, inverter efficiencies, vegetation management), and decommissioning (lifespan, recycling of materials, and handling and disposal of hazardous materials).

A 15-day comment period, closing on January 28, 2020, provided the public an opportunity to submit written comments on potential impacts and mitigation measures for consideration in the scope of the EA. Comments were received from four citizens, the Minnesota Department of Natural Resources (DNR), and from Rock County-Land Management/SWCD.[14]

The Minnesota Pollution Control Agency (MPCA)[15] and the Laborers' International Union of North America (LIUNA)[16] commented previously, during the PUC's comment period on application completeness.

Citizen comments ranged from overall support for solar power and the Elk Creek Solar Project to expressed concerns about the low capacity factor for Minnesota solar, competition between food production and energy production, and the loss of productive farmland.

The Minnesota Department of Natural Resources (MNDNR) recommended that the Applicant consider the establishing of a cover crop several months ahead of construction to stabilize soils prior to construction, thereby minimizing erosion issues. Additionally, that construction should be planned for drier, late summer conditions to reduce the likelihood of storm-water related construction challenges.

The DNR letter also noted the presence of two state-listed species within one mile of the project: the Topeka shiner (state species of special concern) and the plains topminnow (state threatened species), and that measures (siting and BMPs) should be taken to avoid potential impacts.

The DNR letter continues, with a recommendation that the EA discuss options for perimeter fencing and its potential impact on wildlife, and the importance of incorporating and establishing pollinator habitat into the project design.

The MPCA's comment letter addressed the required National Pollutant Discharge Elimination System/State Disposal System (NPDES/SDS) Construction Stormwater Permit (CSW Permit) and available guidance on calculating quantities of stormwater at solar sites. Additionally, given the proposed setbacks, the MPCA does not anticipate any long-term noise impacts from operation of the facility.

[14]Comments (oral and written) from January 13, 2020, Public Information and EA Scoping Meeting, eDockets Number 20201-159824-01.
[15] MPCA comment letter dated October 9, 2019. eDocket No. 201910-156450-01.
[16] LiUNA comment letter dated October 4, 2019. eDocket No. 201910-156361-02.

Rock County Land Management group brought up several points and made a number of requests that lie outside the scope of environmental review (see list below). Many of the associated components within this list (emergency services, descriptions of staging and laydown areas, potential impacts on transportation systems and drainage infrastructure) are covered in the EA Scoping Decision per the factors to be considered.[17] However, overall, the various requests are more appropriately raised at the public hearing and will not be addressed in the EA.

- In the interest of emergency services, E-911 addresses should be considered and required for this project, particularly for structures including the O & M Facility and substations. E-911 addresses should probably be considered at each access road throughout the solar farm, in the interest of directing emergency services.
- Rock County respectfully requests the opportunity to conduct public hearings for the issuance of Conditional Use Permits for staging areas/laydown yards/facilities
- Rock County respectfully requests the opportunity to issue local permits, which would include Land Use Permits for permanent structures, such as the O & M facility and weather stations and SSTS permits for onsite sewer systems at the O & M Facility
- Permits for the approaches for the access roads would need to be obtained from the applicable road authority, whether the Rock County Highway Department or the local Township board of supervisors
- A road use agreement should be considered for this project
- A development agreement should also be considered for this project
- A formal agreement should probably be in place to address issues involving the project and its impact to underground field tile drainage lines

LIUNA stated in its comment letter that they believe the Elk Creek Solar, LLC certificate of need application and site permit application contains the information required under Minn. R.7849.0220, subpart 1, and Minn. R. 7850.3100, and that they support the joint processing of the site permit application and the certificate of need application. LIUNA also stated that they are unaware of any contested issues of fact.

No specific system alternatives (size, type, and timing) or specific alternative sites were proposed for the Elk Creek Solar Project during the scoping period, however, concerns were raised as to the solar capacity factor and the amount of productive farmland displaced by a solar farm as opposed to a large wind energy conversion system (LWECS) project.

The Department issued a scoping decision for the EA on February 6, 2020 (**Appendix A**).[18] The scoping decision identified the issues to be evaluated in this EA. Staff provided notice of the scoping decision to those persons on the service list and project mailing list, and posted the notice to the EERA website.

[17] Minn. R. 7850.4100.
[18] Scoping Decision, February 5, 2020. eDocket No. 20202-160150-01.

2.4 Public Hearing

The alternative permitting process requires a public hearing be held in the project area upon completion of the EA;[19] the hearing will be presided over by an ALJ. Stakeholders will have the opportunity to speak at the hearing, present evidence, ask questions, and submit comments. Commerce staff will respond to your questions and comments about the EA at the public hearing, but staff is not required to revise or supplement the document.[20]

Comments received during the hearing and the associated public comment period become part of the project record. The ALJ will provide a written report (Summary Report) to the commission summarizing the public hearing and comments. The ALJ will also provide the commission with a recommendation whether to issue a certificate of need and a LEPGP site permit.

2.5 Commission Decision

After considering the entire record, including the EA, input received during the public hearings, and the ALJ's Summary Report, the Commission will determine whether to grant a CN for the project as proposed, grant a CN contingent upon modifications to the project, or deny the CN. The Commission may also place conditions on the granting of a CN.

If a CN is granted, the Commission will also determine the conditions appropriate for the Elk Creek's LEPGP site permit and any conditions. LEPGP site permits include conditions specifying construction and operating standards; they also include mitigation plans and project-specific mitigation measures.

Decisions by the Commission on the CN and LEPGP site permit applications are anticipated in late 2021.

2.6 Other Permits and Approvals

A LEPGP site permit for the Elk Creek Solar Project from the Commission is the only state permit required for the siting of the facility. Commission-issued site permits supersede local planning and zoning and bind state agencies;[21] thus, state agencies are required to participate in the Commission's permitting process to aid the Commission's decision-making and to indicate sites that are not permittable.

However, various federal, tribal, state, and local approvals may be required for activities related to the construction and operation of the project. All permits subsequent to the Commission's issuance of a

[19] Minn. R. 7850.3800, subp. 1.
[20] Minn. R. 7850.3800, subp. 4
[21] Minnesota Statutes, sections 216F.07 and 216E.10

LEPGP site permit and necessary for the project (commonly referred to as "downstream permits") must be obtained by a permittee. The information in this EA may be used by downstream permitting agencies in their evaluation of impacts to resources. Table 1 lists permits and approvals that could be required for the Elk Creek Solar Project, depending on the final design.

2.6.1 Federal Approvals

The United States Army Corps of Engineers (USACE) regulates potential impacts to waters of the United States. Dredged or fill material, including material that moves from construction sites into these waters, could impact the water quality. The USACE requires permits for projects that may cause such impacts. The USACE is also charged with coordinating with Native American tribes regarding potential impacts to traditional cultural properties.

The U.S. Fish and Wildlife Service (USFWS) requires permits for the taking of threatened or endangered species. The USFWS encourages consultation with project proposers to ascertain a project's potential to impact these species and to identify general mitigation measures for a project.

The Federal Aviation Administration (FAA) regulates civil aviation, including the airspace used for aviation. The FAA requires permits for tall structures, such as wind turbines, MET towers, and transmission structures, which could adversely impact aviation.

2.6.2 State of Minnesota Approvals

The Minnesota Department of Natural Resources (DNR) regulates potential impacts to Minnesota's public lands and waters. The DNR requires a license to cross public lands and waters; licenses may require mitigation measures. Similar to the USFWS, the DNR encourages consultation with project proposers to ascertain a project's potential to impact state-listed threatened and endangered species and possible mitigation measures.

A general national pollutant discharge elimination system/sanitary disposal system (NPDES/ SDS) construction stormwater permit from the Minnesota Pollution Control Agency (MPCA) is required for stormwater discharges from construction sites. A permit is required if a project disturbs 1 acre or more of land. To ensure that state water quality standards are not compromised, the general NPDES/SDS permit requires:

- Use of best management practices (BMPs),
- A stormwater pollution prevention plan, and
- Adequate stormwater treatment capacity once the project is constructed.

Table 1. Potential Permits and Approvals Required for DCW Project

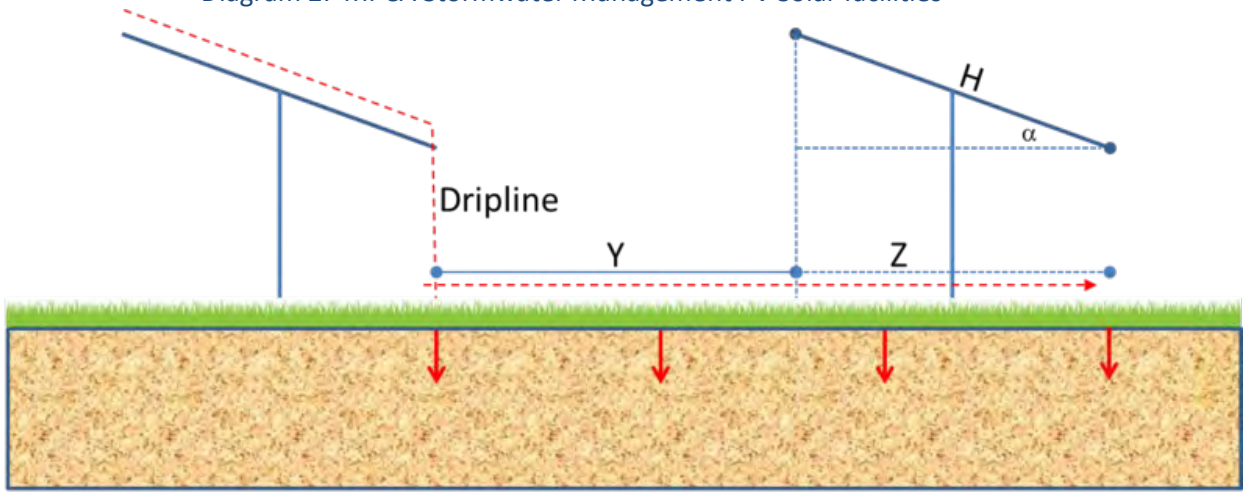
Agency	Permit	Applicability	Permit Status and Timing
Federal			
U.S. Army Corps of Engineers (USACE)	Section 404 Permit for wetland impacts.	Dredging or filling jurisdictional waters of the United States	To be obtained prior to construction, if necessary
U.S. Environmental Protection Agency	Spill Prevention, Control, and Countermeasures Plan	Required if any facility associated with the Project (operations and maintenance [O&M] building or substation) has oil storage of more than 1,320 gallons	To be obtained prior to construction, if necessary
State			
Minnesota Public Utilities Commission	Site Permit	Construction of energy conversion facility	To be obtained prior to construction
	Certificate of Need	Required for generating plants larger than 50 MW	Filed concurrent with the Site Permit
Minnesota Pollution Control Agency	Section 401 Certification	Required for filling in jurisdictional waters of the United States and if a Section 404 permit is required from the USACE	To be obtained prior to construction, if necessary
	National Pollutant Discharge Elimination System General Permit (includes Stormwater Pollution Prevention Plan)	For stormwater discharges from construction activities with disturbances greater than one acre	To be obtained prior to construction
Minnesota Department of Health	Well construction permit	Required for installation of a well	To be obtained prior to construction of low-volume well at O&M building
Minnesota Department of Natural Resources	Water Appropriation Permit	Required if trench dewatering is necessary	To be obtained prior to construction, if necessary
Minnesota Department of Labor and Industry	Request for Electrical Inspection	Required to comply with the state electrical code	To be obtained during construction.

Agency	Permit	Applicability	Permit Status and Timing
State Historic Preservation Office	Review and Coordination	Provide concurrence on Phase I inventory	Completed (SPA Appendix A)
County/Local			
Rock County	Subsurface Sewage Treatment System Permit	Required prior to installation of any septic system in Rock County	To be obtained prior to construction for the O&M building
	Floodplain Development Permit	Required for development within a floodplain	Not applicable. There are no Federal Emergency Management Agency mapped floodplains in the Land Control Area
	Conditional Use Permit	Required for construction within Rock County	To be obtained prior to construction for the O&M facility and laydown areas
	County Entrance Permit	Required for access from county roads	To be obtained prior to construction
	Utility Permit	Required to place facilities within public road right-of-way	To be obtained prior to construction, if necessary
	Local government unit for Minnesota Wetland Conservation Act	Required for wetland impacts	To be obtained prior to construction, if necessary

Estimating stormwater retained for a photovoltaic solar farm project can be challenging because the panels are impervious, but the area beneath the panels is often pervious. Since the standard calculation for the water quality volume (1 inch times the impervious surface) required by the NPDES construction stormwater permit doesn't recognize the vegetated surface left in place under the panels (**Diagram 2**), the calculation may be done using the disconnected impervious credit described in the MPCA's methodology and guidelines.[22] For solar installations, the remaining water quality volume after applying the credit will still need to be treated using more traditional stormwater management practices.

[22] https://stormwater.pca.state.mn.us/index.php?title=File:Solar_panels_1.png.

Diagram 2. MPCA Stormwater Management PV Solar facilities[23]



Water flow path

Y = Pervious length between panels in adjacent rows

Z = Average horizontal distance below panel

H = Length of panel

α = angle of solar panel from horizontal

Rain falls on the solar panel and runs off to the edge of the panel, where it falls vertically at the dripline to the ground below. From there this water can infiltrate or move along the ground surface toward the next panel. The area beneath the panel and between panels consists of pervious soil with well-maintained vegetation. Water falling from a panel can therefore infiltrate from the dripline until it encounters the next dripline, where additional water is supplied from the next panel.

The Minnesota State Historic Preservation Office (SHPO) is charged with preserving and protecting the state's historic resources. SHPO consults with project proposers and state agencies to identify historic resources (through surveys) and to avoid and minimize impacts to these resources.

The Minnesota Department of Agriculture (MDA) ensures the integrity of Minnesota's food supply while protecting the health of its environment and the resources required for food production. MDA assists in the development of *Agricultural Impact Mitigation Plans* (AIMP) to avoid and mitigate impacts to agricultural lands.

The Minnesota Board of Water and Soil Resources (BWSR) oversees implementation of Minnesota's Wetland Conservation Act (WCA). The WCA is implemented by local units of government (LGUs). For projects that cross multiple LGUs, BWSR typically coordinates the review of potential wetland impacts among the affected LGUs. The WCA requires anyone proposing to impact a wetland to:

[23] https://stormwater.pca.state.mn.us/images/5/52/Solar_panels_1.png.

- Try to avoid the impact.
- Try to minimize any unavoidable impacts, and
- Replace any lost wetland functions.

2.6.3 Local Approvals

Commission LEPGP site permits preempt local zoning, building, and land use rules, regulations, or ordinances promulgated by regional, county, local, and special purpose government; however, coordination with local governments may be required for the issues listed below:

- Access/Driveway. Coordination may be required to construct access roads or driveways from county or township roads.
- Public Lands. Coordination would be required to occupy county or township lands such as forest lands, park lands, watershed districts, and other properties owned by these entities.
- Overwidth Load. Coordination may be required to move over-width or heavy loads on county or township roads.
- Road Crossing and Right-of-Way. Coordination may be required to cross or occupy county or township road rights-of-way.

2.6.4 National Electric Safety and Reliability Code

The Project must meet requirements of the National Electrical Safety Code.[24] These standards are designed to safeguard human health "from hazards arising from the installation, operation, or maintenance of conductors and equipment in electric supply stations and overhead and underground electric supply . . . lines."[25] They also ensure that facilities and all associated structures are built from materials that will withstand the operational stresses placed upon them over the expected lifespan of the equipment, provided routine operational maintenance is performed.

The Project must be designed to meet North American Electric Reliability Corporation (NERC) requirements, which define the reliability requirements for planning and operating the electrical transmission grid in North America.[26]

[24] Minn. Stat. 326B.35; Minn. R. 7826.0300, subp. 1 (requiring utilities to comply with the most recent edition of the National Electric Safety Code when constructing new facilities or reinvesting capital in existing facilities); *see also* Appendix C Sample Solar Site Permit, Section 4.5.1 (requiring compliance with NESC standards).
[25] IEEE Standards Association (n.d.) *2017 – National Electrical Safety Code Brochure*, Retrieved from: https://standards.ieee.org/content/dam/ieee-standards/standards/web/documents/other/nesc_2017_brochure.pdf.
[26] North American Electric Reliability Corporation (2017) *Standards*, Retrieved from: http://www.nerc.com/pa/stand/Pages/default.aspx.

3 Proposed Solar Facility and System Alternatives

The Applicant proposes to construct the Elk Creek Solar Project to increase solar generating capacity in Minnesota that can contribute to meeting demands for renewable energy. As described in Chapter 2, the commission must determine if the project is needed or if another project is more appropriate for Minnesota. For example, a project of a different type or size, or a project that is not needed until further into the future.

Chapter 3 describes the proposed Project and system alternatives to the Project. This chapter also discusses the no-build option. Under Minnesota Rule 7849.1500, an ER must provide a general description of the Project, discuss potential human and environmental impacts and possible mitigation measures, and analyze the feasibility and availability of each system alternative studied. It must also describe specific emissions, and water and waste related impacts.

The Applicant requested exemptions from certain certificate of need filing requirements concerning alternatives to the Project that otherwise must be discussed in an ER. The commission authorized these exemptions.[27] As a result, the following system alternatives are not discussed: demand side management; purchased power; facilities using a non-renewable energy source; upgrading existing facilities; and transmission rather than generation.

For the Certificate of Need environmental review requirement of preparing an environmental report[28], the alternatives to be considered in this document are:

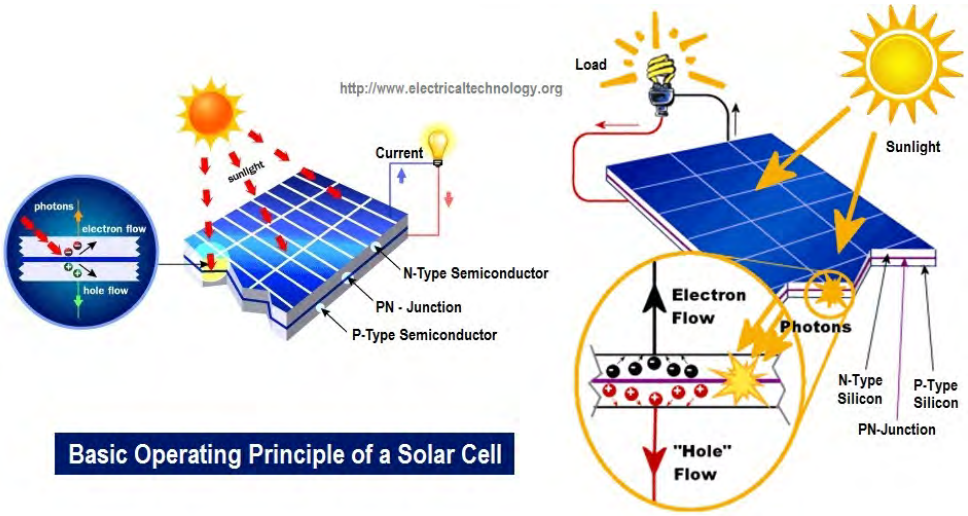
- A generic 80 MW wind generation project sited elsewhere in Minnesota.
- An 80 MW solar farm sited elsewhere in Minnesota. And,
- The "no-build" alternative.

3.1 Elk Creek Solar

PV solar systems convert both direct and indirect solar energy (direct and scattered sunlight) to electrical energy by capitalizing on nature's inherent desire to keep electrical charges in balance (Diagram 3). At the most basic level, electrical current is the flow of electrons through a conductor. When solar radiation strikes a PV cell some of it is absorbed, exciting electrons within the cell. Some of these electrons move freely between layers from negative to positive. In the process, electrons from the positive layer are disrupted and "flow" back to the negative layer through the external load creating a continuous flow of electrons, or, a continuous flow of electric current.

[27] Public Utilities Commission (August 19, 2019) *Order Regarding Exemption from Certain Certificate of Need Application Content Requirements*, eDockets No. 20198-155289-01.
[28] Minnesota Rule 7849.1200.

Diagram 3. Solar Cell [29]



PV Solar farms can be configured as a fixed or tracking system. Permanently mounted in a stationary position, fixed systems are aligned to gather the greatest level of solar radiation over the course of the year. Tracking systems increase efficiencies by orientating the PV panels towards the sun. There are both single axis and dual axis tracking systems. Single axis systems track the sun from east to west throughout the day. Dual axis systems track the sun both east to west throughout the day and north to south throughout the year.

PV cells generate direct current (DC) electricity, which must be converted to alternating current (AC) electricity before reaching the electrical grid. Solar panels are arranged into electrically connected blocks and connected to inverters. An inverter converts DC electricity to AC electricity. Transformers then step up the electrical voltage before the electrical power is collected through a collection system. Collection systems combine the electricity from across the array and deliver it to one location.

3.1.1 Project Description

The Applicant proposes to construct, own, and operate a solar energy conversion LEPGP with a total nameplate capacity of up to 80 MW. Elk Creek has obtained leases and purchase options for 976 acres of land, considered the *Land Control Area*. The solar project facilities will occupy approximately 681 acres of the Land Control Area, the remaining 295 acres that Elk Creek has site control over are not currently planned for occupation by solar facilities (**Figure 1**). The underlying landowner of these 295 acres can continue to farm the area once released from Elk Creek's control.

[29] Source: https://www.electricaltechnology.org/2015/06/how-to-make-a-solar-cell-photovoltaic-cell.html

The Elk Creek Solar Project will interconnect into the existing ITC 161-kV Magnolia Substation via a 161-kV overhead gen-tie transmission line of less than 1,500 feet.[30] There will be a single dead-end structure within the project substation and 2 to 3 additional structures to enter the Magnolia Substation, with an overall length currently estimated to be 300 feet. It is anticipated that these structures will be constructed of wood and less than 150 feet tall. The transmission line does not meet the *High Voltage Transmission Line* (HVTL) definition because it is less than 1,500 feet in length.[31] As such, a HVTL Route Permit from the Commission will not be required for the gen-tie line.

The Elk Creek Solar Project's primary components include PV panels affixed to linear ground-mounted single-axis tracking systems, inverters and transformers housed in electrical cabinets, electrical collection system, project substation, and SCADA systems and metering equipment. It also requires fencing, access roads, laydown areas, weather stations, and an operation and maintenance facility.

PV Array

The most visible component of the Elk Creek Solar Project will be the PV arrays. Anti-reflective coating and backsheet are applied to the front and back of each photovoltaic cell, respectively. Multiple PV cells are combined into modules to generate greater quantities of electricity. Modules are encased in glass, and sealed within an aluminum frame; modules are further combined into panels that are arranged in electrically connected blocks throughout the solar farm. Taken together, the panels are referred to as a solar array (Diagram 4).

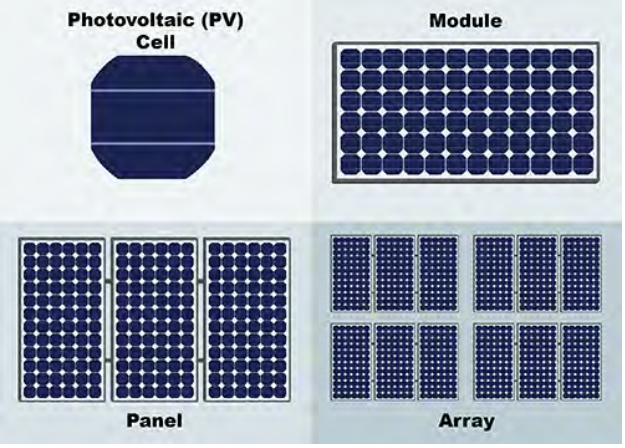
The Project will utilize photovoltaic (PV) panels with tempered glass; the size of the panels will vary from approximately 4 to 6.5 feet long by 2 to 3.5 feet wide, and 1 to 2 inches thick. The panels will be installed on a tracking rack system that utilizes galvanized steel and aluminum for the foundations and frame with a motor that allows the racking to rotate from east to west throughout the day (Diagram 5).

Each tracking rack will contain multiple panels. On the tracking rack system, panels will be approximately 15 feet in height from the ground to the top of the panels when at a 45-degree angle (Diagram 6). Height may vary due to manufacturer, topography and vegetation constraints and could reach a height of approximately 20 feet from the ground. Depending on the technology selected, the PV panels may have an aluminum frame, silicon, and weatherized plastic backing or a side-mount or under-mount aluminum frame, heat strengthened front glass, and laminate material encapsulation for weather protection.

The tracking rack system is mounted on top of steel piers that are typically driven or augured into the ground, without a need for excavation or concrete to install the piers.

[30] SPA, at p. 6.
[31] Minn. Stat. 216E.01 subd. 4.

Diagram 4. Photovoltaic cells, modules, panels and arrays[32]



Solar PV panels are constructed of dark, light-absorbing materials to limit reflected light; approximately two percent of the incoming sunlight, depending on the angle of the sun, is reflected. The solar array will occupy most of the development area of the Project site.

The linear axis tracking rack system allows the PV panels to track the solar resource throughout the day. The panels and tracking rack system are generally aligned in rows north and south with the PV panels facing east toward the rising sun in the morning, parallel to the ground during mid-day, and then west toward the setting sun in the afternoon. The panels are rotated by a small motor connected to the tracking rack system to slowly track with the sun throughout the day. The tracking rack system allows the solar farm to optimize the angle of the panels in relation to the sun throughout the day, thereby maximizing production of electricity (capacity factor).

The tracking rack system is mounted on top of steel piers that are typically driven into the ground, without a need for excavation or concrete to install the piers (Diagram 7).

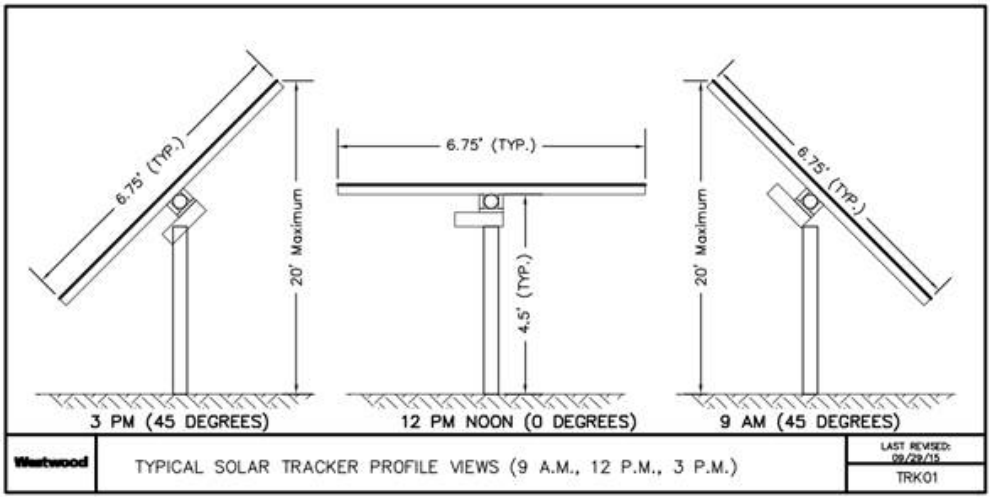
Inverters, Transformers, and SCADA Systems

Inverter skids centralized within PV panel blocks will house inverters, transformers, and *Supervisory Control and Data Acquisition* (SCADA) equipment. These metal skids will be approximately 10 feet wide by 25 feet long and 12 feet in hieght. From a distance, they will appear similar to a small semi-trailer box (Diagram 8); as an example full length semi-trailers are usually 48 to 53 feet long, eight feet wide, and eight feet tall. The skids will be placed on concrete or pier foundations along access roads. The Applicant states that one inverter will be required for every two to three MW of electricity. Therefore, based on this estimate, up to 50 skids might be needed.[33]

[32] Source: http://www.fsec.ucf.edu/en/consumer/solar_electricity/basics/cells_modules_arrays.htm.
[33] SPA, p. 18, 3.1.2.

Diagram 5. Arrays Mounted onto Tracking Rack System[34]

Diagram 6. Tracking Rack System Dimensions[35]



[34] Source: http://www.esolarfirst.com/goodsolarmounting/169.html.
[35] SPA, p. 17, Image 4.

Diagram 7. Standard Steel Pier Foundations[36]

Electrical Collection System

An electrical collection system will collect DC electricity generated by the solar panels and funnel it to the inverter skid where it will be converted to AC electricity. The system then directs the AC electricity to the project substation. This happens within individual panel blocks across the array. The Applicant indicates the electrical collection system may be installed in either a below-ground, an above-ground, or a hybrid (combination of both) collection system.

Above-ground System: DC collection cables will be located underneath each panel row on steel arms attached to the foundation posts (Diagram 9). Hanging brackets would connect panel blocks to a common collection point where the cables would be routed below-ground to an inverter skid. The AC power will be routed below-ground to a distribution-type pole. The electrical cables will be strung on poles to the project substation. These poles would be made of wood, approximately 18 inches in diameter, up to 30 feet tall, and spaced approximately 200 feet apart.[37]

[36] SPA, at p. 18, Image 5.
[37] SPA, at pp. 19-20.

Diagram 8. Typical Inverter and Transformer Station[38]

Below-ground System: For each panel block, DC collection cables will be routed below-ground (approximately four feet deep and one to two feet wide) to an inverter skid. The AC power will then be routed below-ground to the project substation. During all trench excavations the topsoil and subsoil will be removed and stockpiled separately in accordance with the AIMP. Once the cables are laid in the trench, the area will be backfilled with subsoil followed by topsoil.[39]

Hybrid System: Similar to the above-ground system, DC collection cables will be located underneath each panel row on steel arms attached to the foundation posts and supported by a steel cable. Hanging brackets would connect panel blocks to a common collection point where the cables will be routed below-ground to an inverter skid. The AC power will then be routed below-ground to the project substation.

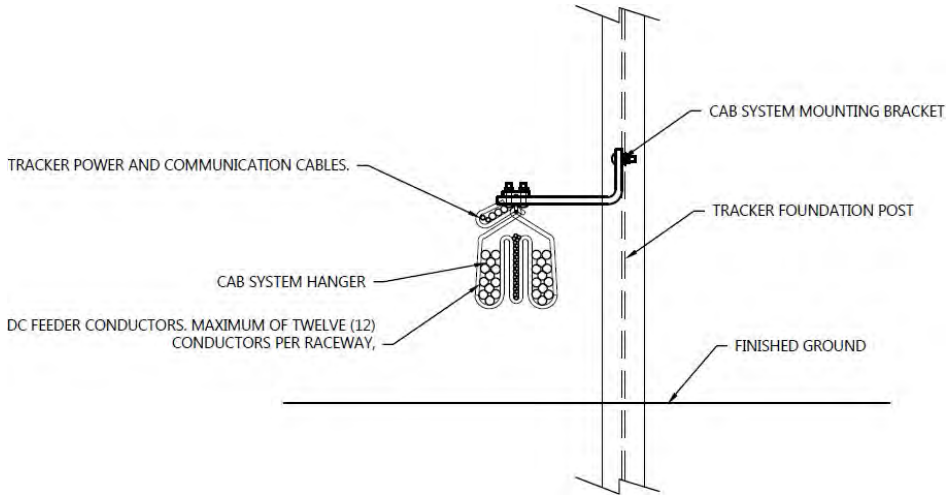
Associated facilities

The following facilities will be permitted as part of the project.

Project Substation: The project generates AC electricity at 34.5 kV, but would connect to the electrical transmission grid at 161 kV. Therefore, a project substation with a 34.5/161 kV step-up transformer needs to be constructed. The project substation will have metering and switching gear. The area within the project substation will be graveled to minimize vegetation growth in the area and reduce fire risk. The project substation will be fenced with a 6-foot chain-link fence, topped with one foot of barbed wire for security and safety purposes. The project substation's area will be approximately 150 feet by 150 feet once construction is complete.

[38] SPA, at p. 18, Image 5.
[39] Ibid, at pp. 18-19.

Diagram 9. Typical Above-Ground Collection Hanging Bracket[40]



Access Roads: Approximately 12.8 miles of 16-foot wide (wider along curves at internal road intersections, approximately 45 feet) graveled access roads will be constructed, and will lead to the inverters and project substation to provide access for maintenance activities. Access roads will also be constructed around the project perimeter to reduce the chance of fire reaching the solar array.

Upgrades to public roads may be required, which could include general improvements, additional aggregate, and driveway changes. The Applicant would be responsible to pay for these upgrades and to coordinate with the LUGs.

Construction crews will use the space between panel rows to access the project once foundations posts are driven. These temporary access corridors will not be improved or augmented with additional materials, but will be easily identified as a function of the construction process as foundation posts would be installed first.

Security: The entire project area will be fenced to prevent the public from gaining access to the electrical equipment, which could cause injury. The solar array will be enclosed by an agricultural style woven fence. The fence will be six feet tall and topped with three to four strands of smooth wire angled at 45 degrees. In total, the fence will be about 7 feet tall. The project substation will be enclosed in a chain-link fence topped with barbed wire (to comply with the National Electric Code). The project will also have security cameras and down lit lighting at select locations.

Weather Stations: Up to two weather stations might be constructed. These stations will be mounted on 20-foot wood poles, and be located within the developed area of the project (Diagram 10).

[40] SPA, at p. 20, Image 7.

Diagram 10. Weather Station[41]

Operation and Maintenance Building: An operation and maintenance building will be constructed near the project substation, along 190th Avenue. It will be approximately 60 feet long by 40 feet wide and constructed of metal. It will look similar to a pole barn. The operation and maintenance building will house a SCADA cabinet, spare panels and parts, hydraulic oil and fuel, and safety equipment. A 500 square-foot parking lot will also be constructed, adjacent to the O&M building.

Temporary Facilities: Five temporary laydown areas totaling approximately 17.6 acres will be used for parking and staging equipment and materials during construction. Laydown areas will be used to receive and store construction materials and might house temporary onsite construction trailers. After construction, the laydown areas will be restored and reseeded.

Transmission System: The Project will interconnect into the existing Magnolia Substation via a 161-kV overhead gen-tie transmission line of less than 1,500 feet. There will be a single dead-end structure within the project substation and likely 2 to 3 additional structures to enter the Magnolia Substation. The structures will be wood and less than 150 feet tall.

[41] SPA, at p. 24, Image 9.

Stormwater Drainage Basins: Preliminarily designs contain 13 stormwater drainage basins located throughout the Development Area and range in size from 0.7 to 1.8-acre (see Appendix B, SPA). These basins are located in existing low areas that also contain hydric soils; these areas will be vegetated with a wet seed mix to help stabilize soils after rain events.

