COMMERCE DEPARTMENT

Plum Creek Wind Project

Final Environmental Impact Statement

The Human and Environmental Impacts of Constructing and Operating a 414 MW Wind Farm and Associated 345 kV Transmission Project

April 2021

eDocket Nos. IP-6997/CN-18-699;
IP-6997/WS-18-700; and IP-6997/TL-18-701

Abstract

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Plum Creek Wind Farm, LLC (Plum Creek or Applicant) is proposing to build a 414-megawatt wind farm in Cottonwood, Murray, and Redwood Counties in southwest Minnesota. The applicant is also proposing to build approximately 30-mile long 345-kilovolt high-voltage transmission line to connect the wind farm to the electric grid. Plum Creek anticipates that construction will take approximately 12 months to complete, and the project will be in- service in late 2022.

In order to build the project, Plum Creek must obtain three approvals from the Public Utilities Commission (Commission): a certificate of need (CN) for the project as a whole, a site permit for the wind farm, and a route permit for the transmission line. The purpose of this environmental impact statement (EIS) is to provide information the Commission needs to make these permit decisions.

This final EIS addresses the issues and mitigation measures identified in the Department's scoping decision of November 4, 2020 and reflects comments received on draft EIS (January 11, 2021). It evaluates the potential human and environmental impacts of the proposed Plum Creek Wind Project and possible mitigation measures including transmission line route, route segment, and alignment alternatives.

Additional materials related to this project and its permitting proceedings are available on the Department's website: http://mn.gov/commerce/energyfacilities and on the State of Minnesota's eDockets system: https://www.edockets.state.mn.us/EFiling/search.jsp (enter the year "18" and the number "699," "700,"or "701").

Persons interested in receiving future notices about this project can place their names on the project mailing list by contacting docketing.puc@state.mn.us or 651-201-2246 and providing the docket number (18-699, 18-700, or 18-701), their name, email address, and mailing address. Please indicate how you would like to receive notices – by email or U.S. mail.

This document can be made available in alternative formats (i.e., large print or audio) by calling 651-539- 1530 (voice).

Acronyms and Abbreviations

AADT	average annual daily traffic
AC	Alternating Current
ACS	American Community Survey
ACSR	aluminum-conductor steel-reinforced
AIMP	agricultural impact mitigation plan
ALJ	administrative law judge
AM	amplitude modulated
amps	amperes
ASTM	American Society for Testing and Materials
BMPs	best management practices
BWSR	Minnesota Board of Water and Soil Resources
CN	certificate of need
Commission	Minnesota Public Utilities Commission
CREP	Conservation Reserve Enhancement Program
CRP	Conservation Reserve Program
CSAH	County State Aid Highway
CWA	Clean Water Act
dB	decibel
dBA	A-weighted decibel scale
Department	Minnesota Department of Commerce
DEED	Minnesota Department of Employment and Economic Development
DNR	Minnesota Department of Natural Resources
ECS	Ecological Classification System
EERA	Energy Environmental Review and Analysis
EIS	Environmental Impact Statement
ELF	extremely low frequency
EMF	electric and magnetic fields
EPA	United States Environmental Protection Agency
ESA	Phase I Environmental Site Assessment
FAA	Federal Aviation Administration
FEMA	Federal Emergency Management Agency
FM	frequency modulated
FSA	Farm Services Agency
GIS	geographic information system
GPS	global positioning system
HAP	hazardous air pollutants
Hz	Hertz
ICDs	implantable cardioverter defibrillators
JEDI	Jobs and Economic Development Impacts

kV	kilovolt
kV/m	kilovolts per meter
MBS	Minnesota Biological Survey
MDA	Minnesota Department of Agriculture
MDH	Minnesota Department of Health
MET tower	meteorological tower
mG	milliGauss
MHz	megahertz
MMPA	Minnesota Municipal Power Agency
MISO	Midcontinent Independent System Operator
MnDOT	Minnesota Department of Transportation
MPCA	Minnesota Pollution Control Agency
MW	megawatt
NAAA	National Aviation Aircraft Association
NAC	noise area classification
NEPA	National Environmental Policy Act
NERC	North American Electric Reliability Corporation
NESC	National Electrical Safety Code
NHIS	Natural Heritage Information System
NHPA	National Historic Preservation Act
NORAD	North American Aerospace Defense Command
NOX	nitrogen oxide
NPDES	National Pollutant Discharge Elimination System
NPDES/SDS	national pollutant discharge elimination system/sanitary disposal system
NREL	National Renewable Energy Laboratory
NRHP	National Register of Historic Places
NTIA	National Telecommunications and Information Administration
O&M	operations and maintenance
OAH	Office of Administrative Hearings
PM	Particulate matter
ppm	parts per million
PWI	public waters inventory
RIM	Reinvest in Minnesota
ROI	regions of influence
ROW	right-of-way
RTK GPS	real-time kinematic GPS
SHPO	Minnesota State Historic Preservation Office
SMMPA	Southern Municipal Power Agency
SWPPP	Stormwater Pollution Prevention Plan
TCP	Traditional cultural property
UHF	ultra-high frequency
USACE	United States Army Corps of Engineers

USDA	U.S. Department of Agriculture
USFWS	U.S. Fish and Wildlife Service
VOC	volatile organic chemicals
WCA	Wetland Conservation Act
WMA	wildlife management area
WNS	White Nose Syndrome
WPA	waterfowl production area

Executive Summary

Plum Creek Wind Farm, LLC (Plum Creek or Applicant) is proposing to build a 414-megawatt wind farm in Cottonwood, Murray, and Redwood Counties in southwest Minnesota. The Applicant is also proposing to build an approximately 31~~0~~-mile long 345-kilovolt (kV) high-voltage transmission line (HVTL) to connect the wind farm to the electric grid. Plum Creek anticipates that construction will take approximately 12 months to complete, and the project will be in- service in late 2022.

In order to build the project, Plum Creek must obtain three approvals from the Public Utilities Commission (Commission): a certificate of need (CN) for the project as a whole, a site permit for the wind farm, and a route permit for the transmission line. The purpose of this environmental impact statement (EIS) is to provide information the Commission needs to make these permit decisions.

This EIS evaluates alternatives to the project itself. It also evaluates the potential human and environmental impacts of the proposed project and possible mitigation measures including transmission line route, route segment, and alignment alternatives.

This EIS is not a decision-making document, but rather serves as a guide for decision makers.

Project

The Plum Creek Wind Project consists of two parts – a wind farm and a transmission line that connects the wind farm to the electrical grid:

- Wind Farm: The proposed 414 MW wind farm consists of up to 74 turbines to be located within an area of approximately 73,085 acres (the site). Plum Creek anticipates that the wind farm would consist of wind turbines with rated nameplate power outputs ranging from 5.6 MW (Vestas V162) to 6.2 MW (Siemens Gamesa SG170), corresponding to between 67 and 74 wind turbines at the site. The wind farm also includes underground electric collection lines, an operation and maintenance building, permanent meteorological towers, and gravel access roads.
- Transmission Project: Plum Creek proposes to construct a HVTL that will connect the wind farm's Collector Substations to a proposed Switching Station at the existing Brookings to Hampton 345 kV transmission line, approximately 26 miles north of the Plum Creek site. Plum Creek proposed two possible routes for the transmission line (Blue and Red Routes) from the wind farm to the Switching Station and two routes (Yellow and Green Routes) to connect the wind farm's Collector Substations together.

Plum Creek is an independent power producer; the power generated by the Project will be offered for sale to wholesale customers, including Minnesota utilities and cooperatives, and commercial and

industrial customers that have identified a need for additional renewable energy or set clean energy goals.

State of Minnesota's Role

In addition to the three approvals from the Commission, the Applicant also requires approvals (permits, licenses) from other state agencies and federal agencies with permitting authority for specific resources (the waters of Minnesota). Commission site and route permits supersede and preempt all zoning, building, and land-use regulations promulgated by local units of government.

The Applicant applied to the Commission for a CN, a site permit, and a route permit for the project in November 2019; a Supplemental and Amended Site Permit Application was filed on August 28, 2020. With these applications, the Commission has before it three distinct considerations:

- 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,
- if the Project is needed, is the wind farm as proposed compatible with environmental preservation, sustainable development, and the efficient use of resources, and
- if the proposed Project is needed, where is the transmission line best located and what conditions should be placed on the route permit.

To help the Commission with its decision-making, the state of Minnesota has set out a process for the Commission to follow in making its decisions. This process requires the development of an EIS and public hearings before an administrative law judge (ALJ).

The goal of the EIS 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 EIS and the report from the ALJ, including all public input and testimony—is considered by the Commission when it makes its decisions on the applicant's CN, site, and route permit applications.

Certificate of Need Decision

Construction of a large energy facility in Minnesota requires a CN from the Commission. Both the 414-MW wind farm and the 345 kV transmission line meet the definition of a large energy facility and require a CN.

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 project's termini, or its start and end points. The Commission could place conditions on the granting of a CN.

The CN decision does not determine the locations of wind turbines or the route for transmission line; these determinations are made in the site and route permits for the project.

Need for the Wind Farm

Section 3 of the EIS provides an analysis of impacts associated with the Plum Creek Wind Farm and alternatives to the wind farm portion of the Project. Because the Plum Creek Wind Project is intended to meet renewable energy objectives, wind farm alternatives examined in this EIS are limited to technologies that support renewable energy objectives. These alternatives are:

- a generic 414-MW wind generation project sited elsewhere in Minnesota,
- a 414-MW solar farm, and
- a "no-build" alternative is included in the analysis as a consequence of Minn. Rule 7849.0340, the No-facility Alternative requirement.

It should be noted that testimony and surrebuttal provided in the record by the Department's Division of Energy Resources (DER) concluded that the Applicant has not provided sufficient evidence to meet the requirements of Minnesota Rule 7849.0120 A-1 (the accuracy of the applicant's forecast of demand for the type of energy that would be supplied by the proposed facility). However, the Department did agree generally with the Applicant's reasoning that the Project's large size and construction timeline will provide economies of scale and reduce costs through currently available federal tax incentives that favor the size and timing of the Project. Also, DER concluded that the Project's proposed Gen-Tie line is reasonably sized.

The Plum Creek Wind Farm would create human and environmental impacts similar to other large wind projects located in Minnesota:

- With use of mitigation measures outlined in its site permit application and site permit conditions, it is not anticipated that the wind farm would create significant impacts to air quality, water quality, wetlands, solid or hazardous wastes, overall vegetative cover in the project area, non-avian wildlife, rare and unique natural features, or property values.
- The proposed wind farm is consistent with local planning and zoning.
- The wind farm has the potential for impacts to avian and bat populations. Plum Creek has incorporated pre-construction avian studies in the design and layout of the wind farm. Preconstruction studies have also been used to inform the design of Plum Creek's proposed post-construction avian fatality monitoring. The Commission's Draft Site Permit requires curtailment of turbine operation to minimize avian and bat fatalities, including restrictions on turbine operations during bat migration season and software that allows for adjustment of cut-in speeds during the operational life of the project.
- The Plum Creek Wind Farm would create noise. The predicted post project sound level is below the 50 dBA limit at all modeled residences within the site.
- The Plum Creek Wind Farm would create both short-term and long-term economic benefits. Short-term economic benefits would occur as a result of the approximately 250 temporary construction jobs during the construction period and construction-related spending. Once the project becomes operational, approximately 13 full-time workers will be required to operate and maintain the facility. Landowners with turbines or other wind farm facilities on their land would receive an annual lease payment for the life of the project. Local governments would receive wind production tax revenues over the operating life of the project. Plume Creek estimates annual wind energy production tax payments of between $1,750,000 to $2,000,000.

Need for Transmission Line

Chapter 4 of the EIS reviews potential impacts and mitigation measures for the proposed 345 kV transmission project as well as alternatives (no-build, other voltages, and alternative endpoints) to the 345 kV transmission project. If a transmission line is not built, the generation from the wind farm would have no outlet; the wind farm would not be financially viable, and the project would not be built. Transmission voltages greater than 345 kV, while technically feasible, are in excess of what is required to connect the wind farm to the grid and would have greater costs and impacts than the proposed 345 kV transmission project. Transmission alternatives that connect the wind farm to the grid at a lower voltage are feasible and available, although they would have higher line losses, would subject the wind farm to a higher risk of curtailment, and may be more expensive than the proposed 345 kV transmission project. However, DER in direct testimony and surrebutal concluded that the Project's proposed Gen-Tie line is reasonably sized.