3.1.2 Project Purpose

In 2013, the Minnesota Legislature established the Solar Energy Standard (SES) requiring electric utilities to obtain at least one and one-half percent of their total Minnesota retail sales from solar energy by the end of 2020, with a goal of obtaining 10 percent of these sales from solar energy by 2030.[42] Three utilities are subject to the SES—Minnesota Power, Ottertail Power Company, and Xcel Energy—and are required to submit annual reports detailing compliance efforts. These efforts are summarized in *Minnesota Renewable Energy Standard: Utility Compliance* prepared by the Division of Energy Resources within Commerce.

It is estimated that Otter Tail Power Company requires 30 MW of solar capacity to meet the 2020 SES requirement. The company continues to evaluate solar project. Minnesota Power requires 30 MW of solar capacity to meet the 2020 SES requirement. The company plans to purchase energy from a 10 MW solar project scheduled to come online in 2020. Xcel Energy requires 226 MW of solar capacity to meet the 2020 SES requirement. The company has 273 MW of community solar gardens in the design and construction process. Xcel Energy included a target of 750 MW of additional solar generation by 2030 in its 2016 – 2030 resource plan approved by the commission.[43]

The Applicant is an independent power producer (IPP) that proposes to construct and operate the Elk Creek Solar Project at a site within Vienna Township, Rock County, Minnesota. Production is intended to help meet the growing demand for additional renewable resources required to meet energy sector needs, consumer demand, and renewable and other clean energy requirements in Minnesota and neighboring states.[44] Elk Creek has entered into a power purchase agreement with Northern States Power Company (Xcel Energy), whereby Xcel Energy agreed to purchase up to 80 MW generated by the Project.[45]

3.1.3 Project Location

The proposed Elk Creek Solar Project is located in Sections 27, 34, and 35, Township 103 North, Range 44 West, Rock County, Minnesota (**Diagram 1, Figure 1**). The Applicant developed several selection

[42] Excluding retail sales to customers that are iron mining extraction and processing facilities, or paper mills and wood products manufacturers from the retail sales calculation. The statute further requires that at least 10 percent of the 1.5 percent SES goal be met by solar energy from facilities with a nameplate capacity of 20 kW or less.
[43] DOC - Renewable energy update 2018.
[44] SPA, at p. 2.
[45] CNA, at p. 8.

criteria for siting a solar facility in Minnesota.[46] These criteria included:

- solar irradiance,
- proximity to existing electrical infrastructure,
- proximity to existing transportation infrastructure,
- availability of willing landowners (sell or lease),
- environmental constraints, and
- regulatory constraints (factors considered, prohibited sites, downstream permitting)

Solar Irradiance

The greater the solar irradiance, which is a measure of both direct and scattered solar radiation, the greater potential exists for solar generation. Minnesota has a similar solar resource as other Great Lakes states, such as Wisconsin, Michigan, Pennsylvania, and New York (Diagram 11). Nationally, Minnesota's solar resource would rank somewhere in the bottom half, making solar energy less efficient and more expensive than more southern states.

The greatest concentration of solar irradiance in Minnesota is concentrated in the southwest. Rock and Nobles Counties are centrally located in this area and also have the benefit of being largely agricultural (large tracts of land and low population densities); all characteristics that foster the growth of solar energy generation.

The Applicant explored Rock and Nobles Counties for a solar project based on the high solar resource in this portion of the state and prior project experience in the area.[47]

Electrical Infrastructure

While these counties rank high in solar irradiance and have an abundance of large tracts of land, they are also located far from load centers, requiring transmission lines to transport electricity to the more populated areas. The Applicant identified the Magnolia Substation (Rock County) as a potential interconnect location because of its available capacity to interconnect the Project to the transmission system; from there the search focused on a radius of five miles surrounding the Magnolia substation.[48] This distance was selected to account for transmission interconnect efficiency; siting the Project close to an existing substation allows Elk Creek to make efficient use of existing equipment, minimize line loss and avoid the need for large transmission line construction.

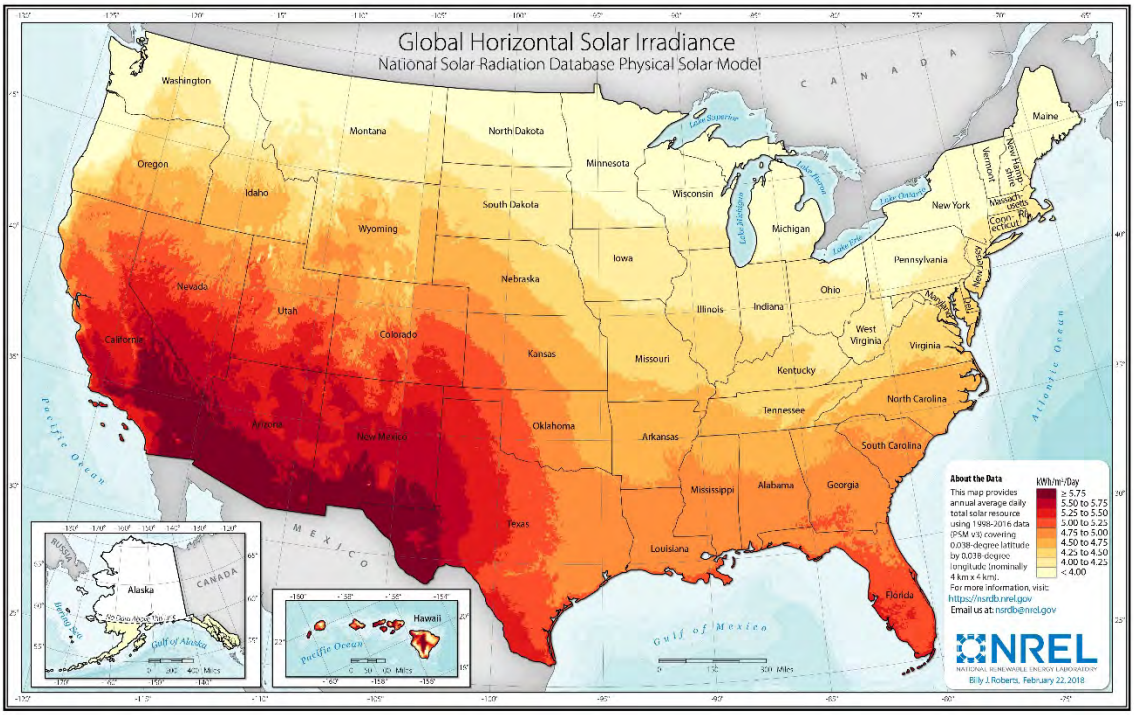
Transportation Infrastructure

A major roadway, Interstate 90, is located approximately 2.5 miles south of the proposed Project site, while CSAH 3, a paved roadway, forms the eastern boundary of the Project. Access to transportation

[46] SPA, at p. 8.
[47] SPA, at pp. 6-10.
[48] SPA, at pp. 6-10.

infrastructure is important to support the delivery of personnel, large equipment, and project components.

Diagram 11. Global Horizontal Solar Irradiance: United States[49]



Willing Landowners

The Applicant met with landowners within five miles surrounding the Magnolia Substation to gauge whether there was enough interest from relatively contiguous landowners in voluntary participating in the Elk Creek Solar Project. Within Rock and Nobles Counties and the five mile radius from the Magnolia substation, the Applicant screened sites/parcels with willing landowners for environmental constraints that may prohibit or make solar development more challenging (**Figure 2**).[50]

Environmental and Regulatory Constraints

Within Rock and Nobles Counties and five miles from the Magnolia substation, the Applicant screened potential parcels to avoid regulatory prohibited sites or sites that had environmental constraints that would be incompatible with the development of a solar project. These include parcels:

- owned or managed by a state or federal agency (i.e., state park, WMA, or Waterfowl Production Area);

[49] https://www.researchgate.net/figure/Concentrating-solar-resource-of-the-USA-Source-National-Renewable-Energy-Laboratory_fig2_305517001.
[50] SPA, at pp. 6-10.

- within a municipality;
- within 2 miles of an airport;
- with U.S. Fish and Wildlife Service (USFWS) designated critical habitat for Topeka shiner;
- with Minnesota Department of Natural Resources (MNDNR) Sites of Biodiversity Significance (SOBS);
- with MNDNR mapped native plant communities (NPC) and native prairie;
- with MNDNR Public Waters Inventory watercourses; and
- with MNDNR rare species records.

Elk Creek ultimately signed leases and/or purchase options with landowners that owned relatively flat, unobstructed, generally contiguous parcels of land, with limited environmental constraints directly adjacent to the Magnolia substation.[51]

3.1.4 Project Layout

The Project's ultimate layout depends on several factors, including which collection system (below-ground, above-ground or hybrid) is selected in the final design. The footprint of the arrays is the same between the below-ground and the hybrid systems; the different layout for the above-ground system is due to the presence of the poles and their potential to cast shadows on the panels (**Figure 3 and Figure 4**).

Elk Creek reviewed and designed the Project to accommodate county setbacks (**Table 2**).

Table 2. Rock County Solar Setback Requirements[52]

Feature	Setback Requirement (feet) to solar array	Project Design (at closest)
Neighboring Property Lines (property lines within project boundary are exempt)	25'	61'
Non-participating residences	200'	220'
Road Right-of-Way	25'	71'
Public Conservation Lands	200'	The closest public conservation land is 3 miles west of the Project.

[51] Ibid.
[52] SPA, at p. 25, Table 3.2-1.

Sets of panels will be electrically connected in series and terminated at an inverter. The inverters will convert the DC power (1,500 volts) from the panels to AC power (650-950 volts). Next, a transformer will step up the AC voltage of generated electricity to 34.5 kV. From the transformers, electrical cable will be buried below-ground, or pole mounted above-ground for routing to the Project substation where the electricity will be stepped up to 161 kV to interconnect to the existing transmission infrastructure.

Acreage required for the Project's various components is described in **Table 3**.

3.1.5 Project Cost and Schedule

The installed capital costs for the proposed Elk Creek Solar Farm are estimated to be approximately $118 million, including development, design and construction of the facilities (**Table 4**). The expected service life of the Project is 25 to 40 years, and Elk Creek estimates that the Project will result in up to four full-time permanent positions to operate and maintain the facilities.[53]

Table 3. Estimated Project Facility Acreages within Preliminary Development Area[54]

Project Facilities	Acres	
	Below-Ground Configuration	Above-Ground Configuration
Access Roads	23.2	23.2
Inverters	0.4	0.4
Project Substation and O&M Building	2.5	2.5
Laydown Areas	17.6 1	20.4 1
Solar Panels	628.2 2	625.4 2
Collection line between North and South Units	7.0	7.0
Unused area	2.3 3	2.3 3
Project Total	**681.2**	**681.2**

1 The laydown areas are temporary impacts to be used only during construction.
2 The impacts associated with solar panels include 13-foot-wide grass area between every row of panels
3 This 2.3-acre area is within the Preliminary Development Area but not currently planned to host facilities

The major milestones for the Project are listed below:[55]

- **Land acquisition**: Complete. Elk Creek has a combination of lease agreements and purchase options for the Project site. After issuance of the Site Permit and prior to construction of the Project, Elk Creek will purchase a portion of the Project site from the underlying landowners

[53] SPA, at p. 31.
[54] SPA, at p. 26, Table 3.3-1.
[55] SPA, at p. 3-4.

with purchase options and the leases will enter into the construction and operations terms. Land that is under lease and which will not be utilized by the Project will revert back to the underlying landowner for continued agricultural use.

- **Site Permit:** Elk Creek anticipates the Site Permit will be issued in the summer of 2020.
- **Other Permits:** Elk Creek will acquire all other permits necessary for construction of the Project prior to conducting the work for which the permit is required.
- **Equipment Acquisition:** Elk Creek is in the process of evaluating and procuring solar equipment for the Project facilities.
- **Construction:** Elk Creek anticipates that construction will begin early fall of 2020 and will be completed by the end of 2021.
- **Commercial Testing:** Testing for the Project is expected to begin as early as the third quarter 2021, following the completion of construction.
- **Commercial Operations:** Commercial operation for the Project is scheduled to begin by the end of 2021, following the completion of construction and testing.

Table 4. Estimated Project Costs[56]

Project Components	Cost
Engineering, Procurement, Construction Contractor	$96.4 million
Development Expense	$6.4 million
Interconnection	$10.4 million
Financing	$4.8 million
Project Total	**$118 million**

3.1.6 Project Construction

Construction cannot not begin until the Applicant obtains the necessary approvals. All activities must comply with the LEPGP Site Permit conditions and requirements of any "downstream" permits.

The Applicant anticipates an average of 80 workers (laborers, supervisory personnel, support personnel, and construction management personnel) at the project site during construction. During peak construction periods up to 130 workers might be employed at the site. The applicant plans for construction activities to occur between 7 a.m. and 5 p.m., Monday through Saturday. In some cases, construction activities may occur outside of these times. In situations where activities such as testing or commissioning need to be performed outside of daylight, temporary lighting for these activities will be provided.

[56] SPA, at p. 13, Table 2.5-1.

Construction equipment such as scrapers, dozers, dump trucks, watering trucks, motor graders, vibratory compactors and pile drivers, pickup trucks, skid steer loaders, medium duty cranes, all-terrain forklifts, concrete truck and boom truck, high reach bucket truck, auger or drill rigs, and backhoes will be used during construction.

A project-specific safety plan will be developed and implemented. The plan will outline safety rules and procedures required on-site. All personnel will be required to complete a safety orientation and training. Weekly safety meetings will occur. At the start of work each day, crews will perform a field level hazard assessment to review hazards associated with work to be completed that day.

The preliminary list of activities necessary to develop the Project include:

- Pre-construction
  - Geotechnical analysis;
  - Design substation and electrical collection system;
  - Design solar array, access roads, and O&M building;
  - Underground utility discovery; and
  - Procure all necessary facility components (solar panels, tracking system, and transformers).
- Construction
  - Site preparation, grubbing, and grading;
  - Construct laydown areas and set up temporary job site trailers;
  - Construct fencing;
  - Civil construction of access roads;
  - Install PV mounting posts;
  - Install below-ground or above-ground collection system;
  - Install electrical enclosure/inverter;
  - Tracker installation;
  - PV panel installation; and
  - Construct gen-tie line.
- Post-construction
  - Restore disturbed areas not intended for permanent above-ground facilities. Permanent above-ground facilities include the substation, O&M building, inverter skids and electrical cabinets, and access roads;
  - Test facility; and
  - Commence commercial operation.

3.1.7 Project Decommissioning

If granted a LEPGP site permit from the Commission, the Applicant would be required to submit a formal *Decommissioning Plan* with updates every five years.[57] Information in this section is adapted from the Elk Creek application for a site permit.[58]

The anticipated service life of the project is 25 to 40 years.[59] At the end of the Project's useful life, Elk Creek will either take the necessary steps to continue operation of the Project (re-permitting and retrofitting) or will decommission the Project.

At the time of decommissioning Elk Creek or the Project owners will be responsible for removing the solar facilities and restoring the site to prior conditions.

The overhead electrical lines associated with the Project substation and electrical collection system (poles, conductors, switches, and lines) 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. Pole foundation holes will be filled with a suitable clean compactable material. Topsoil will be applied and the areas re-vegetated to pre-construction conditions.

Pad mounted inverters and transformers will be disconnected and removed from the site. The concrete pads will be crushed and hauled offsite.

Unless a landowner requests Elk Creek or the Project owners otherwise, access roads, will be removed and the land will be restored to pre-construction conditions.

Underground collection lines buried above four feet below the surface will be removed. Underground collection buried greater than four feet below the surface will be abandoned in place unless requested by the landowner. In certain cases, landowners may wish to abandon underground collector lines in place when located above four feet below the surface to minimize impacts to the environment. Site permits issued by the Commission require that any agreement between landowners and Elk Creek to leave underground cables in place at a lesser depth or no removal must be recorded with the county and show the location of all remaining infrastructure. If the cables are to be removed, a trench will be opened the cables pulled out, cut into manageable lengths and removed from the site.

All unsalvageable materials will be disposed of at authorized sites in accordance with applicable regulations.

After dismantling the Project, Elk Creek (or the Project owners) would remove components having salvage value. Generally, functioning panels, transformers, electrical components, steel pier

[57] PUC staff Briefing Papers Application Acceptance, October 30, 2019. eDocket No. 201910-157014-02.
[58] SPA, at pp. 34-36.
[59] Ibid, p. 31.

foundations, and transmission poles are refurbished and resold or are recycled for scrap. Unless expressly requested by the landowner, non-salvageable material will be broken down for transport, removed from the site, and disposed at an authorized site in accordance with applicable regulations.

Elk Creek estimates the decommissioning costs for the solar farm to be approximately $4.6 million out of a net total cost of approximately $13.7 million (salvage value for the wind farm is estimated at $9.1 million).

3.2 System Alternatives

The Commission must consider system alternatives to the proposed Project as they weigh the CN decision.[60] In addition to evaluating alternatives and their impacts, a no build option must also be evaluated. This section provides a discussion of system alternatives, as well as the no-build alternative, to the Elk Creek Solar Farm.

The system alternatives considered would generate energy equivalent to that of the proposed solar farm and provide renewable, low, or zero carbon emission energy. Typically, alternatives to a project before the Commission would include generation facilities of all types, including plants that use coal, natural gas, fuel oil, or similar non-renewable fuels, as well as transmission facilities (to import energy) in lieu of generation. However, because the proposed solar farm would be producing renewable energy for use in Minnesota and the surrounding area, system alternatives considered here were selected as they are technologies eligible to be counted toward renewable energy objectives.[61] The no-build alternative is also provided.

System alternatives evaluated include:

- A generic 80 MW wind generation project sited elsewhere in Minnesota.
- A generic 80 MW solar farm sited elsewhere in Minnesota. And
- The “no-build” alternative.

3.2.1 Generic 80 MW Wind Farm

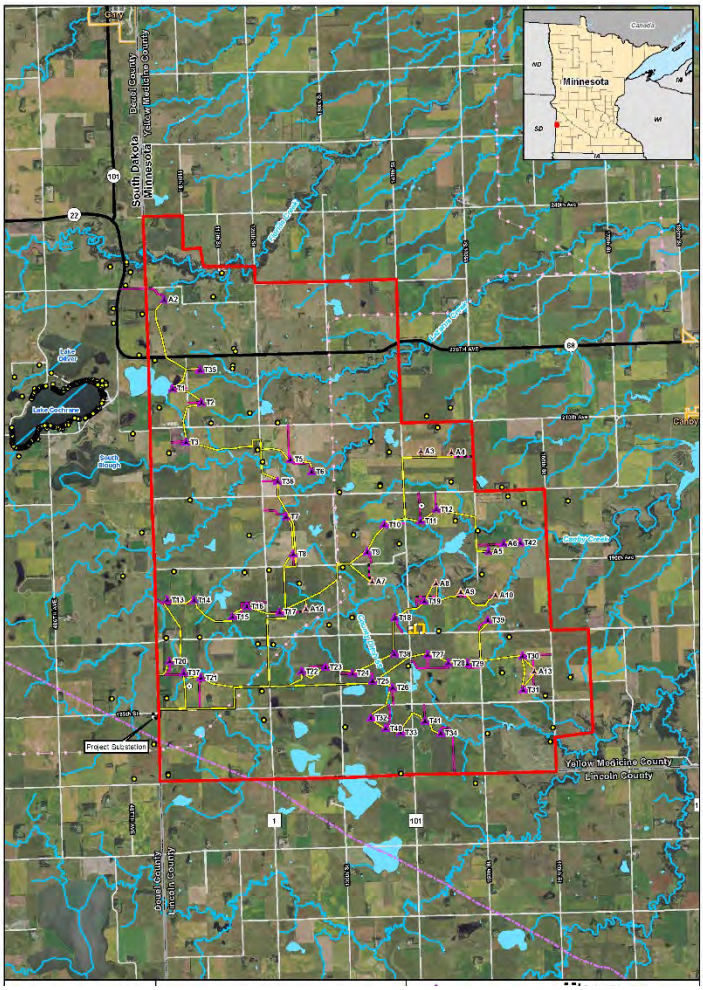
An alternative to the proposed solar farm that would utilize an eligible renewable energy resource is a wind farm sited elsewhere in Minnesota. The analysis in this EA will attempt to describe differences in the impacts associated with a generic 80 MW wind farm sited in Minnesota and the proposed Elk Creek Solar Farm. Many of the impacts upon the *Factors Considered* [62](and the elements within) are

[60] Minnesota Rule 7849.1200.
[61] Minn. Statute 216B.1691, Subd. 1. Eligible energy technologies include technologies that generate electricity from solar, wind, hydroelectric, hydrogen, or biomass.
[62] Minnesota Rule 7850.4100 – Factors Considered.

highly dependent on the geographical location (site) of the alternative and consequentially cannot truly be compared, hence, the following review will attempt to highlight those impacts that are not site specific.

As with a solar farm, LWECS includes multiple construction "sites" for installing individual components (turbines, electrical collection system, project substation, O&M building and access roads). LWECS projects generally consist of a large land area (thousands of acres) commonly referred to as the "box" (Diagram 12) in which a developer has obtained wind rights. Individual, discrete turbine locations are sited (micro-siting) within the box in a manner to avoid impeding the air flow between turbines. The large box is necessary due to the internal and external setbacks required to assure wind efficiencies, and to protect wind rights and nearby receptors (residences).

Diagram 12. Example: LWECS "Box"[63]



[63] Application of Flying Cow Wind, LLC for a Site Permit for the Bitter Root Wind Farm in Yellow Medicine County, Minnesota. Docket No. IP-6984/WS-17-1749, Figure 2.

3.2.2 Generic 80 MW Solar Farm

Another alternative renewable energy source to the Elk Creek Solar Farm Project is a solar farm of similar electricity generation as the proposed project, sited elsewhere in Minnesota. The generic solar farm alternative could be at a single site, or could be several smaller utility-scale sites.

Many of the impacts upon the *Factors Considered* [64](and the elements within) are highly dependent on the geographical location (site) of the alternative and consequentially cannot truly be compared, hence, the following review will attempt to highlight those impacts that are not site specific.

3.2.3 No Build Alternative

Since the no-build alternative, neither represents a system alternative or envisions an alternative site, the analysis is limited to the discussion in this section.

The no build alternative assumes that no solar project is constructed. The analysis for this alternative considers the potential benefits and drawbacks of not constructing the Elk Creek Solar Farm. The no build alternative analyzes the impacts of the status quo. For example, with a proposed roadway project, the no build alternative assesses the impacts associated with not improving the roadway. This includes potential traffic increases on nearby roads and highways, increased maintenance costs, and longer travel times.

For the proposed solar farm, the primary impacts of the no build alternative are: (1) reducing the state's ability to meet its renewable energy objectives, (2) foregoing economic benefits in the project area, and (3) the possible negative impact of providing replacement electricity from a non-renewable energy source.

The potential impacts of the no build alternative are discussed below.

3.2.3.1 *Drawbacks*

Failure to Further Renewable Energy Objectives

Minnesota has committed to a renewable energy objective of generating 25 percent of its electricity from eligible renewable sources by the year 2025.[65] Minnesota utilities forecast the need for 5,841 MW of renewable generation by the year 2025 to meet this objective.[66] If the Elk Creek Solar Farm is not built, it could reduce the state's ability to meet renewable energy objectives.

[64] Minnesota Rule 7850.4100 – Factors Considered.
[65] Minn. Statute 216B.1691
[66] Minn. Statutes 216C.05

Impacts of non-renewable energy sources vary. However, it is possible that if the Elk Creek Solar Farm Project is not built, the electrical power it would have produced may be replaced with a non-renewable energy resource. The projected average annual output from the Elk Creek Solar Farm Project is between approximately 156,000 and 168,000 megawatt-hours.[67] Though the impacts associated with non-renewable sources vary, it is possible to estimate, as an example, the impact of replacing the Project's MWh/year output with natural gas or, less likely, coal energy. The Project will generate up to 80 MW, enough energy to provide electricity for approximately 19,000 homes annually and avoid the emission of approximately 119,000 metric tons of carbon annually.[68] However, since no non-renewable proposals are being considered in this case, that comparative analysis is not pursued in this review.

Loss of Economic Benefits

If the proposed solar farm is not built, there would be foregone economic benefits in the project area. Landowners would lose lease payments over the operational life of the project. Local governments would lose solar energy production tax revenues. The solar farm will pay a solar Energy Production Tax to the local units of government of $0.0012 per kilowatt-hour (kWh) of electricity produced. This would result in an estimated annual Energy Production Tax revenues of $180,000.00 annually or approximately 4.5 million over 25 years.[69]

The Applicant has stated that it will also establish the Elk Creek Education Fund, to which Elk Creek will contribute $16,000 annually for the first 20 years of Project operation. Because the Project is located within the Luverne school district, the fund will be distributed to this district.[70]

In addition, lease and purchase payments paid to the landowners will offset potential financial losses associated with removing a portion of their land from agricultural production.

If the Elk Creek Solar Farm is not constructed, there would be foregone revenue to local businesses. The proposed solar farm is expected to generate up to 130 temporary construction jobs and up to four full-time permanent operation and maintenance jobs.[71] These employment opportunities and associated income would be lost if the project is not built. If the Project is not constructed, local labor would not be employed in the construction or operation of the project, although to some degree this loss would be offset by other employment opportunities, the location of these opportunities is unknown.

[67] CN Application, at p. 31.
[68] CN Application, at p. 30.
[69] CN Application, at p. 22.
[70] SPA, at p 49.
[71] SPA, at p. 31.

3.2.3.2 *Benefits*

Benefits of not building the project include avoidance of potential human and environmental impacts associated with the proposed solar farm (see Section 4).

3.2.3.3 *Alternatives Sites*

The Project qualifies for the alternative review process and as such the Applicant is not required to analyze alternative sites.[72] Elk Creek has stated that they did not consider alternative sites other than the Project site because of the proximity of the site to electrical transmission infrastructure, a willing Project participant, optimal solar resource, and the minimal environmental impacts expected from the construction at the Project site.[73]

No requests for an alternative site evaluation were put forth during the scoping process; no alternative sites were included in the *Scoping Decision*.

[72] Minn. Stat. 216E.04, Subd. 2(8) and Minn. R. 7850.2800-7850.3900.
[73] SPA, at p. 13.

4 Elk Creek and System Alternatives – Human and Environmental Impacts

The proposed Elk Creek Solar Farm and the project system alternatives have the potential for human and environmental impacts, which are discussed below, along with possible mitigation strategies.

4.1 Air Quality

Unlike fossil fuel electric generation facilities, renewables such as solar and wind tend to have very limited operational air emissions; any impacts to air quality are primarily associated with construction activities. This EA examines air emissions as required by Minnesota Rule 7849.1500, subpart 2.

4.1.1 Criteria Pollutants

Minnesota Rule 7849.1500 requires examination of emissions of the following pollutants: sulfur dioxide (SO_2), nitrogen oxides (NO_x), carbon dioxide (CO_2), mercury (Hg), and particulate matter (PM). These common pollutants (other than mercury) are known as criteria pollutants.[74]

In Minnesota, air quality is tracked using air quality monitoring stations across the State. The MPCA uses data from these monitors to calculate the Air Quality Index (AQI), on an hourly basis, for O_3, $PM_{2.5}$, SO_2, NO_2, and CO. The pollutant with the highest AQI value for a particular hour sets the overall AQI for that hour. The AQI is used to categorize the air quality of a region as one of five levels of quality: good, moderate, unhealthy for sensitive groups (USG), unhealthy, or very unhealthy.[75]

Elk Creek Solar Farm

The Project is located nearest to the air quality monitor in Marshall, Minnesota. This station monitors for ozone and particulates. The AQI for Marshall for the past five years is provided in Table 5. The air quality in this region is characterized as good, with few moderate days per year and no unhealthy categories reported in recent years.

The Elk Creek Solar Farm would not emit criteria pollutants during operation. Impacts from construction would be short-term and temporary as a result of construction activities. Impacts would include dust due to earth moving and emissions from diesel-powered construction equipment.

Dust and emissions associated with the construction of the Project would be similar to large scale outdoor construction activities such as road work and residential developments. The Project includes multiple construction "sites" for installing individual components (tracking racks/panels, electrical collection

[74] United States Environmental Protection Agency (EPA). *Criteria Air Pollutants*. https://www.epa.gov/criteria-air-pollutants
[75] https://data.web.health.state.mn.us/air_aqi.

system, project substation, O&M building and access roads) over the approximately 681 acres of the Land Control Area.

Table 5. Days in Each Air Quality Index Category (Marshall, Minnesota)[76]

Year	Good	Moderate	Unhealthy for Sensitive Groups	Unhealthy	Very Unhealthy
2017	329	31	0	0	0
2016	336	19	1	0	0
2015	338	26	1	0	0
2014	320	43	1	0	0
2013	291	72	2	0	0

During construction of the Project short-term air emissions are expected as a result of vehicle exhaust from the construction equipment and from vehicles traveling to and from facility location. The magnitude of the construction emissions is influenced heavily by weather conditions and the specific construction activity occurring. Exhaust emissions from primarily diesel equipment would vary according to the phase of construction but would be minimal and temporary.

In addition to emissions from construction equipment, short-term air quality impacts from fugitive dust may result from travel on unpaved roads, some grading at the site, and excavation required for trenching for electrical and communications cables, foundations for inverter boxes, O&M buildings and, depending upon site conditions, solar array piers at some locations. Fugitive dust is considered particulate matter under air quality regulations. The concentrations of fugitive dust that is fine particulate matter (P.M. less than 2.5 microns or $PM_{2.5}$) is generally small, or approximately 3 percent to 10 percent of total particulate matter (US Environmental Protection Agency (EPA) AP-42, Sections 13.2 and 11.9). Since fine particulate matter has the potential to travel further into the lungs, it is of greater concern than larger particle size ranges.

Once construction is completed, air and dust emissions related to vehicular traffic would be reduced. Limited emissions would be associated with routine maintenance and repairs.

The impact of these emissions on air quality would be minimal.

Generic 80 MW Solar Farm

As with the proposed Project, a generic solar farm sited elsewhere would not emit criteria pollutants during operation. Temporary minimal air quality impacts would occur during the construction phase of the solar farm project. Once operational, the project would not generate criteria pollutants or carbon dioxide.

[76] SPA, at p. 59, Table 4.5-1.

Generic 80 MW Wind Farm

A generic 80 MW wind farm would not emit criteria pollutants during operation, and would have ancillary emissions (construction) similar to those of the proposed Project, resulting in temporary minimal impacts.

Mitigation

Common to both solar and wind projects, dust from construction activity can be controlled using standard construction practices such as watering of exposed surfaces, covering of disturbed areas, and reduced speed limits on site. Emissions from construction vehicles can be minimized by limiting construction equipment idling to the extent practical when not in use; and following equipment manufacturer-recommended operations and good combustion practices, including not tampering engines to increase horsepower and using ultra-low sulfur diesel.

4.1.2 Hazardous Air Pollutants and Volatile Organic Compounds

Electric generation facilities have the potential to emit air pollutants during construction and operation. Minnesota Rule 7849.1500 requires this EA to examine emissions of hazardous air pollutants (HAP) and volatile organic compounds (VOC). These classes of pollutants are known or suspected of causing cancer and other serious health effects.[77]

Elk Creek Solar Farm

The Elk Creek Solar farm would emit minimal HAPs or VOCs during operation. Petroleum-based fluids used during the operation and maintenance activities at the facility, such as gasoline/diesel in vehicles, gear box oil, hydraulic fluid and gear grease, have a low vapor pressure.

The impact of any release of VOCs from these sources would be negligible.

Generic 80 MW Solar Farm

As with the proposed Project, a generic solar farm sited elsewhere, would have minor emissions of toxic air pollutants from vehicle and equipment use and from any minor solvent and coating use associated with maintenance of equipment (gear box oil, hydraulic fluid and gear grease) and upkeep of buildings.

The impact of any release of VOCs from these sources would be negligible.

Generic 80 MW Wind Farm

A generic 80 MW wind farm would have HAP and VOC emissions similar to the proposed Project, as the generic 80 MW wind farm would utilize comparable petroleum-based fluids during wind turbine operation and maintenance.
The impact of any release of VOCs from these sources would be negligible.

[77] EPA. *Hazardous Air Pollutants*, https://www.epa.gov/haps

Mitigation

Other than standard best management practices (BMPs) for the handling and storage of the small quantities of hazardous materials, no additional mitigation measures are recommended.

A general condition of the site permit would include that all appropriate precautions to protect against pollution of the environment shall be taken by the Permittee. The Permittee shall be responsible for compliance with all laws applicable to the generation, storage, transportation, clean up and disposal of all wastes generated during construction and operation of the facility.[78]

4.1.3 Ozone

Large electric power generating facilities, such as coal, natural gas, and biomass facilities, have the potential to produce reactive gases, which can lead to ground-level ozone formation. In the case of solar and wind projects, emissions of ozone are generally associated with HVTL conductors required to transmitted the power onto the grid.

Ozone and nitrous oxide are reactive compounds that contribute to smog and can have adverse impacts on human respiratory systems.[79] Accordingly, these compounds are regulated and have permissible concentration limits. Minnesota has an ozone limit of 0.08 parts per million (ppm).[80] The federal ozone limit is 0.07 ppm.[81] Minnesota Rule 7849.1500, subpart 2 requires that anticipated ozone formation be addressed. Ozone can cause human health risks and can also damage crops, trees and other vegetation.[82]

Elk Creek Solar Farm

Operation of the Elk Creek Solar Farm would not produce ozone or ozone precursors. Ozone production can occur adjacent to transmission lines under specific conditions. The Project will interconnect into the existing Magnolia Substation via a 161-kV overhead gen-tie transmission line. There will be a single dead-end structure within the Project substation and likely 2-3 additional structures to enter the Magnolia Substation with an overall length currently estimated to be approximately 300 feet, pending final engineering.[83] Ionization of air molecules surrounding a conductor (corona effect) produces a small amount of ozone and NO_X, both of which are reactive compounds that contribute to smog and could adversely affect human and animal respiratory systems, crops, vegetation, and buildings.

[78] PUC staff Briefing Papers Application Acceptance, October 30, 2019. eDocket No. 201910-157014-02.
[79] EPA. *Criteria Air Pollutants*. https://www.epa.gov/criteria-air-pollutants
[80] Minn. R. 7009.0800, https://www.revisor.mn.gov/rules/?id=7009.0080.
[81] EPA. *2015 National Ambient Air Quality Standards (NAAQA) for Ozone*.https://www.epa.gov/ozone-pollution/2015-national-ambient-air-quality-standards-naaqs-ozone
[82] EPA. *Ozone Pollution.* https://www.epa.gov/ozone-pollution
[83] SPA, at p. 25.

Because the total emissions of ozone and NO_X from operating a transmission line are very small, the 161-kV gen-tie transmission line is not expected to create any potential for concentrations of ozone that might exceed these standards.

Generic 80 MW Solar Farm

The generic 80 MW solar farm would not produce ozone or ozone precursors at the operating of the PV panels. As with the proposed Project, the ozone production associated with an 80 MW solar farm sited elsewhere would depend on the use of associated transmission lines to deliver power to the grid.

Ozone and nitrous oxide emissions from any associated transmission lines are anticipated to be well below regulatory limits.

Generic 80 MW Wind Farm

A generic 80 MW wind farm would not produce ozone or ozone precursors at the operating wind turbines. The generic 80 MW wind farm would have minimal or no impacts related to ozone formation, similar to the proposed Project. Any transmission line associated with the LWECS project, whether new or existing, would generate small amounts of ozone and nitrous oxide.

Mitigation

Since neither the proposed Project, nor the alternative generic wind and solar farms would produce ozone or ozone precursors, no mitigation related to ozone formation is warranted.

4.2 Water Resources

Different generation options have different water usage and effects on the water quality and water resources. Wind and solar have limited potential impacts associated with water withdrawal and discharge. However, there may be impacts through construction activities and changes to the landscape.

4.2.1 Water Appropriations

While large electric power generating facilities that depend on steam generators (coal, natural gas combined cycle) require large amounts of water for operations. Wind and solar facilities require very little water during operation; this section discusses potential water appropriation impacts from such facilities.

Elk Creek Solar Farm

An O&M facility will be constructed within the Project site to serve as a center for the solar farm's O&M efforts, provide access and storage, and house the SCADA system. The O&M facility will provide office space for the crews, as well as a shop/storage area for spare parts and vehicles. It will also house the central monitoring equipment for the generating facility where the tracking rack system/panels are

monitored and controlled. The footprint of the facility is anticipated to be approximately 2,400 square feet and will also require a parking lot of approximately 500 square feet.[84]

The O&M facility will require the installation of a well for potable water and the design and installation of an Individual Sewer Treatment System (septic system).[85] Typical water used for O&M facilities is estimated to be roughly equivalent to the amount consumed by a residence or farmstead in the area (500 gallons per day, or 100 gallons per person per day).

While not anticipated, a water appropriations permit would be required if temporary dewatering activities are needed during construction.[86] The determination of need for the water appropriations permit for construction dewatering activities will be determined by the contractor during construction depending on site conditions. A DNR water appropriation permit would be required to dewater the site if the amount of water that is appropriated from the dewatering wells exceeds 10,000 gallons per day or 1 million gallons per year.[87] The installation of dewatering wells is regulated by the Minnesota Department of Health (MDH).

The need for a temporary concrete batch plant is not anticipated, however, if deemed necessary it would require a well permit (MDH Well Management) and DNR water appropriations permit.[88]

It is anticipated that there would be minimal impacts concerning well construction and water appropriations for the Project.

Generic 80 MW Solar Farm

Similar to the proposed Project, a generic 80 MW solar facility sited elsewhere, would require a potable well to support the similar operations and maintenance (O&M) building.

The minimal need for concrete in the construction of solar farms usually does not warrant a batch plant. Subsurface work (cables, conduit, grading, and trenching) is conducted above water table levels, negating the need for dewatering; however, should dewatering become necessary it would require the comparable regulatory review and permitting as for the proposed Project.

As with the proposed Project, impacts associated with potable water supplies and sit dewatering activities would be expected to be minimal.

[84] SPA, at p 23.
[85] Ibid, at pp. 4-5, p. 61.
[86] Ibid, at p. 61.
[87] https://www.dnr.state.mn.us/waters/watermgmt_section/appropriations/permits.html
[88] Ibid, at pp. 61.

Generic 80 MW Wind Farm

As with the proposed Project, the installation of a well for potable water and the design and installation of an Individual Sewer Treatment System (septic system) to support an O&M facility for a generic 80 MW wind farm would be necessary, depending on available public services. Because of the rural nature in siting wind farms, it would be anticipated that domestic water and sewer services would generally be provided by on-site infrastructure (private well and septic), which would require similar regulatory review and permitting as for the proposed Project.

Due to the depth of wind turbine foundations and the corresponding volume of concrete, the likelihood of requiring some dewatering activities and the need for an on-site concrete batch plant would necessitate permitting a well and obtaining a water appropriation permit from the appropriate regulatory agencies.

Mitigation

No mitigation is believed warranted for the proposed Project.

There would be minimal or no human or environmental impacts concerning water appropriations for these projects, outside of BMPs and standard conditions contained in the MDH and DNR permits. If temporary dewatering is required during construction activities, discharge of dewatering fluid would be conducted under the National Pollutant Discharge Elimination System (NPDES) permit program and addressed by the project's Storm Water Pollution Prevention Plan (SWPPP), as required.

4.2.2 Wastewater

Large electric power generating facilities that depend on steam generators (coal, natural gas combined cycle) require large amounts of water for operations, and thus, produce corresponding quantities of waste water effluent. Since wind and solar facilities require very little water during operation, they consequently produce little waste water.

This section discusses potential impacts from wastewater generation.

Elk Creek Solar Farm

The Elk Creek solar farm's O&M facility would generate household amounts of wastewater. Elk Creek plans to build an on-site septic system to serve the O&M facility.[89] The potential impacts of this wastewater and septic system are anticipated to be minimal. The Applicant would be required to obtain a permit for the Individual Sewage Treatment System from the LGU.

[89] SPA, at pp. 4-5, p. 61..

Generic 80 MW Solar Farm

Similar to the proposed Project, a solar farm sited elsewhere would likely require a private well and septic system at the O&M building to provide sanitary services and water for maintenance.

Generic 80 MW Wind Farm

A generic 80 MW wind farm would have wastewater impacts similar to the proposed Project associated with its O&M facility.

Mitigation

No mitigation beyond the design and installation requirements of the Individual Sewage Treatment System permits[90] is warranted.

4.2.3 Groundwater

Ground water in Minnesota is largely a function of local geologic conditions that determine the type and properties of aquifers. The Minnesota DNR divides the state into six ground water provinces based on bedrock and glacial geology.[91] Most groundwater originates from rain and melting snow and ice that infiltrate into the ground; it is the source of water for springs and wells. It is relied on as a source for drinking water, irrigation, and industrial use. Groundwater can be sourced from shallow surficial aquifers or from deeper confined aquifers. Activities that reduce the quantity of available water or introduce contaminants into these aquifers can affect groundwater resources and the people and industries that rely on them.

The EPA defines a sole source aquifer (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.[92]

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. Public and non-public community water supply source-water protection in Minnesota is administered by the MDH through the Wellhead Protection program. Wellhead Protection Program Areas (WHPA) for public and community water-supply wells are delineated based on a zone of capture for 10-year groundwater time-of-travel to the well and are available through a database and mapping layer maintained by MDH.[93]

[90] https://septic.umn.edu/sites/septic.umn.edu/files/minnesota_rules_chapter_7080.pdf
[91] DNR. *Minnesota Groundwater Provinces* (https://www.dnr.state.mn.us/groundwater/provinces/index.html)
[92] https://www.epa.gov/dwssa/overview-drinking-water-sole-source-aquifer-program#What_Is_SSA.
[93] https://www.pca.state.mn.us/water/wellhead-and-source-water-protection-programs.

The DNR defines an area as sensitive if natural geologic factors create a significant risk of groundwater degradation through the migration of waterborne contaminants. The near-surface sensitivity assessment estimates the time required for water to travel from the land surface; through unsaturated sediment, and finally to the water table. Transmission rates are based on the soil type and the texture of surficial geologic units; the travel time varies from hours to approximately a year. The pollution sensitivity of buried sand and gravel aquifers and of the first buried bedrock surface represents the approximate time it takes for water to move from land surface to the target (residence time).[94]

Relatively high sensitivity does not mean that water quality has been or will be degraded. If there are no contaminant sources, pollution will not occur. Low sensitivity does not guarantee protection. Leakage from an unsealed well for example, may bypass the natural protection, allowing contamination to directly enter an aquifer.

The County Well Index (CWI) is the most complete record of well construction and location in Minnesota and is kept up-to-date and maintained by the Minnesota Geological Survey, in cooperation with the MDH.[95]

This section assesses the potential for construction and operation of the Project to affect the quantity of available water or to introduce pollutants that would degrade the quality of groundwater resources.

Elk Creek Solar Farm

Rock County is part of groundwater province 5 (Western groundwater province). Groundwater in the region is supplied by the Cretaceous aquifer, which consists of thick to thin, discontinuous sandstone beds overlain in places by limestone and shale beds that confine the aquifer.[96]

The aquifer is directly overlain by glacial deposits of clayey glacial drift overlying Cretaceous and Precambrian bedrock. Glacial drift and Cretaceous bedrock contain limited extent sand and sandstone aquifers, respectively. In its principal area of use, the Cretaceous aquifer ranges from about 90 to 170 feet in thickness. The water tends to contain large concentrations of dissolved solids; in some areas, wells have small yields of less than two to 10 gallons per minute. The aquifer is buried by glacial deposits to depths of 700 feet or more near the southern Minnesota border. Although the aquifer contains gypsum, which can increase sulfate concentrations in the groundwater, the aquifer is extensively pumped to supply domestic, small-community, and agricultural needs.[97]

[94] https://www.dnr.state.mn.us/waters/groundwater_section/mapping/sensitivity.html.
[95] https://www.mngs.umn.edu/cwi.html.
[96] SPA, at pp. 59-61.
[97] https://www.dnr.state.mn.us/groundwater/provinces/index.html.

Homes and farms in the vicinity of the Project typically use private wells and septic systems for their household needs.[98]

There are currently no EPA-designated SSAs in the vicinity of the proposed Elk Creek Solar Farm.[99]

The Applicant conducted a search of the CWI and identified the one domestic well associated with a former farmstead within the Land Control Area (**Figure 5**). A review of historic photography indicated this farmstead was mostly demolished sometime between 1991 and 2003; two of the original seven buildings remain on-site and are likely used for agricultural storage. The residential structure where the well is likely located appears to be no longer present. Based on CWI data, it's unknown if this well has been properly abandoned.[100] Although the existing well within the Land Control Area would not be affected by construction and operations within the Preliminary Development Area; prior to construction, the Applicant will assess whether the well has been abandoned in accordance with Minnesota Department of Health requirements.[101]

The Applicant conducted a search for WHPAs in the MDH database; there are no WHPAs within the Land Control Area. The nearest WHPA is located in the town of Luverne, approximately 4.6 miles southwest of the Land Control Area.[102]

Impacts to groundwater resources from construction and operation of the Elk Creek Solar Farm are anticipated to be minimal. Water supply needs during project operation are anticipated to be limited to the O&M facility requirements, which will be satisfied via a private well.

Generic 80 MW Solar Farm

As with the proposed Project, the infrastructure at a generic 80 MW solar farm sited elsewhere in Minnesota would be expected to have similar infrastructure needs, including the direct-embedded piers supporting the PV tracking installations, foundations for inverters and the Operations and Maintenance (O&M) facility. Given similar environmental conditions (depth to water table, proximity to private weels and WHPs) it is unlikely this type of project situated elsewhere in Minnesota would pose a general threat to groundwater quality. However, with certain site specific subsurface conditions (karst or high water table) the risk may increase.

Generic 80 MW Wind Farm

Impacts to groundwater from a generic 80 MW wind farm may be comparable to the Project, depending on site location, underlying geological material, and the groundwater sensitivity underlying the project

[98] SPA, at p. 53.
[99] SPA, at pp.59-61.
[100] Ibid.
[101] Ibid.
[102] Ibid.

site. The potential for groundwater contamination resulting from construction may be higher in areas with karst geology.

The depth of wind turbine foundations, the corresponding volume of concrete, and the likelihood of requiring some dewatering activities may be factors that influence potential groundwater impacts.

Mitigation

Groundwater resources are not expected to be impacted from these activities. In the case of the Elk Creek Solar Farm, the various facilities are located at least 220 feet from the nearest occupied residence, thereby further minimizing the risk of impacts on private wells in the area.[103] During "down-stream" permitting, measures would be taken to identify any nearby wells prior to construction. Permitting agencies such as the DNR, MPCA, and MDH determine appropriate actions to protect local groundwater resources.

Groundwater use for both wind farms and solar farms is anticipated to be minimal, and supply and drawdown impacts would be further addressed, if necessary, in appropriations permits.

4.2.4 Surface Water

As with any large development project, the construction of a LEPGP can impact surface waters by creating water crossings (direct impact) with access roads and electrical collection lines, and via the associated earth moving (indirect impact) in clearing, grubbing, and contouring the site. These potential impacts arise as construction activities make the soil prone to erosion, which can impact water quality.

Changes in topography can modify the areas hydrology and drainage patterns, effecting wetlands and water courses. Siting permanent facilities within a floodplain can impact its flood storage capacity.

Potential impacts to surface waters are discussed below.

Elk Creek Solar Farm

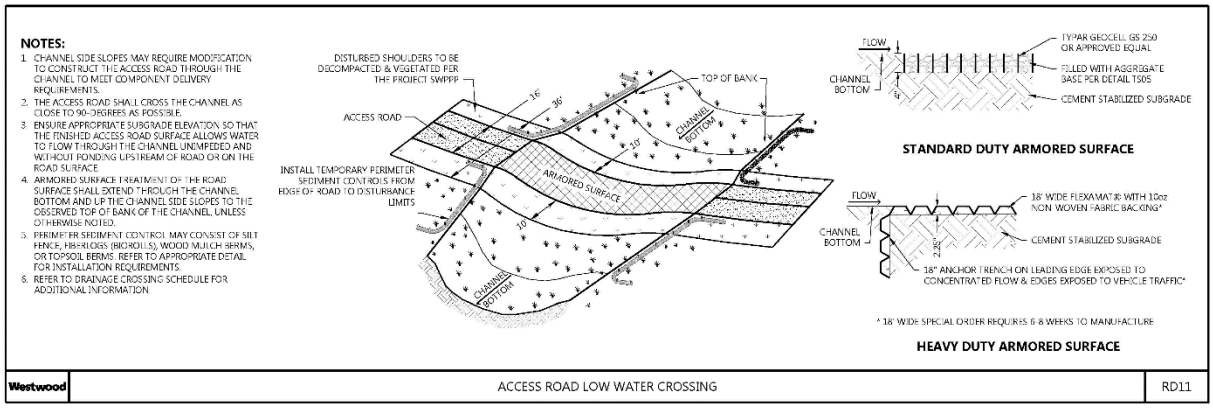
The Elk Creek Solar Farm is located in the Big Sioux Watershed Basin.[104] There are no lakes or rivers in the Land Control Area; no MNDNR Public Waters Inventory (PWI) watercourses or waterbodies are located in the Land Control Area (**Figure 6**).[105] The nearest PWI waterbodies are Champepadan Creek, located approximately 0.4 mile to the north of the Land Control Area; and Elk Creek, located approximately 0.15 mile south of the Land Control Area. Both Champepadan Creek and Elk Creek are listed by MPCA as impaired waters.

[103] SPA, at p. 61.
[104] https://www.dnr.state.mn.us/watersheds/map.html.
[105] SPA, at pp. 66-67.

Surface waters within the Land Control Area are limited to five intermittent waterbodies (four in northwest portion and one in southeast portion of the Land Control Area) and one wetland area. The Applicant confirmed these waterbodies as non-jurisdictional via the wetland delineation, and received concurrence on this matter from the Rock County Technical Evaluation Panel.[106]

Solar panels will not be sited in these intermittent waterbodies; however, one access road will cross an intermittent stream. This crossing, along with other drainage ways crossed by access roads, will be designed as low water crossings (**Diagram 13**) to maintain flow when water is present.[107] A low-water crossing (LWC) is a best management practice (BMP) that is a feasible and efficient road-stream crossing structure. LWCs are road-stream crossing structures designed to be overtopped by high flows or by debris- or ice-laden flows. At times when the structures are overtopped, the road will be closed to traffic, and alternative routes must be used. These relatively inexpensive structures are very useful across ephemeral streams and where the normal depth of flow is low.

Diagram 13. Access Road Low Water Crossing[108]



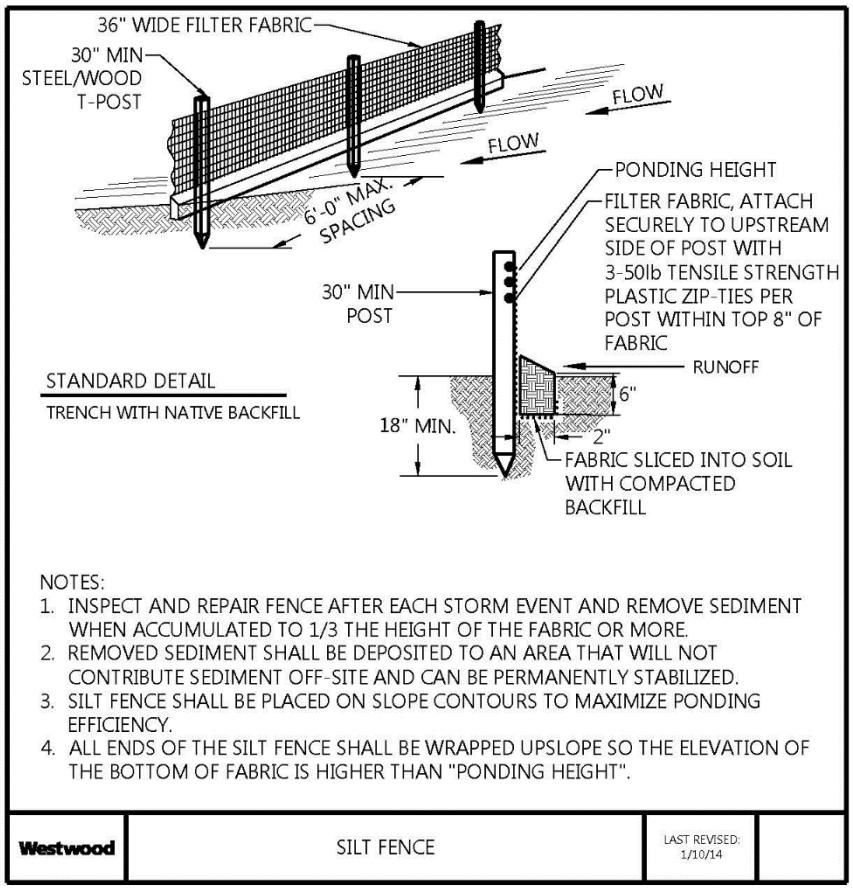
During construction of the Elk Creek Solar Farm, there is the potential for sediment to reach surface waters due to ground disturbances from vegetation clearing, excavation, grading, and construction traffic. However, these impacts will be temporary during construction of the solar farm and will be minimized to the extent possible through the use of BMPs. A Stormwater Pollution Prevention Plan (SWPPP) will be developed for the Project prior to construction that will include BMPs such as silt fencing (**Diagram 14**), revegetation plans, and management of exposed soils to prevent sediment from entering into waterbodies.

In addition to runoff concerns during the construction phase, the Elk Creek Solar Farm will vastly change the impervious surface area within the 681 acre Preliminary Development Area. To handle this potential

[106] SPA, at p. 67 and pp. 83-84.
[107] SPA, at p. 67.
[108] SPA, at Appendix B, sheet C.502.

increase in runoff, the Applicant has designed 13 stormwater drainage basins within existing low-lying areas to help control runoff during rain events.[109]

Diagram 14. Silt Fencing[110]



Floodplains are areas susceptible to flooding that are adjacent to rivers, streams, and lakes. In flat areas, the floodplain can extend more than a mile from the flooding source. Floodplains can also be the normally dry areas adjacent to wetlands, small ponds, or other low areas that cannot drain as quickly as the rain falls.

Based on a review conducted by the Applicant, the proposed Elk Creek Solar Farm will not impact any Federal Emergency Management Agency (FEMA) mapped floodplains. Based on the FEMA 1977 FIRM panel for Rock County, the Land Control Area is not located in any designated flood hazard areas.[111]

[109] SPA, at Appendix B.

[110] SPA, at Appendix B, sheet C.502.

[111] SPA, at p. 67.

Maintenance and operation activities for the PV facilities are not expected to have an adverse impacts on surface water quality.

Generic 80 MW Solar Farm

Similar to the proposed Project, potential impacts to surface waters from a solar farm sited elsewhere can occur during rain events (both in the construction and operation phase); there is the possibility of sediment reaching nearby surface waters and wetlands as the ground is disturbed by excavation, grading and construction traffic, and due to the increase in impervious surfaces. The potential for impacts to surface waters is affected by the solar farm's design and proximity to surface water features, which are highly dependent on site selection.

Generic 80 MW Wind Farm

The primary source of impacts to surface water from a generic 80 MW wind farm would be erosion and runoff during construction; relative to an equivalent solar farm the increase in impervious surfaces is minimal which would reduce the volume of post-construction runoff during rain events.

Generally mitigation strategies during the construction phase would be similar to those of the proposed Project. Turbine siting and general site design (location of access roads and collection lines) would reduce direct impacts to surface waters. Optimal turbine locations are those which are topographically elevated from their surroundings.

Mitigation

Protection of surface waters from construction and operation of the proposed Project is implemented through the NPDES permit and the associated SWPPP. The MPCA issues NPDES permits for construction activities when more than an acre of land is disturbed. A SWPPP will be developed prior to construction. BMPs such as silt fencing, management of exposed soils and revegetation plans to prevent erosion will be included in the SWPPP. In addition to erosion control measures, fueling and lubricating construction equipment away from waterways will ensure that fuel and lubricants do not enter waterways.

Site permits issued by the Commission for solar and wind farms require permits and approvals from the DNR, USFWS and/or Army Corps of Engineers (USACE) for any access roads constructed across regulated streams or drainage ways. If access roads are constructed across streams or drainage ways, roads must be designed to ensure that runoff from the upper portions of the watershed.

4.2.5 Wetlands

Wetlands provide a multitude of ecological, economic and social benefits and vary in type and extent. Some wetlands are dry for much of the year while others are almost always covered by several feet of

water.[112] Some wetlands are dominated by grasses and forbs, others by shrubs and trees. Wetlands also vary in size and extent, with some extending for miles, with annual and seasonal variation. They provide important habitat for wildlife and plants and ecological services such as recharging groundwater, reducing floods, and filtering pollutants from surface water. They are also a source of food and fiber, and support cultural and recreational activities. It is estimated that Minnesota has lost about 50 percent of its original wetland acreage.[113]

The USFWS is the principal US Federal agency tasked with providing information on the status and trends of wetlands. The USFWS National Wetlands Inventory (NWI) is a publically available resource that provides detailed information on the abundance, characteristics, and distribution of US wetlands. NWI wetlands are based on aerial imagery and are not field verified.

In Minnesota, agencies representing three levels of government (federal, state and local) regulate certain activities that affect wetlands, lakes and watercourses. Any wetland listed in the PWI is protected by the Minnesota Public Waters Work Permit. A public waters work permit must be obtained from the DNR for work affecting the course, current or cross-section of public waters, including public waters wetlands. Most other wetlands not listed in the PWI are regulated under the Minnesota Wetland Conservation Act of 1991 (WCA). The WCA is administered by the Minnesota Board of Water and Soil Resources and is implemented by Local Government Units (LGUs).

Wetlands can be impacted directly or indirectly from construction activities (access roads, turbine/PV Panel sites, substation sites, and collection lines) associated with development of solar and wind farms. Direct impacts result from disturbances that occur within the wetland. Indirect impacts result from disturbances that occur in areas outside of the wetland, such as uplands or up-stream waterways.

Elk Creek Solar Farm

Wetlands are not a common feature at the proposed Elk Creek Solar Farm site. Potential for wetlands within the Land Control Area were identified by reviewing desktop resources (National Wetlands Inventory [NWI] data, aerial photography, hydric soils map, LiDAR, and digital elevation models); this was followed by a formal wetland delineation study (**Figure 6**).[114]

Through these investigations, one palustrine emergent wetland (PEM) was identified partially within the southeast portion of the Land Control Area (0.2 acres). Additionally, the wetland delineation also confirmed the absence of two NWI-mapped wetlands in the northwest portion of the Land Control Area. The LGU (Rock County Technical Evaluation Panel-TEP) reviewed and concurred with the Applicant's findings of the wetland delineation.[115] It was also determined that approximately 0.018 acres of wetlands

[112] DNR. *Wetlands*. http://www.dnr.state.mn.us/wetlands/index.html
[113] Ibid.
[114] SPA, at p. 67, and Appendix E.
[115] Ibid.

will be directly impacted by a perimeter access road. The Applicant states that a permit will be obtained for these impacts under U.S. Army Corps of Engineers (USACE) Nationwide Permit (NWP) and by the local government unit (LGU) for the Minnesota Wetland Conservation Act.[116]

Generic 80 MW Solar Farm

Construction and maintenance of a solar facility sited elsewhere has the potential to result in long-term and temporary loss of wetlands or wetland function. The preferred method for minimizing impacts to wetlands is to avoid disturbance of the wetland through project siting and design. Similar to wind farms, potential impacts to wetlands from a solar farm can occur during the construction phase; there is the possibility of sediment reaching nearby wetlands as the ground is disturbed by excavation, grading and construction traffic, potential introduction of invasive species, and changes in wetland type and function.

Post-construction impacts from the development of a solar farm may continue to affect the wetland ecosystem. The solar panel itself will decrease the amount of light reaching the soil surface, which may change the plant community, decrease plant productivity and reduce carbon sequestration, and increase runoff.

As part of maintaining any solar site, vegetation is controlled through mechanical and chemical techniques, which may cause disturbance, damage vegetative populations, and create the potential for contamination due to pesticides.

While the surface area or foot print (PV panels vs turbine tower) of a solar farm is larger than that associated with a wind farm, the mitigation strategies (avoidance through siting and minimization through BMPs) would be similar, however the extent and degree of these strategies would be dependent on site specific features.

Generic 80 MW Wind Project

The primary source of impacts to wetlands from a generic 80 MW wind farm would be similar to those for the Elk Creek Solar Farm (erosion and runoff, dewatering discharges, direct impacts such as compaction from crossing wetlands during construction). Generally mitigation strategies would be similar to those of the proposed Project, however the extent and degree of these strategies would be dependent on site specific features.

Turbines and meteorological towers for wind farms are usually sited and built in upland, higher elevation areas to maximize the wind resources and, in doing so, tend to avoid direct impacts to wetlands and surface waters. Access roads, infrastructure, and operation facilities should be designed and sited to reduce direct impacts on wetlands to the greatest extent feasible. Temporary impacts associated with electric feeder and collector lines, and crane paths should also be minimized by siting to avoid wetland features and the use of standard construction BMPs.

[116] SPA, at p. 67.

Mitigation

Because construction of both wind farm and solar farm projects generally involve the disturbance of more than one acre of soil, the project developer will need to submit a NPDES permit application to the MPCA for construction activities. The NPDES application identifies which BMPs are to be employed during construction of the project. A SWPPP would be developed prior to construction to identify BMPs such as silt fencing, management of exposed soils and revegetation plans to prevent erosion.

In addition to erosion control measures, fueling and lubricating construction equipment away from waterways will ensure that fuel and lubricants do not enter waterways.

Access roads constructed adjacent to streams and drainage-ways can be designed and constructed to have a low-profile that will not impede natural drainage patterns. If construction occurs across drainage ways or drain tiles, it should be conducted in a manner to avoid adverse impacts. If necessary, culverts may be installed within access roads that are constructed in drainage-ways to allow cross drainage and prevent impoundment of water.

A Utility Crossing License would be required for any crossings of PWI by roads, or electric feeder and collector lines; this license would specify methods and mitigation requisites.

A *Vegetation Management Plan* (VMP) can be developed to formalize measures to minimize the disturbance and removal of vegetation on project sites, prevent the introduction of noxious weeds and invasive species and re-vegetate disturbed areas consistent with the safe and reliable operation of the specific project. This is generally a requirement within LEGPG Site Permits issued by the Commission.[117]

4.3 Solid and Hazardous Wastes

Large electric generation facilities have the potential to generate solid and hazardous wastes. Solid and hazardous wastes, if not properly handled, can contaminate surface and ground waters. This contamination can cause a variety of human and environmental health impacts depending on the type and amount of contamination.

Elk Creek Solar Farm

Potential hazardous materials within the site are typical of agricultural uses and may include contamination from petroleum products (diesel fuel, gasoline, natural gas, heating oil, lubricants, and maintenance chemicals), pesticides and herbicides. Older farmsteads may also contain lead-based paint, asbestos-containing building materials (shingles and siding), and polychlorinated biphenyls ("PCBs") in

[117] Commission Staff Briefing Paper, Site Permit Template, October 30, 2019, eDocket No. 201910-157014-02.

electrical transformers. Unmarked farmstead waste dumps which may contain various types of wastes are also commonly found in rural settings.

The proposed Elk Creek Solar Farm would generate solid waste during construction including construction debris such as scrap wood, plastics, cardboard and scrap metals. Petroleum products would also be present on site, such as oil and fuel. Operation of the solar farm is not expected to generate significant quantities of solid and hazardous waste materials. Small quantities of hydraulic oil, lube oil, grease, and cleaning fluid will be maintained and stored at the O&M building, and as these fluids are replaced the waste products will be handled and disposed of through an approved disposal firm as required by regulations.

The Applicant 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); the Resource Conservation and Recovery Act Treatment, Storage, and Disposal and the RCRA hazardous waste generators; the Assessment, Cleanup, and Redevelopment Exchange System; the Minnesota Permitting, Compliance, and Enforcement Information Management System; and the Leaking Underground Storage Tank—American Recovery and Reinvestment Act database.[118] Plum Creek also reviewed the MPCA's *What's in my Neighborhood* (WIMN) database to identify any potential contaminated sites in the Project Area.

No *Recognized Environmental Conditions* (RECs) were identified; the ASTM Standard defines a recognized environmental condition (REC) as the presence or likely presence of any hazardous substances or petroleum products on a property under conditions that indicate an existing release, a past release, or a material threat of a release of any hazardous substances or petroleum products

Solar panels will become a form of hazardous waste when the useful life is over and may harm the environment if they are not recovered or disposed of properly. The International Renewable Energy Agency estimated that there were about 250,000 metric tons of solar panel waste in the world at the end of 2016 and that the figure could reach 78 million metric tons by 2050. Solar panels contain lead, cadmium, and other toxic chemicals that cannot be removed without breaking apart the entire panel. While disposal of solar panels has taken place in regular landfills, it is not recommended because the modules can break and toxic materials can leach into the soil, causing problems with drinking water. Solar panels can be recycled but the cost of recycling is generally more than the economic value of the material recovered.[119]

The Applicant states that non-functioning panels will be packaged and sent to the manufacturer or a third party for recycling or another appropriate disposal method.[120] The site permit template requires

[118] Ibid, at p69.
[119] https://www.instituteforenergyresearch.org/renewable/solar/the-mounting-solar-panel-waste-problem/
[120] SPA, at p. 35.

permittees to submit a *Decommissioning Plan* to the Commission at least 14 days prior to the operation meeting and to provide updates every five years.[121] The decommissioning plan should contain detailed information on the disposal and recycling options, and track how these options develop through the life of the Project.

Generic 80 MW Solar Farm

A solar farm site elsewhere will generate solid waste during construction (scrap wood, plastics, cardboard and wire). Small amounts of hazardous wastes would be generated during operation, (e.g., oils, grease, hydraulic fluids and solvents). The small quantities of hazardous materials would be stored within the O&M facilities.

As with the proposed Project, the handling, disposal and recycling of "end of life" PV panels is a concern.

Generic 80 MW Wind Farm

A generic 80 MW wind farm would have solid and hazardous waste generation similar to the proposed Project and if sited in an agricultural setting would warrant a Phase I Environmental Site Assessment prior to acquiring the property.

Mitigation

Hazardous wastes will need to be handled and stored appropriately; hydraulic fluid, lubrication oil and grease would be disposed of through an approved waste disposal firm. Leaks or spills could be mitigated using appropriate clean up techniques. A listing of all potentially hazardous materials related to the operation of the facilities should be maintained at the O&M facility.

It is not anticipated that a solar or wind farm would require a hazardous waste generators license. Hazardous waste generation would likely fall below the quantity required for a very small quantity generator license (220 pounds per month).

Disposal and recycling opportunities should be tracked within the periodic decommissioning plans, giving preference to those options that reduce, reuse or recycle spent components.

The Phase I ESA should be used to identify and avoid potential bad acts related to previous ownership on any potential development site.

4.4 Natural Resources

[121] Commission Staff Briefing Paper, Site Permit Template, October 30, 2019, eDocket No. 201910-157014-02.

Large electric generation facilities have the potential to impact natural resources, including flora, fauna, habitat, soils and water. This section discusses potential impacts to natural resources from the operation of a generation facility.

4.4.1 Ecological Setting

The DNR and the U.S. Forest Service have developed an Ecological Classification System (ECS) for ecological mapping and landscape classification in Minnesota.[122]

Ecological land classifications are used to identify, describe, and map progressively smaller areas of land with increasingly uniform ecological features. The system uses associations of biotic and environmental factors, including climate, geology, topography, soils, hydrology, and vegetation. The ECS enables resource managers to consider ecological patterns for areas as large as North America or as small as a single timber stand and identify areas with similar management opportunities or constraints relative to that scale. There are eight levels of ECS units in the United States. Map units for six of these levels occur in Minnesota: Provinces, Sections, Subsections, Land Type Associations, Land Types, and Land Type Phases. Diagram 15 represents the Ecological Subsections in Minnesota.