Site Permit Decision

A site permit from the Commission is required to construct a large wind energy conversion system (LWECS), which is any combination of wind turbines and associated facilities with the capacity to generate five MW or more of electricity. The Plum Creek Wind Farm will generate up to 414-MW; thus, it requires a site permit.

In making a siting decision for the wind farm, the Commission considers factors prescribed in statute and rule. Minnesota Statutes, section 216E.03, identifies considerations that the Commission must consider when siting wind farms, including potential impacts on human and natural resources. The Commission also must determine that a project is compatible with environmental preservation, sustainable development, and the efficient use of resources.

Section 3 of this EIS examines the potential impacts on human and natural resources from construction and operation of the wind farm. With use of mitigation measures outlined in its site permit application and site permit conditions the Plum Creek Wind Farm is compatible with environmental preservation, sustainable development, and the efficient use of resources.

Route Permit Decision

The Commission is charged with locating transmission lines in a manner that is "compatible with environmental preservation and the efficient use of resources" and that minimizes "adverse human and environmental impact(s)" while ensuring electric power reliability (Minnesota Statutes, section 216E.02).

The EIS evaluates four routes – as proposed by Plum Creek in its application (the Blue and Red routes and the Yellow and Green routes), along with one alternative alignment (Cottonwood River Alternative Alignment) and one alternative route segment (Alternative Route Segment Blue E).

Comparison of Route Alternatives

Minnesota Rules, part 7850.4100 lists 14 factors for the Commission to consider in its route permitting decisions, including impacts on human settlements, impacts on land-based economies, and impacts on the natural environment.

This EIS discusses the route alternatives, and the potential impacts and mitigation; the merits relative to the routing factors is summarized below:

Human Settlement

- **Displacement**: Displacement of residences or business properties is not anticipated in either the Blue or Red Routes because no home or building is located within the proposed

transmission line's 150-foot right-of-way (ROW), or within 75 feet of the anticipated center line.

Displacement of residences or business properties is not anticipated in either the Yellow or Green Routes because no home or building is located within the proposed transmission line's ROW (within 75 feet of the anticipated centerline).

- Noise: Noise impacts resulting from the construction are anticipated to be minimal for all routes; potential impacts are expected to be short term. Noise impacts resulting from the operation within the Blue or Red Routes is not anticipated to exceed the MPCA State Noise Standards; the closest residences are 192' and 185'from the ROW, respectively.

  Noise impacts resulting from the operation of the Yellow or Green Routes is not anticipated to exceed the MPCA State Noise Standards; the closest residences are 140' and 173'from the ROW, respectively.
- Aesthetics. All routes are anticipated to have incremental impacts on the aesthetic environment. Viewsheds within the area are shaped by existing features such as agricultural fields and farmsteads, highways and county roads, transmission lines and wind turbines.
- Property Values. The placement of infrastructure near human settlements has the potential to impact property values. Impacts on property values decrease with distance from the line. When negative impacts on property values occur, the potential reduction in property values is in the range of 1 to 10 percent. The closest residence to the Blue and Red Route's ROW is 192 feet and 185 feet, respectively.

  The closest residence to the Yellow and Green Route's ROW is 140' and 173', respectively.
- Electronic Interference. No impacts to electronic devices are anticipated as a result of the HVTL project for any of the routing options. Interference due to electromagnetic noise is not anticipated. Interference due to line-of-sight obstruction could occur in select areas but could be mitigated by prudent placement of transmission line poles and electronic antennas.
- Cultural Values. The presence of the HVTLs, with all routes, will not significantly impact the use of land for agricultural production or the general character of the area.
- Zoning Land Use. Construction and operation of the HVTL Project is not expected to have a significant impact on land use within Cottonwood, Murray, and Redwood Counties. The Routes predominantly cross areas zoned as agricultural and the presence of the HVTL does not impair agricultural uses. Though a few smaller pockets of residential zoning are crossed by the routes in all counties, all of the ROWs are sited outside of the residential parcel boundary, and on the opposite side of the road, thereby avoiding direct impacts to parcels zoned as residential.
- Public Services. With proper coordination, project construction and operation should not directly affect any public or emergency services, regardless of the route chosen.

Public Health and Safety

- EMF/Electric Fields. Based on the predicted EMF levels for the project, no adverse health impacts from electric or magnetic fields are anticipated for persons living or working near any of the proposed routes.
- Air Quality. Potential air quality impacts associated with the transmission project come from two primary sources: ozone & nitrogen oxide emissions from operating the HVTL and short-term emissions from construction activities. Emissions from operating any of the proposed lines are anticipated to have negligible impacts on air quality. Air emissions during construction would primarily consist of emissions from construction equipment and would include carbon dioxide, NOX, and particulate matter (PM); dust generated from earth disturbing activities would also give rise to PM. Any emissions from construction would be similar to those from agricultural activities common in the project area and would only occur for short periods of time in localized areas.

Land Based Economies

- Agriculture. The overall impact on agricultural lands is anticipated to be minimal for all of the proposed routes. Construction of the HVTL Project could cause temporary impacts to farmland (soil compaction and rutting, accelerated soil erosion, crop damage, temporary disruption to farm activities, and introduction of noxious weeds); compliance with permit conditions (BMPs, etc.) will minimize potential impacts. Direct impacts (pole placement in cropland) is estimated at 0.3 acres each for the Blue and Red routing options.

  Direct impacts (pole placement in cropland) is estimated at 0.1 acres each for the Yellow and Green routing options.
- Extraction Industries. There are no forestry operations along any of the proposed Routes' ROW. There are two gravel pits mapped along the Cottonwood River in the area between the Blue and Red Routes; there are no gravel pits within the ROW of either of these routes.

  No gravel pits are mapped within two miles of the Green and Yellow Routes.
- Recreation/Tourism. Impacts to recreation areas would mostly be related to HVTL Project construction (noise, dust, etc.), and will be minimal, and temporary for all routes.

Archaeological & Historic Resources

- Archaeological & Historic Resources. Three previously recorded archaeological sites were identified within one mile of the Blue Route; no previously recorded archaeological sites were identified within the Blue Route's route width. Eight previously recorded historic architectural resources were identified within one mile of the Blue Route. Seven recorded archaeological sites lie within one mile of the Red Route; most notably, the remains of Laura Ingalls Wilder's homesite along Plum Creek lies approximately 250 feet east of the Red Route. Twelve previously recorded historic architectural resources were identified within one mile of the Red Route.

No previously recorded archaeological sites were identified within one mile of or within the route width of the Yellow Route. Two previously recorded historic architectural resources were identified within one mile of the Yellow Route; these resources are not present within the Yellow Route's route width.

No previously recorded archaeological sites were identified within one mile of or within the route width of the Green Route. One previously recorded historic architectural resource was identified within one mile of the Green Route; this resource is not present within the Green Route's route width.

All the proposed routes were designed to avoid any direct physical impacts to all previously documented archaeological and historic architectural resources identified during the background literature review.

Natural Resources

- Surface Waters. Impacts to surface waters are anticipated to be minimal for all routes given compliance with permit conditions and BMPs at stream crossings. The Blue and Red routes each include 19 waterbody crossings.

  The Yellow Route ROW crosses four waterbodies; all of the waterbodies crossed are intermittent streams. Of these streams, two unnamed streams are PWI waters. The Green Route ROW crosses eight waterbodies; all of the waterbodies crossed are intermittent streams. Of these streams, two are unnamed PWI waters.
- Wetlands. The Blue Route crosses less acres (9.1) of NWI wetlands than the Red Route (15.0). Three poles would be placed in wetlands along the Blue Route, while the Red Route would have 10 poles placed in wetlands associated with the Cottonwood River.

  The Yellow Route crosses 1.2 acres of NWI wetlands (including 0.2 acres of forested wetland) and would require one pole to be placed in wetlands. The Green Route crosses 1.9 acres of NWI wetlands (including 0.5 acres of forested wetlands) and would require no poles be placed in wetlands.

  Impacts to wetlands are anticipated to be minimal with the use of BMPs (frozen construction season, wetland mats, equipment assembly on upland areas).
- Vegetation. Vegetation impact for all routes would be minimal to moderate. The Blue and Red routes contain similar amounts and landcover types; the Red Route having slightly more herbaceous cover within the ROW then the Blue Route (3.6 acres vs 0.7 acres).

  The Yellow Route contains 43.1 acres of cultivated crops within the ROW, while 47.2 acres are identified as developed areas. The Green Route contains 64.5 acres of cultivated crops within

the ROW, while 34 acres are identified as developed areas. The Green Route also cross some emergent herbaceous wetlands (0.7 acres), while the Yellow Segment does not.

- Wildlife. Given that the majority of the land use along all the proposed routes is cultivated cropland, it is anticipated that the potential impacts on wildlife and wildlife habitat during construction and maintenance of the HVTL Project will be minimal for all the routing options.
- Rare and Unique Natural Resources. The Blue Route ROW crosses two SOBS that are ranked below the minimum threshold for statewide biodiversity significance, Johnsonville 28 and North Hero 32. The Red Route ROW crosses one SOBS that is ranked moderate (Gales 24), and one SOBS ranked below the minimum threshold (Gales 14).

  The ROW of the Green and Yellow Routes do not cross SOBS, NPCs, native prairie, railroad right-of-way prairie, WMAs, Scientific and Natural Areas.

Use or Paralleling of Existing Rights-of-Way

- Use or Paralleling of Existing Rights-of-Way. Approximately 84 percent of the Blue Route is co-located with roads; the other 14 percent is located along property lines and field edges. The Red Route is heavily co-located with roads, as approximately 92 percent of the Route parallels roads. The other eight percent follow property lines and/or field edges. While both routes parallel existing features for the majority of their length, the Red Route makes relatively better use of existing infrastructure (roads).

  The Green and Yellow Routes do not cross and are not co-located with any United States or state highways; these routes primarily cross and are co-located with CSAHs and township roadways. Of the 5-mile-long Yellow Route, 4 miles are co-located along roadways (CSAH 11 and 340th Avenue). Of the 5.5-mile-long Green Route, 1 mile is co-located along roadways (CSAH 7 and 340th Avenue).

Design-Route Dependent Costs

- Design-Route Dependent Costs. Estimated costs (2019 dollars) for the Blue and Red Route are $23,000,000 and $23,300,000, respectively.

  Estimated costs (2019 dollars) for the Yellow and Green Route are $4,220,000 and $4,642,000, respectively.

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Appendices

1 Introduction

This environmental impact statement (EIS) has been prepared for the Plum Creek Wind Project (Plum Creek Project or Project) proposed by Plum Creek Wind Farm, LLC (Plum Creek or applicant). This EIS evaluates the potential human and environmental impacts of the proposed project and possible mitigation measures including route, route segment, and alignment alternatives. Additionally, it evaluates alternatives to the Project itself.

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

Plum Creek filed three separate applications in support of its proposed 414-megawatt (MW) large wind energy conversion system (LWECS) and a 31-mile 345 kilovolt (kV) transmission line to be located in Cottonwood, Murray, and Redwood counties (collectively, the Plum Creek Project):

- a certificate of need application for the wind farm and the associated 345 kV transmission line,[1]
- a large wind energy conversion system (LWECS) site permit application,[2] and
- a high-voltage transmission line (HVTL) route permit application for the proposed 345 kV transmission line.[3]

1.1 Project

The Project consists of two major components, a LWECS of up to 414 MW, and the 345 kV HVTL of approximately 31 miles.