Elk Creek Solar Farm

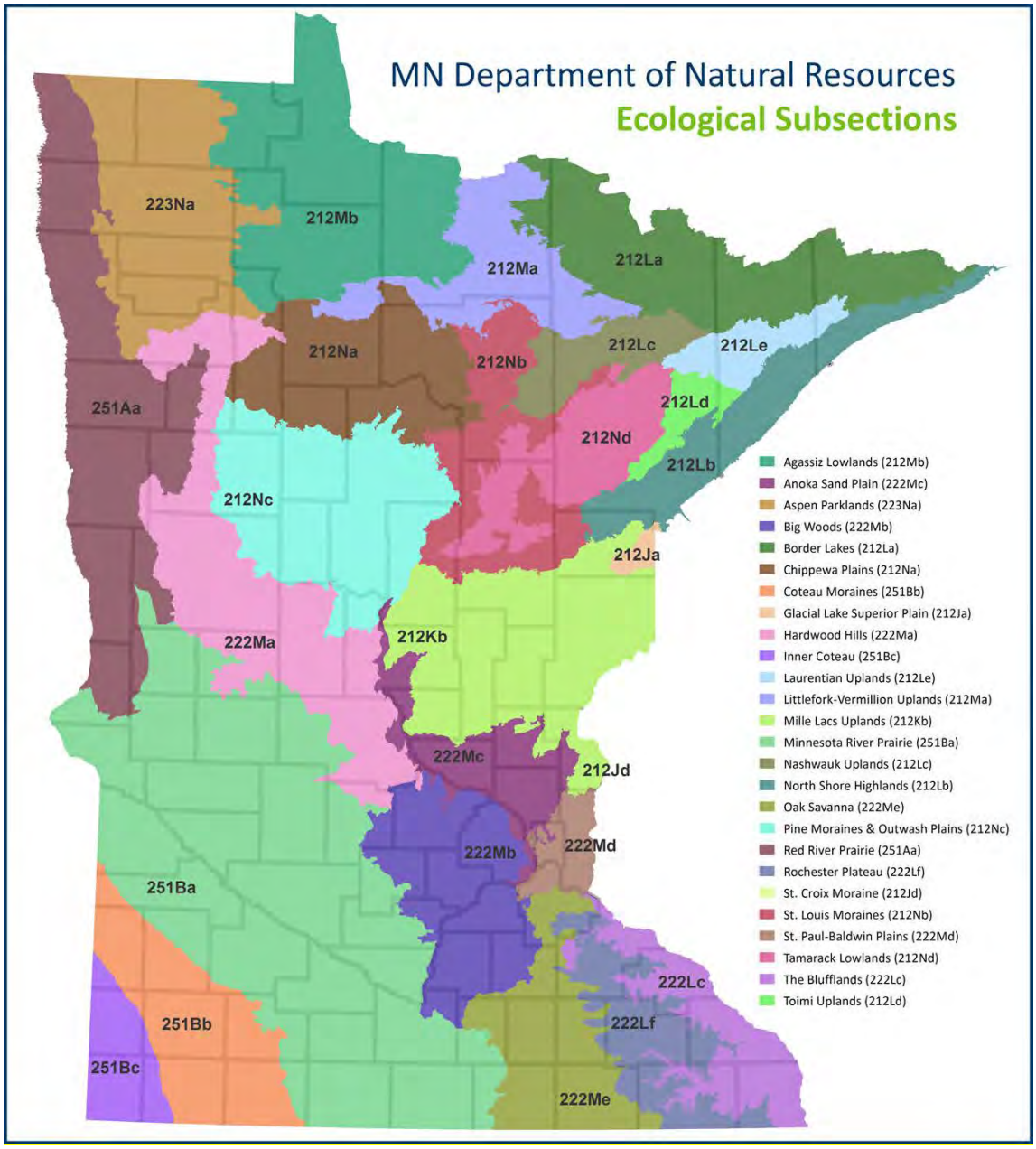
The proposed Elk Creek Solar Farm is located in the Prairies Parkland Province which traverses western Minnesota, extending northwest into Manitoba, west into North Dakota and South Dakota. In Minnesota, the province covers just over 16 million acres (6.5 million hectares), coinciding with the part of the state historically dominated by tallgrass prairie. The land surface of the province was heavily influenced by the most recent glaciation. Ice sheets crossed the province several times during the Wisconsin glaciation, depositing a mantle of drift 100 feet to 600 feet thick in most places.[123] The last lobe of ice, the Des Moines lobe, deposited calcareous drift in the southern part of the province. Because of the thick mantle of drift covering most of the province, bedrock exposures are rare, being limited to the deeply downcut Minnesota River valley and a few places where quartzite bedrock highs protrude through thinner drift in the southwestern corner of the province.[124]

Within this Province, the Project is located in the Inner Coteau Subsection, which coincides with the highest portion of the coteau complex in Minnesota. The northern boundary (with the Coteau Moraines subsection) is a transition between areas of thick loess deposits and thinner deposits over glacial till. This subsection is part of a high glacial landform occupying southwestern Minnesota, southeastern South Dakota and northwestern Iowa. It is topped by Buffalo Ridge (1995 feet above sea level) in northern

[122] DNR *Ecological Classification System*, http://www.dnr.state.mn.us/ecs/index.html
[123] DNR *Ecological Classification System*, http://www.dnr.state.mn.us/ecs/index.html
[124] Ibid.

Pipestone County. The high elevation is caused by thick deposits of pre-Wisconsin age glacial till of up to 800 feet thick, however, there are exposures of bedrock in Rock County.[125]

Diagram 15. Minnesota Ecological Subsections[126]



[125] Ibid.

[126] DNR (1999) *Ecological Section of Minnesota*, Available from: https://gisdata.mn.gov/

Prior to Euro-American settlement, vegetation in this subsection was predominantly tallgrass prairie, with wet prairies and forest restricted to ravines along a few streams. Currently land used in this subsection is agricultural; there remain few remnants of pre-settlement vegetation.

The Project is located approximately 1.5 miles north of Magnolia and 4.5 miles northeast of Luverne (**Figure 1**). Residences are scattered throughout the rural area where the land use is dominated by agricultural fields, predominately corn planted in row crops. With the exception of County State Aid Highway (CSAH) 3, which forms the eastern boundary of the Project, roads that surround the Land Control

Area are local county or township roads. The Land Control Area is bordered on the north by 151st Street and on the south by 131st Street; 141st Street bisects the northwest and southeast portions of the site. Similarly, the Land Control Area is bordered by 180th Avenue on the west, CSAH 3 on the east, and 190th Avenue bisects the two portions. The Magnolia substation is immediately adjacent to the central portion of the Land Control Area with two transmission lines at least partially within parts of the Land Control Area. The Project is located on relatively flat fields conducive to solar development.

Soils in the Land Control Area are characterized as loamy and well-drained with thick dark surface horizons.

Generic 80 MW Solar Farm

While the site selection criteria for a solar farm site elsewhere in Minnesota would be expected to share some common prerequisites (point of interconnect, adequate roadways and stakeholder concerns), there are sufficient variations across the state where these requirements overlap to expect different siting outcomes (environmental setting).

Generic 80 MW Wind Farm

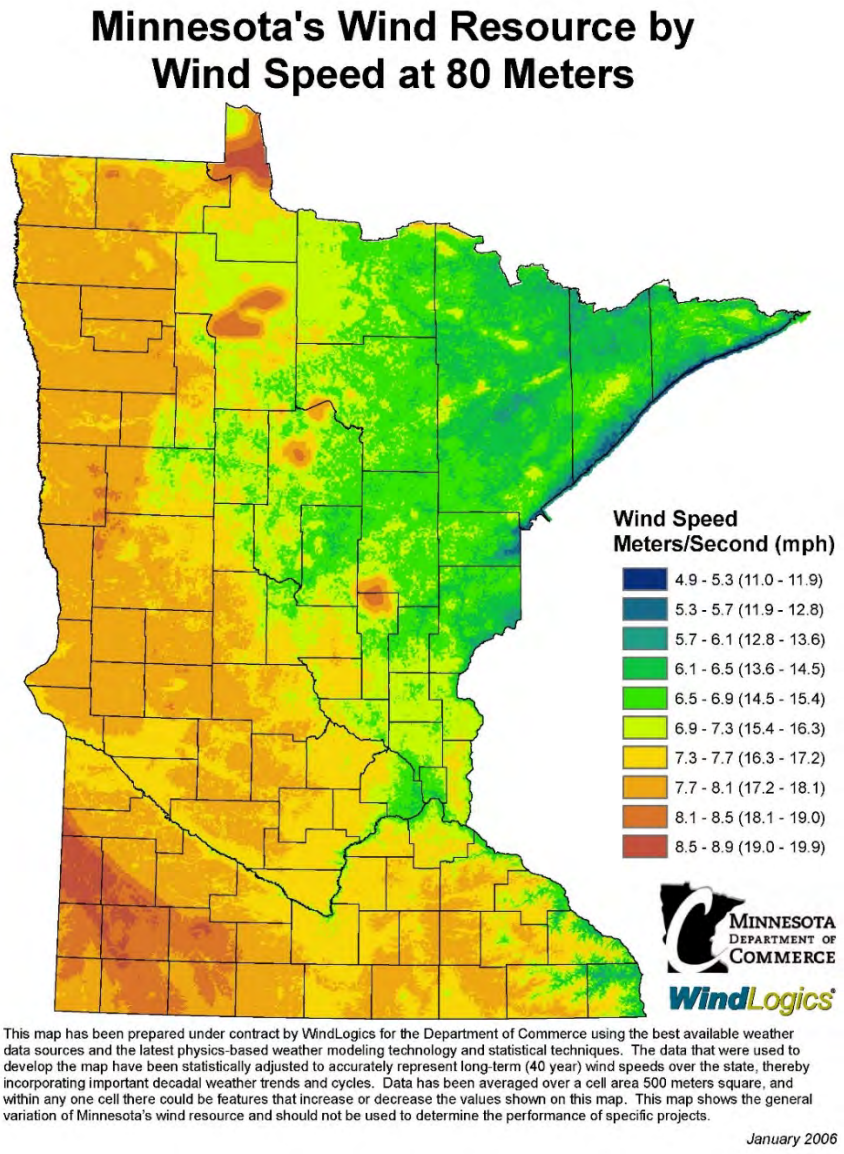
A generic 80 MW wind farm located elsewhere in Minnesota may have different ecological and environmental features (setting) compared to the proposed Project. Wind farms tend to be sited in areas of the state that provide the greatest wind resources (**Diagram 16**).

4.4.2 Soils

Soil varies considerably in its physical and chemical characteristics, these characteristics strongly influence the suitability and limitations that soil has for construction, reclamation, and restoration. Major soil properties are listed below.

• Soil texture. Soil texture affects water infiltration and percolation, drought tolerance, compaction, rutting, and revegetation among other things. Soil texture is described by the soil textural family, which indicates the range of soil particle sizes averaged for the whole soil.

Diagram 16. Wind Resource Map



• Drainage and wetness. Soil drainage indicates the wetness in the soil profile along with the speed at which internal water moves. Soil Drainage affects constructability, erosion by wind and water, and revegetation success.

• Presence of stones, rocks, and shallow bedrock. The presence of bedrock near the soil surface and rocks and stones in the soil profile affects constructability and revegetation.

• Fertility and topsoil characteristics. Topsoil depth affects soil plant nutrition and surface soil structure

• Soil slope. Slope affects constructability, water erosion, revegetation, compaction and rutting, among other properties.

Elk Creek Solar Farm

The Applicant utilized the Soil Survey Geographic database (SSURGO) to characterize the soils within the Land Control Area. Soils in the area are characterized by fourteen soils associations, dominated by silty clay loams. A soil association has a distinctive pattern of soils, relief, and drainage (**Table 6, Figure 7**). How these characteristics breakdown across the Preliminary Development Area are listed in **Table 7.**[127]

All of the soils within the Preliminary Development Area (680 acres) are in the Fine Silty (660 acres, 97 percent) and Fine Loamy (20 acres, 3 percent) textural families, indicating medium-textured soils dominated by soil particles in the loam and silt fractions (between 0.002 and 3 mm) with fewer particles in the clay (<0.002 mm) and sand (>2 mm) fractions. Medium-textured soils typically have good physical and available-water characteristics to support plant growth if not in excessively steep or wet conditions. They have high water-holding capacity, with most of the water being readily available for plant growth.[128]

Most of the soils within the Preliminary Development Area are in the moderately well and somewhat poor drainage classes (302 and 203 acres, respectively, cumulatively 74 percent of the Preliminary Development Area acreage), with smaller areas mapped into Well (22 acres, 4 percent) and Poor (154 acres, 23 percent) drainage classes. None of the soils are excessively drained that would be subject to drought. Soils in Somewhat Poor and Poor drainage classes are highly productive when drained and are frequently converted to agriculture by the installation of subsurface drain tile. Virtually all of the soils in Somewhat Poor and Poor drainage classes in the Preliminary Development Area have been drained. Moderately well and somewhat poorly drained soils typically are not droughty or wet and are typically well suited to intensive agriculture.[129]

No soils in the Preliminary Development Area are shallow to bedrock or have stones at the soil surface or within the soil profile.[130]

To maintain soil productivity, soils with thick topsoil will require larger areas for storage of larger volume of topsoil stripped from permanent infrastructure footprints such as permanent access roads, inverters, and the Project substation. Most of the soils within the Preliminary Development Area are Mollisols and are characterized by the presence of relatively thick topsoil greater than 12 inches in depth (678 acres, 99 percent).[131]

All of the soils (680 acres) within the Preliminary Development Area are nearly level soils with representative slopes falling within the 0-5 percent slope range.[132]

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[127] SPA, at Appendix C Agricultural Impact Mitigation Plan, pp. 11-12.
[128] SPA, at pp. 62-63, Table 4.5-2.
[129] SPA, at Appendix C Agricultural Impact Mitigation Plan, p. 14.
[130] SPA, at Appendix C Agricultural Impact Mitigation Plan, p. 14.
[131] Ibid.
[132] Ibid.

Table 6. Summary of Soils within the Elk Creek Land Control Area[133]

Map Unit Symbol	Soil Name	Acres	Percent Of Land Control Area	Farmland Designation	Hydric Soil	K-Factor	Wind Erodibility Group
P48A	Allendorf silty clay loam, 0 to 2 percent slopes	0.2	0.02%	All areas are prime farmland	No	.24	6
P12B	Everly silty clay loam, 2 to 6 percent slopes	26.4	2.70%	All areas are prime farmland	No	.28	6
P14B	Flandreau silt loam, 2 to 6 percent slopes	78.0	7.99%	All areas are prime farmland	No	.32	6
P15B	Galva silty clay loam, 2 to 5 percent slopes	17.3	1.77%	All areas are prime farmland	No	.24	6
P55A	Kato silty clay loam, 0 to 2 percent slopes	9.6	0.99%	Prime farmland if drained	Yes	.32	6
P21A	Marcus silty clay loam, 0 to 2 percent slopes	49.2	5.04%	Prime farmland if drained	Yes	.28	4
P27A	Primghar silty clay loam, 1 to 3 percent slopes	221.6	22.71%	All areas are prime farmland	No	.32	6
P28A	Ransom silty clay loam, 1 to 3 percent slopes	29.8	3.06%	All areas are prime farmland	No	.32	6
P29A	Rushmore silty clay loam, 0 to 2 percent slopes	54.7	5.61%	Prime farmland if drained	Yes	.32	6
P30B	Sac silty clay loam, loam substratum, 2 to 5 percent slopes	333.6	34.18%	All areas are prime farmland	No	.32	6
P31A	Spicer silty clay loam, 0 to 2 percent slopes	6.0	0.62%	Prime farmland if drained	Yes	.32	4L
P38B	Thurman sandy loam, 2 to 6 percent slopes	9.2	0.95%	Farmland of statewide importance	No	.20	3
P42A	Whitewood silty clay loam, 0 to 2 percent slopes	120.0	12.29%	Prime farmland if drained	Yes	.32	6
P43A	Wilmonton silty clay loam, 1 to 3 percent slopes	20.3	2.08%	All areas are prime farmland	No	.28	6
		975.9	**100%**				

Generally, the soils within the Project site are characterized by silty clay loams that are deep, moderately well drained, Mollisols underlain by firm glacial till. In addition to soil associations, the United States Department of Agriculture, Natural Resources Conservation Service (NRCS) identifies areas that are important to agricultural use, such as prime farmland and farmland of statewide importance.

[133] SPA, at pp. 62-63, Table 4.5-2.

As shown in Table 8, 100 percent of the soils impacted by the Project are classified as prime farmland soils, or prime farmland if drained; however, it is important to note that the prime farmland designation is independent of current land use.

The Elk Creek Solar Farm site will require some grading activities to raise or lower certain areas within the Project site, the majority of the site's topography would be left unchanged. Because most of the Project site is currently nearly level or has slightly rolling terrain, the amount of grading anticipated within the Preliminary Development Area is expected to be minimal. The PV arrays can be designed to follow the existing grade of the site within certain tolerances, which allows the designer of the facility to minimize the amount of earthmoving activities that are required. The remainder of earthmoving activities would consist of work on the interior access roads, trenches for the DC and AC collection system, and foundational work for the Project substation and inverter skids, as necessary.[134]

Generic 80 MW Solar Farm

The suitability for construction and susceptibility of soils to degradation for a generic 80 MW solar farm sited elsewhere in Minnesota, would be highly dependent on the specific site conditions. However, the character of the soils

Generic 80 MW Wind Farm

A generic 80 MW wind farm located elsewhere in Minnesota may have different ecological and environmental features, including soil characteristics, compared to the proposed Project

Mitigation

Elk Creek's AIMP includes descriptions of the policies and the best management practices (BMPs) that will be used during construction to minimize long-term impacts to soil. These efforts begin with the hiring of a third-party environmental monitor to observe construction activities to ensure compliance with the AIMP.[135] The duties of the environmental monitor include:[136]

- Perform weekly inspections during the major earthmoving phase of Project construction;
- observe construction crews and activities to ensure that topsoil is being segregated and managed appropriately;
- monitor the site for areas of potential soil compaction (except within access roads) and make specific recommendations for de-compaction;
- make recommendations to Elk Creek's construction manager;

[134] SPA, at Appendix C, Section 4 – BMPs During Construction and Operation.
[135] SPA, at Appendix C, Section 4 – BMPs During Construction and Operation.
[136] Ibid.

Table 7. Acreage of Soils with Selected Physical Characteristics by Project Feature within the Preliminary Development Area (Total 976 acres)[137]

Project Feature	Total Acres[1]	Textural Family[2]				Slope Range[3]		Drainage Class[4]					Topsoil Thickness[5]			Shallow Bedrock/ Stony[6]
		Fine Loamy	Fine Silty	Fine-Silty over Sandy	Sandy	0-5	>5-8	SWE	W	MW	SWP	P	>6 - 12	>12 - 18	>18	
	Acres															
Preliminary Development Area (Potential Disturbance)																
Fence Area	630.2	18.5	611.7	-	-	630.2	-	-	19.8	280.0	186.0	144.3	1.3	313.9	315.0	-
Access Roads	23.2	1.5	21.7	-	-	23.2	-	-	1.7	8.9	7.8	4.8	0.2	10.6	12.3	-
Inverters	0.4	tr	0.3	-	-	0.4	-	-	tr	0.2	0.1	0.1	-	0.2	0.1	-
Laydown Yards	16.9	-	16.9	-	-	16.9	-	-	0.7	8.4	4.6	3.2	0.7	8.9	7.3	-
O&M building/Sub-station	2.5	-	2.5	-	-	2.5	-	-	-	0.6	0.9	1.0	-	0.6	1.9	-
Collection	7.0	-	7.0	-	-	7.0	-	-	-	3.4	3.1	0.5	-	3.4	3.6	-
Subtotal	**680.1**	**20.0**	**660.1**	**-**	**-**	**680.1**	**-**	**-**	**22.2**	**301.5**	**202.5**	**153.9**	**2.3**	**337.6**	**340.2**	**-**
Land Under Control but Not Currently Planned for Development																
Undisturbed	296.2	104.7	172.5	9.8	9.2	296.2	-	9.2	99.6	32.3	69.4	85.7	41.4	107.2	147.6	-
Grand Total																
Grand Total	**976.4**	**124.6**	**832.7**	**9.8**	**9.2**	**976.4**	**-**	**9.2**	**121.8**	**333.8**	**271.9**	**239.6**	**43.6**	**444.9**	**487.9**	**0.0**

[137] SPA, at Appendix C Agricultural Impact Mitigation Plan, Table 1.

1	Total acres of Project features that are anticipated to be disturbed by supporting construction equipment traffic, excavation, and grading. Data obtained by merging Project facility polygons with the SSURGO spatial data in ArcGIS. Summations were performed in Microsoft[tm] Access.
2	Data available directly from the Natural Resources Conservation Service (NRCS) SSURGO spatial or attribute database via geospatial query of the spatial or attribute data.
3	Representative slope values are taken directly from the SSURGO database. The SSURGO database provides representative slope values for all component soil series. Slope classes represent the slope class grouping in percent that contains the representative slope value for a major component soil series. For example, a soil mapped in the 2-6% slope class has an average slope of 4%, which is within the 0-5% slope range.
4	Drainage class as taken directly from the SSURGO database.
5	Topsoil thickness is the aggregate thickness of the A horizons described in the SSURGO database.
6	Depth to bedrock taken directly from the SSURGO database. Stony/Rocky soils are those soils that have either a cobbley, stony, boulder, shaly, very gravelly or extremely gravelly modifier to the textural class of the surface layer or that have a surface layer with > 5% stones or rocks > 3 inches in any dimension.

Table 8. Farmland Classifications within the Preliminary Development Area[138]

Farmland Classification	Area (acres)	Percent of Preliminary Development Area
Prime Farmland	554.9	81.4%
Prime Farmland if Drained	126.3	18.6%
Farmland of Statewide Importance	0.0	0%
Not Prime Farmland	0.0	0%
TOTAL	**681.2**	**100%**

[138] SPA, at p.66, Table 4.5-3.

- assist in determining if weather events have created "wet weather" conditions and provide recommendations to the construction manager on the ability to proceed with construction; and,
- submit a report of Elk Creek's adherence to soil BMPs to MDA on a weekly basis during the major earthmoving phase of Project construction and upon completion of earthmoving activities.

During the construction of the Project, it is likely that there will be periods of wet weather that may necessitate a temporary halt of construction activities. The Elk Creek Construction Manager will have responsibility for halting activities if weather conditions pose a risk to worker safety or if conditions are such that heavy equipment would cause severe rutting/compaction of the ground.[139]

The DNR recommended that the Applicant consider the establishing of a cover crop several months ahead of construction to stabilize soils prior to construction, thereby minimizing erosion issues. Additionally, construction should be planned for drier, late summer conditions to reduce the likelihood of storm-water related construction challenges.

4.4.3 Prime Farmland

No large electric power generating plant site may be permitted where the developed portion of the plant site, excluding water storage reservoirs and cooling ponds, includes more than 0.5 acres of prime farmland per megawatt of net generating capacity, unless there is no feasible and prudent alternative. Economic considerations alone do not justify the use of more prime farmland.[140]

Therefore, an assessment of the availability of feasible and prudent alternatives is a critical component in the review of any project before the Commission. The Department, along with the Department of Agricultural, has developed a guidance document[141] to assist developers when evaluating potential solar sites relative to the feasible and prudent language in the rule. Since the State of Minnesota has dual mandates to advance solar energy production and protect prime farmland, and due to the inherent difficulties in avoiding prime farmland, the guidance document is meant to assist developers in defining feasible and prudent in relation to siting alternatives and encourage them to build a record early in the site selection process showing whether or not an exception to the prime farmland exclusion is warranted.

Additionally, through the EA scoping process, the Department offers stakeholders an opportunity to propose alternative sites for comparative study if they believe a more "feasible and prudent" site exists.

"Prime farmland" means those soils that meet the specifications of Code of Federal Regulations 1980, title 7, section 657.5, paragraph (a). These provisions do not apply to areas located within home rule

[139] SPA, at Appendix C, Section 4 – BMPs During Construction and Operation.
[140] Minn. Rules 7850.4400, Subpart 4.
[141] Solar Energy Production and Prime Farmland, May 19, 2020. https://mn.gov/eera/web/project-file/11367/

charter or statutory cities; areas located within two miles of home rule charter or statutory cities of the first, second, and third class; or areas designated for orderly annexation under Minnesota Statutes, section 414.0325.

Prime farmland is defined as land that has the best combination of physical and chemical characteristics for producing food, feed, forage, fiber, and oilseed crops, and is also available for these uses (the land could be cropland, pastureland, rangeland, forest land, or other land, but not urban built-up land or water). It has the soil quality, growing season, and moisture supply needed to economically produce sustained high yields of crops when treated and managed, including water management, according to acceptable farming methods. In general, prime farmlands have an adequate and dependable water supply from precipitation or irrigation, a favorable temperature and growing season, acceptable acidity or alkalinity, acceptable salt and sodium content, and few or no rocks. They are permeable to water and air. Prime farmlands are not excessively erodible or saturated with water for a long period of time, and they either do not flood frequently or are protected from flooding.[142]

Elk Creek Solar Farm

As stated above, subject to the "feasible and prudent" exceptions, Minnesota Rules 7850.4400, subpart 4 prohibits large energy power generating plants from being sited on more than 0.5-acre of prime farmland per MW of net generating capacity. Since the Elk Creek Solar Farm's Preliminary Development Area is sited on prime farmland and given the 80 MW net generating capacity of the Project, this rule would allow use of up to 40 acres of prime farmland for the Project if there is a feasible and prudent alternative to the proposed Project. Approximately 554 acres of prime farmland and 126 acres of prime farmland if drained are located within the Preliminary Development Area.

Elk Creek, through its LEPGP site selection and evaluation process,[143] contends that it satisfies the "…*unless there is no feasible and prudent alternative*" prime farmland clause of Minnesota Rules 7850.4400, subpart 4, thus allowing development of the proposed site. In the end concluding that "…there is no area in either county {Rock and Nobles) let alone within an area within five miles of the Magnolia substation, that is conducive to solar development of approximately 700 acres that is not defined as prime farmland."[144]

Elk Creek selected the proposed location based on a number of criteria, these criteria included:[145]

- concentration of solar irradiation;
- proximity to existing electrical and transportation infrastructure;
- avoidance of prohibited and exclusion sites;

[142] https://www.law.cornell.edu/cfr/text/7/657.5.
[143] SPA, at pp. 6-13.
[144] Ibid.
[145] SPA, at p.66, Table 4.5-3.

- landowner interest;
- minimal environmental impact.

As noted in Section 3.1.3 *Project Location*, the greatest concentration of solar irradiation in Minnesota occurs in the southwestern portions of the state. Southwestern Minnesota also has a long history of agricultural activities (**Diagram 17**), in part due to the nutrient rich soil. In Rock County, approximately 91 percent of the soils are classified as prime farmland (**Figure 8**) as defined under 7 CFR 657.5 paragraph (a). In neighboring Nobles County, approximately 92 percent of the soils are classified as prime farmland (**Figure 8**).

During the site evaluation process, the Applicant reviewed parcels within a five-mile radius of the Magnolia Substation (both in Rock and Nobles Counties), taking note to avoid prohibited sites (Minn. Rule 7850.4400 – *Prohibited Sites*) and parcels with environmental constraints.

The Applicant also met with landowners within approximately five miles of the Magnolia Substation to gauge whether there was enough interest from relatively contiguous landowners in voluntarily participating in the Project.

The Applicant is proposing to build its solar facility in Sections 27, 34, and 35, Township 103 North, Range 44 West, Rock County, Minnesota, approximately 1.5 miles north of the Magnolia Substation.

In addition to Elk Creek's position on the provisions of Minnesota Rules 7850.4400, subpart 4, the Applicant has also postulated that conversion of the Preliminary Development Area into non-row-crop uses for the life of the Project may have beneficial environmental impacts ("offsets") such as soil building, erosion control, habitat for wildlife, and protection of groundwater and surface water resources from nitrogen pollution.[146] To that effort Elk Creek has developed an *Agricultural Impact Mitigation Plan* (AIMP) and a *Vegetation Management Plan* (VMP) to identify measures that the Applicant and its contractors can take to avoid, and/or repair potential negative agricultural impacts from the construction, operation, and eventual decommissioning of the Elk Creek Solar Farm; these plans outline measures designed to ensure the land may be returned to future agricultural usages following the closure and decommissioning of the Project.[147]

No alternative sites (see Section 2.3 - *Environmental Review*) were identified during the scoping process for the Elk Creek Solar Project.

[146] SPA, at pp. 6-13.
[147] SPA, at Appendix C – Agricultural Impact Mitigation Plan, p. 1.

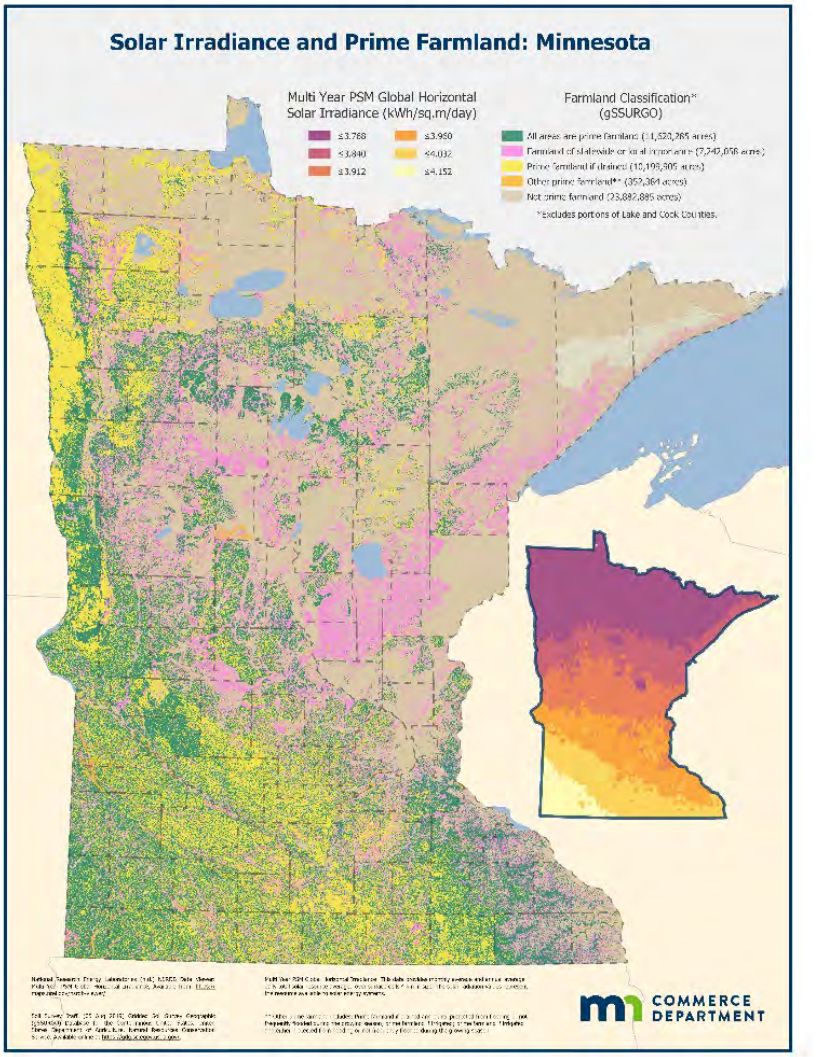
Generic 80 MW Solar Farm

A generic 80 MW solar farm sited elsewhere in Minnesota, if sited in the highly solar productive southwestern portion of the state, would be expected to have similar agricultural/prime farm land impacts.

Generic 80 MW Wind Farm

A generic 80 MW wind farm located elsewhere in Minnesota may have different ecological and environmental features (setting) compared to the proposed Project. However, wind farms are often sited in areas of the state that provide the best wind resources (Diagram 16), which in Minnesota happen to correspond with those areas with the greatest solar irradiation and also tend to be in agricultural areas of the state (Diagram 17).

Diagram 17. Solar Irradiance and Prime farmland



While LWECS (wind farm) sites tend to be larger (on a wind rights basis or what is referred to as the "box") than solar farm sites, the direct on the ground impact (footprint) is much less with a wind farm. As such, generically, a solar farm will have relatively greater impacts on land use and agriculture than a wind farm. Solar farms require 7 to 10 acres of land per MW, while wind farms require about 0.75 acres per turbine or approximately 0.3 acres of land per MW. Accordingly, from a land use perspective wind farm projects are relatively more compatible with agricultural production.

Mitigation

If the site selection assessment results in a determination that the facility is justifiably located within a region of the state that will result in a conflict with the prime farmland exclusion, meaning avoidance of prime farmland is not practical, measures must be implemented to minimize and mitigate the impact to the developed areas. Many of the same mitigation measures described in Sections 4.2.4-Surface Water, 4.2.5-Wetlands, 4.4.2-Soils and 4.4.6-Vegetation, as well as the provisions contained within the AIMP and VMP, would be beneficial to preserving those site characteristics necessary to ensure that the site could be returned to agricultural uses following the closure and decommissioning of the Project.

4.4.4 Wildlife

Wildlife can potentially be impacted by large energy projects. Wildlife such as birds, mammals, fish, reptiles, amphibians and insects, can be permanent or migratory. Many species may utilize the available habitat in and adjacent to a given project's area for forage, breeding and shelter.

Elk Creek Solar Farm

Historically, the proposed Elk Creek Solar Farm site and surrounding region contained a variety of natural communities and habitats that supported diverse species of wildlife. Vegetative cover at the proposed site is dominated by cultivated agricultural field and to a lesser extent by pasturelands; very little remains of the pre-settlement vegetation (tallgrass prairie). As the historic vegetation has been converted to agricultural use (**Figure 9**), the wildlife species that occupy the landscape reflect the changes in habitat type and availability. Land uses in the Land Control Area are primarily agricultural (96.1 percent), with some small amounts of developed areas (3.4 percent), forested land (0.3 percent), and shrubland (0.2 percent). The forested land that is present is generally limited to windbreaks around residences.[148]

The most common species within the site tend to be generalists and are able to utilize rural, urban or agricultural habitats. The predominance of non-native cover types are typically used by common wildlife species that are accustomed to agricultural habitats. Examples of such species would include deer, squirrel, raccoons, mice, voles, common perching birds, red-tail hawks, reptiles and amphibians. It is anticipated that these species' use of the current habitat available in the proposed Preliminary

[148] SPA, at pp. 68-70.

Development Area is largely limited to occasional foraging in the fields and shelter within wooded areas that may surround the fields.

The Land Control Area also has very little open water (five intermittent waterbodies) or wetlands (one PEM wetland); the nearest PWI waterbodies are Champepadan Creek, located approximately 0.4 mile to the north of the Land Control Area; and Elk Creek, located approximately 0.15 mile south of the Land Control Area. Few wetland- or water-dependent birds would be anticipated to use the Land Control Area for nesting. Species of migratory birds associated with grasslands would also be limited or absent; few if any Birds of Conservation Concern (BCC) are likely to use the Land Control Area as habitat.

Habitat fragmentation is also a concern regarding wildlife; certain species are impacted when larger areas of habitat are divided into smaller areas with associated reductions in habitat connectivity. At present, the Land Control Area is highly fragmented given that 99.5 percent is used for agriculture or is developed, therefore it is doubtful that species sensitive to habitat fragmentation occur in the Land Control Area.

Wildlife that resides within the construction zone will likely be temporarily displaced to adjacent habitats during the construction process. The wildlife species found in the Land Control Area do not generally require specialized habitats and are able to find suitable habitat nearby. Comparable habitat is near the site, and it is likely that these animals would only be displaced a short distance. Once restoration of the land is established after construction, the current non-native habitats that are used by habitat generalists will be replaced by a modified habitat that may be attractive to some species and less attractive to species that use the open farm and pasturelands.

Permanent security fencing, compliant with the DNR guidance,[149] will be installed along the perimeter of the solar arrays and Preliminary Development Area. Fencing will be secured to posts which will be directly embedded in the soil or set in concrete foundations as required for structural integrity. Fencing around the facilities may disturb wildlife movement corridors. Although a variety of birds and small mammals, are likely to still be able to gain access to the developed area of the site to use the habitats under and around the solar arrays, access will be limited for larger wildlife.

Plastic erosion control netting is frequently used for erosion control during construction and landscape projects and can negatively impact terrestrial and aquatic wildlife populations as well as get snag in maintenance machinery, resulting in costly repairs and delays. Wildlife entanglement in and death from plastic netting and other man-made plastic materials has been documented in birds, fish, mammals and reptiles.[150]

[149] https://files.dnr.state.mn.us/publications/ewr/commercial_solar_siting_guidance.pdf.
[150] MNDNR. *Wildlife Friendly Erosion Control Fact Sheet.* 2013, http://files.dnr.state.mn.us/eco/nongame/wildlife-friendly-erosion-control.pdf

A National Fish and Wildlife Forensics Laboratory report has identified some avian risks associated with PV facilities.[151] Some birds in the study suffered impact trauma, and related predation. Preliminary findings, based on limited data, suspect the danger is the possible appearance of the facility as a large body of water. Migrating birds may attempt to land, consequently incurring the trauma.

After construction, following site restoration and during operations, the Project site should provide wildlife habitat for those adaptable species (generalists). While 26.1 acres within the Preliminary

Development Area would have permanent facilities (access roads, Project substation, O&M building, and inverters) and would not serve as wildlife habitat during operations, 655.1 acres would be restored as herbaceous cover, including a seed mix with some native plants.

Given the developed (agricultural) nature of the site, impacts to the current wildlife inhabiting to area is expected to temporary and minimal.

Generic 80 MW Solar Farm

As with both the Elk Creek Solar Farm and a generic 80 MW wind farm, impacts to wildlife from a generic 80 MW solar farm depends upon specific site characteristics, it is difficult to assess wildlife impacts for a solar farm without detailed knowledge of the proposed site's environmental setting.

A generic 80 MW solar farm sited elsewhere in Minnesota likely would be sited on agricultural land and similar types of wildlife common to disturbed areas, such as the proposed Elk Creek Solar Farm, along with similar impacts and mitigations.

Should the alternative site be forested rather than agricultural, requiring significant tree clearing, the impacts would be anticipated to be commensurate with the change in ecological setting.

Generic 80 MW Wind Farm

A generic 80 MW wind farm located elsewhere in Minnesota may have different ecological and environmental features (setting) compared to the proposed project. As previously mentioned, wind farms are sited in areas of the state that provide the best wind resources, which generally correspond to the agricultural areas of the southern and southwestern portions of the state.

As is the case with the proposed Elk Creek Solar Farm, the most common species within wind farm sites located in agricultural areas tend to be generalists and are able to utilize rural, urban or agricultural habitats.

[151] USFWS Forensics Lab, *Avian Mortality at Solar Energy Facilities in Southern California: A Preliminary Analysis*, 2014, http://www.ourenergypolicy.org/wp-content/uploads/2014/04/avian-mortality.pdf

The potential for habitat fragmentation impacts as a result of a wind farm in these agricultural areas is low because much of the remaining habitat is disturbed. Turbine placement at wind farm sites are designed to avoid placing turbines and access roads in DNR-mapped native prairie, native plant communities, and sites of biodiversity significance (SOBS).

It can be expected that, similar to other LWECS projects in the southern Minnesota region, there is a high likelihood that individual bird and bat fatalities would occur at a generic 80 MW wind farm project. Estimated bird carcass rates would be expected to be within the range reported from studies at other wind facilities located on agricultural landscapes in southern Minnesota (Table 9).

Table 9. Avian Fatalities Estimates – Huso Estimator[152]

Project Name	Estimated Bird Carcasses/ Megawatt/Year
Odell	4.69
Red Pine	4.47
Lakefield	2.75

Studies of bird fatalities near wind farms indicate that fatalities will occur and that they will vary with bird type (raptor, waterfowl, passerine), habitat availability, and other resources available within the site. Studies looking at avian fatalities caused by wind turbines throughout the United States estimated a fatality range of between 134,000 to 327,000 birds per year.[153]

Bald eagle collisions with wind turbines are of additional concern as bald eagles populations continues to grow and expand throughout Minnesota. Bald eagles are afforded additional protections under the Bald and Golden Eagle Protection Act, which is administered by the USFWS. Wind energy facilities are eligible to apply for Incidental Take Permits and Nest Removal Permits issued by the USFWS, which will allow for the non-intentional take of bald eagles and the removal of bald eagle nests, respectively. Bald eagle incidental take permits and nest removal permits are considered to be voluntary permits, meaning a project proposer must make the determination to pursue a permit based on the respective risk of their project's potential to take a bald eagle.

Bat fatality studies indicate a broad range of fatalities across the United States as a result of wind development. Fatality rates are highest for migrating-tree roosting bat species, with the majority of fatalities occurring during the late summer and early fall migration (roughly July-October). Documented bat fatalities are highest in the eastern United States, while those in the Midwest represent a wide range

[152] Site Permit Application for a LWECS – Plum Creek Wind Farm, at pp. 106 – 109. Docket No. IP6997/WS-18-700.
[153] USFWS. *Migratory Birds Program. Wind Turbines*, https://www.fws.gov/birds/bird-enthusiasts/threats-to-birds/collisions/wind-turbines.php

of fatality rates. Post-construction fatality studies completed in Iowa, Minnesota and Wisconsin show bat fatality estimates ranging from 1 to 24 bats/MW/year.[154]

It is presumed that projects in areas with similar habitat and cover types would have similar fatality rates, depending on migration patterns, known roosting and foraging areas, and hibernacula. However, bat migration routes and behavioral patterns are poorly understood and there is a lack of comparative studies of bat fatalities from wind facilities, making it difficult to determine fatality rates at regional levels much less at broader scales. Estimated bat carcass rates at a generic 80 MW wind farm located elsewhere in Minnesota would be expected to be within the range reported from studies at other wind facilities in the region (Table 10).

Table 10. Bat Fatalities Estimate – Huso Estimator[155]

Project Name	Estimated Bat Carcasses/ Megawatt/Year
Odell	6.74
Red Pine	2.68
Lakefield	19.97

Bat species present in Minnesota include the hoary bat, eastern red bat, big brown bat, silver-haired bat, tri-colored bat, little brown bat, northern long-eared bat, and evening bat. The northern long-eared bat is federally listed threatened and state listed as special concern. The big brown bat, little brown bat, and tri-colored bat are also listed as special concern.

Mitigation

Many of the following mitigative strategies can be applied to both solar and wind farm projects.

Siting of solar farms in locations that avoid or minimize impacts to known wildlife movement corridors can minimize impacts to wildlife. The Site Permit issued by the Commission for solar farms can require that Biological and Natural Resource Inventories include identification of any known wildlife movement corridors.

Planting wildflower meadows and restoring natural grasslands in the "unused" margins between solar panel rows to attract insects, bees, and butterflies to the sites may provide food and nesting spots for birds.

[154] National Wind Coordinating Committee. *Wind Turbine Interactions with Birds, Bats, and their Habitats*, (2010) https://www1.eere.energy.gov/wind/pdfs/birds_and_bats_fact_sheet.pdf

[155] Site Permit Application for a LWECS – Plum Creek Wind Farm, at pp. 106 – 109. Docket No. IP6997/WS-18-700.

The MNDNR recommends that border fencing surrounding solar facilities avoid the use of barbed wire and instead topping the fence with one foot of 3-4 strands of smooth wire to prevent wildlife from injury (primarily deer).

Avoiding the use of photodegradable erosion-control materials where possible and using biodegradable materials (typically made from natural fibers) instead, preferably those that will biodegrade under a variety of conditions, can minimize the impact to wildlife. The Site Permit could include the use of these materials as a standard condition or as a special condition.

Checking open trenches and removing trapped turtles before filling trenches can minimize impacts to turtles.

Wildlife mitigation strategies for wind farm sites generally incorporate a combination of micro-siting and best management practices, including among other efforts, the placing of turbines and project infrastructure outside of sensitive areas (native prairies, native plant communities, SOBS). Common mitigative measures used at wind farms include:

- Prioritize turbine siting in cultivated cropland.
- Avoid siting turbines in mapped native prairie, native plant communities, and SOBS (all ranks).
- Maintain, at a minimum, the three by five times the RD setback from adjacent WMAs and WPAs to reduce risk to waterfowl/waterbirds and grassland-associated birds when siting turbines.
- Avoid siting turbines within a 1,000-foot habitat connectivity buffer of forested areas associated with aquatic environments.
- Avoid or minimize disturbance of individual wetlands or drainage systems during Project construction. Wetland delineations should be conducted prior to construction to identify the limits of wetland boundaries in the vicinity of project activities.
- Conduct one year of post-construction project monitoring for birds and bats 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 an Avian and Bat Protection plan (ABPP) during construction and operation of the project for minimizing impacts to avian and bat species during construction and operation of wind energy projects.
- Feather turbines, up to the manufacturer's standard cut-in speed, from one-half hour before sunset to one-half hour after sunrise, from April 1 to October 31, of each year of operation through the life of the project.
- Prepare and implement a Native Prairie Protection Plan.

High wind conditions reduce bird and bat flight activity. Wind turbines require a minimum wind speed (cut-in speed) for operation. Impacts to birds and bats could be mitigated by "feathering" or locking the turbine blades up to the manufacture's designated cut-in speed, or by increasing the cut-in speed during periods of high activity. Curtailment of turbines has been found to effectively reduce bat fatalities by a minimum of 50 percent by raising operational cut-in speeds.[156] Recently issued site permits by the Commission for wind farms have included curtailment provisions.

4.4.5 Rare and Unique Natural Resources

Construction of large energy producing facilities have the potential to negatively impact individual plants and animals or might alter their habitat so that it becomes unsuitable for them. For example, trees used by rare birds for nesting might be cut down, soil disturbance from construction activities may destroy rare plant species or communities, or soil erosion may degrade rivers and wetlands that provide required habitat.

Endangered species are species whose continued existence is in jeopardy. Threatened species are likely to become endangered. Species of special concern have some problems related to their abundance or distribution, although more study is required.

The DNR Division of Ecological and Water Resources manages the Natural Heritage Information System (NHIS) which provides information on Minnesota's rare and sensitive species. The NHIS is continually updated as new information becomes available and is the most complete source of data on Minnesota's rare or otherwise significant species, native plant communities and other natural features. Its purpose is to foster better understanding and conservation of these features.[157]

[156] https://www.energy.gov/sites/prod/files/2015/03/f20/Operational-Mitigation-Synthesis-FINAL-REPORT-UPDATED.pdf.
[157] https://www.dnr.state.mn.us/nhnrp/nhis.html.

The USFWS Information for Planning and Conservation (IPaC) website is a project planning tool which aids in the streamlining the USFWS environmental review process. IPaC is available to everyone, whether private citizens or public employees, who need information to assist in determining how their activities may impact sensitive natural resources, and who would like to obtain suggestions for ways to address these impacts. IPaC is also designed to assist the USFWS who is charged with evaluating such impacts.[158]

In addition to rare and sensitive species, the DNR also maps Sites of Biological Significance (SOBS), rare and unique plant communities (prairie) and higher quality examples of more common plant communities (wet meadow).[159] The Minnesota Biological Survey (DNR) designates and assigns rankings to SOBS, based on landscape context, native plant community, and occurrence of rare species populations.[160] There are four biodiversity significance ranks: outstanding, high, moderate, and below.

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. Approximately 250,000 acres of native prairies ranked good to excellent remain in Minnesota.[161]

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.[162]

Some areas of the state have not been surveyed extensively or recently, so the NHIS database cannot be relied upon as a sole information source for rare species. Nevertheless, the NHIS database provides a starting point for anticipating potential impacts to rare and unique natural species and communities.

Critical habitat is specific geographical areas designated by the USFWS with biological and physical features that are essential to the recovery of the species. Critical habitat may be occupied or unoccupied at the time of designation. Critical habitat is protected against destruction or adverse modification under Section 7 of the ESA during actions that are funded, permitted, or implemented by a federal agency.[163]

Elk Creek Solar Farm

The Applicant reviewed the USFWS-IPaC website and the DNR-NHIS data bases for federal and state listed species, candidate species and species of concern, and designated or proposed critical habitat that may be present within the Land Control Area, including a one mile buffer (**Figures 10**).[164] Based on Elk

[158] https://ecos.fws.gov/ipac/.
[159] https://www.dnr.state.mn.us/eco/mcbs/biodiversity_guidelines.html.
[160] https://www.dnr.state.mn.us/mbs/index.html
[161] https://www.dnr.state.mn.us/rys/pg/dryprairie.html
[162] https://www.dnr.state.mn.us/npc/index.html
[163] https://www.fws.gov/endangered/what-we-do/critical-habitats.html.
[164] SPA, at pp.70-78.

Creek's review, there was two special concern (Northern long-eared bat and Topeka Shiner), two threatened (Plains Topminnow and Prairie Bush Clover), and one endangered (Western Prairie Fringed Orchid) species recorded within the search area (Table 11).[165]

According to Elk Creek's review of the USFWS IPaC, four species that are listed as threatened or endangered under the federal Endangered Species Act (ESA) may occur in Rock County, Minnesota: northern long-eared bat (NLEB) (*Myotis septentrionalis*), Topeka shiner (Notropis topeka), prairie bush clover (*Lespedeza leptostachya*), and western prairie fringed orchid (*Platanthera praeclara*). In addition to these four federally listed species, there is designated critical habitat for the Topeka shiner in Rock County.

Northern Long-eared Bat. The NLEB is listed as threatened under the ESA. It is medium-sized bat species that occurs across the eastern and central U.S. The annual life history of the NLEB includes an inactive period when the species is hibernating and an active period when the species forages, raises its young, and breeds. Hibernation generally occurs in caves and mines between November 1 and March 31. In April, the species emerges from its hibernacula and moves to summer habitat. NLEB typically forage on flies, moths, beetles, caddisflies, and other insects in the understory of wooded areas. Adult females form breeding or maternity colonies that are variable in size, ranging from a few individuals to as many as 60 adults. During the summer, the species roosts in live and dead trees in cavities and crevices and under bark. The NLEB forages primarily in forested areas. The NLEB is currently declining due to a disease that affects hibernating bats called white-nose syndrome.[166]

The Land Control Area is primarily agricultural lands with only a small area of forested habitat (0.3 percent); the landscape surrounding the Land Control Area is also dominated by agriculture. During their active season (April 1 through October 31), NLEB may roost in the trees within the Land Control Area.

Records of documented hibernacula and roost trees are maintained in the MNDNR's NHIS. Based on the Applicant's review of NLEB NHIS records, no documented NLEB maternity roost trees within 150 feet of the Land Control Area or documented hibernacula within 0.25-mile of the Land Control Area. Although there are no records of NLEB, the species may still be present in the Land Control Area.

It is not anticipated that the Project will impact NLEB during construction or operations. Construction of the Project will not require tree clearing; NLEB may be temporarily disturbed during construction activities due to human presence or noise if they are roosting in the trees within the Land Control Area, but it is anticipated that any impacts due to noise and human presence would be insignificant.

[165] Ibid.
[166] SPA, at pp.70-78.

Table 11. Federal and State Listed Species Documented within One Mile of the Land Control Area[167]

Common Name	Scientific Name	Habitat	Within One Mile of Land Control Area	Within Land Control Area	Status a	
					State b	Federal c
Mammals						
Northern long-eared bat (NLEB) d	*Myotis septentrionalis*	In winter, hibernates in caves and mines. In fall, swarms in forested areas surrounding hibernation sites. During late spring and summer, forages and roosts in upland forests (USFWS, 2018b)	No	No	SC	T
Fish						
Topeka Shiner	*Notropis topeka*	Pools and runs in small to mid-size prairie streams (USFWS, 2019b)	Yes	No	SC	E & CH
Plains Topminnow	*Fundulus sciadicus*	Backwaters and pools of creeks and rivers with aquatic plants and a rocky or sandy bottom (MNDNR, 2019e)	Yes	No	T	None
Plants						
Prairie Bush Clover	*Lespedeza leptostachya*	Dry to mesic tallgrass prairies with gravelly soils (USFWS, 2009)	No	No	T	T
Western Prairie Fringed Orchid	*Platanthera praeclara*	Primarily mesic to wet unplowed tallgrass prairies. Less often in old fields and roadside ditches (USFWS, 2019c)	No	No	E	T

a E = Endangered, T = Threatened, SC = Special Concern, CH = Critical Habitat; b MNDNR, 2013; MNDNR, 2019d; cUSFWS, 2019a

d Elk Creek's review of the NHIS did not indicate any records of the NLEB, western prairie fringed orchid, or prairie bush-clover within a mile of the Land Control Area or within the Land Control Area; however, review of the USFWS' IPaC indicated that these three species have the potential to occur in Rock County.

[167] SPA, at p. 71, Table 4.5-4.

Topeka Shiner. Topeka shiner (*Notropis topeka*) occur in small to mid-size prairie streams in the southwestern Minnesota. The species has been documented in the Rock River and its tributaries and tributaries to the Big Sioux. Streams inhabited by Topeka shiner are slow-moving, low-gradient, and winding with sand, rubble, or silt-covered gravel substrates. They often live in the pool areas of the streams.[168]

The Land Control Area is primarily agricultural lands with no perennial streams. Thus, no Topeka shiner are expected within the Land Control Area. The DNR NHIS review confirmed records of Topeka shiner within one mile of the Land Control Area.

In Minnesota, Topeka shiner critical habitat is located throughout the Rock River and Big Sioux River watersheds. The nearest streams with designated critical habitat to the Land Control Area are Elk Creek, which is 0.15 mile southeast of the Land Control Area, and Champepadan Creek, which is 0.4 mile north of the Land Control Area. The physical and biological features that are essential to Topeka shiner recovery and that characterize the species' critical habitat include the following: "space for individual and population growth, and for normal behavior; food, water, air, light, minerals, or other nutritional or physiological requirements; cover or shelter; sites for breeding, reproduction, rearing (or development) of offspring; and habitats protected from disturbance or that are representative of the historic geographical and ecological distribution of the species".[169]

Habitat for Topeka shiner is not present in the Land Control Area. No direct impacts from the Project on Topeka shiner critical habitat are anticipated because the critical habitat does not intersect the Land Control Area.

Prairie Bush Clover. The federally threatened prairie bush clover (*Lespedeza leptostachya*) is a tallgrass prairie endemic native to the upper Mississippi River Valley. Its current range is limited to discrete locations in Minnesota, Illinois, Iowa, and Wisconsin. The species flowers in mid-July to early August producing pale-pink flowers arranged loosely on an open spike. Prairie bush clover occurs on dry- mesic prairies with gravelly soils on north-, northeast- or northwest-facing slopes in southwestern Minnesota. Remaining occurrences of the species are generally restricted to remnant prairies; in Minnesota, most populations occur in prairies that were formerly or are currently pasture. The primary threat to the species is habitat loss and destruction.[170]

The Land Control Area is dominated by agriculture (96.1 percent) with small amounts of developed lands (3.4 percent) and forested areas (0.3 percent). There is no prairie within the Land Control Area; no

[168] SPA, at p. 71.
[169] SPA, at pp.70-78.
[170] Ibid.

impacts on prairie bush clover are expected during Project construction and operations because no tallgrass prairie habitat is present within the Land Control Area.[171]

Western Prairie Fringed Orchid. Western prairie fringed orchid occurs in mesic to wet tallgrass prairies and sedge meadows, although the species has also been documented in roadside ditches and old fields. The species is pollinated primarily by hawkmoths that are attracted to the orchid's nocturnally fragrant flowers. Adequate nutrition and water uptake are dependent on a symbiotic relationship between the orchid's root system and a fungus within the soil. The species' primary threat has been conversion of its prairie habitats to cropland.[172]

The majority of the Land Control Area is used for agriculture, specifically row crops; no prairie habitat or old fields are present. Some roadside ditches are present along the perimeter of portions of the Land Control Area. No western prairie fringed orchids were observed during wetland delineations at the Project.[173] Due to the limited habitat available in the Land Control Area, impacts on western prairie fringed orchid are not anticipated.

State listed species with documented occurrences within one mile of the Land Control Area are shown in Table 11. Based on the Applicant's NHIS review, there are no records of state listed species within the Land Control Area. Within one mile of the Land Control Area, there are three records of the Topeka shiner, a state species of concern, and one record of the plains topminnow (*Fundulus sciadicus*), a state threatened species.[174]

Plains topminnows occur in backwaters and pools of creeks and rivers with aquatic plants and a rocky or sand bottom. The plains topminnow lives in small schools or independently; its prey includes ostracods, larval blackflies and midges, and small snails. No rivers or streams are located in the Land Control Area; no impacts on the plains topminnows are anticipated.

Rare Species and Native Plant Communities. This includes records of federal and state-listed species tracked by the DNR in the NHIS database. Additionally, the DNR has classified NPCs within the state using plant species, soils, and other site-specific data from vegetation plots.[175] 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.[176]

[171] SPA, at p. 71.
[172] Ibid.
[173] SPA, at pp.70-78.
[174] Ibid, and Appendix A.
[175] https://www.dnr.state.mn.us/rys/pg/npc.html.
[176] Ibid.

Based on the Applicant's review of the DNR's data, there are no NPCs or mapped native prairie within the Land Control Area.[177]

The DNR's Minnesota Biological Survey (MBS) assesses Minnesota landscapes for NPCs, rare animals, rare plants, and animal communities through desktop review and follow-up field survey. Based on this assessment, MBS designates and assigns rankings to SOBS, based landscape context, NPC, and occurrence of rare species populations. The MBS groups and ranks SOBS for each Minnesota's system subsections for the purpose of designating and cataloguing the state's most notable examples of NPCs and rare species.

Based on the Applicant's review of the DNR's data, there are no SOBS within the Land Control Area.[178]

Native Prairie. Native prairie is defined as a grassland that has not been plowed with plant species typical of prairies. The DNR's railroad prairie rights-of-way are 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. The DNR ranks railroad rights-of-way into three categories: very good, good, and fair.[179]

There is no DNR-mapped native prairie in the Land Control Area.[180]

Generic 80 MW Solar Farm

As with both the Elk Creek Solar Farm and a generic 80 MW wind farm, impacts to Rare and Unique Natural Resources from a generic 80 MW solar farm depends upon specific site characteristics, it is difficult to assess these impacts for a solar farm without detailed knowledge of the proposed site's environmental setting.

Generic 80 MW Wind Farm

Because impacts to Rare and Unique Natural Resources would depend upon specific site characteristics, it is difficult to assess these impacts for a generic 80 MW wind farm located elsewhere in Minnesota. As discussed in the previous section (3.3.4.3 - *Wildlife*), impacts to birds and bats are the primary concern with wind projects, and less so indirect impacts to habitat due to the smaller footprint.

Mitigation

The mitigative measures described Section 3.3.4.3 - *Wildlife* and Section 3.3.4.5 - *Vegetation* are also applicable to minimizing impacts to sensitive species. Avoidance of identified areas of biological

[177] SPA, at pp.70-78.
[178] Ibid.
[179] https://www.dnr.state.mn.us/privatelandhabitat/prairie-habitat.html.
[180] SPA, at pp.70-78.

significance and rare species is the most effective mitigation strategy to limit direct impacts to the sensitive natural resources. Indirect impacts are handled through proper use of BMPs and compliance with the AIMP and VMP.

The Site Permit should require field surveys of sensitive biological areas. Information from field surveys would be used to identify areas to be avoided in final site design. Areas to be avoided are typically marked in site plans in order to minimize the potential for inadvertent incursions into these areas during the construction phase.

Planting wildflower meadows and restoring natural grasslands in the "unused" margins between solar panel rows to attract insects, bees, and butterflies to the sites may provide food and nesting spots for birds.

4.4.6 Vegetation

Construction and operation of LEPGPs may cause short-term and long-term impacts to vegetation. Short-term impacts are associated with construction; once the construction activity (temporary lay-down areas, grading and excavation of soils, trenching for electric feeder/collector lines, etc.) is completed the disturbed area can be returned to pre-construction conditions. Long-term impacts include those which are permanent in nature and are usually associated with the construction site of individual components such as piers for the solar arrays and turbine towers and associated facilities (collector and feeder lines, access roads, and O&M building).

Construction activities could potentially lead to introduction of noxious weeds and invasive species through ground disturbance, extended periods of exposed soils, the introduction of topsoil contaminated with weed seeds, vehicles importing weed seed from a contaminated site to an uncontaminated site, and conversion of land cover types, particularly from forested to open settings. Invasive species and noxious weeds out-compete native plants, alter species composition and natural communities, and diminish ecosystem functions.

Maintenance and emergency repair activities could also result in direct impacts to vegetation from removal of vegetation, localized physical disturbance, and soil compaction caused by the use of equipment. Such impacts on vegetation would be short-term and more localized than construction-related impacts.

Elk Creek Solar Farm

Based on the United States Geological Society's National Land Cover Database, land cover in the Project area is primarily agricultural land (**Figure 9**), which account for 96.1 percent of the land cover in the Land Control Area. Forested land within the Land Control Area consists of an isolated block of trees serving as a shelter belt or wind break around a farmstead in an agricultural field.

Agricultural land within the Preliminary Development Area will be converted from an agricultural use to solar energy use for the life of the Project and will be converted to open, herbaceous (within the racking area) cover with the exception of the substation and O&M building, inverter skids, and access roads which will be converted to developed land and impervious surfaces (23.8 acres). The Project has been designed to avoid any tree clearing.

The primary impact from construction of the Project would be the cutting, clearing, and removal of existing vegetation within the Preliminary Development Area. The degree of impact would depend on the type and amount of vegetation affected, the rate at which the vegetation would regenerate after construction (restoration), 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, and a temporary local reduction in available wildlife habitat.

Generic 80 MW Solar Farm

As with a wind farm impacts to vegetation from solar farm development depend upon site-specific characteristics; it is difficult to assess the degree and ecological significance of vegetative impacts for a solar farm without knowledge of the land cover types, topography, and general environmental setting of a hypothetical project site. During the site preparation phase for utility-scale solar facilities, developers often grade land (cut and fill) and remove all vegetation to minimize installation and operational costs, prevent plants (including crops) from shading panels, and minimize potential fire or wildlife risks.

Ground-mounted PV solar farms require approximately 7 to 10 acres per MW; the North Star 100 MW solar farm project occupies approximately 800 acres, of which approximately 170 acres required grading (i.e., cut and fill).[181] Given the larger footprint required for solar farms, it would be expected that the impacts to vegetation would be greater than that for a comparable capacity wind farm.

Generic 80 MW Wind Farm

The potential impacts to vegetation, including native prairie, native plant communities, and sites of biodiversity significance, are difficult to assess for a generic 80 MW wind farm located elsewhere in Minnesota without a full understanding of the specific project's environmental setting and site specific information.

While LWECS (wind farm) sites tend to be larger (on a wind rights basis or what is referred to as the "box") than solar farm sites, the direct footprint on the ground impact to vegetation would be expected to be much less with a wind farm.

[181] *North Star Solar EA*

Mitigation

In both solar farm and wind farm projects have the potential to impact vegetation and can be mitigated by using BMPs and standard construction practices to minimize soil erosion (including the prompt revegetation of disturbed soils) and micro siting of the various project components and infrastructure to avoid sensitive plants and plant communities.

Preparation and development of a Vegetation Management Plan, in consultation with resources agencies (DNR[182] and BWSR[183]), is a common requirement of Commission issued site permits. If sensitive plants or communities are identified during plant surveys, individual avoidance (micro siting) and minimization measures would be evaluated by the appropriate resource agencies.

Continuing mitigation measures to reduce the spread of nonnative plant species during construction should be employed and include: regular, frequent cleaning of construction equipment and vehicles; minimization of ground disturbance to the greatest degree practicable and rapid revegetation of disturbed areas with native or appropriately certified weed-free seed mixes; conducting field surveys prior to construction to identify areas that currently contain noxious weed; attending to new infestations of noxious weed within the project areas by identifying and eradication as soon as practicable in conjunction with property owners input.

The impacts arising from the common site preparation practice of removing vegetation from solar farm sites can be minimized in certain circumstances by co-locating solar farms with agricultural operations (harvestable crops, grazing, and apiary).[184] There have been successful examples where solar facilities are co-located with these type of agricultural operations.

4.5 Human and Social Environment

Large electric power generating plants have the potential for effects real or perceived on a local area, including impacts to human, community and social environments. The human setting into which a LEPGP project is being proposed will determine the overall potential impacts that may be experienced by the host community.

4.5.1 Land Use and Zoning Compatibility

[182] https://files.dnr.state.mn.us/publications/ewr/commercial_solar_siting_guidance.pdf.
[183] https://bwsr.state.mn.us/minnesota-habitat-friendly-solar-program.
[184] Macknick et al. (2013).*Overview of Opportunities for Co-Location of Solar Energy Technologies and Vegetation*. National Renewable Energy Laboratory, NREL/TP-6A20-60240.

Zoning is a regulatory tool used by local governments (counties, cities and some townships) to geographically restrict or promote certain types of land uses. Minnesota statutes provide local governments with zoning authority to promote the public health and general welfare.

Large electric power generating plants are subject to permitting under Minnesota's Power Plant Siting Act (PPSA). With respect to the role of state permitting of these facilities, Minnesota Statute 216E.10, subdivision 1 states:

> *To assure the paramount and controlling effect of the provisions herein over other state agencies, regional, county, and local governments, and special purpose government districts, the issuance of a site permit or route permit and subsequent purchase and use of such site or route locations for large electric power generating plant and high-voltage transmission line purposes shall be the sole site or route approval required to be obtained by the utility. Such permit shall supersede and preempt all zoning, building, or land use rules, regulations, or ordinances promulgated by regional, county, local and special purpose government.*

Although LEPGPs permitted through the PPSA are not required to seek permits or variances from local government to comply with local zoning, impacts to local zoning are clearly an impact to current and planned human settlement, and the Commission considers impacts to human settlement as a factor in its siting decision.

Elk Creek Solar Farm

The Elk Creek Solar Farm is set within the rural landscape of Rock County, with the primary land use in the Land Control Area being agricultural (96.1 percent). The remainder of the Land Control Area consists of developed land (3.4 percent) and a small amount of forested land (0.3 percent) and shrubland (0.2 percent). Most of the agricultural land in the Land Control Area is subject to row-crop agriculture, such as corn and soybeans. The forested lands within the Land Control Area consists mainly of woodlot shelterbelts associated with former farmsteads. The small area (1.6 acre) of shrubland within the Land Control Area is associated with roadside ditches. There are no wetlands or open water identified in the Land Control Area.

Table 12 lists the land use within the Land Control Area; Figure 9 illustrates the U.S. Geological Survey (USGS) Gap Analysis Program (GAP) data for the Project site.

Farmsteads are thinly dispersed throughout this portion of Rock County, commonly situated near public roads; there are four residences located on parcels adjacent to the Land Control Area. However, the Project will not cause the displacement of any residences.

The development of the Elk Creek Solar Farm would change the land use within the Preliminary Development Area from an agricultural use to an industrial use for at least 25 years. After its useful life, the development area could be restored for use as agricultural or other planned land uses. This

conversion of agricultural land into a solar farm will have a minimal impact on the rural character of the surrounding area or Rock County. Of the 309,120 acres in Rock County, approximately 90 percent (approximately 280,537 acres) are classified as agricultural land; impacts to the 670.0 acres of agricultural land within the Project's Preliminary Development Area would reduce the amount of agricultural land in the county by less than one percent.

No other development plans have come to light for the immediate area for which the Project would serve as an impediment.

Based on Rock County zoning data, the Land Control Area is zoned as general agricultural; Rock County does have a Renewable Energy Ordinance that governs the development of large solar energy systems within the general agricultural district through a conditional use permit. While the Rock County Renewable Energy Ordinance applies to solar energy systems that are not otherwise subject to siting and oversight by the State of Minnesota under the PPSA, the Applicant has applied the county standards to the Project where practicable. Compliance with the intent of local ordinances ensures compatibility with land use planning, resulting in a minimization of impacts.

Table 12. Land Use within the Land Control Area and Preliminary Development Area[185]

Land Use Type	Acres in Land Control Area	Percent of Total Acreage
Agricultural	938.4	96.1%
Developed	33.0	3.4%
Forested	2.9	0.3%
Shrubland	1.6	0.2%
Total	**975.9**	**100.0%**
Land Use Type	**Acres in Preliminary Development Area**	**Percent of Total Acreage**
Agricultural	670.1	98.4%
Developed	10.6	1.5%
Forest & Woodland	0.0	0.0%
Shrubland	0.6	<0.1%
Total	**681.2**	**100.0%**

Generic 80 MW Solar Farm

A generic 80 MW solar farm would require a site permit from the Commission. Although the Commission permit supersedes local zoning, applications for a site permit for a generic 80 MW solar farm sited elsewhere in Minnesota would be reviewed for compatibility with local land uses.

[185] SPA, at p. 51, Tables 4.2-6 and 4.2-7.

Generic 80 MW Wind Farm

Minnesota Statutes Chapter 216F covers the permitting and approval requirements for LWECS, which are defined as any combination of wind energy conversion systems with a combined nameplate capacity of 5 MW or more. The Public Utilities Commission has authority to permit LWECS projects. A site permit from the PUC is required to construct a Large Wind Energy Conversion System (LWECS).

Small Wind Energy Conversion System (SWECS), those under 5 MW, are not covered by the chapter and local governments are free to establish requirements for siting and construction of those systems.[186]

LWECS between five and 25 megawatts can, in lieu of PUC permitting, be permitted according to local ordinances if the applicable counties assume permitting responsibility and provide notice to the PUC.[187] This assumption requires a county board resolution and notice to the PUC. Counties must incorporate PUC-prescribed general permit standards in all permits they issue. Statute provides that "The general permit standards shall apply to permits issued by counties and to permits issued by the commission for LWECS with a combined nameplate capacity of less than 25 MW." The PUC or a county may grant a variance from a general permit standard if the variance is found to be in the public interest.

Minnesota Statute 216F.081, provides that a county may adopt by ordinance standards for LWECS that are more stringent than the PUC's General Permit Standards. The PUC must consider and apply these more stringent standards in its consideration of permit applications for LWECS in that county, unless it finds good cause not to do so. However, a county only has the authority to adopt ordinances covering the siting of LWECS if it assumes responsibility for processing applications for LWECS from 5 to less than 25 MW pursuant to 216F.08.

Minnesota Statute 216F.07 provides that a permit under this chapter is the only site approval required for an LWECS and that this site approval supersedes and preempts local ordinances. Thus, while local governments are free to adopt ordinances for SWECS with whatever requirements they deem appropriate, the state is not bound by these in its siting of LWECS.

That said, the PUC invite and encourage local governments to comment on LWECS applications, including comments on potential conflicts with adopted comprehensive plans and zoning ordinances. The state strives to build as robust a record as possible to insure that all concerns are evaluated and decision-making is sound.