414 MW LWECS

The Project will be located in northwestern Cottonwood, northeastern Murray, and southern Redwood counties, Minnesota (**Diagram 1 and Figure 1**). The Project will have up to 414 MW of nameplate wind energy capacity. Plum Creek continued to assess its turbine options throughout the SPA review process and has selected wind turbines with rated nameplate power outputs ranging from 5.6 MW (Vestas V162) to 6.2 MW (Siemens Gamesa SG170), corresponding to between 67 and 74 wind turbines at the site.[4]

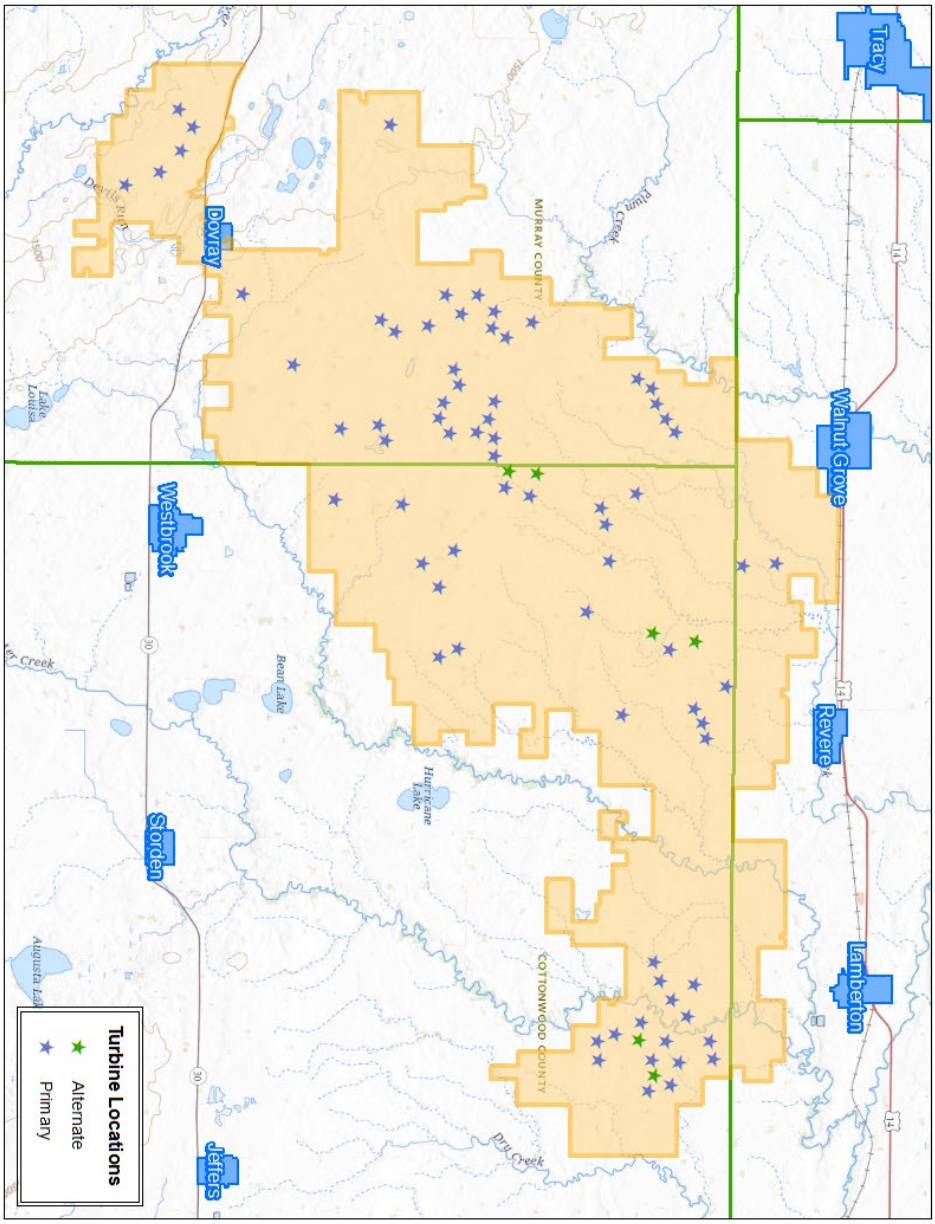
[1] Plum Creek Wind Farm, LLC, *Application for a Certificate of Need*, November 12, 2018. eDocket ID: 201911-1157472-01, -02, -03, -04 [hereinafter Certificate of Need Application or CNA].

[2] Plum Creek Wind Farm, LLC, Supplemental and Amended *Application for a Large Wind Energy Conversion System Site Permit*. August 28, 2020. eDocket ID: 20208-166257-01, -02, -03, - 04, -05, -06, -09, -10, 20208-166258-01, -02, -03, -04, -05, -08, -09, -10, 20209-166395-01, -02, -03. [hereinafter Site Permit Application or SPA].

[3] Plum Creek Wind Farm, LLC, *Application to the Minnesota Public Utilities Commission for a Route Permit for a 345 kV High Voltage Transmission Line*, November 20, 2018, eDocket ID: 201911-57483-01, -02, -03, - 04, -05, -06, -07, 08. [hereinafter Route Permit Application or RPA].

[4] Multiple Plum Creek Comment Letters (July 7, 2020 eDocket No. 20207-164707-03, July 21, 2020 eDocket No. 20207-165134-01, July 24, 2020 eDocket No. 20207-165266-02, and August 4, 2020 eDocket No. 20208-165570-01 & 02).

Diagram 1. Plum Creek Wind Farm[5]



A number of facilities will be constructed to support the operation of the wind turbines and facilitate the delivery of the electricity to consumers. Plum Creek is seeking approval from the Commission through the LWECS site permit for the following associated facilities: permanent meteorological towers and other weather data collection systems, up to two ADLS radars, an electrical collection and communications system, access roads, temporary laydown and staging areas, two collector substations and associated equipment, and an O&M facility.[6]

[5] Power Point Presentation, PI/Scoping Meeting. Geronimo Energy, June 16, 2020.

[6] Site Permit Application (SPA), at Section 4.0.

At the time of the filing, Plum Creek stated it had acquired 73 percent of the land required for successful construction and operation of the Project site.[7] Easement negotiations are ongoing. Plum Creek anticipates commencing construction of the LWECS in the fourth quarter of 2020, with an anticipated commercial operation date (COD) in the fourth quarter of 2022.[8]

The Project will generate up to 414 MW of electric energy at the Plum Creek Wind Farm; the Applicant states that Project is needed to 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.[9] The Applicant continues that given the demand for renewable energy, a market exists for independently produced electricity generated from wind and other renewables, including the up to 414 MW to be generated by the Project.[10]

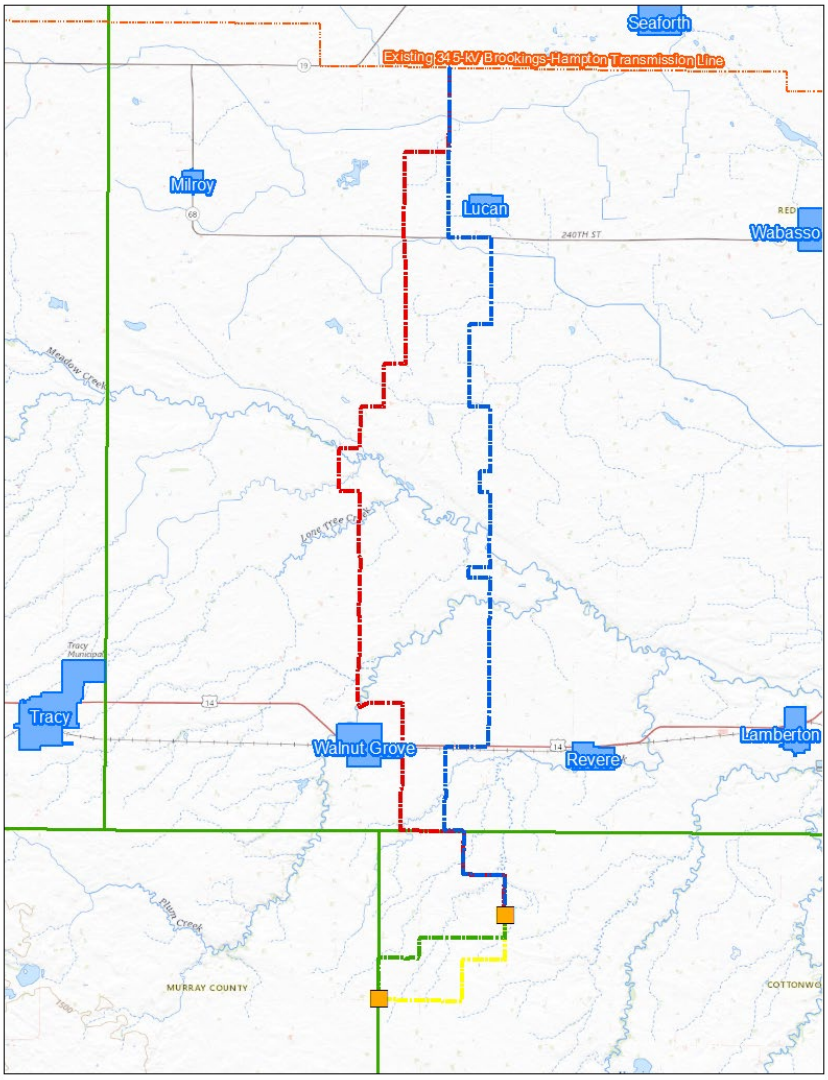
345 kV HVTL

Plum Creek proposes to construct two new collector substations (Collector Substation 1 and Collector Substation 2) within the LWECS site.[11] Plum Creek proposes to connect the LWECS to the electrical grid through approximately 31 miles of new 345 kV transmission line. The HVTL Project will begin at the new Collector Substation 2 to be constructed in Ann Township of northwestern Cottonwood County; the HVTL will then proceed generally north and east for approximately five miles to connect to the Collector Substation 1, also in Ann Township. The HVTL Project will then connect Collector Substation 1 to the proposed Switching Station, which connects the proposed transmission line to the existing Brookings to Hampton 345 kV transmission line, approximately 26 miles north of the Plum Creek site (**Diagram 2 and Figure 2**).[12]

Minnesota Rule 7850.1900, Subpart 2, Item C, requires that an applicant provide at least two proposed routes for the HVTL and identify the applicant's preferred route and reasons therefore, however, Minnesota statute 216E.03, subdivision 3 states that neither of the two proposed routes may be designated as a preferred route. Plum Creek identified two potential route segments between Collector Substation 2 and Collector Substation 1 (the Green and Yellow) and two potential routes between Collector Substation 1 and the Switching Station (the Blue and Red).[13]

[7] Ibid, at Section 7.0.
[8] Ibid, at Section 10.8
[9] Certificate of Need Application (CNA), at p. 5.
[10] CNA, at p. 7.
[11] Route Permit Application (RPA), at Appendix C, page 1 of 4.
[12] Ibid, at Section 2.1.
[13] Ibid, at Section 2.1 and Figure 2.0-1.

Diagram 2. Plum Creek Wind Transmssion Project[14]



Plum Creek indicates that the proposed single-circuit 345 kV HVTL will require a right-of-way (easement width) of 150 feet but has stated in areas where paralleling existing road rights-of-way that poles would be placed on adjacent private property, within approximately 10 feet of the existing road right-of-way. This pole placement allows the transmission line right-of-way to share (overlap) existing road rights-of-way and will reduce the overall size of the easement required from the private landowner along roads.[15]

[14] Power Point Presentation, PI/Scoping Meeting. Geronimo Energy, June 16, 2020.
[15] RPA, at Section 2.4.

Plum Creek requests a 1,000-foot route width for the Green, Yellow, and Blue proposed routes. For the proposed Red route, Plum Creek is requesting a varying route width from 1,000 feet up to 6,250 feet (1.2 miles).[16]

At the time of filing, Plum Creek had secured 100 percent of the total necessary private easements on the Blue route and 70 percent of the total necessary easements on the Red route.[17] If additional property rights are required for the HVTL, Plum Creek has stated that it will seek to negotiate a voluntary easement agreement with each affected landowner; however, if Plum Creek and the landowner are unable to negotiate an easement for the right-of-way, Plum Creek has stated that "Plum Creek reserves the right to evaluate whether the use of eminent domain is appropriate under Minn. Stat. Ch. 117, based on specific circumstances."[18]

Plum Creek proposes to use four types of steel monopole structures: tangent, small angle, heavy angle, and dead end. The proposed structures will range in height from approximately 110 feet to 125 feet, with spans of approximately 650 feet between structures.[19]

Plum Creek anticipates that project construction will begin in the second quarter 2021 and that the new line will be in service by the third quarter of 2022.[20]

1.2 State of Minnesota's Role

In order to build the Plum Creek, Plum Creek must obtain three approvals from the Public Utilities Commission (Commission)—a certificate of need (CN) for the project as a whole, a site permit for the wind farm, and a route permit for the transmission line. In addition to these approvals from the Commission, the Project also requires approvals (e.g., permits, licenses) from other state agencies and federal agencies with permitting authority for specific resources (e.g., the waters of Minnesota). Commission site and route permits supersede and preempt all zoning, building, and land-use regulations promulgated by local units of government.[21]

Plum Creek applied to the Commission for a CN, the site permit, and the route permit for the project in November 2018. With these applications, the Commission has before it three distinct considerations:

[16] RPA, at Section 2.2.
[17] Ibid, at p.14.
[18] Applicant Notice (Minn. Stat. 216E.03, subd. 4, Minn. R. 7850.2100 and Minn. R. 7829.2500) Notice of Plum Creek Wind Farm, LLC's Filing of Certificate of Need, Site Permit and Route Permit Applications with the Minnesota Public Utilities Commission (MPUC Docket Nos. IP-6997/CN-18-699, WS-18-700 and TL-18-701).
[19] RPA, at Section 2.3.
[20] Ibid, at Section 2.6.
[21] Minnesota Statutes 216E.10

- 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,
- if the Project is needed, is the wind farm as proposed compatible with environmental preservation, sustainable development, and the efficient use of resources, and
- if the proposed Project is needed, where is the transmission line best located and what conditions should be placed on the route permit.

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[22]:

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

The goal of the EIS 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 EIS 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, site, and route permit applications.

1.3 Organization of Environmental Impact Statement

This EIS is based on Plum Creek's certificate of need, site permit, and route permit applications, public comments received during the scoping comment period for this EIS, and input from the Commission. This EIS addresses the matters identified in the scoping decision for this project (Appendix A) and is organized as outlined 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

[22] Minnesota Statutes 216B and 216E

		the permits and approvals that would be required for the project.
Chapter 3	Proposed Wind Farm and System Alternatives	Describes the engineering, design, and construction of the proposed wind farm. Chapter 3 also discusses the feasibility, availability, and potential impacts of the wind farm and alternatives, including a generic wind farm located elsewhere in Minnesota, a 414 MW solar facility, and a no-build alternative.
Chapter 4	Proposed Transmission Project and System Alternatives	Describes the engineering, design, and construction of the proposed transmission project. Chapter 4 also discusses the feasibility, availability, and potential impacts of system alternatives—i.e., alternatives other than a 345 kV transmission line that may meet the stated need for the transmission project.
Chapter 5	Transmission Project - Routing Alternatives	Describes the transmission project including possible routes, route segments, and alignment alternatives. Chapter 5 also describes the route alternatives considered, but not carried forward for full analysis.
Chapter 6	Transmission Project – Affected Environment, Potential Impacts, and Mitigation Measures	Discusses the resources in the project area and the potential human and environmental impacts of the project and identifies measures that could be implemented to avoid or mitigate potential adverse impacts. Chapter 6 also discusses the merits of the routes relative to the routing factors of Minnesota Rules, part 7850.4100
Chapter 7	Cumulative Potential Effects	Describes reasonably foreseeable projects in the project area and assesses the cumulative impacts of the proposed project in the context of these reasonably foreseeable projects.

This EIS was issued in draft form on January 11, 2021. Comments on the draft EIS were accepted through February 1, 2021. All comments received on the draft EIS and responses to these comments are included in this final EIS (Appendix G). Changes to the EIS text as a result of comments received are indicated by underlined passages (additions) or strikeouts (deletions). In addition, errors, and omissions in the draft EIS identified by Department staff have been corrected.

1.4 Describing Potential Impacts and Mitigation

This EIS analyzes potential impacts of both the wind farm and the transmission 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.

- Negligible - Negligible means the impacts are so small or unimportant as to be not worth considering; insignificant.
- 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.

This EIS 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 EIS are the applications for the CN, site permit, and route permit (and application amendments) submitted by Plum Creek. Additional sources of information are

identified in the footnotes throughout the 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 EIS. 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, e.g., acres of wetland within the anticipated right-of-way.

2 Regulatory Framework

The Plum Creek Project requires three approvals from the Commission – a CN, a site permit for the wind farm, and a route permit for the transmission project. The Project will also require approvals from other state and federal agencies with permitting authority for actions related to the project.

2.1 Certificate of Need

Construction of a large energy facility in Minnesota requires a CN from the Commission.[23] Both the 414 MW wind farm and the 345 kV transmission line meet the definition of a large energy facility and require a CN. Plum Creek submitted a CN application to the Commission on November 12, 2019. The Commission accepted the application[24] as complete and referred it to the Office of Administrative Hearings (OAH) for contested and public hearings, to be conducted jointly with the hearings for the site and route permit applications, and authorized the Department of Commerce (Department) to conduct environmental review jointly with the site and route 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 project's termini, or its start and end points. The Commission could place conditions on the granting of a CN.

[23] Minnesota Statutes 216B.243.

[24] Commission Order on Application Acceptance, accepting applications, establishing procedural framework, varying rules, and notice of and order for hearing. January 30, 2020. eDocket No. 20201-159855-01.

The CN decision does not determine the locations of wind turbines or the route for transmission line; these determinations are made in the site and route permits for the project.

2.2 Site Permit

A site permit from the Commission is required to construct a large wind energy conversion system (LWECS), which is any combination of wind turbines and associated facilities with the capacity to generate five MW or more of electricity. This requirement became law in 1995. The Minnesota Wind Siting Act is found at Minnesota Statutes Chapter 216F. The rules to implement the permitting requirements are in Minnesota Rule 7854.

The Plum Creek Wind Farm will generate up to 414 MW; thus, it requires a site permit. Plum Creek submitted the original site permit application to the Commission on November 12, 2019; a Supplemental and Amended Site Permit Application was filed on August 28, 2020. The Commission issued a Draft Site Permit on October 30, 2020 (Appendix B).

2.2.1 Site Permit Decision Criteria

In making a siting decision for the wind farm, the Commission considers factors prescribed in statute and rule. Minnesota Statutes, section 216E.03, identifies considerations that the Commission must take into account when siting wind farms, including potential impacts on human and natural resources. The Commission also must determine that a project is compatible with environmental preservation, sustainable development, and the efficient use of resources.[25]

2.3 Route Permit

Construction of a high-voltage transmission line in Minnesota requires a route permit from the Commission.[26] The 345 kV transmission line proposed by Plum Creek, meets the definition of a high-voltage transmission line and requires a route permit from the Commission. Plum Creek submitted a route permit application to the Commission on November 20, 2019. After accepting the application as complete,[27] the Commission referred it to the Office of Administrative Hearings (OAH) for contested and public hearings, to be conducted jointly with the hearings for the CN and site permit applications, and authorized the Department to conduct environmental review jointly with the CN application.

2.3.1 Route Permit Criteria

[25] Minnesota Statute 216F.03.

[26] Minnesota Statute Section 216E.03.

[27] Commission Order on Application Acceptance, accepting applications, establishing procedural framework, varying rules, and notice of and order for hearing. January 30, 2020. eDocket No. 20201-159855-01.

The Commission is charged with selecting transmission line routes that minimize adverse human and environmental impacts while ensuring electric power system reliability and integrity. Route permits issued by the Commission include a permitted route and anticipated alignment, as well as conditions specifying construction and operation standards. A sample route permit is included in Appendix C.

Minnesota Statutes, section 216E.03, identifies considerations that the Commission must take into account when designating transmission lines routes. Minnesota Rules, part 7850.4100 lists 14 factors for the Commission to consider when making a decision on a route permit:

- 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 right-of-way (ROW), 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 systems 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 must make specific findings that it has considered locating a route for a new transmission line along an existing transmission line ROW or parallel to existing highway ROW and, to the extent these are not used for the route, the Commission must state the reasons why.[28] The Commission may not issue a route permit for a project that requires a CN until a CN has been approved by the Commission, though these approvals may occur consecutively at the same Commission meeting.

[28] Minnesota Statute 216E.03.

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

2.4 Environmental Review

The Minnesota Environmental Policy Act requires that an EIS be prepared for major governmental actions with the potential to create significant environmental impacts.[29]

An EIS 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 EIS 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 Plum Creek's CN and site and route permit applications, it must determine whether the EIS is adequate.

When there are multiple applications before the Commission for a single project, the environmental reviews required for each application may be combined. For this project, the Commission has authorized the Department to combine the environmental reviews required for the CN and site and route permits. This EIS addresses the CN and site and route permit applications.

2.4.1 Environmental Impact Statement

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

- gather public input as to the impacts, mitigation measures, and alternatives to study in the EIS.
- focus the EIS on those impacts, mitigation measures, and alternatives that will aid in the Commission's decisions on the certificate of need and route permit applications.[30]

[29] Minnesota Statute 116D.04.

[30] "The scoping process must be used to reduce the scope and bulk of an environmental impact statement by identifying the potentially significant issues and alternatives requiring analysis and establishing the detail into which the issues will be analyzed." (Minnesota Rule 7850.2500, subpart. 4)

Department staff gathered input on the scope of the EIS through a public meeting and an associated comment period. Commission and EERA staff held a joint public information and EIS scoping meeting on June 16, 2020.

Due to the current COVID-19 pandemic, a remote-access meeting replaced the standard in-person meeting, as directed by the Governor's Executive Order 20-78.[31] Similar to an in-person meeting, the remote-access meeting provided interested persons the opportunity to: (1) learn about the state permitting process and the proposed project; and (2) ask questions and provide comments on potential issues and alternatives to be considered for analysis in the EIS or included as a condition in a draft LWECS site permit.

Total attendance, including staff, at this meeting was approximately 54 persons; 10 individuals took the opportunity to comment.[32] Comments were mostly from LIUNA and Local 563 and the Iron Workers 512, who commented that they supported the project for the potential jobs and other positive socioeconomic impacts that would result from this project.

One citizen shared concern about the environmental impacts of wind turbines, specifically to the bald eagle populations in the area, and concerns about what would happen to the wind turbines after their lifecycle ends. This person was also concerned about the noise from turbines.

Another citizen was interested in decommissioning of the project and soil remediation related to salinity. This commenter also wanted more information about what compensation would be available to nonparticipating landowners.

A 20-day comment period, closing on July 7, 2020, provided the public an opportunity to submit written comments to EERA staff on potential impacts and mitigation measures for consideration in the scope of the EIS. Comments were received from eight citizens, the Applicant,[33] and the Minnesota Department of Natural Resources (DNR),[34] the Minnesota Department of Transportation (MnDOT)[35] and the Minnesota Pollution Control Agency (MPCA).[36]

Citizen written comments expressed general support for the Project, as well as, concern about a variety of potential impacts associated with the Project, including impacts to public safety, noise, and compliance with the Minnesota Environmental Policy Act.

[31] https://www.leg.state.mn.us/archive/execorders/20-78.pdf.
[32] Oral Comments from June 16, 2020, Public Information and EIS Scoping Meeting, eDocket No. 20207-164841-01.
[33] Written Public Comments on Scope of EIS, eDocket No. 20207-164766-01.
[34] Minnesota Department of Natural Resources Scoping Comments, April 8, 2020. eDocket No. 20204-161904-01.
[35] Minnesota Department of Transportation Scoping Comments, April 8, 2020. eDocket No. 20204-161915-01.
[36] Written Public Comments (MPCA 1/16/2020) on Scope of EIS, eDocket No. 20207-164766-01.

No system alternatives (LWECS/HVTL CN) or specific route alternatives (HVTL routing) were proposed for consideration in the EIS during the scoping comment period.

Relative to the HVTL portion of the Project, the DNR requested that the EIS describe the criteria the applicant proposes for identifying avian flight diverter locations and to recognize that the DNR's License to Cross Public Waters may require flight diverters. Prior to Plum Creek's submittal of the HVTL Route Permit Application, the DNR requested that the Applicant evaluate an *alternative route segment* where the proposed Red Route crosses the Cottonwood River; this alternative would lie outside the original planned route width of the Red Route. In response to the DNR's request, the Applicant widened the portion of the Red Route (to 6,250 feet) near the intersection of County State Aid Highway (CSAH) 5 and CSAH 4 and the Cottonwood River. Expanding the requested route width allows flexibility in crossing the Cottonwood River and its associated floodplain and wetlands along the Red Route.

The MnDOT stated that their policy[37] is to work to accommodate HVTLs within or as near as feasible to the trunk highway rights of way, while ensuring that appropriate clearance is maintained to preserve the safety of the traveling public and highway workers and the effective operation of the highway system now and in the foreseeable future.

MnDOT's review of the proposed routes indicates that the Red Route would cross TH 68 and US 14, stating that both of these crossings are allowable if the Applicant adheres to the MnDOT Accommodation Policy. The Blue Route appears to have the potential to both cross and parallel TH 68 and US 14. The paralleling of TH 68, with aerial encroachment, looks to be permittable. However, as communicated to the Applicant in an email dated December 3rd, 2019, the potential aerial encroachment of US 14 may not be allowed if the placement of the line cannot meet the more restrictive Clear Zone requirements in that area.