A well planned and sited wind farm should account for local land use and planning during the design phase and include known setback requirements in the project layout.

[186] Minnesota Statute 216F.02.
[187] Minnesota Statute 216F.08.

Mitigation

No mitigation is proposed for the Elk Creek Solar Farm in regards to zoning. The solar farm is a conditionally permitted use in Rock County and the Project is compatible with existing land use and zoning. The Applicant Creek has stated that it plans to comply with the Rock County setbacks for large solar energy systems.[188]

Meeting all set back requirements and properly siting a wind farm in areas zoned for wind mitigates impacts to zoning. The identification and evaluation of "alternate turbine locations" within the development plans of a LWECS provide some flexibility in micro-siting and if necessary, can be used to mitigate specific issues should they arise at a given turbine location.

4.5.2 Demographics and Socioeconomics

Broadly defined, demography is the study of the characteristics of populations through statistical data. It provides a description of a population and how those characteristics change over time. Where there are foreseeable impacts, the incorporation of demographic data into environmental review may be useful in the evaluation of these potential impacts to the host community. These impacts may be beneficial or adverse. The discussion should address whether any social group is disproportionally impacted and identify possible mitigation measures to avoid or minimize any adverse impacts.

Socioeconomics is an umbrella term used to describe aspects of a project that are either social or economic in nature, or a combination of the two. A socioeconomic analysis evaluates how elements of the human environment such as population, employment, housing, and public services might be affected by the proposed action and alternative(s).

Large electric power generating facilities, such as utility scale solar and wind projects, which are generally sited in rural, less densely populated regions in Minnesota, would be anticipated to have similar socioeconomics impacts. These projects often provide similar tax revenues via energy production taxes to local governments and communities.

Elk Creek Solar Farm

The Elk Creek Solar Farm site is located in southwestern Minnesota (Economic Development Region 8) in a rural agricultural region in Rock County (Vienna Township). The 2010 census population for Rock County was 9,687, while the U.S. Census 2019 American Community Survey (ACS) population estimate for Rock County was 9,315, representing a decrease of approximately 3.8 percent.[189] The 2010 census population for Minnesota was 5,303,925, while the U.S. Census 2017 population estimate for Minnesota was 5,577,487.

[188] SPA, at p. 51.

[189] https://www.census.gov/quickfacts/fact/table/rockcountyminnesota/BZA110217.

There are no incorporated communities located within the Land Control Area. The closest incorporated communities to the Land Control Area are Magnolia (1.5 miles south), Kenneth (3.0 miles north/northwest), Luverne (4.5 miles southwest), Hardwick (5.6 miles northwest), and Adrian (6.9 miles southeast). The nearest metropolitan area is Sioux Falls, South Dakota which is approximately 29 miles southwest of the Project.

Table 13 provides selected population characteristics for Rock County.

Table 13. Selected Population Characteristics for Rock County[190]

State/County	Total Population (2010)	Vacant Housing Units	Per Capita Income	Individuals Below Poverty Level (percent)	Unemployment Rate (percent)
Minnesota	5,303,925	259,974	$34,712	10.5	4.3
Rock	9,687	344	$29,000	11.0	1.9

The per capita income of Rock County is $29,000, which is lower than the state average. The unemployment rate in Rock County (1.9 percent) is significantly lower than the state average of 4.3 percent. The percentage of individuals classified as living below the poverty level (11 percent) in Rock County is similar to the state average of 10.5 percent. The primary industries in Rock County are classified as educational services, health care, and social assistance (25.8 percent), followed by retail trade (12.1 percent), and manufacturing (11.2 percent).

There are approximately 344 vacant housing units in Rock County.[191] In Sioux Falls, South Dakota, there are approximately 4,576 vacant housing units.[192] There are approximately 58 hotels and motels, three bed and breakfasts, and five campgrounds available in the greater Sioux Falls area.[193] These residence and temporary housing statistics suggest the local area could support an influx of construction workers.

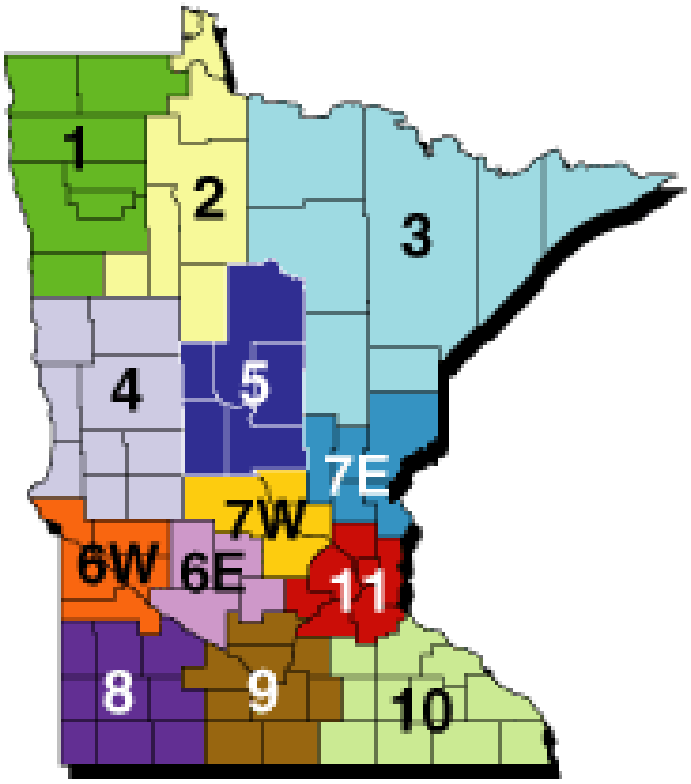
The local economic benefit of construction-period wages is difficult to quantify, and the conclusions drawn can vary depending on the assumptions made to conduct the economic model. Site-specific variables are also relevant, including the availability of local labor and the extent to which the construction contractor recruits and hires the local labor that is available.

Economic Development Region 8 (Diagram 18) had an annual average labor force count of just over 64,000 workers through 2018. In line with the region's population decline, Region 8 has lost about 2,350 workers since 2000; and is down from a peak of 68,343 workers in 2001. While previous jumps in labor

[190] SPA, at p. 49, Table 4.2-5.
[191] https://www.census.gov/newsroom/press-kits/2018/acs-5year.html.
[192] Ibid.
[193] SPA, at p. 48.

force size coincided with recessions (in 2001 and 2007-2009), the recent rise from 2014 to 2015 happened during better economic times. However, the labor force has been shrinking again in recent years. With low unemployment rates, the labor market in Region 8 is now extremely tight, with just 1,925 unemployed workers actively seeking work in 2018, down from a peak of nearly 4,000 workers in 2009 and 2010.[194]

Diagram 18. Economic Development Region[195]



According to commuting data from the Census Bureau, Region 8 is a net labor exporter, having more workers than available jobs. In sum, 43,624 workers both lived and worked in Region 8 in 2017, while another 12,968 workers drove into the region from surrounding counties for work, compared to 13,553 workers who lived in the region but drove elsewhere for work.

Household incomes were significantly lower in Region 8 than the rest of the state. The median household income in Region 8 was $53,051 in 2017, compared to $65,699 in Minnesota. Almost half (47.1 percent) of the households in the region had incomes below $50,000 in 2017, compared to just 37.8 percent statewide. Another 34 percent of households earned between $50,000 and $100,000 in the

[194] https://mn.gov/deed/assets/rp_edr8_2019_tcm1045-133260.pdf
[195] Ibid.

region. In contrast, only 19.1 percent of households in Region 8 earned over $100,000 per year, compared to 29.7 percent of households statewide.[196]

The median hourly wage for all occupations in Region 8 was $17.66 in the first quarter of 2019, which was the third lowest wage level of the 13 economic development regions in the state. Region 8's median wage was $3.29 below the state's median hourly wage, and over $5.00 below the median hourly wage in the 7-County Twin Cities metro area, which would amount to $10,650 per year for a full-time worker. Region 8 had slightly lower wages than Region 6W at $18.01, but significantly lower wages than surrounding regions like Region 6E and Region 9, which were at $18.15 and $18.24, respectively.[197]

Region 8 stands out for having higher concentrations of farming, healthcare support, production, transportation and material moving, and installation, maintenance, and repair workers than the state.

The largest occupations in the region include office and administrative support, production, transportation and material moving, and sales positions. Not surprisingly, the lowest-paying are concentrated in food prep and serving, building, grounds cleaning and maintenance, sales and related, personal care and service, and healthcare support, which tend to have lower educational and training requirements. For the most part, the gap in pay between Region 8 and the state is also much lower in these jobs.[198]

The Applicant estimates that the Project will employ up to four full-time permanent positions to operate and maintain the facility.

Socioeconomic impacts resulting from the Project will be primarily positive with an influx of wages and expenditures made at local businesses during the construction of the project, increased tax revenue, and increased opportunities for business development. A temporary increase to the revenue of the area through increased demand for lodging, food services, fuel, transportation and general supplies is anticipated. The Project will also create new local job opportunities for various trade professionals that live and work in the area and to fill required construction positions. Opportunities will be created for sub-contracting to local contractors for gravel, fill, and civil work.

Related to the discussion in Section 3.2.3.1 *Loss of Economic Benefits*, landowners will receive lease payments over the operational life of the project. Local governments will gain tax revenues via solar energy production. The Elk Creek Solar Farm will pay a solar Energy Production Tax to the local units of government of $0.0012 per kilowatt-hour (kWh) of electricity produced. This would result in an

[196] https://mn.gov/deed/assets/rp_edr8_2019_tcm1045-133260.pdf.
[197] Ibid.
[198] Ibid.

estimated annual Energy Production Tax revenues of $180,000.00 annually or approximately 4.5 million over 25 years.[199]

Additionally, the Applicant has stated that it will also establish an education fund, to which the Project will contribute $16,000 annually for the first 20 years of operation. Because the Project is located within the Luverne school district, the fund will be distributed to this district.[200]

Specialized labor will be required for certain aspects of the Project, which may necessitate the import of specialized labor forces from other areas of Minnesota or neighboring states. The relatively short construction duration, along with the requirement to use Minnesota licensed (Minnesota State Electrical Code) personnel, limits certain "on the job" training opportunities.[201]

Generic 80 MW Solar Farm

During construction, a 80 MW solar farm would be expected to have similar socioeconomic impacts to that of a generic wind farm due to the influx of wages and expenditures made at local businesses during the construction and increased tax revenue for the life of the project.

For example, the North Star Solar Project developer anticipated that approximately 250-300 jobs would be directly created during the construction phase of the project, and once operational, would require up to 12 permanent employees.[202]

The generic solar farm would also pay property taxes and production taxes. Solar projects, like wind projects, pay production tax of $1.20 per MWh. Production taxes are calculated based on energy production, and are paid to the local governments where the facility is located; 80 percent to the county and 20 percent to the city or township. Based on the North Star Solar Project's estimated annual electricity production of approximately 200,000 MWh, the production tax would produce approximately $240,000 annually for local governments.[203]

Generic 80 MW Wind Farm

The potential impacts on the host community of a generic 80 MW wind farm, located elsewhere in Minnesota, is dependent on the social and economic characteristics that make up the specific population. It is anticipated, given the set-back requirements for wind farms, that a wind farm of similar capacity would have land requirements in the order of 36,000 acres (as in the proposed 40 turbine, 111 MW Walleye Wind Project in Rock County, Minnesota). These projects require large, unobstructed land commitments which dictate rural, agricultural settings.

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[199] CN Application, at p. 22.
[200] SPA, at p 49.
[201] SPA, at p. 49.
[202] *North Star Solar EA*
[203] Ibid.

Utility scale wind developments provide economic benefits across all phases of development and across industries, such as manufacturing; construction, operation and maintenance. Minnesota ranks seventh in the country for installed wind capacity (3,845 MW), with a total capital investment of $7.4 billion.[204]

Construction of wind farms requires a variety of skilled and non-skilled construction workers; typical types of labor for construction of wind farms includes construction laborers, equipment operators and electricians. Education for these jobs can be a combination of on-the-job training, certifications, apprenticeships, and post-secondary education.[205] Types of construction jobs, median wages, and training are included in Table 14.

Table 14. Wind Farm Construction – Wages and Skills

Labor Type/Occupation	National Median Annual Wage[206]	MN Prevailing Wage[207]	Education and Training
Construction Laborers	$29.1	25.74	On the job training and apprenticeships
Operating Engineers and other construction equipment operators	$39,530	$36.34	On-the-job training, apprenticeships, union instruction
Crane and Tower Operators	$47,170	Not specified	On-the-job training, apprenticeships, union instruction
Electricians	$49,800	$35.61	Apprenticeship programs that combine on-the-job training with related classroom instruction
Project Managers	$82,000-$100,000+	Not specified	Direct experience, undergraduate degree in related field, business degree

Several case studies have examined the economic impact of utility-scale wind power development on local economies.[208] These studies have used a variety of methodologies (modeling, observation, and post-construction data). The research on the impacts of wind farms on local economies is evolving, but based on the studies to date, several key factors appear to influence the overall impact a project has on the local economy:

- the remoteness of a project and its proximity to population centers;

[204] American Wind Energy Association, *Factsheet: Wind Energy in Minnesota* (https://www.awea.org/Awea/media/Resources/StateFactSheets/Minnesota.pdf).
[205] Hamilton, James, Liming, Drew. 2010. *Careers in Green Energy*. US Bureau of Labor and Statistics. https://www.bls.gov/green/wind_energy/wind_energy.pdf
[206] Ibid.
[207] Hatt, Katie; Franco, Lucas. *Catching the Wind: The impact of Local vs. Non-Local Hiring Practices in Construction of Minnesota Wind Farms.* North Star Policy Institute. 2018. http://northstarpolicy.org/wp-content/uploads/2018/06/Catching-the-Wind-North-Star.pdf
[208] Brown et al (2011), Slattery et al (2011), Constani (2004), Lantz (2009), Hatt and Franco, 2018, Kildegaard (2013), and UMD Labovitz School of Business and Economics (2017).

- the ownership structure of the project (locally developed and owned, compared to non-local or "absentee" ownership); and
- access to a skilled labor pool.

Local economies that are “well-linked” are those that are nearer other communities, more diversified in terms of types of businesses, and tend to be more stable.[209] As a result, they also tend to have access to a larger, more diverse labor pool. This was also evident in a case study from Texas, which found that in areas where nearby businesses and services are lacking, there is "leakage" outside the project area to areas where those services can be acquired.[210] The same study did find overall economic benefits to rural communities because of utility scale wind development.

Most of these studies use standardized input/output models such as IMPLAN or NREL’s wind-project specific JEDI model to estimate local economic impacts. All models have limitations, however, based on one comparison study, these economic models do appear to provide a reasonable estimate of real world impacts. The study Ex *Post Analysis of Economic Impacts from Wind Power Development in U.S. Counties* compared data from a range of constructed wind projects to modeling results and found that the results were similar to those of the common input/output models when using default assumptions and developer projections. Given the similarities between post construction data and modeled projections, the common input/output models such as IMPLAN and JEDI appear to provide reasonable projections regarding the economic impacts of a project.

Depending on the size of the development and the duration of construction activities, the total number of jobs created varies. A recent study in Minnesota, compared model predictions and developer projections to determine the number of construction workers hired. The study found an average of between 150 and 200 construction workers for Minnesota wind projects during the approximately six month construction period. The study estimates that a generic 150-megawatt project in Minnesota would provide about $12 million in local wages in benefits—about $60,000 per worker.[211]

When local economies are well linked and diversified, there is a greater likelihood that a local labor pool is present. Generally the more that a contractor uses local labor to construct the project, the greater the local economic impact for the community because a greater proportion of money earned is circulated back into the local economy. In areas where the local economy is not as well developed or linked, outside inputs are necessary, and the economic benefits "leak" to areas that can provide the necessary labor, goods, and services. However, to hire local labor, not only must the right labor pool exist in the project area, but it must be available. Estimating the economic benefit of local labor to the local community would require detailed cost information from the construction contractor by cost category,

[209] Constani, 2004.
[210] Slattery et al., 2011.
[211] *Catching the Wind: The impact of local vs. non-local hiring practices in construction of Minnesota wind farms* at pp. 9 10

the availability of local skilled and non-skilled labor, and information about the capacity of local restaurants, hotels, and other local businesses to accommodate non-local labor spending.

Lease payments to landowners and energy production taxes to local units of government where wind projects are located provide additional benefits from wind development. Landowners negotiate leases with project developers for the life of the project. Assuming the landowner lives in the project area, the lease payments provide a direct benefit to the local economy.

In addition, in Minnesota, local units of government receive an energy production tax as a result of wind development. These payments have a significant impact on rural economies during the life of the project. Over time, these payments are greater than the economic impacts generated during construction of the project.

Statewide, wind projects generate approximately $15.5 million in annual state and local tax payments and approximately $10 - $15 million in annual lease payments.[212]

4.5.3 Aesthetic Impact and Visibility Impairment

Large electric power generating plants can pose an impact aesthetically or on visual resources. Aesthetic, or visual resources, are generally defined as the natural and built features of a landscape that may be viewed by the public and contribute to the visual quality and character of an area. Aesthetic resources form the overall impression that an observer has of an area or its landscape character. Distinctive landforms, water bodies, vegetation, and human-made features that contribute to an area's aesthetic qualities are elements that contribute to an area's visual character. Visual quality is generally defined as the visual significance or appeal of a landscape based on cultural values and the landscape's intrinsic physical elements.

Visual sensitivity is a measure of viewer interest and concern for the visual quality of the landscape and potential changes to it, which is determined based on a combination of viewer sensitivity and viewer exposure. Viewer sensitivity varies for individuals and groups depending on the activities viewers are engaged in, their values and expectations related to the appearance and character of the landscape, and their potential level of concern for changes to the landscape. High viewer sensitivity is typically assigned to viewer groups engaged in: recreational or leisure activities; traveling on scenic routes for pleasure or to and from recreational or scenic areas; experiencing or traveling to or from protected, natural, cultural, or historic areas; or experiencing views from resort areas or their residences. Low viewer sensitivity is typically assigned to viewer groups engaged in work activities or commuting to or from work.

[212] *Catching the Wind: The impact of local vs. non-local hiring practices in construction of Minnesota wind farms* at pp. 9 10

Viewer exposure varies for any particular view location or travel route depending on the number of viewers and the frequency and duration of their views. Viewer exposure would typically be highest for views experienced by high numbers of people, frequently, and for long periods. Other factors, such as viewing angle and viewer position relative to a feature or area, can also be contributing factors to viewer exposure.

Elk Creek Solar Farm

Because they are generally large facilities with numerous highly geometric and sometimes highly reflective surfaces, solar farms may create visual impacts; however, being visible is not necessarily the same as being intrusive.

Installation of the proposed Elk Creek Solar farm will result in visible landscape changes as land that is now primarily covered in row crops or pastureland is converted to a solar facility. The topography of the Land Control Area is generally flat with elevations ranging from 1530 to 1550 feet above sea level. Based on preliminary designs, up to 699 acres will be converted from its current use, primarily cropland or pasture, for at least 25 years, the minimum estimated useful life of a PV facility. The primary components of a Project that will alter the landscape are the solar arrays and the perimeter fencing; electrical transformers and inverters, a substation and O&M building, and access roads are additional features of the proposed Project. The Project substation will be of similar vertical profile as the existing Magnolia Substation adjacent to the Land Control Area. In the above-ground electrical configuration, conductors (wires) would be supported from poles; the poles would be up to 30 feet in height and predominately paralleling the access roads.

The Applicant has generated two photo-renderings of how the proposed Project would appear from 180th Avenue on the west side of the Project; one image (**Diagram 18**) for the below-ground configuration and one image (**Diagram 19**) for the above-ground configuration.

Because of their relatively low profile, the arrays will not be visible from great distance, however, the Above-ground Layout option will have the larger impact. The aesthetic impacts will be experienced primarily by nearby residents and people using the roads adjacent to the site. There are no residences or businesses within the Land Control Area; however, there are four residences and several agricultural buildings on parcels adjacent to the Land Control Area (see **Figure 3** and **Figure 4**, Below-Ground Preliminary Project Layout and Above-Ground Preliminary Project Layout, respectively). **Table 15** provides distances to the nearest homes to the Project, including approximate distance to the Preliminary Development Area boundary and approximate distance to the edge of solar arrays.

Residence A is located adjacent to the northwest portion of the Land Control Area west of 180th Avenue. This residence has existing vegetative screening around three sides of the farmstead, including east side adjacent to the Project.

Table 15. Proximity of Residences to Elk Creek Solar Facility[213]

Residence	Distance to Development Boundary (feet)	Distance to Solar Arrays (feet) 1	Distance to Nearest Inverter (feet) 1
A	169	220	788
B	1,262	1,302	1,917
C	668	711	1,328
D	3,182	3,445	3,965

1 Based on preliminary design.

Residence B is located adjacent to the southwest portion of the Land Control Area. The residence faces southeast and has existing vegetative screening along the west and north sides of the farmstead.

Residence C is located adjacent to the southeast portion of the Land Control Area south of 131st Street. The residence faces southeast and has existing vegetative screening along the west and north sides of the farmstead.

Residence D is located adjacent to the northwest portion of the Land Control Areas east of Highway 3. The residence is screened on all sides within the farmstead.

When the PV panels are at a zero degree angle (sun is directly overhead) panels will be approximately four to six feet off of the ground. When panels are at their maximum tilt of 45 degrees (tilted east in the morning and west in the afternoon as the panels follow the sun) the tops of the panels will be approximately 20 feet off the ground. Unlike concentrating solar, which uses mirrors to concentrate the solar energy to create heat energy used to create electricity, PV panels are constructed of dark, light-absorbing material and covered with an anti-reflective coating in order to limit reflection. Because of the materials used, glare and reflection are expected to be minimal; today's panels reflect as little as two percent of the incoming sunlight depending on the angle of the sun and assuming use of anti-reflective coatings.

The existing Magnolia substation is located adjacent to the Land Control Area. Additionally, there are two existing transmission lines within or adjacent to the Land Control Area (see **Figure 3 and Figure 4**).

A 161-kV line runs east-west through Section 35 out of the Magnolia substation and bisects the easternmost portion of the Land Control Area. A 69-kV transmission line exits the Magnolia substation and runs south along 190th Avenue before turning east along 131st Street. This transmission line is partially within the Land Control Area along portions of both roads (see **Figure 5**). These transmission lines and the substation represent existing visual man-made features upon the landscape.

[213] SPA, at p. 43, Table 4.2-4.

Diagram 19. Visual Rendering of Elk Creek Solar Facility from 180th Avenue (below-ground configuration)[214]

[214] SPA, at p. 46.

Diagram 20. Visual Rendering of Elk Creek Solar Facility from 180th Avenue (above-ground configuration)[215]

[215] SPA, at p. 47.

The Project will connect to the grid via a new 161-kV overhead transmission line, requiring 2-3 new transmission structures to link the Project substation to the Magnolia Substation. Each structure would be less than 150 feet in height and span approximately 300 feet. These transmission structures would be in addition to the approximately 185 AC collection poles (30 feet in height, 18 inches in diameter with a span of 200 feet) required should the above-ground electrical collection system be approved in the Commission's LEPGP site permit.

Generic 80 MW Solar Farm

Because they are generally large facilities with numerous highly geometric and sometimes highly reflective surfaces, solar energy facilities may create visual impacts; while not necessarily being intrusive. The installation of a solar farm will result in visible landscape changes and given that the foot print is larger than that for wind farm (800 acres for the 100 MW North Star Solar Project) more land surface would be converted in a solar farm application. However, due to their relatively low profile, PV solar facilities will not be visible from great distance; the aesthetic impacts will be experienced primarily by nearby residents and people using the roads adjacent to the facilities.

Generic 80 MW Wind Farm

A generic 80 MW wind farm would alter the existing landscape through the introduction of large wind turbines. Many factors influence how a wind energy facility is perceived. Factors may include levels of visual sensitivity of individuals, viewing conditions, visual settings, and individual ideas and experiences. Distance from a turbine(s) and activities within and near the project area, landscape features such as hills and tree cover, as well an individual's personal feelings about wind energy technology can all contribute to how a wind energy facility is perceived.

Due to the large, unobstructed land commitments which utility scale wind projects require, and the location of wind resources in Minnesota, it is anticipated that the siting a generic 80 MW wind farm would be in a predominantly rural, agricultural area characterized by flat to gently undulating topography.

Commission LWECS site permits require turbine set back from public and private (both participating and non-participating landowners) lands based on a minimum of the 3 by 5 rotor diameters (RD) per the Commission siting guidelines. These set backs are established to mitigate the potential impacts (wind rights, aesthetics, noise, shadow flicker, etc.) from wind development on the host community.

Residences with turbines and associated infrastructure closest to their homes are generally those that are participating in the Project by signing easements.

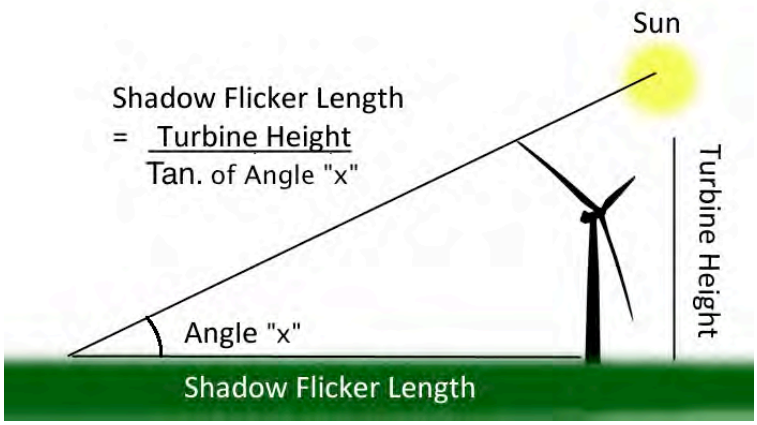
LWECS facilities would generally have some type of lighting at the facility to ensure safe operation of the facility. The Federal Aviation Administration (FAA) requires that all structures more than 200 feet

above the ground have proper lighting or marking to allow for safe air navigation.[216] To meet this requirement wind turbines are typically lighted with red flashing lights, which can create an undesirable nighttime view in a rural setting for some individuals. FAA requires synchronized flashing of red lights for wind turbines, where all the lights flash at the same time. Among being less aesthetically intrusive, it also mitigates disorientating effect on nocturnal migrating birds.

Night time lighting would also be provided at the O&M facility, entrances, inverters and project substation.

Shadow flicker (**Diagram 21**) is a phenomenon associated with wind farms; the effect of the sun (low on the horizon) shining through the rotating blades of a wind turbine, casting a moving shadow. It is perceived as a "flicker" due to the rotating blades repeatedly casting the shadow. Although in many cases shadow flicker occurs only a few hours in a year, it can potentially create a nuisance for homeowners in close proximity to turbines. 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 close enough to the turbine to be able to distinguish a shadow.

Diagram 21. Shadow Flicker[217]



Shadow intensity, or how "light" or "dark" a shadow appears at a specific receptor, will vary with distance from the turbine. The closer a receptor is to a turbine, the more turbine blades block out the sun's rays, and shadows will be wider and darker. Receptors located farther away from a turbine experience thinner and less distinct shadows since the blades block out less sunlight. Shadow flicker is

[216] Federal Aviation Administration. 2000. *Proposed construction or alteration of objects that may affect the navigable airspace. FAA Advisory Circular AC 70/7460-2K*, http://rgl.faa.gov/REGULATORY_AND_GUIDANCE_LIBRARY/RGADVISORYCIRCULAR.NSF/0/22990146db0931f186256c2a00721867/$FILE/ac70-7460-2K.pdf

[217] Environmental issues and impacts for wind power, John Twidell. *EU/Thailand Seminar, Bangkok; Oct 4 & 5 2012.*

reduced or eliminated when buildings, trees, blinds, or curtains are located between the turbine and receptor.

While there are no rules for a Minnesota "light standard" defining the amount of shadow flicker that is acceptable for a commercial wind project, the default industry standard is for no occupied residence to receive more than 30 hours per year of shadow flicker. No other states have adopted a standard for shadow flicker, however, other countries have examined the issue and have adopted standards. Standards depend on assumptions about how flicker impacts are to be calculated:[218]

- Germany has established a "norm" for shadow flicker that does not exceed 30 hours/yr. or 30 minutes/day at a receptor. It is unclear whether this is a worst-case scenario (e.g., clear skies every day) or a real-case scenario (weather representative of the Project area).
- Belgium has adopted the German norm, adding a requirement for modeling in an EIA.
- Denmark recommends a maximum of 10 hours/yr. assuming average cloud cover in the Project area.
- France has adopted no standard but requires shadow flicker modeling.
- The Netherlands have adopted a yearly maximum of 5 hours and 40 minutes assuming clear skies.
- The State of Victoria, Australia, has adopted a shadow flicker standard of 30 hours/yr.

Shadow flicker from wind turbines has raised concerns 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.[219] 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 (1.5 flashes per second), which is below the frequency range that is thought to trigger seizures.

Mitigation

The primary strategy for minimizing aesthetic impacts is choosing a site where solar facilities are in keeping with the existing landscape, separated as far as possible from existing homes or shielded from view by terrain or existing vegetation. Landscaping plans can be developed to identify site-specific landscaping techniques including vegetation screening, berms or fencing to minimize visual impacts to adjacent land uses.

[218] Haugen, Katherine M.B. 2011. *International Review of Policies and Recommendations for Wind Turbine Setbacks from Residences: Setbacks, Noise, Shadow Flicker, and Other Concerns*. Minnesota Department of Commerce. https://mn.gov/eera/web/project-file?legacyPath=/opt/documents/International_Review_of_Wind_Policies_and_Recommendations.pdf

[219] https://www.epilepsysociety.org.uk/wind-turbines-and-photosensitive-epilepsy#.XjmIb2dYbcs

As an alternative to chain link fencing (a seven-foot fence with an additional extension angled outward at 45 degrees), the Applicant has stated that it will be using six foot wood pole and woven wire fence.[220] This fence design is frequently referred to as a "deer fence" or an "agricultural fence." This wood pole and woven wire fence design potentially offers superior aesthetics to the standard chain link fence; however, the fencing around the substation will be a 6-feet above grade chain-link fence and include one foot of barbed wire to comply with the National Electric Code. This fencing will be designed to prevent the public from gaining access to electrical equipment which could cause injury.

The Applicant has stated that lighting will be down lit to minimize impacts to adjacent land uses. It is anticipated that most maintenance activities will be performed during the day, although it may be preferable to perform some maintenance activities that require activation of facility lighting after the sun is down in order to limit impacts to energy production.

The use of the below-ground or the hybrid electrical collection system would minimize the visual impact by reducing the number of aerial structures visible from a distance.

Mitigation of impacts to aesthetic and visual resources is best accomplished through micro-siting of wind turbines and maintaining designated setbacks from participating and non-participating landowners. In general, siting wind projects in rural areas minimizes human impacts. Aesthetic impacts to public lands can be mitigated by siting wind projects outside of these areas, and utilizing natural features such as topography and vegetation to reduce visual intrusions.

Setbacks for individual turbines assist in mitigating visibility impacts. Wind turbines must be set back from non-participating property lines a minimum distance of 5 RD on the prevailing wind direction and 3 RD on the non-prevailing wind direction. Turbines are designed to be a uniform off-white color to blend in with the horizon and reduce visibility impacts.

General mitigation measures at wind farms include:

- Wind turbines to exhibit visual uniformity in the shape, color, and size of rotor blades, nacelles, and towers.
- Collection cables or lines to be buried in a manner that minimizes additional surface disturbance (collocating them with access roads, where feasible).
- For ancillary buildings and other structures, low-profile structures tol be chosen whenever possible to reduce their visibility.
- Turbine foundations and roads designed to minimize and balance cuts and fills.
- Facilities, structures, and roads to be located in stable fertile soils to reduce visual contrasts from erosion and to better support rapid and complete regrowth of

[220] SPA, at pp. 22-23.

vegetation

- Lighting for facilities not exceed the minimum required for safety and security, and full-cutoff designs that minimize upward light pollution to be selected.
- Installation of aircraft detection lighting system that are off until aircraft approach.
- Commercial messages and symbols on wind turbines to be avoided.

The FAA-has approved commercial operation of Aircraft Detection Lighting System (ADLS) for use at wind farms. The ADLS is designed to mitigate the impact of nighttime lights by deploying a radar-based system around a wind farm, turning lights on only when low-flying aircraft are detected nearby.[221] The ADLS can be designed for a single wind farm, or to serve multiple wind farms (**Diagram 21**).

Diagram 22. Aircraft Detection Lighting System[222]

4.5.4 Noise

Large electric power generating plants produce noise. Potential human impacts due to noise include hearing loss, stress, annoyance, and sleep disturbance. Noise can be defined as unwanted or inappropriate sound. Sound has multiple characteristics which determine whether a sound is too loud or otherwise inappropriate. Sound travels in a wave motion and produces a sound pressure level. This sound pressure level is commonly measured in decibels (dB). Sounds also consists of frequencies, (the high frequency or pitch of a whistle). Most sounds are not a single frequency but a mixture of frequencies. Finally, sounds can be constant or intermittent. The perceived loudness of a sound depends on all of these characteristics.

A sound meter is used to measure loudness. The meter sums up the sound pressure levels for all frequencies of a sound and calculates a single loudness reading. This loudness reading is reported in decibels, with a suffix indicating the type of calculation used. The A-weighted decibel scale (dBA) is

[221] Patterson, James. *Performance Assessment of the Laufer Wind Aircraft Detection System as an Aircraft Detection Lighting System*. FAA. 2018. http://www.airporttech.tc.faa.gov/DesktopModules/EasyDNNNews/DocumentDownload.ashx?portalid=0&moduleid=3682&articleid=26&documentid=1203

[222] Electronics 360. *Video: Lighting Up Wind Turbine Airspace.* https://electronics360.globalspec.com/article/8760/video-lighting-up-wind-turbine-airspace

commonly used to measure the selective sensitivity of human hearing. This scales the physical sound levels that are measured as a pressure wave to match an equivalent "loudness" level across the audible spectrum that more closely resembles what a human ear would perceive. The A-weighted scale effectively puts more relative weight on the range of frequencies that the average human ear perceives clearly (mid-level frequencies) and less weight on those that humans do not perceive as well (very high and lower frequencies). Noise levels depend on the distance from the noise source and the attenuation of the surrounding environment. Table 16 below provides an estimate of decibel levels of common noise sources.

The State of Minnesota has promulgated standards designed to ensure public health and minimize citizen exposure to inappropriate sounds. The rules for permissible sound levels vary according to land use, according to their noise area classification (NAC).