On July 7, 2020, Plum Creek, through its council, notified the EERA staff of potential changes to the alignment along US 14 to address MnDOT's concerns. Plum Creek identified two options: (1) using the proposed horizontal configuration and shifting the alignment approximately 20 feet away from the edge of the highway right-of-way edge, and (2) using a vertical design coupled with more minor pole shifts, in the 10-feet range.[38]

Additionally, MnDOT requested that the Applicant coordinate with the agency in the planning of construction work, including delivery of oversized loads that may affect MnDOT right of way.

The MPCA comments on the HVTL portion of the Project focused on potential impacts to water resources, noting the requirements of the National Pollution Discharge Elimination System and the

[37] Utility Accommodation on Trunk Highway Right of Way, http://www.dot.state.mn.us/policy/operations/op002.html.
[38] Fredrikson and Byron, PA, comment letter, July 7, 2020. eDocket No. 20207-164707-03.

State Disposal System Construction Stormwater Permit. Additionally, the MPCA requested that the EIS contain detailed information on the total new impervious surfaces that will be created by the Project, and an estimation (acres) of permanent impacts to wetlands.

On July 21, 2020, Department staff provided the Commission with a summary of the EIS scoping process.[39] The DNR's request concerning the crossing of Plum Creek was included in EERA's proposed scoping decision (in this case as the *Cottonwood River Alternative Alignment*).

In its Order of October 30, 2020, the Commission found that the route alternatives proposed by Department staff were reasonable and appropriate for further analysis in the EIS.[40]

The Department issued a scoping decision for the EIS on October 4, 2020 (Appendix A). The scoping decision identifies the route, route segment, and alignment alternatives evaluated in this EIS and those alternatives that were not carried forward for evaluation. Department staff provided notice of the scoping decision to those persons on the project mailing list and to all landowners along alternatives newly proposed during the scoping process. Based on the scoping decision, Department staff prepared the EIS.

EERA staff issued a draft EIS on January 11, 2021. EERA staff sought public comments on the draft EIS through public meetings and a public comment period. Comments on the draft EIS were accepted through February 11, 2021. All comments received on the draft EIS and responses to the comments are included in this final EIS (Appendix G). Changes to the EIS text as a result of comments received are indicated by underlined passages (additions) or strikeouts (deletions). In addition, errors, and omissions in the draft EIS identified by Department staff have been corrected.

The final EIS is entered into the record for these proceedings so it can be used by the Commission in making decisions about the project.

2.5 Public Hearing

Public hearings, presided over by an administrative law judge (ALJ) from the Office of Administrative Hearings (OAH), were held via remote access on February 16, 2021. At these hearings, citizens, agencies, and governmental bodies had an opportunity to submit comments, present evidence, and ask questions. An evidentiary hearing was held via remote access on February 16, 2021.

The ALJ will submit a report to the Commission with findings of facts, conclusions of law, and recommendations regarding a CN and a site and route permit for the project. Decisions by the Commission on the CN, and site and route permit applications are anticipated in late 2021.

[39] Department EERA Comments and Recommendations EIS Scoping Summary, July 21, 202018, eDocket No.20207-165144-01.
[40] Commission, Order Identifying Route Alternatives and Issuing a Draft Site Permit, October 30, 20209, eDocket ID: 202010-167812-01

2.6 Commission Decision

After considering the entire record, including the final EIS, input received during the public hearings, and the ALJ's findings and recommendations, 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 wind farm's site permit and the conditions and route for the transmission line. Site and route permits include conditions specifying construction and operating standards; they also include mitigation plans and project-specific mitigation measures. Route permits include a permitted route and an anticipated alignment.

Decisions by the Commission on the CN and site and route permit applications are anticipated in the spring of 2021.

2.7 Other Permits and Approvals

A site permit for the wind farm from the Commission is the only state permit required for the siting of the wind farm. Likewise, a route permit from the Commission is the only state permit required for the routing of the transmission project (i.e., the Commission's route permit determines where the line will be located). Commission-issued site and route permits supersede local planning and zoning and bind state agencies;[41] thus, state agencies are required to participate in the Commission's permitting process to aid the Commission's decision-making and to indicate site and routes 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 route permit and necessary for the project (commonly referred to as "downstream permits") must be obtained by a permittee. The information in this EIS 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 project, depending on the final design.

2.7.1 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 quality of the waters. The USACE requires permits for projects that

[41] Minnesota Statutes, sections 216F.07 and 216E.10.

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 the 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 and transmission structures, which could adversely impact aviation.

2.7.2 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. Additionally, a water use permit from the DNR is required for all users withdrawing more than 10,000 gallons of water per day or 1 million gallons per year. 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,
- a stormwater pollution prevention plan, and
- adequate stormwater treatment capacity once the project is constructed.

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 (e.g., 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.

Table 1. Potential Permits and Approvals Required for the Plum Creek Project

Unit of Government	Type of Application	Purpose
U.S. Army Corps of Engineers – St. Paul District (USACE)	Section 404 Clean Water Act – Dredge and Fill	Protects water quality through authorized discharges of dredged and fill material into waters of the United States.
	Section 10 – Rivers and Harbor Act	Protects water quality through authorized crossings of navigable waters.
U.S. Fish and Wildlife Service (USFWS)	Section 7 Endangered Species Act Consultation	Establishes conservation measures for endangered species.
	Special Use Permit	Authorization to cross USFWS-owned land or easements.
Federal Aviation Administration (FAA)	Part 7460 Review	Review to prevent airspace hazards due to structures taller than 200 feet.
Native American Tribes	National Historic Preservation Act (NHPA), coordination in support of USACE Section 106 to determine impacts on traditional cultural properties	Coordination to prevent impacts to traditional cultural properties.
Minnesota Department of Natural Resources (DNR)	License to Cross Public Waters	License to prevent impacts associated with crossing public waters.
	License to Cross Public Lands	License to prevent impacts associated with crossing public lands.
	State Threatened and Endangered Species Consultation	Consultation to avoid, minimize, and mitigate impacts to state-listed species.
	Water Appropriations Permit	A water use permit from the DNR is required for all users withdrawing more than 10,000 gallons of water per day or 1 million gallons per year.
Minnesota Pollution Control Agency (MPCA)	National Pollutant Discharge Elimination System (NPDES) Construction Stormwater Permit	Minimizes impacts to waters due to construction of the project.
	Section 401 Clean Water Act – Water Quality Certification	Ensures project will comply with state water quality standards.
Minnesota State Historic Preservation Office (SHPO)	National Historic Preservation Act Section 106 Consultation	Ensures adequate consideration of impacts on significant cultural resources.
Minnesota Department of Agriculture (MDA)	Agriculture Impact Mitigation Plan (AIMP)	Establishes measures for protection of agricultural resources.
Minnesota Department of Transportation (DOT)	Utility Permit	Authorizes accommodation of utilities along highway rights-of-way
	Driveway Access	Authorizes access to driveways along highways.
	Oversize/Overweight Permit	Authorizes the use of roads for oversize or overweight vehicles.
Minnesota Board of Water and Soil Resources (BWSR)	Wetland Conservation Act	Coordination with BWSR and local governments to ensure conservation of wetlands.
Local/County Governments	Wetland Conservation Act, Road Crossing, Driveway, Oversize or Overweight, and Land Permits	Permits from local governments to ensure conservation of wetlands, proper use of local roads and lands.

A permit from the Minnesota Department of Transportation (MnDOT) is required for transmission lines that are adjacent to or cross over Minnesota trunk highway rights-of-way. MnDOT's utility

accommodation policy generally allows utilities to occupy portions of highway rights-of-way where such occupation does not put the safety of the traveling public or highway workers at risk or unduly impair the public's investment in the transportation system.

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 linear 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:

- try to avoid the impact,
- try to minimize any unavoidable impacts, and
- replace any lost wetland functions.

2.7.3 Local Approvals

The Commission's site and route permits supersede local planning and zoning regulations and ordinances. However, permittees must obtain all local approvals necessary for the project that are not preempted by the Commission's site or route permits (approvals for the safe use of local roads).

2.7.4 Conservation Programs

Conservation easements involve the acquisition of limited rights in land for conservation purposes. Landowners who offer the state a conservation easement receive a payment to stop cropping and/or grazing the land, and in turn the landowners establish conservation practices such as native grass and forbs, trees or wetland restorations. The easement is recorded on the land title with the county recorder and transfers with the land when the parcel is sold.[42] There are lands throughout the wind farm site that are part of various conservation programs including Reinvest in Minnesota (RIM) and the Conservation Reserve Enhancement Program (CREP).

The CREP is an offshoot of the Conservation Reserve Program (CRP) which is a land conservation program established by the U.S. Department of Agriculture and administered by the Farm Service Agency that pays farmers a yearly rental fee for agreeing to take environmentally sensitive land out of agricultural production in an effort to improve environmental health and quality. Minnesota implemented the CREP to target state-identified, high-priority conservation resources by offering payments to farmers and agricultural landowners to retire environmentally sensitive land using the Reinvest in Minnesota (RIM) Reserve Program.[43]

[42] Board of Water and Soil Resources, http://bwsr.state.mn.us/what-are-conservation-easements
[43] Ibid.

2.7.5 National Electric Safety and Reliability Code

The project, both the wind farm and the transmission project, must meet the requirements of the National Electrical Safety Code (NESC). Permittees must comply with the most recent edition of the NESC, as published by the Institute of Electrical and Electronics Engineers, Inc., and approved by the American National Standards Institute, when constructing new facilities or upgrading existing facilities.[44]

The NESC is designed to protect human health and the environment. It also ensures that the collection system, the transmission lines and all associated structures are built from high-quality materials that will withstand the operational stresses placed upon them over the expected lifespan of the equipment, provided that routine maintenance is performed.

Permittees must also comply with North American Electric Reliability Corporation (NERC) standards. NERC standards define the reliability requirements for planning and operating the electrical transmission grid in North America.

[44] Minnesota Statute 326B.35.

3 Proposed Wind Farm and System Alternatives

Plum Creek proposes to construct, own, and operate a 414 MW Large Wind Energy Conversion System (LWECS or wind farm) consisting of up to 74 turbines to be located within an area of approximately 73,000 acres (the Project Area) in Cottonwood, Murray, and Redwood counties.[45]

This section of the EIS provides a high-level analysis of impacts associated with the Wind Farm and alternatives to the wind farm portion of the Project.

If the Plum Creek Project is approved by the Commission, Plum Creek will provide wind-generated electricity to the grid via the Brookings-to-Hampton 345 kV transmission line, part of the Midcontinent Independent System Operator, Inc. (MISO) Multi-Value Project Transmission line portfolio approximately 20 miles north of the wind farm.[46] 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.[47]

For the wind farm portion of the Project, the alternatives will include:

- a generic 414 MW wind generation project sited elsewhere in Minnesota,
- a 414 MW solar farm, and
- a "no-build" alternative is included in the analysis as a consequence of Minn. Rule 7849.0340, the No-facility Alternative requirement.

3.1 Wind Farm Project Description

Plum Creek continued to assess its turbine options throughout the SPA review process and has selected wind turbines with rated nameplate power outputs ranging from 5.6 MW (Vestas V162) to 6.2 MW (Siemens Gamesa SG170), corresponding to between 67 and 74 wind turbines at the site.[48]

The SG170 turbine layout includes 67 primary turbines and 11 alternate turbines; the V162 layout has 74 primary turbines and 6 alternate turbines. Each turbine model has its own layout; that is, turbine positions are not the same between the two turbine models; the SG170 layout is shown in **Figure 3a**, while the Vestas V162 layout is shown in **Figure 3b**.

[45] SPA LWECS, at pp. 9-11.
[46] Ibid, at p. 1.
[47] CNA, at p. 5.
[48] Multiple Plum Creek Comment Letters (July 7, 2020 eDocket No. 20207-164707-03, July 21, 2020 eDocket No. 20207-165134-01, July 24, 2020 eDocket No. 20207-165266-02, and August 4, 2020 eDocket No. 20208-165570-01 & 02).

Each tower will be secured by a concrete foundation that varies in design depending on soil conditions. A control panel inside the base of each turbine tower houses communication and electronic circuitry. Each turbine is equipped with a wind speed and direction sensor that communicates with the turbine's control system to signal when sufficient winds are present for operation. Turbines feature variable-speed control and independent blade pitch to ensure aerodynamic efficiency.

Each turbine will be grounded and shielded to protect against lightning. The grounding system installed during foundation work will be designed for local soil conditions and in accordance with local utility or code requirements. Lightning receptors are placed in each rotor blade and in the turbine tower. The electrical components are also protected.

The turbines have active yaw and pitch regulation and asynchronous generators. The turbines use a bedplate drivetrain design, where all nacelle components are joined on common structures to improve durability.

The rotor consists of three blades mounted to a rotor hub. The hub is attached to the nacelle, which houses the gearbox, generator, brake, cooling system, and other electrical and mechanical systems. Hub heights are 115 meters (377 feet) for the SG170 and 119 meters (390 feet) for the V162 turbines. The rotor diameters are 170 meters (557 feet) for the SG170 and 162 meters (531 feet) for the V162 turbines, with rotor speeds of 3.8-8.5, and 4.3 – 12.1 rotations per minute, respectively. A smooth tubular steel tower supports the nacelle and rotor. All modern turbine models contain emergency and backup power systems to allow shutdown of the turbine if power to the grid is lost.

The portion of the foundation that is above ground is roughly 20 feet wide at the base of the tower and typically range in depth from four to six feet. The turbine towers, on which the nacelle is mounted, consist of three or four sections welded together at the factory by automatically controlled power welding machines. Welds are and ultrasonically inspected during manufacturing per American National Standards Institute (ANSI) specifications. All surfaces are coated for protection against corrosion in a non-glare white, off-white, or light gray color. Access to the turbine is through a lockable steel door at the base of the tower.[49] Geotechnical surveys, turbine tower load specifications, and cost considerations will dictate final design parameters of the foundations.

All turbines will use Low Noise Trailing Edge serrations along approximately 20 to 30 percent of the trailing edge of the outboard blade to reduce operating noise.[50] The turbine specifications are provided in Table 2.

[49] SPA LWECS, at pp. 12-20.
[50] Ibid.

A number of facilities will be constructed to support the operation of the wind turbines and facilitate the delivery of the electricity to consumers. Plum Creek is seeking approval from the Commission through the LWECS site permit for the following associated facilities: permanent meteorological towers and other weather data collection systems, up to two ADLS radars, an electrical collection and communications system, access roads, temporary laydown and staging areas, two collector substations and associated equipment, and an O&M facility.

Table 2. Wind Turbine Specifications[51]

Characteristic	Turbine	
	Siemens Gamesa SG170	Vestas 5.6-V162
Nameplate capacity (kilowatts)	6,200	5,600
Hub height in meters (m)[1]	115	125
Rotor Diameter (m)	170	162
Total height[2] **(m)**	200	201
Cut-in wind speed[3] **meters per second (m/s)**	3	3
Rated capacity wind speed[4] **(m/s)**	11	12
Cut-out wind speed[5] **(m/s)**	25	24
Maximum sustained wind speed[6] **(m/s)**	52.5	52.5
Wind Swept Area (m^2)	22,698	21,520
Rotor speed (rpm)	3.8-8.5	4.3-12.1
Primary Turbine Positions	67	74
Alternate Turbine Positions	11	6
Pitch Regulation	Individual hydraulic	Individual hydraulic
Gearbox	3-stage planetary/parallel	2-stage planetary
Yaw Control	8 planetary gears	6 planetary gears
Braking System	Main aerodynamic brake, hydraulic disk brake on high-speed shaft	Main aerodynamic brake (individual blade), mechanical brake on medium-speed shaft
Main Bearing	2x tapered roller	Cylindrical roller

1 Hub height = the turbine height from the ground to the top of the nacelle.
2 Total height = the total turbine height from the ground to the tip of the blade in an upright position.
3 Cut-in wind speed = wind speed at which turbine begins operation
4 Rated capacity wind speed = wind speed at which turbine reaches its rated capacity
5 Cut-out wind speed = wind speed above which turbine shuts down operation
6 Maximum sustained wind speed = wind speed up to which turbine is designed to withstand

3.1.1 Project Location

[51] SPA LWECS, at Table 5.2-1, p. 18.

The Project is located in Cottonwood, Murray, and Redwood counties in southern Minnesota, southeast of Walnut Grove, Minnesota. The site is within Germantown, Highwater, Ann, and Westbrook townships in Cottonwood County; Holly, Dovray, Murray, and Des Moines River townships in Murray County; and within North Hero and Lamberton townships in Redwood County (**Figure 1**). **Table 3** lists the Township, Range, and Sections in which the project is located.

Table 3. Plum Creek Wind Farm Location[52]

County Name	Township Name	Township	Range	Sections
Cottonwood	Germantown	108	36	7, 18
	Highwater	108	37	1-14, 16-18, 20-21, 24-25
	Ann	108	38	1-36
	Westbrook	107	38	2-9
Murray	Holly	108	39	1-2, 11-15, 21-28, 30-36
	Dovray	107	39	1-16, 19-24, 28-33
	Murray	107	40	1, 12, 23-26, 36
	Des Moines River	106	39	4-5
Redwood	North Hero	109	38	27-36
	Lamberton	109	37	31-36

Within the approximately 73,000 acre Project Area, Plum Creek has secured wind rights for approximately 53,223 acres of private land, or approximately 73 percent of the land required for the wind farm.[53] Plum Creek intends to commence commercial operation of the Project by the fourth quarter of October 2022.[54]

The Project Area is predominantly rural with sparsely scattered rural residences, farmsteads, commercial livestock operations, agricultural support facilities, and commercial business throughout. The majority of land use in the Project Area is cultivated crop land (approximately 66,654 acres or 91.2 percent); pasture/hay lands comprise approximately 1,302 acres (1.8 percent) of the Project Area (**Figures 4a and 4b**).[55] The municipal boundary of Dovray is partially within the Project Area in Murray County.

The preliminary site layouts for the two turbine options are shown on Figures 3a and 3b; the wind farm design/layout incorporates the wind energy conversion facility siting criteria outlined in the Commission's Order Establishing General Wind Permit Standards (Docket No. E, G999/M-07-1102, January 11, 2008 - Commission General Permit Standards) and the Department's Site Permit

[52] SPA LWECS, at Table 4-1, p. 9.
[53] Ibid, at p. 8.
[54] SPA LWECS, at p. 137.
[55] Ibid, at p. 94.

Application Guidance.[56] Table 4 incorporates avoidance and setback requirements used by Plum Creek.[57]

Table 4. Wind Project Setback Comparison

Turbine Setback Requirement	Distance for Setback	Authority	Setback applied to Plum Creek Wind Farm
Wind Access Buffer – Prevailing Wind Directions	5 x rotor diameter (RD)	Commission's General Permit Standards	5 x RD
Wind Access Buffer – Non-Prevailing Wind Directions	3 x RD	Commission's General Permit Standards	3 x RD
Residences	500 feet, or the minimum distance required to meet the state noise standard of 50 decibels (dB) using the A-weighted scale (dB(A)), whichever is greater	Commission's General Permit Standards	1,000 feet from residences
	1,000 feet and/or sufficient distance to meet state noise standards, whichever is greater[1]	Murray County Renewable Energy Ordinance	
Noise Requirements	Distance must meet the state noise standard of 50 dB(A)[2]	Minnesota Pollution Control Agency (MPCA)	Turbines are sited for turbine-only noise to be < 45 dB(A) at non-participating residences and < 47 dB(A) at participating residences
Property Lines	3 x RD on east-west axis and 5 x RD on north-south axis	Murray County Renewable Energy Ordinance	3 x RD in non- prevailing wind direction and 5 x RD in prevailing wind direction
Public Roads and Trails	Minimum 250 feet	Commission's General Permit Standards	1.1 x total turbine height

[56] SPA LWECS, at pp.10-14.
[57] Ibid. at Table 5.1-1, p.10-12.

Turbine Setback Requirement	Distance for Setback	Authority	Setback applied to Plum Creek Wind Farm
Other Rights-of-Way (powerline, pipeline)	1.1 x the total height	Murray County Renewable Energy Ordinance	1.1 x total turbine height
Public Conservation Land Managed as Grasslands	3 x RD on east-west axis and 5 x RD on north-south axis[3]	Murray County Renewable Energy Ordinance	3 x RD in non- prevailing wind direction and 5 x RD in prevailing wind direction
U.S. Fish and Wildlife Service Wetlands Types III, IV, and V which are 10 acres or greater	3 x RD on east-west axis and 5 x RD on north-south axis	Murray County Renewable Energy Ordinance	3 x RD in non- prevailing wind direction and 5 x RD in prevailing wind direction (in Murray County only)
Other Structures (barns, grain bins, etc.)	1.1 x the total height	Murray County Renewable Energy Ordinance	1.1 x total turbine height (in Murray County only)
Other Existing WECS and Internal Spacing	3 x RD on east-west axis and 5 x RD on north-south axis	Murray County Renewable Energy Ordinance	N/A

[1] Commission's General Permit Standards identify the minimum setback from residences as 500 feet, or the minimum distance required to meet the state noise standard of 50 decibels dB(A), whichever is greater. Plum Creek follows the practice of siting turbines at least 1,000 feet from residences or the minimum distance required to meet the state noise standard of 50 decibels dB(A), whichever is greater.

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

[3] Plum Creek implemented this setback based on the prevailing and non-prevailing wind directions. The Project's "wind rose" displaying the prevailing and non-prevailing wind directions is provided in Section 9.1.10.

Turbine Description	5 RD[1] (m)	3 RD[1] (m)	1.1x Total Height (including blades, m)
Siemens Gamesa SG170	850	510	220
Vestas V162	810	486	200

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

3.1.2 Project Cost and Schedule

The installed capital costs for the proposed wind farm are estimated to be approximately $625 million, including development, design and construction of the facilities. Ongoing operations and maintenance costs are estimated to be approximately $20-25 million per year one, including payments to landowners for wind lease and easement rights.[58]

Depending on interconnection process completion, permitting, and other development activities the Project is expected to achieve commercial operation by the fourth quarter 2022.

3.1.3 Project Decommissioning

Information in this section is adapted from the Decommissioning Plan prepared by Plum Creek and submitted with the LWECS site permit application.[59]

The anticipated lifespan of the wind farm is 30 years.

Plum Creek or the Project owners will be responsible for removing wind facilities and removing the turbine foundations to a depth of four feet below grade. The overhead electrical lines associated with the Project connect the voltage step-up substation(s), located within Project footprint, to the interconnection switching station north of the Project. All poles, conductors, switches, and lines associated with this interconnection link will be removed and hauled off-site to a recycling facility or disposal site. Underground infrastructure such as pole foundations will be removed down to four feet below grade. Pole foundation holes will be filled with a suitable clean compactable material. Topsoil will be applied and the areas and re-vegetated to pre-construction conditions.

The decommissioning of the wind farm will look like the installation, but in reverse order. A crane will be used to remove hub and blades from the nacelle and placed on the ground. Once on the ground, a crew and small crane will remove the blades from the hub. Disassembled, blades will be placed into a carrying frame and loaded onto a truck for removal from the site. The hub will also be loaded onto a truck for removal.

After removal of the rotor, the crane will remove the nacelle and then take down the tower section by section. Turbine foundations will be removed to a depth of four feet and removed from the site unless the landowner wishes to keep the extracted concrete. If landowners prefer to keep extracted concrete, the concrete will be crushed and provided to the landowner.

Pad mounted transformers will be disconnected and removed from the site. The concrete pads will be crushed and hauled offsite, unless the landowner requests to retain the concrete.

[58] SPA, at pp.139-141.
[59] Ibid, at p. 137 and Appendix H.

A crane will be used to dismantle MET towers from the top down and will be loaded onto trucks to be removed from the site. Unless a landowner informs Plum Creek otherwise, access road, will be removed and the land will be restored.

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 or other entity. 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 Plum 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, Plum Creek (or the Project owners), or its contractor, would remove components having salvage value. Generally, turbines, transformers, electrical components, towers, and transmission poles are refurbished and resold or are recycled for scrap. Decommissioning of the existing turbines will include removal and transport of generators and towers offsite to disposal facilities and/or sale of towers and generators. 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. About 85 percent of turbine component materials—such as steel, copper wire, electronics, and gearing—can be recycled or reused. But the blades are different as they are made up of fiberglass (a composite material) to be lightweight for efficiency yet still durable enough to withstand storms.[60] The fiberglass blades pose the greatest challenge to end-of-use considerations; while it is possible to cut the blades into pieces onsite during a decommissioning or repowering process, the pieces are still difficult and costly to transport for recycling or disposal. Additionally, the process of cutting the extremely strong blades requires enormous equipment such as vehicle mounted wire saws or diamond-wire saws. Because there are so few options for recycling the blades currently, the vast majority of those that reach end-of-use are either being stored in various places or taken to landfills.[61]

The estimated decommissioning costs is approximately $4,423,180 for the 67 SG170 turbines ($66,018 per turbine after salvage value) and $4,581,950 ($61,918 per turbine after salvage value) for

[60] Wind Turbine Blades Don't Have to End Up In Landfills - Union of Concerned Scientists (ucsusa.org).
[61] Ibid.

the 74 V162 turbines. The cost to decommission will depend upon the prevailing rates for salvage value of the equipment and labor costs.[62]

3.2 Project Alternatives

The Commission must consider alternatives to the proposed Project.[63] In addition to evaluating alternatives and their impacts, a no build option must also be evaluated. This section provides a discussion of alternate power sources to the Plum Creek Wind Farm.