Table 16. Common Noise Sources and Levels (A-weighted Decibels)[223]

Sound Pressure Level (dBA)	Common Indoor and Outdoor Noise Sources
100-110	Rock band (at 16.4 ft [5 m]) Jet flyover (at 984.3 ft [300 m])
90-100	Gas lawnmower (at 3.28 ft [1 m])
80-90	Food blender (at 3.28 ft [1 m])
70-80	Shouting (at 3.28 ft [1 m]) Vacuum cleaner (at 9.84 ft [3 m])
60-70	Normal speech (at 3.28 ft [1 m])
50-60	Large business office Dishwasher next room, quiet urban daytime
40-50	Library, quiet urban nighttime
30-40	Quiet suburban nighttime
20-30	Bedroom at night
10-20	Quiet rural nighttime Broadcast recording studio
0	Threshold of hearing

In a residential setting, for example, restrictions are more stringent than in an industrial setting. Rural residential homes are considered NAC 1 (residential), while agricultural land and agricultural activities

[223] Minnesota Pollution Control Agency (MPCA). 2015. *A Guide to Noise Control in Minnesota: Acoustical Properties, Measurement, Analysis and Regulation*. pca.mn.us

are classified as NAC 3 (industrial). The rules also distinguish between nighttime and daytime noise; less noise is permitted at night. Sound levels are not to be exceeded for 10 percent and 50 percent of the time in a one-hour survey (L_{10} and L_{50}) for each noise area classification. **Table 17** lists Minnesota's noise standards by area classification.

The C-weighted scale (dBC) is used to measure human sensitivity at louder levels. C-weighted decibels are often used as a proxy to estimate the impact of low frequency noise. This scale puts more weight on the lower frequencies than the A-weighted scale.[224]

The G-Weighted scale (dBG) is designed for sound or noise whose spectrum lies partly or wholly within the frequency band of 1 Hz to 20 Hz.[225]

Table 17. MPCA Noise Standards - Hourly A-Weighted Decibels

Noise Area Classification	Daytime		Nighttime	
	L50	L10	L50	L10
1	60	65	50	55
2	65	70	65	70
3	75	80	75	80

The numerical value of the results will, in general, differ between the A-weightings, C-weightings and G-weightings. Numerical values across weightings should be compared with caution, since the respective results relate to different frequencies of the noise spectrum. Measurement programs for wind turbine noise have documented a significant correlation between dBA and dBC levels.

Additionally, measurements comparing A-weighted noise levels and G-weighted noise levels show a significant correlation between the dBA and dBG as well.[226]

Low frequency noise is considered audible but only at high amplitudes. Low frequency noise is commonly considered to be in the range of 20-200 Hz. Infrasound occurs in even lower frequency ranges (less than 20 Hz), and is generally inaudible to the human ear. However, it may still interact with the body and may be felt as vibrations. Studies have shown that pain from infrasound can result when sound levels are 165 dB or above at 2 Hz and 145 dB or above at 20 Hz. (Massachusetts

[224] Minnesota Pollution Control Agency (MPCA). 2015. *A Guide to Noise Control in Minnesota: Acoustical Properties, Measurement, Analysis and Regulation*. pca.mn.us

[225] State Government of Victoria Department of Health. 2013. *Wind Farms, Sound, and Health: Technical Information.* https://www2.health.vic.gov.au/public-health/environmental-health/environmental-health-in-the-community/wind-farms-sound-and-health.

[226] Ibid.

Department of Public Health 2012). The magnitude of existing background low frequency noise/infrasound levels vary, but can be of sufficient strength to mask the low frequency noise and infrasound contributions from wind turbines. Common background sound sources of low frequency noise and infrasound include wind interacting with vegetation, agricultural machinery and roadway noise.[227]

Elk Creek 80 MW Solar Farm

Noise concerns for the Elk Creek Solar Farm are related primarily to the construction phase as the result of heavy equipment operation and increased vehicle traffic associated with the transport of construction materials and personnel to and from the work area. It is anticipated that construction activities will only occur during daylight hours.

During operation of the Elk Creek Solar Farm, the primary source of noise will be from the inverters, and to a lesser extent from the transformers and rotation of tracking systems, located at each facility. All electrical equipment would be designed to National Electrical Manufacturer Association standards; anticipated inverter and tracker noise for the Project are summarized in Table 18.[228]

The results of noise modeling show that noise levels will be less than 50 dBA between 58 and 260 feet from the inverter, depending on which model is selected. Similarly, noise levels will be less than 50 dBA between 5 and 82 feet from the trackers, depending on which model is selected. The closest residence to the facility is 220 feet away from the edge of a solar array. The distance of the nearest inverter to a residence is 788 feet.[229] Noise from the electric collection system is not expected to be perceptible.

Table 18. Inverter and Tracker Noise Levels[230]

Facility Type	Equipment Model	Distance to 50 dBA	dBA at 50 feet
Inverter	TMEIC Solar Ware Ninja PVU-L0920GR	58 feet	51
	SMA Sunny Central 2750-EV-US	160 feet	60
	ABB PVS980	260 feet	64
Tracker	ATI DuraTrack HZ v3	5 feet	30
	NexTracker	82 feet	54

Because the Project does not generate electricity at night, the tracking systems would not be rotating and noise from inverters would be at less than peak levels. While most maintenance activities would

[227] State Government of Victoria Department of Health. 2013. *Wind Farms, Sound, and Health: Technical Information.* https://www2.health.vic.gov.au/public-health/environmental-health/environmental-health-in-the-community/wind-farms-sound-and-health.

[228] SPA, at p.42.

[229] SPA, at pp. 42-43.

[230] SPA, at p. 42, Table 4.2-3.

be performed during the day, it may be preferable to perform some maintenance activities after the sun is down in order to limit impacts to energy production.

Generic 80 MW Solar Farm

Noise concerns for a generic 80 MW solar farm are related primarily to the construction phase as the result of heavy equipment operation and increased vehicle traffic associated with the transport of construction materials and personnel to and from the work area. As in the North Star Solar project it is anticipated that construction activities will only occur during daylight hours.

During operation of a generic solar farm, the primary source of noise will be from the inverters, and to a lesser extent from the transformers and rotation of tracking systems, located at each facility. All electrical equipment would be designed to National Electrical Manufacturer Association standards; anticipated inverter noise for the North Star Solar project was predicted to produce 65 dBA at the source.[231]

Noise from a generic solar farm's electric collection system would not be expected to be perceptible. Because the solar facilities do not generate electricity at night, the tracking systems would not be rotating and noise from inverters would be at less than peak levels. While most maintenance activities would be performed during the day, it may be preferable to perform some maintenance activities after the sun is down in order to limit impacts to energy production.

Generic 80 MW Wind Farm

The operation of wind turbines will produce noise. Turbines produce mechanical noise (noise due to the gearbox and generator in the nacelle) and aerodynamic noise (noise due to wind passing over the turbine blades).[232] Perceived sound characteristics would depend on the type/size of turbine, the speed of the turbine (if turning), and the distance of the listener from the turbine.

Wind turbines produce audible, low frequency sound and sub-audible sound (infrasound).[233] These sounds can have a rhythmic modulation due to the spinning of the turbine blades. Impacts due to these sound characteristics are subjective (human sensitivity, especially to low frequency sound, is variable). However, low frequency sounds may cause annoyance and sleep disturbance for more sensitive individuals.[234]

LWECS sites are located in predominately rural agricultural landscapes. The ground cover is primarily farmland and open fields, with residential dwellings interspersed throughout the area. Typical

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[231] *North Star Solar EA*

[232] Minnesota Department of Health, *Public Health Impacts of Wind Turbines*. 2009, http://www.health.state.mn.us/divs/eh/hazardous/topics/windturbines.pdf

[233] https://www.masterresource.org/wind-power-health-effects/infrasound-growing-liability-windpower/.

[234] Ibid.

agricultural noise sources include farm machinery, agricultural vehicle operations, recreational activities, (such as hunting and all-terrain vehicles), motor vehicle traffic, and road construction activities.

The 2019 LWECS Application Guidance provides that post-project total sound levels must meet MN standards (Minnesota Rules Chapter 7030) at all residential receptors. If background sound levels are less than the applicable standard at nearby receptors, the modeled turbine-only noise levels should not cause an exceedance of the applicable state standard at nearby receptors, inclusive of the measured background sound level. "Cause" means that the project turbine-only contribution is in excess of the applicable state standard. If background sound levels are equal to or greater than the applicable state standard at the nearby receptors, the windfarm should not contribute more than 47 dB(A) to total sound levels at the nearby receptors. Therefore, for example, when nighttime background sound levels are at 50 dB(A), a maximum turbine-only contribution of 47 dB(A) would result in a non-significant increase in total sound of 3 dB(A).[235]

Mitigation

Section 4.3.6 of the Site Permit Template would require Elk Creek to limit construction and maintenance activities to daytime working hours as defined in Minnesota Rule 7030.0200. Maintenance activities that may potentially create excessive noise would necessarily be performed during the day in order to minimize noise impacts to nearby residents.

No mitigation measures are proposed for the operational phase of the Elk Creek Solar Farm, as operational noise levels are not predicted to exceed the state noise limits.

The primary means of mitigating sound (noise) produced by wind turbines is siting. Turbines must be sited to comply with noise standards in Minnesota Rule 7030.[236] For rural residential areas, this means sound levels must meet an L50 standard of 50 dBA. Compliance with these noise standards is usually accomplished via set-back requirements. Setback requirements are enforced by the Site Permit issued by the Commission. The Commission continuously reviews public health setbacks related to wind farms to determine if they remain appropriate and reasonable.[237]

[235] https://mn.gov/eera/web/doc/13655/.
[236] Minn. Rules 7030.0040, Noise Standards, https://www.revisor.leg.state.mn.us/rules/?id=7030.0040
[237] Commission *Investigation into Large Wind Energy Conversion Systems Permit Conditions on Setbacks and the Minnesota Department of Health Environmental Health Division's White Paper on Public Health Impacts of Wind Turbines*, CI-09-845, found on eDockets, https://www.edockets.state.mn.us/EFiling/edockets/searchDocuments.do?method=showeDocketsSearch&showEdocket=true&userType=public, enter "09" for year and "845" for number

Strategies for reducing aerodynamic noise include adaptive approaches or Noise Reduction Modes of operation (such as varying the speed of rotation of the blades or changing the pitch angle) and wind turbine blade modification (such as *low-noise trailing edge* attachments).

Since an increase in rotational speed will also lead to increased noise production, lowering the rotational speed will lead to decreased sound.[238] However the rotational speed decrease reduces power output, and therefore should only be implemented within a certain range of wind velocities, since high winds also have the added benefit of masking the sound of the wind turbine with the sound of the wind itself. The pitch angle of the wind turbine blades also has an important role in noise production.[239] An increase in pitch angle will lead to a reduction in the angle of attack. As the angle of attack increases, the size of the turbulent boundary layer on the suction side of the airfoil grows, thereby increasing noise production in the wind turbine. Therefore, if the pitch angle is reduced, a thinner boundary layer results on the suction side, which is considered the strongest source of noise production.[240] This also implies that, on the pressure side, the effect is the opposite; therefore when using this method for noise control, it is important to find the appropriate pitch angle range for optimal noise control. As with the lowering the rotational speed, the major drawback to this adaptive noise control method is the corresponding reduction of power since the angle of attack is decreased.

4.5.5 Property values

Large electric power generation plants have the potential to impact property values. Because property values are influenced by a complex interaction between factors specific to each individual piece of real estate as well as local and national market conditions, the effect of one particular project on the value of one particular property is difficult to determine.

The placement of infrastructure near human settlements has the potential to impact property values. The impacts can be positive and negative. The type and extent of impacts depends on the relative location of the infrastructure and existing land uses in a given area. For example, a new highway may increase the value of properties anticipated to be used for commercial purposes, but decrease the value of nearby residential properties.

Potential impacts to property values due to large energy facilities are related to three main concerns:

- Potential aesthetic impacts of the facility,
- Concern over potential health effects from emissions (air emissions, wastewater discharges,

[238] Romero-Sanz, I., Matesanz, A. Noise management on modern wind turbines. *Wind Engineering*, 2008, 32, 27-44.
[239] Ibid.
[240] Brooks, T.F., Pope, D.S., Marcolini, M.A. Airfoil Self-noise and Prediction. NASA Reference Publication 1218, National Aeronautics and Space Administration, 1989, USA.

electric and magnetic fields, etc.), and

- Potential interference with agriculture or other land uses.

Elk Creek Solar Farm

The presence of the Elk Creek Solar Farm would become one of many interacting factors that could affect a property's value. Unlike fossil-fueled electric generating facilities, the Project would have no emissions and essentially no noise impacts to adjacent land uses during operation of the facility. The installation of the Elk Creek Solar Farm would create a visual impact, but lacking the height of smokestacks or wind turbines, the visual impact at ground level, or within a neighboring propoerty, would be more limited.

A review of the literature found no research specifically aimed at quantifying impacts to property values based solely on proximity to utility-scale PV facilities. As the industry continues to develop comparable data should become available.

For these reasons, the impact to the value on one particular property based solely on its proximity to the Elk Creek Solar Farm is difficult to determine. Widespread negative impacts to property values are not anticipated, however, in unique situations it is possible that individual property values might be negatively impacted.

Generic 80 MW Solar Farm

Often, negative effects from the presence of LEPGPs are the result of impacts that extend beyond the immediate footprint. Examples include noise, emissions and visual impacts, however, like the proposed Project a generic 80 MW solar farm sited elsewhere in Minnesota would have no emissions and essentially no noise impacts to adjacent land uses during operation of the facility. The installation of PV facilities would create a visual impact, but lacking the height of smokestacks or wind turbines, the visual impact at ground level, or within a neighboring properties, would be more limited.

Generic 80 MW Wind Farm

A generic 80 MW wind farm would have property value impacts similar to that of the proposed Project. If a generic 80 MW wind farm were constructed and operated in an area of the state with minimal or no LWECSs present on the landscape there could be more noticeable impacts on property values, but this impact is difficult to quantify or estimate for comparison purposes.

The impacts on property values due to the development of a generic 80 MW Wind Farm are difficult to quantify. Numerous factors influence a property's market value, including acreage, schools, parks, neighborhood characteristics and improvements. The overall status of the housing/land market at the time of sale is an important factor on the value of a property.

In December 2009, the United States Department of Energy Lawrence Berkeley National Laboratory released a technical analysis of wind energy facilities' impacts on the property values of nearby residences. Using a variety of different analytic approaches, the report found no evidence that sales price of homes surrounding wind facilities were measurably affected by either the view of wind facilities or the distance of the home to those facilities. Though the analysis acknowledged the possibility that individual homes or small numbers of homes may be negatively impacted, it concluded that if these impacts do exist, their frequency is too small to result in any widespread, statistically observable impact.[241]

Southern and southwestern Minnesota have experienced the greatest development of wind energy facilities in the state and several wind farms exist in the region. Six counties in southern Minnesota (Dodge, Jackson, Lincoln, Martin, Mower and Murray counties) with large wind energy conversion systems responded to a Stearns County survey asking about impacts on property values as a result of wind farms. That survey showed that neither properties hosting turbines nor those adjacent to those properties in the counties listed, have been negatively impacted by the presence of wind farms. [242]

Mitigation

For PV solar facilities, minimal if any impacts to property values are anticipated. As discussed in Section 4.5.3 *Aesthetic Impact and Visibility Impairment* and Section 4.5.4 *Noise*, those factors relevant to property values can also be mitigated through proper siting, BMPs (restoration and vegetation management) and screening the site (berms, deer fencing, and vegetation).

Negative impacts to property value due to the development of a generic 80 MW wind farm are not anticipated. In unique situations it is possible that specific, individual property values may be negatively impacted. Such impacts may be mitigated by siting turbines away from residences. As with solar farms, impacts to property values can be mitigated by reducing the aesthetic and noise impacts through micro-siting turbines and reducing encumbrances to future land use. Enhanced educational out-reach concerning the perceived health risks may also be helpful.

4.5.6 Public Health and Safety

Construction and operation of large electric power generating plants may have the potential to impact human health and safety. This section discusses potential health and safety concerns.

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[241] Hoen et al. 2009. *The Impact of Wind Power Projects on Residential Property Values in the United States: A Multi-Site Hedonic Analysis*. https://emp.lbl.gov/publications/impact-wind-power-projects

[242] Stearns County Board of Commissioners. 2010.*Stearns County Resolution No. 10-46: Resolution Adopting Findings of Fact for the Proposed Stearns County Interim Ordinance No. 444 Imposing a Moratorium on Large Wind Energy Conversion Systems (LWECS) for Projects 5 MW or Greater.* https://www.edockets.state.mn.us/EFiling/edockets/searchDocuments.do?method=showPoup&documentId=%7B84D17419-28C1-4D3F-AAE0-5D4DE117F9E4%7D&documentTitle=20106-52067-01

4.5.6.1 *Electromagnetic Fields*

Electromagnetic fields (EMF) are invisible regions of force resulting from the presence of electricity. EMF is often raised as a concern with large electric generating plants and electric transmission facilities. Naturally occurring EMF are caused by the earth's weather and geomagnetic field. Man-made EMF are caused by any electrical device and found wherever people use electricity.

- Electric fields are created by the electric charge (i.e., voltage) on a transmission line. Electric fields are solely dependent upon the voltage of a line (volts), not the current (amps). Electric field strength is measured in kilovolts per meter (kV/m). The strength of an electric field decreases rapidly as the distance from the source increases. Electric fields are easily shielded or weakened by most objects and materials, such as trees and buildings.

- Magnetic fields are created by the electrical current moving through a transmission line. The magnetic field strength is proportional to the electrical current (amps). Magnetic field strength is typically measured in milliGauss (mG). Similar to electric fields, the strength of a magnetic field decreases rapidly as the distance from the source increases. However, unlike electric fields, magnetic fields are not easily shielded or weakened by objects or materials.

Currently, there are no federal regulations regarding allowable electric or magnetic fields produced by transmission lines in the United States. However, some state governments and international organizations have developed regulations and guidelines (Table 19 and Table 20). The Minnesota Public Utilities Commission limits the maximum electric field directly under all transmission lines in Minnesota to 8.0 kV/m. A standard for magnetic fields has not been adopted, however, the Commission has adopted a prudent avoidance approach in routing transmission lines.

Elk Creek Solar Farm

While the electricity throughout the majority of a solar site is DC electricity, the inverters convert this DC electricity to alternating current (AC) electricity matching the 60 Hz frequency of the grid. The direct current (DC) electricity produced by PV panels produces what is termed *stationary* (0 Hz) electric and magnetic fields and are of little concern regarding the potential health risks.[243] It is the inverters, collection wires, substation, and the transmission conductors delivering the AC electricity to the grid that produces the *non-stationary* EMF (aka, extremely low frequency (ELF) EMF), which is often a subject of public concern.

[243] World Health Organization. *Electromagnetic Fields and Public Health: Static Electric and Magnetic Fields*. March 2006. Accessed August 2016. http://www.who.int/peh-emf/publications/facts/fs299/en/.

The strength of ELF-EMF present at the perimeter of a solar facility is significantly lower than the typical American's average EMF exposure.[244] Researchers in Massachusetts measured magnetic fields

Table 19. State Electric and Magnetic Field Standards[245]

State	Electric Field (kV/m)		Magnetic Field (µG)
	Within Right-of-Way	Edge of Right-of-Way	Edge of Right-of-Way
Florida	8.0[a]	2.0	150[a] (max load)
	10.0[b]	—	200[b] (max load)
	—	—	250[c] (max load)
Massachusetts	—	—	85[g]
Montana	7.0[d]	1.0[e]	—
New Jersey	—	3.0	—
New York	11.8	1.6	200
	11.0[f]	—	—
	7.0[d]	—	—
Oregon	9.0	—	—

Table 20. International Organizations with Electric and Magnetic Field Guidelines[246]

Organization	Electric Field (kV/m)		Magnetic Field (µG)	
	General Public	Occupational	General Public	Occupational
Institute of Electrical and Electronics Engineers	5.0	20	9,040	27,100
Int'l Commission on Non-Ionizing Radiation Protection	4.2	8.3	2,000	4,200
American Conference of Industrial Hygienists	—	25	—	10,000/ 1,000 (med. device)
National Radiological Protection Board	4.2	—	830	4,200

[244] R.A. Tell et al, *Electromagnetic Fields Associated with Commercial Solar Photovoltaic Electric Power Generating Facilities*, Journal of Occupational and Environmental Hygiene, Volume 12, 2015,- Issue 11. Abstract Accessed March 2016: http://www.tandfonline.com/doi/full/10.1080/15459624.2015.1047021.

[245] National Institute of Environmental Health Sciences (2002).

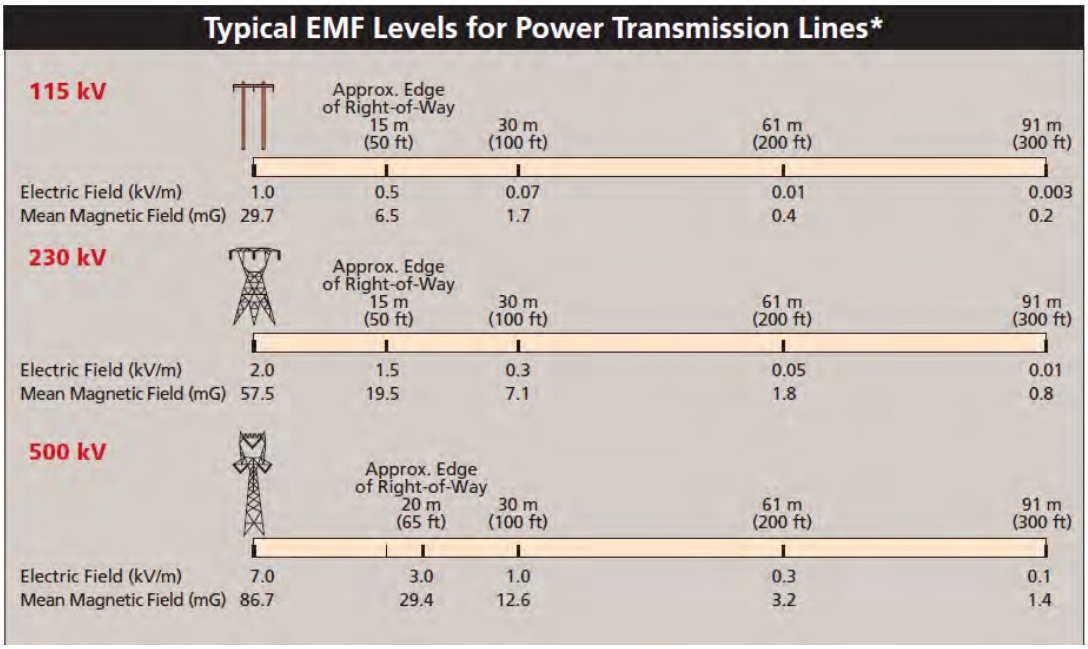
[246] National Institute of Environmental Health Sciences (2002).

at PV projects and found the magnetic fields dropped to very low levels of 0.5 mG or less, and in many cases to less than background levels (0.2 mG), at distances of no more than 150 feet from the utility-scale inverters.[247][248] It is typical that utility scale designs locate large inverters central to the PV panels that feed them because this minimizes the length of wire required and shields neighbors from the sound of the inverter's cooling fans. Thus, it is rare for a large PV inverter to be within 150 feet of a project's security fence.

The Elk Creek Solar Farm will interconnect into the existing Magnolia Substation via a 161 kV transmission (gen-tie) line of less than 1,500 feet in length.

The National Institute of Environmental Health Sciences provides typical EMF levels for power transmission lines (Diagram 23). The electric fields directly below the Project's gen-tie line would be expected to be below the 2.0 kV/m (dissipating to 1.5 kV/m at 50 feet) shown for a 230 kV HVTL in the NIEHS' example. Similarly, average magnetic fields directly below the 230 kV transmission line used in the example were reported at 57.5 mG (dissipating to 19.5 mG at 50 feet),[249] the gen-tie line would be less.

Diagram 23. Typical EMF Levels for Power Transmission lines[250]



[247] Massachusetts Department of Energy Resources, Massachusetts Department of Environmental Protection, and Massachusetts Clean Energy Center. *Questions & Answers: Ground-Mounted Solar Photovoltaic Systems*. June 2015. Accessed August 2016. http://www.mass.gov/eea/docs/doer/renewables/solar/solar-pv-guide.pdf.

[248] Ibid.

[249] Electric and Magnetic Fields Associated with the Use of Electric Power, June 2002. NIEHS/DOE RAPID Program.

[250] Electric and Magnetic Fields Associated with the Use of Electric Power, June 2002. NIEHS/DOE RAPID Program.

Anyone relying on a medical device such as pacemaker or other implanted device to maintain proper heart rhythm may have concern about the potential for a solar project to interfere with the operation of his or her device. However, there is no reason for concern because the EMF outside of the solar facility's fence is less than 1/1000 of the level at which manufacturers test for ELF EMF interference, which is 1,000 mG.[251]

Generic 80 MW Solar Farm

A generic 80 MW solar farm sited elsewhere in Minnesota would be expected to have a similar EMF profile as the proposed Project. It would also require the installation of similar infrastructure (transmission lines and substation) to transmit the power output to the grid beyond the on-site facilities (PV arrays, inverters/transformers, electrical collection system).

Someone outside of the fenced perimeter of a solar farm is not exposed to significant EMF from the facility. Therefore, there is no negative health impact are anticipated from the EMF produced in a solar farm.

Generic 80 MW Wind Farm

A generic 80 MW wind farm will generally require transmission facilities to transmit the power to an interconnection point on the grid. The size (voltage) and length of the transmission line would be dependent on project specific details and engineering. EMF impacts from collector and feeder lines located within the wind farm are expected to be negligible, as in the case for a solar farm.

EMF associated with the transformers within the nacelle of a wind turbine dissipates within 5 feet, so the required turbine set back (minimally, a 1,000-foot) from residences would be adequate to avoid any EMF exposure to homes.

Mitigation

Safety issues at PV solar farms are largely associated with construction. Safety concerns associated with the operation of a PV facility are limited.

The nearest residence to the Elk Creek Solar Farm arrays is 220 feet and 788 feet to the nearest inverter, electrical collection line, and transformer. At this distance, both electric and magnetic fields would have dissipated to background levels, as such, impacts will be negligible and no additional mitigation measures are warranted.

4.5.6.2 Stray Voltage

[251] *EMFs and medical devices*, Accessed March 2017. www.emfs.info/effects/medical-devices/.

Stray voltage is sometimes raised as an issue associated with electric transmission. Stray voltage (also referred to as neutral to earth voltage) is an extraneous voltage that appears on metal surfaces in buildings, barns and other structures, which are grounded to earth. Stray voltage is typically experienced by livestock who simultaneously come into contact with two metal objects (feeders, waterers, stalls). If there is a voltage between these objects, a small current will flow through the livestock.

The fact that both objects are grounded to the same place (earth) would seem to prevent any voltage from existing between the objects. However, this is not the case – a number of factors determine whether an object is, in fact, grounded. These include wire size and length, the quality of connections, the number and resistance of ground rods, and the current being grounded. Thus, stray voltage can exist at any house or farm which uses electricity, independent of whether there is a transmission line nearby. Stray voltage is more commonly associated with small electrical distribution lines, which connect homes to larger transmission lines, and provide electricity to individual residences, farms, businesses, etc.[252]

Elk Creek Solar Farm

All electrical components in the Elk Creek Solar Farm, including inverters and transformers, 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 help design grounding systems.[253]

The potential for stray voltage as a result of the Project will be negligible. Should a fault occur during operation, it would be quickly identified by the facility's monitoring systems and corrected.[254]

No areas used for animal husbandry (livestock) are located within the Land Control Area; therefore, no impacts to livestock are anticipated.

Generic 80 MW Solar Farm

As with the proposed Elk Creek Solar Farm, a generic 80 MW solar farm sited elsewhere in Minnesota would also require the installation of similar on-site facilities (i.e., PV arrays, including electrical cables and conduit, electrical cabinets, step-up transformers, SCADA systems and metering equipment) to gather the power produced from the individual components (PV arrays, turbines) and transmit it to the grid.

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[252] Wisconsin Public Service. *Answers to Your Stray Voltage Questions: Backed by Research*. 2011. http://www.wisconsinpublicservice.com/business/pdf/farm_voltage.pdf

[253] SPA, at p. 40.

[254] Ibid.

As with both solar farms and wind farms, stray voltage concerns from collector and feeder lines located within the facilities are addressed through project design of these systems and generally not a concern.

Generic 80 MW Wind Farm

As is the case with the proposed Project, a generic 80 MW wind farm would also require the installation of similar infrastructure (transmission lines and substation) to transmit the power output to the grid beyond the on-site facilities (turbines/generators, inverters/transformers, electrical collection system).

To address stray voltage, electrical systems, including farm systems and utility distribution systems, must be adequately grounded to the earth to ensure continuous safety and reliability, and to minimize this current flow. LWECS electrical collection systems mitigate such issue by running a continuous bare ground conductor from the furthest turbine to the substation. Stray voltage issues would not be expected to arise from these systems; problems would be detected via the facility's monitoring systems and corrected.

Mitigation

Due to low risk, mitigation measures are not proposed, beyond sound electric system design.

4.5.7 Displacement

In the context of large electric generation plants and siting proceedings, displacement refers to the removal of a residence or building to facilitate the safe operation of a LEPGP or HVTL.

Elk Creek Solar Farm

There is one grain bin within the northern portion of the Land Control Area at a field edge along 141st Street. The Applicant has coordinated with the landowner of the grain bin, who has agreed to its removal as part of the Project. There are no residences, business, or other structures such as barns or sheds within the Land Control Area.

Generic 80 MW Solar Farm

Because of the land requirements, solar facilities are generally sited away homes or business. In some cases, however, construction of solar facilities may require displacement or relocation of existing structures such as outbuildings or grain bins to allow for the efficient use of land.

Generic 80 MW Wind Farm

Wind farm projects require large, unobstructed land commitments, which in Minnesota generally dictates siting in rural, agricultural settings. Given the set-back requirements for wind farms, a wind farm of similar capacity to the Elk Creek Solar Farm would have land requirements in the order of

36,000 acres (as in the proposed 40 turbine, 111 MW Walleye Wind Project in Rock County, Minnesota), while the actual footprint of the facilities (turbines and towers) may only require 0.75 acres per turbine. This large geographical area (the "box") allows many opportunities through micro-siting to avoid the need to displace residences, business, or other structures.

Mitigation

As the removal of the grain bin is part of a voluntary agreement between the Applicant and the landowner, no additional measures are identified to mitigate the displacement. Because there are no unaccounted buildings or structures in the Land Control Area for the Elk Creek Solar Farm, there will not be any further displacement; as such, no mitigation is proposed.

4.5.8 Public Services and Transportation

This section provides a description of public services that could be impacted by development of the Project site and generic system alternatives, as well as potential mitigation measures.

Public services are those typically provided by a government entity to its citizens and those services are used to benefit public health and safety. These services can include emergency services, transportation, and utilities

Elk Creek Solar Farm

Most rural residences in Rock County are supplied water by wells (see Section 4.2) or by Rock County Rural Water. Sewage is serviced by residential septic tanks and/or drain fields. Telephone services are provided by Quest Corporation; there are a number of broadband providers in Rock County.

The Project is located adjacent to the existing ITC Magnolia substation. As mentioned in Section 3.1, there are two transmission lines at least partially within the Land Control Area. Approximate locations of these transmission lines are displayed on **Figure 5**. There are no pipelines in the Land Control Area.[255] During the interconnection process, customers may experience short outages when the Magnolia Substation is shut down and temporary service is being established. The timing and duration of any service interruptions would be determined and communicated by the interconnecting utility (ITC Midwest)

The major roadway in the Project area is Interstate 90, approximately 2.5 miles south of the Land Control Area. With the exception of CSAH 3 which forms the eastern boundary of the Elk Creek Solar Farm site, roads that surround the Land Control Area are local county or township roads. The Land Control Area is bordered on the north by 151st Street, bordered on the south by 131st Street and

[255] https://catalog.data.gov/dataset/national-pipeline-mapping-system-map-tool

bisected (east-west) by 141st Street. Likewise, the Land Control Area is bordered by 180th Avenue on the west, CSAH 3 on the east, and bisected (north-south) by 190th Avenue. Annual Average Daily Traffic (AADT) counts are provided in **Table 21** and displayed on **Figure 5**.[256]

During the construction phase, temporary impacts are anticipated on some public roads within the vicinity of the Project. This will principally consist of additional traffic (work crew, construction personnel) and slow-moving construction vehicles. Traffic during construction is estimated to be approximately on average 50-100 pickup trucks, cars, and/or other types of employee vehicles. It is estimated that approximately 10-20 semi-trucks per day will be used for delivery of facility components. Semi-truck delivery will vary per day depending on time of construction and delivery timeline of equipment.[257]

Preliminary designs indicate that there will be four access points onto the Elk Creek Solar Farm: the northern unit of the Project will be accessed from 190th Avenue and the central and southern units of the Project will be accessed from CSAH 3. The Project substation will be accessed from 190th Avenue.

There are no railroads within one mile of the Land Control Area; the Chicago and Northwestern railway is located approximately two miles south of the Land Control Area and parallels Interstate 90.

Table 21. Annual Average Daily Traffic in the Project Vicinity[258]

Roadway	Year	AADT Traffic Volume Total
CSAH 3 (adjacent to Land Control Area)	2018	290
Interstate 90 (approximately 2.5 miles south of Land Control Area)	2018	10,100
CSAH 8 (one mile north of Land Control Area)	2018	210

The nearest Federal Aviation Administration (FAA)-registered airport to the Elk Creek Solar Farm is the Quentin Aanenson Field Airport, which operates one asphalt runway, located approximately 7.5 miles to the southwest. Results from the Applicant's completion of the FAA Notice Criteria Tool to determine the need for filing 7460-1 Notice of Proposed Construction forms indicate that the Project does not exceed the Notice Criteria. The Applicant received, following the filing of a 7460-1 form, a determination of "No Hazard to air navigation".[259]

[256] https://www.dot.state.mn.us/traffic/data/maps-county-alpha.html
[257] SPA, at p. 55.
[258] SPA, at p. 54, Table 4.2-8.
[259] Ibid, at p.55.

Generic 80 MW Solar Farm

Due to the large land requirements associated with utility scale solar farms, it is anticipated that a generic 80 MW solar farm sited elsewhere in Minnesota would also be in a rural, largely agricultural area with similar public services as the proposed Project.

Generic 80 MW Wind Farm

The potential impact of a generic 80 MW wind farm on public services is highly dependent on the location chosen for the project. As has been established, utility scale wind farms necessitate large commitments of land due to setbacks and wind rights requirements; this allows many opportunities through micro-siting to avoid impacting ground based utility services and infrastructure (transmission lines, pipelines, roads, communication cables).