The alternatives considered would generate energy equivalent to that of the proposed wind farm and provide renewable, low, or zero carbon emission energy. Typically, alternatives to the project 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 wind farm would be producing renewable energy for use in Minnesota and the surrounding area, alternatives considered here were selected as they are technologies eligible to be counted toward renewable energy objectives.[64] Alternatives to the transmission project associated with the wind farm are discussed in Chapter 4.
Alternatives evaluated include:

- a 414 MW wind generation plant sited elsewhere in Minnesota,
- a 414 MW Solar Farm, and
- the "no build" alternative.

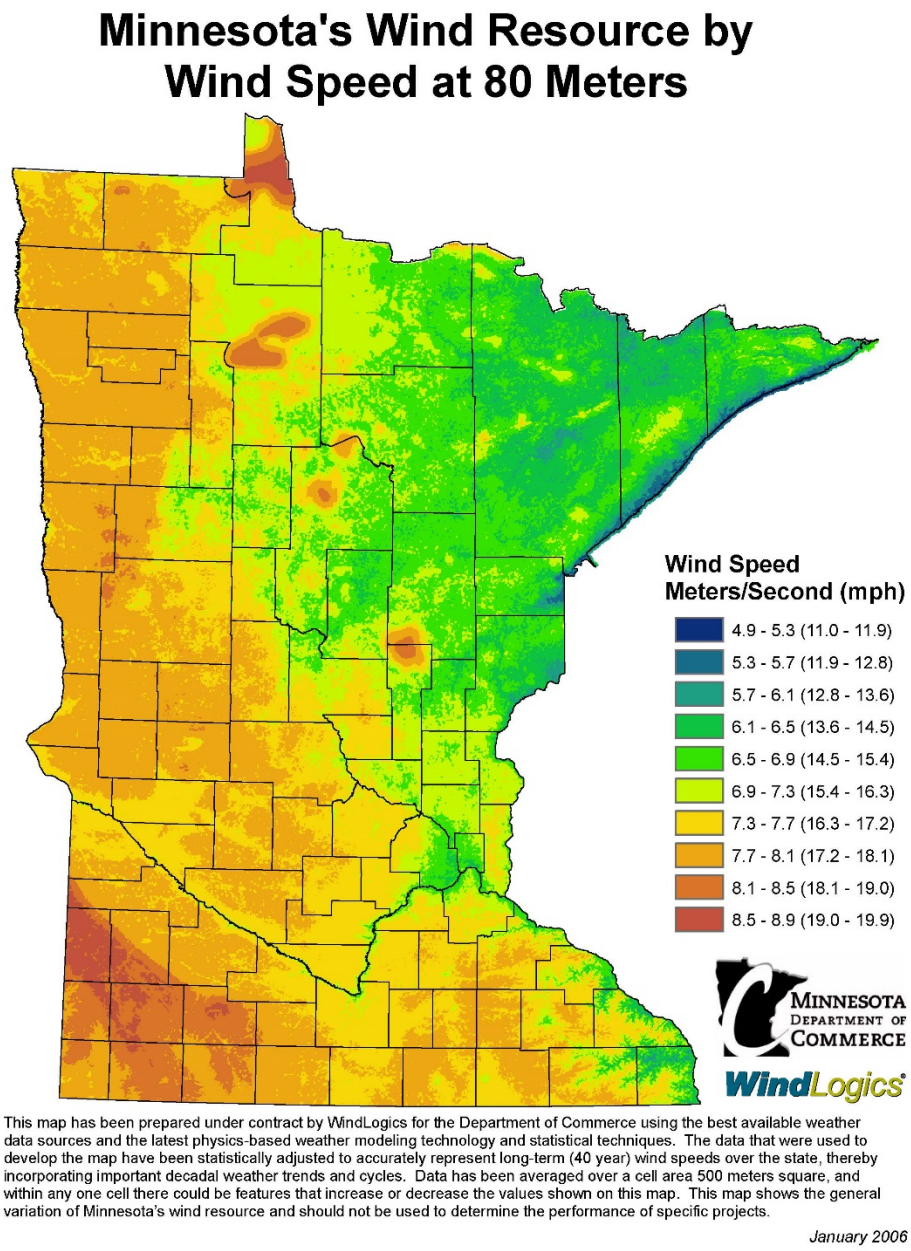
3.2.1 Generic 414 MW Wind Farm

An alternative to the proposed wind farm that would utilize an eligible renewable energy resource is a wind farm sited elsewhere in Minnesota. Such a project could be an approximately 414 MW Project or a combination of smaller dispersed projects. While possible to site a windfarm elsewhere in Minnesota, potential alternative locations are subject to areas in the state with adequate wind resources as shown in Diagram 3.

The analysis in this EIS will attempt to describe differences in the impacts associated with a generic 414 MW wind farm sited in Minnesota and the proposed Plum Creek Wind Farm.

[62] SPA, at pp. 140-141.
[63] Minnesota Rule 7849.1200.
[64] Minn. Statute 216B.1691, Subdivision. 1. Eligible energy technologies include technologies that generate electricity from solar, wind, hydroelectric, hydrogen, or biomass.

Diagram 3. Minnesota Wind Resource Map[65]



3.2.2 Generic 414 MW Solar Farm

Another alternative renewable energy source to the Plum Creek Wind Farm is a solar farm of similar electricity generation as the proposed project. A photovoltaic power station, also known as a solar

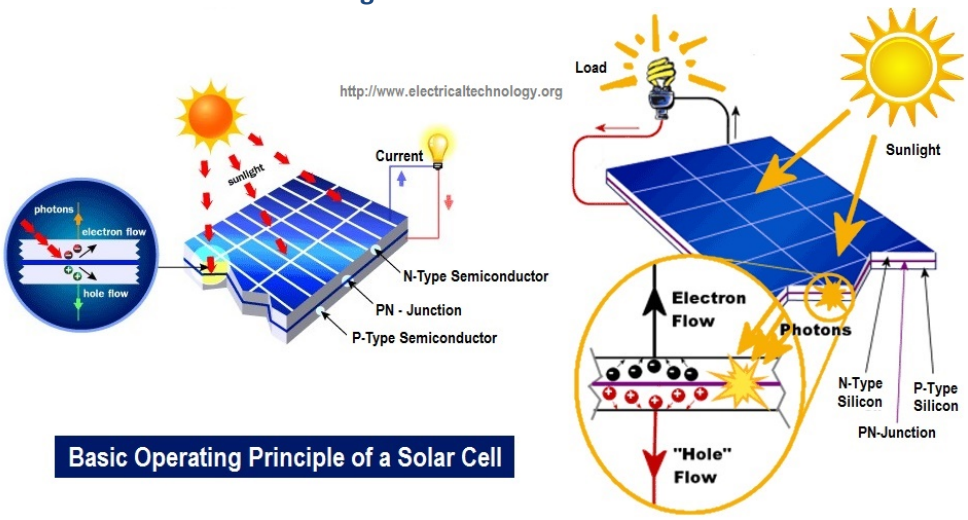
[65] Minnesota Department of Commerce, Map Resources https://stage.wcm.mnit.mn.gov/commerce/industries/energy/technical-assistance/maps.jsp

farm, is a large-scale photovoltaic system (PV system) designed for the supply of power into the electrical grid. They are differentiated from most building-mounted and other decentralized solar power applications because they supply power at the utility scale, rather than to a local user or users. As with the generic wind farm alternative, the solar farm alternative could be at a single site, or could be several smaller utility-scale sites.

The analysis for this alternative relies on data from other utility scale solar projects reviewed by the Commission,[66] as well as literary searches. While the capacity of these projects may differ, many of the impacts associated with utility scale solar projects are similar.

PV 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 4). 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.

Diagram 4. Solar Cell [67]



3.2.3 No Build Alternative

The no build alternative assumes no wind project is constructed. The analysis for this alternative considers the potential benefits and drawbacks of not constructing the Plum Creek Wind Farm.

[66] Elk Creek Solar Project (eDocket No. IP7009/GS-19-495), North Star Solar Project (IP6943/GS-15-33), Marshall Solar Project, (IP6941/GS-14-1052), Aurora Distributed Solar Project (E6928/GS-14-515), and Regal Solar Project (IP7003/GS-19-395).
[67] Source: https://www.electricaltechnology.org/2015/06/how-to-make-a-solar-cell-photovoltaic-cell.html.

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 wind farm, the primary impacts of the no build alternative are: (1) reducing the state's ability to meet its renewable energy objectives, (2) the loss of 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.[68] Minnesota utilities forecast the need for 5,841 MW of renewable generation by the year 2025 to meet this objective.[69] If the Plum Creek Wind Farm is not built, it could reduce the state's ability to meet renewable energy objectives.

Loss of Economic Benefits

If the proposed wind farm is not built, there would be a loss of economic benefits in the project area. Landowners would lose lease payments over the operational life of the project. Local governments would lose wind energy production tax revenues. The wind farm will pay a Wind 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 Wind Energy Production Tax revenues of between $1,750,000 and $2,000,000.[70]

Plum Creek has stated that it will form the "Plum Creek Community Fund," a 501(c)(3) organization for the purpose of engaging in and contributing money to the support of charitable activities within the communities near the Project. Assuming the Project is constructed at 414 MW, the Project will contribute $82,800 annually to the Plum Creek Community Fund to support charitable activities within the neighboring communities. The funds will be administered by a volunteer board of directors consisting of, but may not be limited to, participating landowners, township officials and one at-large community member.[71]

[68] Minn. Statute 216B.1691.
[69] Minn. Statutes 216C.05.
[70] CNA, at p.14.
[71] SPA, at p. 80.

If the Plum Creek Wind Farm is not constructed, there would be a loss of revenue to local businesses. The proposed wind farm is expected to generate approximately 250 temporary construction jobs and 11-15 permanent operation and maintenance jobs.[72] These employment opportunities and associated income would be lost if the project is not built. If the Plum Creek Wind Farm 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.

Replacement with Non-Renewable Resources

Impacts of non-renewable energy sources vary. However, it is possible that if the Plum Creek Wind Farm 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 Plum Creek Wind Farm is between approximately 1,450,000 and 1,740,000 megawatt-hours.[73] Though the impacts associated with non-renewable sources vary, it is possible to estimate, as an example, the impact of replacing the Plum Creek project MWh/year output with natural gas or, less likely, coal energy. However, since no non-renewable proposals are being considered in this case, that comparative analysis is not pursued in this review.

3.2.3.2 *Benefits*

Benefits of not building the project include avoidance of potential human and environmental impacts associated with the proposed wind farm. These potential impacts are discussed further below in this section for the wind farm and in Chapter 6 of this EIS for the associated transmission project.

3.3 Plum Creek Wind Farm and Alternatives - Human and Environmental Impacts

The proposed wind farm and the project alternatives have the potential for human and environmental impacts, which are discussed below, along with possible mitigation strategies.

3.3.1 Air Quality

Electric generation facilities may emit air pollutants during construction and operation. This EIS examines air emissions as required by Minnesota Rule 7849.1500, subpart 2.

3.3.1.1 *Criteria Pollutants*

[72] SPA, at p. 79.
[73] CNA, at p. 21.

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]

Plum Creek Wind Farm

The proposed wind 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 vehicle travel as well as 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 site includes multiple construction "sites" for installing individual turbines and access roads. 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.

Generic 414 MW Wind Farm

A generic 414 MW wind farm, site elsewhere in Minnesota, would not emit criteria pollutants during operation, and would have ancillary emissions (construction, transmission line) similar to those of the proposed project.

414 MW Solar Farm

As with the proposed project, a solar farm would not emit criteria pollutants during operation. Temporary air quality impacts would occur during the construction phase of the solar farm project similar to that for the wind farm.

During construction of the solar farm 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.