While the "on the ground" footprint of a wind farm may be small per megawatt compared to a solar farm, wind farms can have a considerably large aerial ("air draft") or vertical footprint due to the tower heights and rotor sweep area. This aerial footprint can impact public services such as air service (airports/travel, air ambulance), over the air communications networks (radio, television, mobile phone, and wireless broadband), Common Air Route Surveillance Radar, and Global positioning systems (GPS) used to guide agricultural operations.

These potential impacts require an addition amount of due diligence from project developers when siting LWECS. Due to their low profiles solar farms would not be anticipated to infer with these type of systems.

Under 14 CFR Part 77.9, all structures exceeding 200 feet above ground level must be submitted to the FAA so that an aeronautical study can be conducted. [260] The purpose of the study is to identify obstacle clearance surfaces that could limit the placement of wind turbines. The end result of the aeronautical study is the issuance of a Determination of Hazard or No Hazard. Additionally, a Tall Towers Permit and approval may be required by the MnDOT prior to constructing the project to ensure the safety of airspace within Minnesota.

In addition to commercial flights associated with any nearby airports, air traffic associated with the crop dusting of agricultural fields should also be taken into account when siting LWECS.

Mitigation

Whether constructing a solar or wind farm, a developer would need to do an appropriate search (Gopher State One Call, American Land Title Association survey, etc.) to identify the locations of underground utilities, drain tiles, and pipelines as part of site development.

[260] https://www.law.cornell.edu/cfr/text/14/77.9

During construction any work that affects road users (including vehicles, bicycles, and pedestrians) requires proper Temporary Traffic Control (TTC) plans. The goal of the Temporary Traffic Control zone is to provide for the safe and efficient movement of traffic around a location where the normal function of the roadway is temporarily suspended.

In addition to searches for potential underground utilities, the 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, this necessitates that the wind farm developer conducted searches to identify local radio, landline telephone service, television, cell towers, micro-beam paths, and broadband services that could be affected by the project. Once identified, micro-siting of turbines can be used to avoid such impacts.

Due to the vertical draft of LWECS, setbacks to airport facilities must be in accordance with MnDOT Office of Aeronautics and FAA requirements. The project turbines must each receive a *Determination of No Hazard* from the FAA, and all turbines over 499 feet tall must also obtain an *Airspace Obstruction Permit* from the MnDOT Aeronautics Division prior to construction.

A generic 80 MW wind farm sited elsewhere in Minnesota would also have to comply with FAA and the MnDOT Office of Aeronautics and Aviation requirements, requiring both turbines and meteorological towers to be identified and fitted with the appropriate markings and lights. Pre-screening of potential wind farm sites must take into consideration the potential for conflicts between the use of airspace and project infrastructure.

If crop dusting operations service lands within a wind farm, or those of surrounding properties, notification and coordination with those providers is warranted.

Due to the potential damage to local roads, a road use agreement with the LGUs should be considered for these projects.

4.5.9 Land-based Economies

Installation of a large electric power generation plant will result in a change of land use. The current land use would be displaced with PV panels or wind tower/turbines, access roads, fencing, inverters, electrical collection system and other infrastructure necessary to support the operation of either the solar or wind farm.

To the extent that the LEPGP displaces other economic uses of the land, such as farming, mining or forestry, the facility will impact land-based economies at the site.

4.5.9.1 Agricultural

Cropland. Cropland includes areas used for the production of adapted crops for harvest. Cultivated cropland comprises land in row crops or close-grown crops and also other cultivated cropland, for example, hay land or pastureland that is in a rotation with row or close-grown crops.

Prime farmland is discussed in Section 4.4.3 – *Prime Farmland*.

Elk Creek Solar Farm

Rock County contains 309,120 acres, of which approximately 280,537 acres (90 percent) are farmland. A total of 689 individual farms are located in Rock County, with the average farm size at 407 acres. The top crops, by acre, are corn, soybeans, foraging crops (hay and haylage, grass silage, and green chop), oats, barley, and other (vegetables).[261] Top of the list of livestock inventory in Rock County are hogs and pigs, followed by cattle, sheep and lambs, and poultry.[262]

The market value of agricultural production in Rock County was approximately $398 million in 2012. Livestock, poultry, and their products accounted for approximately 55.3 percent of the total value of agricultural production, while crop sales accounted for the remaining 44.7 percent.[263]

The Elk Creek Solar Farm will directly impact approximately 670.1 acres of agricultural land within the Preliminary Development Area, this acreage constitutes less than one half of one percent of the agricultural land in Rock County (280,537 acres).[264] Agricultural production would be allowed to continue in the area within the Land Control Area but outside the fence of the Preliminary Development Area during construction and operation of the Project. Similarly, if hazing or grazing vegetation management strategies are used, some agricultural activities would continue within the Preliminary Development Area.

The Applicant reports that it has obtained drain tile mapping from landowners for all but 80 acres of the Land Control Area and efforts (community outreach, infrared aerial photographs, LiDAR data, and, site-specific tile surveys) will continue to map the tiling on the remaining 80-acre parcel. In the event the remaining drain tile mapping cannot be identified, the Applicant will utilize other sources, including infrared aerial photographs, LiDAR data, and, if necessary, a site-specific tile locate survey.

The AIMP contains information on drain tile identification, design considerations, construction measures, and operational measures.[265]

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[261] https://www.nass.usda.gov/Publications/AgCensus/2017/Full_Report/Census_by_State/Minnesota/.
[262] Ibid.
[263] Ibid.
[264] SPA, at pp. 55-56.
[265] SPA, at Appendix C, Section4.9.

Generic 80 MW Solar Farm

Due to the large land requirements associated with utility scale solar farms, it is anticipated that a generic 80 MW solar farm sited elsewhere in Minnesota would also be in a rural, largely agricultural area with similar public services as the proposed Project.

Generic 80 MW Wind Farm

The placement of a generic 80 MW wind farm (wind turbines, access roads, and electrical collector systems, and substations) 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.

Construction of a LWECS 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 presence of the wind farm should 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.

After construction of a wind farm is complete, farming is allowed to continue on all land surrounding the turbines, access roads, collector substations, and O&M facility. Due to the smaller footprint per megawatt of LWECS when compared to solar farms, permanent loss of crop land would be anticipated to be less.

The aviation industry is concerned that the growth of wind energy development will endanger agricultural aviators and restrict the business opportunities for aerial application of seeds, fertilizers and crop protection chemicals. A wind turbine in a farm field subject to aerial spraying represents an obstacle for the pilot; agricultural aviators fly below the height of turbine blades while distributing (as low as 10 feet above ground level), but need to rise to a higher altitude to turn around for their next pass. This turn can take a half mile to complete. In addition to collision risk, the vortices and the turbulence that the wind turbines generate can also be a concern for agricultural aviators.

According to the National Agricultural Aircraft Association (NAAA), there are about 1,560 aerial agricultural application businesses within the United States.[266] Minnesota has approximately 150 agricultural aircraft pilots.[267] Fixed-wing aircraft account for 87 percent of the aircraft used by agricultural applicators, helicopters and other rotorcraft account for the rest. Approximately 208 million acres of U.S. croplands are treated with crop protection products; aerial application accounts for about a fifth to a quarter of that acreage.[268]

[266] National Agricultural Aviation Association. 2019. *Industry Facts*, https://www.agaviation.org/industryfacts, accessed March 26, 2019.
[267] Minnesota Agricultural Aircraft Association. https://mnagaviation.com/
[268] National Agricultural Aviation Association. 2019. *Industry Facts*, https://www.agaviation.org/industryfacts, accessed March 26, 2019.

The NAAA reports that between 2009 and 2019, nine (9) percent of aerial application fatalities were the result of collisions with various types of towers and 13 percent were the result of collisions with wires.[269] The Minnesota Agricultural Aviation Association, in previous dockets, has noted in that nationwide, in the past 10 years, there have been 102 aerial collisions with towers and wires, 21 of these have been fatal.[270]

The development of wind farm provides numerous economic and environmental benefits to both individuals and surrounding communities. Less apparent are the negative consequences of these projects, especially when they constrain a landowner's agribusiness. Both participating and non-participating landowner's operations may be affected; if one landowner erects a wind tower that resides too close to an adjacent landowner's field, the second landowner may lose their current or future opportunity to spray their crops, detrimentally affecting agricultural production.

Additionally, where aerial applications in the vicinity of wind farms are still possible, the increased complexity and time required results in higher cost (most spray policies charge premiums up to 50 percent above standard costs on fields within a mile of the towers, whether a participating landowner or not) to the farmer.[271]

While ground application can be just as effective as aerial spraying, there are certain circumstances where aerial application is preferred or required, such as specific stages of growth (height of corn and sunflower), weather conditions (wet, saturated soils subject to compaction), areas requiring split applications of fertilizer (for groundwater protection), and where timing is urgent (emergency pest control). Furthermore, ground sprayers can increase the spread of disease by carrying it through the crop on the sprayer components after it brushes by diseased plants.

A Purdue University study shows ground applicator rigs damage approximately 1.5 to 5 percent of soybean crops.[272] Building on the Purdue study, Russ Gasper (Nebraska Department of Aeronautics) calculated a potential economic loss due to trampling from ground applicator rigs on Nebraska corn harvest of 25 million dollars.[273]

Mitigation

[269] National Agricultural Aviation Association. 2014. *Fact Sheet on the Dangerous Effects Low Level Obstacles Pose to the Aerial Application Industry.* https://www.agaviation.org/Files/policyinitiatives/Advocacy%20Papers/Tower%20Issue%20Paper%20FINAL.pdf, accessed March 26, 2019

[270] Minnesota Agricultural Aviation Association, Comment Letter November 1, 2018. eDocket No. 201811-148027-08

[271] Illinois Agricultural Aviation Association. 2019. *Wind Farms.* https://agaviation.com/wind-farms/

[272] Hanna et al. 2007. *Managing Fungicide Applications in Soybeans*. Bulletin SPS-103-W. Purdue University Extension Service. https://www.extension.purdue.edu/extmedia/sps/sps-103-w.pdf

[273] Gaspar, Russ. 2015. *Agriculture, Aerial Applicators, and Airports.* Agricultural Aviation. September-October, 2015. http://www.agaviationmagazine.org/agriculturalaviation/september_october_2015?pg=54#pg54

For both solar farms and wind farms sited on agricultural croplands, the revenue lost by removing land from agricultural production should be offset by the leases and purchase options with the landowners.

Site permits issued by the Commission generally require Agriculture Mitigation Plans and Vegetation Management Plans[274] to ensure that areas disturbed during construction are repaired and restored to pre-construction contours and characteristics to the extent practicable. These restoration efforts allow the land surfaces to drain properly, blend with the natural terrain, re-vegetate, and avoid erosion. In the event that damage occurs to drain tile or private ditches as a result of construction activities, site permits require the repair of any damages.

If possible, constructing the project during winter months would further minimize impacts to agricultural land by avoiding planting and harvesting seasons, avoiding the risk of crop damage, and minimizing the likelihood of rutting, accelerated soil erosion, and introduction of noxious weeds to the soil surface.

Livestock. Large electric generation plants have the potential to impact domesticated animals and livestock indirectly through environmental impacts.

Livestock health depends on ecosystem health (clean water, fresh air, healthy soils and crops). Generation facilities that impair ecosystem functions can also negatively impact livestock health, such as through emissions of hazardous air pollutants or through the contamination of water systems.

Potential ecosystem impacts due to generation facilities are discussed elsewhere in this report.

Potential impacts to livestock can arise during construction, or during O&M activities. Gates restricting livestock can inadvertently be left open, and livestock fences can be damaged. Cattle, in particular, can be put at risk of walking on to a public roadway and being struck by a vehicle if gates are left open or fences are damaged. Other potential impacts to livestock health include annoyance or stress. Stress may result from a variety of impacts related to generation facility operations, such as lights, noise, and stray voltage.

Elk Creek Solar Farm

No areas used for animal husbandry are located within the Land Control Area of the Elk Creek Solar Farm; therefore, no impacts to livestock are anticipated.

[274] PUC Staff Briefing Paper, Site Permit Template, October 30, 2019, eDocket No. 201910-157014-01.

Generic 80 MW Solar Farm

While offering some siting and design challenges, solar farms can be compatible with livestock operations.[275] Cattle and other large livestock would require physical barriers to separate the livestock from the solar farm arrays; the panels are fixed relatively low to the ground, so cattle cannot graze beneath them. Sheep have been used to manage vegetation at some solar facilities in Minnesota.

Generic 80 MW Wind Farm

Livestock in and adjacent to LWECS sites would be exposed to noise and shadow flicker created by wind turbines. Exposure levels would depend on factors such as grazing, housing, and the distance between livestock and the turbines. Health impacts from turbine noise and shadow flicker are uncertain. Information about impacts to livestock is anecdotal and indicates that livestock are not impacted by turbine operations. Animals do graze near, under and up to turbine towers.
The electrical collection system for wind farms are designed to be a separately derived system as defined in the NESC. The system should have no direct electrical connection (including grounded circuit conductors) to conductors originating in another system. The wind farm collection system would have its own substations and transformers.

Mitigation

The Site Permit template (4.3.15 and 4.3.18) has specific conditions requiring the protection of property and livestock during all phases of the proposed project, and also the immediate repair of any fences or gates damaged during Project construction or O&M activities.

4.5.9.2 Forestry

Elk Creek Solar Farm

Although there are wooded areas within the Land Control Area, these areas are associated with shelterbelts, homesteads and waterways and are not managed for economic purposes. No economically significant forestry resources will be affected by the Project.

Generic 80 MW Solar Farm

Given the similar land requirements (large, contiguous tracts of open, relatively flat land) the potential impact on the forest industry of a generic 80 MW solar farms would be dependent on siting. For the Elk Creek Solar Farm, the "open" criteria has been met through the use of agricultural lands rather than the clearing of forested land, however, similar to concerns raised here in Minnesota concerning

[275] Kellner, Chelsea. 2018. *Got Sheep? Want a Solar Farm?* North Carolina State University College of Agriculture and Life Sciences News. https://cals.ncsu.edu/news/got-sheep-want-a-solar-farm/

the use of prime farmland for the development of solar farm projects, in many areas of the country the concern is working forest versus lands for solar farms.[276]

Generic 80 MW Wind Farm

Results for a generic 80 MW wind farm would be dependent on the geographical location of the project, however, in Minnesota the setting (rural, largely agricultural area) would be expected to be similar.

Mitigation

As none of the trees in the Land Control Area of the Elk Creek Solar Farm are considered forestry resources, and all trees will be allowed to remain, no mitigative measures are proposed.

4.5.9.3 Tourism and Recreation

Elk Creek Solar Farm

Outdoor recreational opportunities in the greater area include hiking, biking, camping, hunting, fishing, wildlife viewing, cross-country skiing and snowmobiling in several areas located west of the proposed Project (**Figure 11**).

There are no DNR Scientific and Natural Areas, state trails, state water trails, WMAs, Aquatic Management Areas, state parks, migratory waterfowl feeding and resting areas, or DNR mapped snowmobile trails within one mile of the Land Control Area. There are no county or city parks within one mile of the Land Control Area. The nearest city is the City of Magnolia, whose municipal boundary is located 1.5 miles south of the Land Control Area.

The nearest DNR WMA is the Rock River WMA, located 3 miles west of the Land Control Area; and the nearest state park is the Blue Mounds State Park, also located 3 miles west of the Land Control Area. There are several other managed lands associated with the Rock River west of the Land Control Area and near Luverne including: Stephen WMA, Russ Blanford WMA, P.F. Mulder WMA, and the Stephens Aquatic Management Area.

The DNR has established Wildlife Management Areas (WMAs) to provide wildlife habitat, improve wildlife production, and provide public opportunities for hunting and trapping. WMAs are open to the public for hunting, fishing, trapping and wildlife viewing but are closed to all-terrain vehicles and horses because of potential detrimental effects on wildlife habitat.

No impacts to tourism or recreational opportunities are anticipated from the Project.

[276] https://www.forest2market.com/blog/working-forests-vs.-solar-farms.

Generic 80 MW Solar Farm

Results for a generic 80 MW solar farm sited elsewhere in Minnesota would be dependent on the geographical location of the project and the recreational opportunities surrounding it.

Generic 80 MW Wind Farm

Results for a generic 80 MW wind farm would be dependent on the geographical location of the project.

Mitigation

No mitigative measures are proposed.

4.5.9.4 Mining

Elk Creek Solar Farm

There are no gravel pits in the Land Control Area.[277] On the Rock County Pit Map, two gravel pits are shown between 2.7- and 3.6-miles southwest of the Land Control Area, near the City of Luverne.[278]

Construction or operation of the proposed elk Creek Solar Farm would not impact any mining or mineral extraction activities. If sites are activated around the Project boundary, that activity could have an effect on solar operations and efficiency due to fugitive dust. Local permitting agencies may consider dust control measures for those operations.

Generic 80 MW Solar Farm

Results for a generic 80 MW solar farm sited elsewhere in Minnesota would be dependent on the geographical location of the project.

Generic 80 MW Wind Farm

Results for a generic 80 MW wind farm would be dependent on the geographical location of the project.

Mitigation

No mitigative measures are proposed.

4.5.10 Archaeological and Historic Resources

[277] https://www.dot.state.mn.us/materials/maps/copitmaps/rock.pdf.
[278] Ibid.

Archaeological and historic resources and artifacts can be impacted by the construction of a LEPGP; artifacts can be lost or damaged as soil and earth are disturbed, architectural resources can be impacted by changes to the landscape.

Elk Creek Solar Farm

The Applicant contracted with *Area M Consulting* to conduct a Phase I Archaeological Reconnaissance Survey (Phase I) to ensure that no unrecorded cultural resources would be disturbed during Project activities. The Phase I inventory included a review of documentation on file at the Minnesota State Historic Preservation Office (SHPO), as well as various historical maps (Century Public Land Survey maps, Andreas maps, General Land Office maps, Trygg maps, LiDAR maps, and historic aerial photographs), in an effort to identify archaeological or historic sites, historic architectural resources, and previous cultural resource inventories within one-half mile of the Land Control Area. [279]

The archaeological study was conducted in accordance with the Minnesota Field Archaeology Act of 1963. [280]

No previously recorded archaeological or historic sites, historic architectural resources, or previous cultural resources inventories were noted within one-half mile of the Project.

Additionally, a field inventory of the entire 970-acre Land Control Area was completed, which included systematic pedestrian survey along transects spaced 3 meters apart and subsurface shovel testing along transects placed 15 meters apart. [281]

No sites were identified during the field inventory survey.

Generic 80 MW Solar Farm

The land requirements (footprint) and setting (rural, largely agricultural area) for a generic 80 MW solar farm sited elsewhere in Minnesota would be expected to be similar to the proposed project. The potential to impact any archaeological or historic resources would be dependent on the site location and application to the Commission would also require the appropriate archaeological and historic resource investigations.

Generic 80 MW Wind Farm

As with all LEPGP sites seeking a Site Permit from the Commission, an appropriate archaeological and historic resource investigations would be required to determine whether potential impacts to said resources exist. Results for a generic 80 MW wind farm would be dependent on the geographical location of the project.

[279] SPA, at Appendix D, Phase I Reconnaissance Cultural Resources Survey For The Elk Creek Solar Project, Rock County, Minnesota.
[280] Ibid.
[281] Ibid.

The large geographical area (the "box") that contain the numerous, discreet turbines that make up a wind farm, allows many opportunities through micro-siting to avoid any archaeological or historic resources on the ground. While at the same time, the large aerial footprint may be perceived as intrusive to historic architectural resources.

Mitigation

Avoidance of archaeological and historic architectural properties is the preferred mitigative policy for construction of LEPGP. If avoidance is not possible, then appropriate mitigative measures will be developed in consultation with Minnesota SHPO, the State Archaeologist, and consulting American Indian communities.

Section 4.3.13 of the Site Permit template requires coordination with SHPO in the event that new unrecorded sites are discovered during construction. The procedures outlined in permit condition could be formalized in an *Unanticipated Discoveries Plan* to outline the process for resolution should any previously unknown archaeological resource or human remains be encountered.

No archaeological or historic sites, or historic architectural resources were identified during Phase I inventory of the Land Control Area for the Elk Creek Solar Farm; the construction and operation of the Project will not impact historic properties listed in, eligible for, or potentially eligible for listing in the NRHP.

Before construction of the Project begins, the Applicant has stated that it will prepare an *Unanticipated Discoveries Plan* that will outline the steps to be taken if previously unrecorded cultural resources or human remains are encountered during construction.[282]

4.6 Availability and Feasibility of Alternatives

Having analyzed comparative impacts of alternatives, an Environmental Report is required to offer an assessment of the availability and feasibility of those alternatives (Minn. Rule 7849.1500 subp. 1F). This section describes the feasibility and availability of alternatives to the Elk Creek solar project.

Elk Creek Solar Farm

The Elk Creek Solar Farm is located in a rural area with a primarily farm-based economy. Solar farm projects have typically been well integrated into similar settings. Solar resources in this region are among some of the best in the State of Minnesota. In addition, access to the grid is available in the area.

[282] SPA, at p. 58.

The proposed solar farm is feasible and available to be implemented once interconnection details and designs have been completed.

Generic 80 MW Solar Farm

An 80 MW solar farm sited elsewhere is potentially feasible, (see the 100 MW Regal Solar Project, eDocket No. 19-395) currently undergoing review by the Commission. Recently permitted solar farms include the 100 MW Aurora Distributed Solar Project (eDocket No. 14-515), the 100 MW North Star Solar Project (eDocket No. 15-33), and the 62.25 MW Marshall Solar Project (eDocket 14-1052).

In 2013, Minnesota established a Solar Energy Standard that mandates Minnesota's investor-owned electric utilities to generate 1.5 percent of their electric power from solar by the end of 2020. Minnesota Power and Otter Tail Power are planning for additional solar development to reach their solar targets by 2020. In addition, Xcel Energy included a target of 650 MW of solar generation by 2020 and an additional 750 MW by 2030 in its 2016-2030 resource plan approved by the Minnesota Public Utilities Commission in 2016 as a least-cost plan for the utility's system needs.[283]

The cost and reliability of wind power continues to be more favorable than for solar power despite recent substantial decreases in cost for solar. Wind continues to be more cost-effective than solar-powered electricity and remains the lowest-cost new source of renewable energy. The United States Energy Information Administration projects the levelized total system cost for new generation resources entering service in 2023 to be $42.8/MWh (36.6 with tax credit) for onshore wind compared with $48.8/MWh ($37.6/MWh with tax credit)for solar photovoltaic entering service.[284]

From a land-use perspective, a MW of solar requires more land be used (taken out of production) for the life of the project to achieve the same number of MWs as wind.

Generic 80 MW Wind Farm

An alternative to the Project is a large wind energy conversion system sited elsewhere in Minnesota. There are good wind resources in other parts of the state, and wind farms could be placed in these areas. Such a project could be a single 80 MW project or a combination of smaller dispersed projects.

In addition to wind resource availability, access to transmission interconnection is also important for a project to be viable; transmission access can be a constraint for the development of wind energy in Minnesota.

[283] Minnesota Department of Commerce. 2018. *Minnesota Renewable Energy Update*. https://mn.gov/commerce-stat/pdfs/2017-renewable-energy-update.pdf

[284] U.S. Energy Information Administration. 2019. *Levelized Cost and Levelized Avoided Cost of New Generation Resources in the Annual Energy Outlook* 2018, *available at:* https://www.eia.gov/outlooks/aeo/pdf/electricity_generation.pdf.

4.6.1 No-build Alternative

The Elk Creek Solar Farm has been proposed to meet growing electric demand in Minnesota and growing demand for additional renewable resources in Minnesota and neighboring states. Minnesota has committed to a renewable energy objective of generating 25 percent of its electricity from eligible renewable sources by the year 2025.[285] Minnesota utilities had approximately 3,700 MW of wind generation in their portfolios at the end of 2017, with an additional 3,000 MW of wind generation planned for the Minnesota Market.[286] In addition to Minnesota's renewable energy objective, there is a regional need and desire for wind energy.

The "no-build alternative" would result in the Elk Creek Solar Project not moving forward and would result in no physical impact to the proposed site in Rock County. However, not building the Project would result in a loss of the additional source of tax revenues to the county, and the income stream to residences and businesses that this Project would generate.

It is unknown whether, or to what extent, not building the Elk Creek Solar Project would have on meeting Minnesota and regional demand for renewable electric power generation.

4.7 Unavoidable Impacts

Where feasible, the EA suggests mitigation measures to be incorporated into the planning, design, and construction of the proposed Project to substantially eliminate the adverse impacts. In other areas of consideration, adverse impacts can be reduced but not eliminated and are therefore determined to be unavoidable. Most unavoidable adverse impacts would occur during the construction phase of the proposed Project and would be temporary.

Aesthetic impacts cannot be avoided; the Elk Creek Solar Farm would introduce a new feature into the project area and the existing landscape.

Temporary construction-related impacts, including construction-related noise and dust generation, disruption of traffic, and the disturbance to and displacement of some species of wildlife, near construction sites, are also unavoidable.

The Elk Creek Solar Farm will also create unavoidable impacts to agriculture; changes in land use and vegetation from agricultural land of predominately corn and beans to a solar facility with herbaceous

[285] Minn. Statute 216B.1691
[286] Minnesota Department of Commerce. 2018. *Minnesota Renewable Energy Update*. https://mn.gov/commerce-stat/pdfs/2017-renewable-energy-update.pdf

vegetation underneath and around the Preliminary Development Area. This will result in a loss of tillable acreage.

4.8 Irreversible Commitment of Resources

A commitment of resources is irreversible when its primary or secondary impacts limit the future option for a resource. An irretrievable commitment refers to the use or consumption of resources that is neither renewable nor recoverable for later use by future generations. The commitment of resources refers primarily to the use of nonrenewable resources such as fossil fuels, water, and other materials (aggregate minerals, steel/metals, etc.).

Construction activities would require the use of fossil fuels for electricity (portable generators) and for the operation of vehicles and equipment. Use of raw building materials for construction would be an irretrievable commitment of resources from which these materials are produced, excluding those materials that may be recycled at the end of the Project life cycle. The use of water for dust abatement during construction activities would be irreversible. Commitment of labor and fiscal resources to develop and build the project is considered irretrievable.

5 Application of Siting Factors

The Power Plant Siting Act requires the Commission to locate large electric power facilities in an orderly manner compatible with environmental preservation and the efficient use of resources and in a way that minimizes adverse human and environmental impact while insuring electric power reliability.[287] Minnesota Statute Section 216E.03, subdivision 7(b) identifies considerations that the Commission must take into account when making its final determination on siting of large electric power facilities. Minnesota Rule 7850.4100, lists 14 factors to guide Commission site and route designations, including the evaluation and minimization of adverse environmental impacts, impacts to public health and welfare, and adverse economic impacts. These factors are outlined in Section 2.2.1 of this document.

5.1 Relative Merits

Generally, an Environmental Assessment will review the Factors to help establish the relative merits of a proposed project against any alternative sites or routes that have been reviewed in the EA. Since only the proposed Elk Creek Solar Farm site (no alternative sites were put forth during scoping) is being considered in the current review for LEPGP site permit, and the 161 kV transmission line is less than 1,500 feet[288] (does not meet the definition of a HVTL) the concept of relative merits is not applicable.

5.2 Review of Siting Factors

This review looked not only at the Factors, but also the Elements that make up those Factors (see subsections below). For the most part, adherence to best management practices during construction and operation and the general permit conditions in the Site Permit Template provided by Commission Staff in this record (Appendix B) is anticipated to result in minimal to moderate impacts from the facilities. In some instances, however, the addition of special permit conditions could help to minimize impacts.

5.2.1 Factor: Effects on Human Settlement

Elements: Noise, cultural values, public services, recreation

Impacts related to noise, cultural values, public services and recreation are anticipated to be minimal with the use of standard construction techniques and the general conditions in the Site Permit Template.

[287] Minnesota Statute 216E.02, https://www.revisor.mn.gov/statutes/?id=216E.02

[288] Minnesota Statute 216E.01, Subdivision 4.

Element: Aesthetics

Impacts are anticipated to be minimal with the use of standard construction techniques and the general conditions identified in the Site Permit Template. Aesthetic impacts at the solar farm are anticipated to be minimal to moderate, but may be mitigated to a degree with special permit conditions, such as requiring the electric collection system to use the below ground option as opposed to the above-ground option.

Given the proximity of the Elk Creek Solar farm to the few existing residences in the immediate area, development of a landscaping plan that identifies site-specific landscaping techniques (including, but not limited to, vegetation screening, berms and fencing) could be used to minimize visual impacts to adjacent homes.

Aesthetics impacts from the short span of the 161 kV transmission line connecting the project substation to the Magnolia Substation should be minimal, as the line would represent only an incremental addition to the existing Magnolia Substation, the existing 161 kV HVTL and the existing 69 kV line.

Element: Consistency with Local Land Use and Planning

The Rock County Renewable Energy Ordinance recognizes development of large solar energy systems within the general agricultural district is a conditionally permitted use

5.2.2 Factor: Effects on Public Health and Safety

Construction presents the only potential impacts to public health and safety. These are anticipated to be minimal with use of standard construction techniques, traffic control measures during deliveries, and the general conditions identified in the Site Permit Template. Operation of the facility is not anticipated to be a public health or safety concern, especially considering the secured access.

5.2.3 Factor: Effects on Land-Based Economies

Elements: Forestry, Tourism and Mining

Impacts to forestry, tourism and mining are avoided; therefore any potential impacts are anticipated to be negligible with the use of standard construction techniques and the general conditions in the Site Permit Template.

Element: Agriculture

There will be direct impacts to agriculture through the 554 acres of prime farmland and 126 acres of prime farmland if drained taken out of production for the life of the Project. Given the 80 MW net generating capacity of the Elk Creek solar project, Minnesota Rules 7850.4400, subpart 4, would allow only the use of up to 40 acres of prime farmland for the Project. The Applicant believes, through its

site selection efforts, that it has met the "no feasible and prudent" test provision within this rule (see discussion in Section 3.1.3 *Project location* and Section 4.4.3 *Prime Farmland*.

5.2.4 Factor: Effects on Archaeological and Historic Resources

Impacts are anticipated to be negligible with use of standard construction techniques and the general conditions identified in the Site Permit Template. No known archaeological or historical sites were identified within the Land Control Area and the one-mile buffer surrounding the Project.

The procedures outlined in Section 4.3.13 of the Site Permit Template provide an outline of the process for resolution should any previously unknown archaeological resource or human remains be encountered.

5.2.5 Factor: Effects on Natural Environment

Element: Air
Impacts to air quality are anticipated to be negligible with the use of standard construction techniques and the general conditions in the Site Permit Template.

Element: Surface Water
Impacts to surface waters are anticipated to be minimal with the use of standard construction techniques and the general conditions identified in the Site Permit Template, and the nominal open water space in the Land Control Area. There are no Shoreland Overlay Districts.

Element: Wetlands
Impacts to wetlands are expected to be minimal with the use of standard construction techniques and the general conditions in the Site Permit Template.

Element: Soils and Groundwater
Impacts to soils and groundwater are anticipated to be minimal with the use of standard construction techniques and the general conditions in the Site Permit Template.

Element: Vegetation
Impacts to non-cropland vegetation are anticipated to be minimal with the use of standard construction techniques, restoration efforts, development and compliance with the AIMP and VMP, and the general conditions in the Site Permit Template.

Element: Wildlife
Impacts to wildlife are anticipated to be minimal to moderate with the use of standard construction techniques and the general conditions in the Site Permit Template.

In addition to the general conditions in the Site Permit Template provided by Commission staff in this record, the site permit should require that the design of the facilities preserves or replaces identified natural wildlife, wetland, woodland or other corridors.

5.2.6 Factor: Effects on Rare and Unique Natural Resources

The Elk Creek Solar Farm does not appear poised to impact any rare and unique natural resources; impacts should be minimal with standard construction techniques and the general conditions in the Site Permit Template.

5.2.7 Factor: Project Design

Element: Design Options to Maximize Energy Efficiencies

The Project uses a single-axis tracker and module layout designed to maximize exposure to the sun and use of the available land. The locations of the inverters and the layout of the electrical collection system have been designed to avoid energy losses.

Element: Design Options to Accommodate Potential Expansion

The Applicant initially filed an interconnection request for 200 MW, which the Applicant has stated that it plans to reduce the request to 80 MW to reflect the proposed nameplate capacity of the Project.[289]

The Applicant has stated that it may transfer a portion of its transmission service, per Federal Energy Regulatory Commission Order No. 845 and Order No. 845-A, but has no plans to expand the proposed project at this time.[290]

A separate project is under development, by another Geronimo subsidiary, adjacent to the Project; however, the Applicant states that it does not anticipate sharing any infrastructure with the adjacent project, and the separate project will secure its own, leases, purchase options, interconnection agreement, and PPA.[291]

Element: Design Options to Mitigate Adverse Environmental Effects

A description of mitigative measures that could be used to avoid and minimize impacts is thoroughly addressed in the descriptions of impacts in previous portions of this document. To the extent that special conditions may be appropriate for particular Elements, those mitigative measures are identified in the individual resource subsections.

[289] SPA, at p. 14.
[290] Ibid.
[291] Ibid.

5.2.8 Factor: Use of Existing Large Electric Power Generating Plant Sites

The Project does not make use of existing Large Electric Power Generating Plant sites. A solar facility's unique siting requirements, particularly the relatively large land requirements, preference for a site without large structures that may limit solar access, and the need for willing landowners, make using existing power plant sites more challenging.

5.2.9 Factor: Use of existing transmission systems or rights-of-way

The Project surrounds the Magnolia Substation and therefore only requires a short (~300 foot) 161 kV transmission line to connect the project substation to the grid.

5.2.10 Factor: Electrical System Reliability

Electrical system reliability is addressed in the Application for a Certificate of Need (eDocket 19-351). A net capacity factor of between approximately 22.2 percent and 24.0 percent, with a projected average annual output of between approximately 156,000 and 168,000 MWhs, is anticipated for the Elk Creek Solar Farm. The Project will be available at least 98 percent of the time, consistent with other utility scale solar projects.

Reliability is also the focus of the Project's MISO interconnection agreement; a determination on the MISO findings should be released later this year.

5.2.11 Factor: Design-Dependent Costs

The centralization of the energy production in one location creates efficiencies for construction, infrastructure, transmission and interconnection costs.

5.2.12 Factor: Irreversible and Irretrievable Commitments of Resources

See discussion in Section 4.8-*Irreversible Commitment of Resources*.

5.2.13 Factor: Unavoidable Impacts

See discussion in 4.7-*Unavoidable Impacts*.

FIGURES

APPENDICES

APPENDIX A - Scoping Decision

Appendix B - Site Permit Template