Mitigation

Dust from construction activity can be controlled using standard construction Best Management Practices (BMPs) 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-

[74]United States Environmental Protection Agency (EPA). *Criteria Air Pollutants*. https://www.epa.gov/criteria-air-pollutants

recommended operations and good combustion practices, including not tampering engines to increase horsepower and using ultra-low sulfur diesel.

3.3.1.2 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 review 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.[75]

Plum Creek Wind Farm

The wind farm would emit minimal HAPs or VOCs during operation. Petroleum-based fluids used in the operation of wind turbines, such as gear box oil, hydraulic fluid and gear grease, have a low vapor pressure and any release of VOCs would be minimal.

Generic 414 MW Wind Farm

A generic 414 MW wind farm, site elsewhere in Minnesota, would have HAP and VOC emissions similar to the proposed project, as the generic 414 MW wind farm would utilize the petroleum-based fluids during wind turbine operation.

414 MW Solar Farm

As with wind farm, minor emissions of toxic air pollutants would occur 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.

Mitigation

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

3.3.1.3 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. Ozone and nitrous oxide are reactive compounds that contribute to smog and can have adverse impacts on human respiratory systems.[76] Accordingly, these compounds are regulated and have permissible concentration limits. Minnesota has an ozone limit of 0.08 parts per million (ppm).[77] The federal

[75] EPA. *Hazardous Air Pollutants*, https://www.epa.gov/haps.
[76] EPA. *Criteria Air Pollutants*. https://www.epa.gov/criteria-air-pollutants.
[77] Minn. R. 7009.0800, https://www.revisor.mn.gov/rules/?id=7009.0080.

ozone limit is 0.07 ppm.[78] 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.[79]

Plum Creek Wind Farm

The wind farm would not produce ozone or ozone precursors at the operating wind turbines. Ozone production can occur adjacent to transmission lines under specific conditions. Ozone production from the associated transmission project is discussed in Section 6.5.5. The human and environmental impact will be minimal, and no mitigation related to ozone formation is proposed.

Generic 414 MW Wind Farm

A generic 414 MW wind farm, sited elsewhere in Minnesota, would not produce ozone or ozone precursors at the operating wind turbines. The generic 414 MW wind farm would have minimal or no impacts related to ozone formation, similar to the proposed project. Any transmission line associated with the project, whether new or existing, would generate small amounts of ozone and nitrous oxide (see Section 6.5.5).

Generic 414 MW Solar Farm

A 414 MW solar farm would not produce ozone or ozone precursors at the operating of the PV panels. As with wind farm, the ozone production associated with a 414 MW solar farm would depend on the use of associated transmission lines to deliver power to the grid. The generic 414 MW solar farm would have minimal or no impacts related to ozone formation, similar to the proposed project. Ground level ozone formation and associated impacts are anticipated to be minimal.

As with a wind farm, any transmission line associated with the project would generate small amounts of ozone and nitrous oxide (see Section 6.5.5).

Mitigation

Since neither wind farm nor solar farms produce ozone or ozone precursors there will be minimal or no human or environmental impacts, and thus no mitigation related to ozone formation. Ozone and nitrous oxide emissions from the associated transmission line are anticipated to be well below regulatory limits (Section 6.5.5).

3.3.2 Water Resources

[78] EPA. *2015 National Ambient Air Quality Standards (NAAQA) for Ozone.*https://www.epa.gov/ozone-pollution/2015-national-ambient-air-quality-standards-naaqs-ozone.

[79] EPA. *Ozone Pollution.* https://www.epa.gov/ozone-pollution.

Different generation options have different water usage and effects on the water quality and water resources. This EIS examines impact to water resources as required by Minnesota Rule 7849.1500, subpart 2.

3.3.2.1 Water Appropriations

Large electric power generating facilities may require water for operations.

Plum Creek Wind Farm

An O&M facility will be constructed within the site to serve as a center for the wind farm's O&M efforts, provide Project 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 turbines are monitored and controlled. The footprint of the facility is anticipated to be approximately 3,000 to 5,000 square feet and will include an access road and parking lot of approximately 3,000 square feet.[80] 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).[81] 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).

The excavated portion of the concrete turbine pads ranges from approximately 291 to 737 cubic yards depending on soil requirements and turbine size.[82]

A water appropriations permit may also be required if temporary dewatering activities are needed during construction.[83] The determination of need for a Water Appropriations Permit for construction dewatering activities will be determined by the contractor during construction depending on site conditions.

Geotechnical data, turbine loads, and cost considerations will dictate the final design of the foundation at each turbine location.[84] A temporary concrete batch plant, if deemed necessary, for construction of turbine foundations may require a Water Appropriations Permit from the DNR.[85]

[80] SPA, at p 21-22.
[81] Ibid, at p. 132.
[82] Ibid, at p 133.
[83] Ibid, at p. 86.
[84] Ibid, at p. 133.
[85] Ibid, at pp. 86-87.

Generic 414 MW Wind Farm

Water appropriations for a generic 414 MW wind farm, sited elsewhere in Minnesota, would be similar to the proposed project, depending on the need for an on-site concrete batch plant and proximity to existing water supplies.

Generic 414 MW Solar Farm

A utility scale solar facility such as those recently permitted by the Commission typically include an O&M facility with water use similar to that of a wind farm facility. Given the rural nature in siting solar farms, it would be anticipated that domestic water and sewer services (operation and maintenance building) would generally be provided by on-site infrastructure (i.e., private well and septic), which would require similar regulatory review and permitting as for the wind farm.

The minimal need for concrete in the construction of solar farms 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 a solar farm project would require the comparable regulatory review and permitting as for the wind farm.

Mitigation

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 DNR Water Appropriations Permit. No mitigation is required. If temporary dewatering is required during construction activities, discharge of dewatering fluid will 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.

3.3.2.2 Wastewater

Large electric generation facilities have the potential to generate significant amounts of wastewater. This section discusses potential impacts from wastewater generation.

Plum Creek Wind Farm

The wind farm's O&M facility would generate household amounts of wastewater. Plum Creek plans to build an on-site septic system to serve the O&M facility.[86] The potential impacts of this wastewater and septic system are anticipated to be minimal and mitigation beyond that required by the Plum Creek permit for the Individual Sewage Treatment System is not required.

[86] SPA, at p 132.

Generic 414 MW Wind Farm

A generic 414 MW wind farm, site elsewhere in Minnesota, would have wastewater impacts similar to the proposed project.

Generic 414 MW Solar Farm

Similar to a wind farm and its rural setting, a solar farm would likely require a private well and septic system at the O&M building to provide sanitary services and water for maintenance. Wells and septic system installations require state and local permits.

Mitigation

There would be minimal or no human or environmental impacts concerning wastewater from these projects; outside of BMPs and standard conditions contained in the potable well installations and Individual Sewage Treatment System permits, no mitigation is required.

3.3.2.3 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.[87] 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.

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.

Plum Creek Wind Farm

Cottonwood, Murray, and Redwood counties are 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.[88]

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. The aquifer is

[87] DNR. *Minnesota Groundwater Provinces* (https://www.dnr.state.mn.us/groundwater/provinces/index.html).
[88] SPA, at p. 86.

buried by glacial deposits to depths of 700 feet or more. 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.[89]

Homes and farms in the Project Area typically use private wells and septic systems for their household needs. According to the Minnesota Department of Health's Minnesota Well Index online database, there are 105 located wells, and an additional 25 unverified well locations within the Project Area and are generally associated with residences (Minnesota Department of Health, 2019).[90]

Large scale excavation at wind farms is limited to the turbine pads and the O&M facility (including well and septic) and are temporary. Groundwater resources are not expected to be impacted from these activities. Individual wind turbine locations should not impact the use of existing water wells; to comply with residential and noise setbacks, turbines are generally located at least 1,000 feet from homes, well away from where most residential wells are located.

Impacts to groundwater resources from construction and operation of the wind farm are anticipated to be minimal due to adequate supply, the aquifer depth, and lack of potential sources of contamination. 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. As previously noted, the temporary concrete batch plant may need a water well to provide water for concrete production during the construction phase of the project.

Generic 414 MW Wind Farm

Impacts to groundwater from a generic 414 MW wind farm might be comparable to the Plum Creek Wind Farm, depending on site location and geological material underlying the project site. The potential for groundwater contamination resulting from construction may be higher in areas with karst geology.

Generic 414 MW Solar Farm

The infrastructure at previously reviewed solar projects, included the direct-embedded piers supporting the PV tracking installations, foundations for inverters and the Operations and Maintenance (O&M) facility, and transmission poles that were typically installed at a depth above the average depth to groundwater of 15-40 feet. No impacts to geologic and groundwater resources would be anticipated as a result of construction or operation of the alternative solar project.

With the shallow subsurface depth requirements for infrastructure at solar farms it is unlikely these type of projects situated elsewhere in Minnesota would pose a general threat to groundwater quality;

[89] SPA, at pp. 86-87.
[90] SPA, at p. 86.

however, with certain site specific subsurface conditions (karst or high water table) the risk may increase.

Mitigation

During "down-stream" permitting, measures would be taken to identify any nearby wells prior to construction of turbine foundations. 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 site-specific supply and drawdown impacts will be further addressed, if necessary, in appropriations permits.

3.3.2.4 Surface Water

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

Plum Creek Wind Farm

The Cottonwood River watershed occupies the majority of the Project Area boundaries, while the southwestern corner of the Project Area in Murray County occurs within the Des Moines River watershed (Figures 5a and 5b).[91] Streams within the Project Area include Pell Creek, Dutch Charley Creek, Plum Creek, the Des Moines River, and Highwater Creek.

There are no trout streams within the Project Area; the nearest trout stream is Scheldorf Creek, located approximately 9.5 miles south of the Project Area.[92] No waterbodies within the Project Area are identified as Outstanding Resource Value Waters under Minn. R. 7050.0335, subpart 3.[93]

Some watercourses and water bodies within the project area are designated as public waters and are listed in the public waters inventory (PWI) by the State of Minnesota. Public waters are designated as such to indicate which lakes, wetlands, and watercourses over which DNR has regulatory jurisdiction. Public waters are identified on PWI maps and are designated as public waters under DNR's Public Waters Permit Program (Minnesota Statute 103G.005, Subdivision 15).

There are 27 PWI watercourses, two PWI basins, and two PWI wetlands in the Project Area that are listed as MNDNR PWI public waters.

[91] SPA, at pp. 86-90.
[92] Ibid.
[93] Ibid.

Table 5 lists the public waters in the site and the distance of the protective buffer.

Table 5 Public Waters Inventory

PWI Type	PWI Feature Name
PWI Watercourse	Highwater Creek (M-055-095-061-001)
	Unnamed Stream (M-055-095-072-021)
	Unnamed Stream (M-055-095-066-011)
	Unnamed Stream (M-055-095-066-010)
	Unnamed Stream (M-055-095-061-005)
	County Ditch 4 (I-037-048)
	Unnamed Stream (M-055-095-057-007)
	Unnamed Stream (M-055-095-057-005)
	Dutch Charley Creek (M-055-095-061)
	Judicial Ditch 3 (M-055-095-061-012)
	Unnamed Stream (M-055-095-061-005-002)
	Unnamed Stream (M-055-095-061-005-001)
	County Ditch 4 (I-037-048)
	Unnamed Stream (M-055-095-066-009-003)
	Unnamed Stream (M-055-095-066-008)
	Unnamed Stream (M-055-095-061-018)
	Des Moines River (I-037)
	Pell Creek (M-055-095-066)
	Unnamed Stream (M-055-095-061-001-001)
	Unnamed Stream (M-055-095-066-002)
	Dry Creek (M-055-095-057)
	Plum Creek (M-055-095-072)
	Unnamed Stream (M-055-095-066-008)
	Judicial Ditch 3 (M-055-095-061-012)
	Unnamed Stream (M-055-095-066-009)
	Dutch Charley Creek (M-055-095-061)
	Unnamed Stream (M-055-095-061-002)
PWI Basin	Julia
	Dovray Marsh
PWI Wetland	Unnamed (51015100)
	Unnamed (51011100)

The Clean Water Act (Section 303(d)) requires each state to list streams and lakes that are not meeting their designated uses (i.e., impaired) because of excess pollutants. Five recorded waterbodies within the Project Area are listed as impaired by the MPCA: the Des Moines River, Plum Creek (Judicial Ditch 20A), Pell Creek, Dutch Charlie Creek, and Devils Run Creek. The Des Moines River and Plum Creek (Judicial Ditch 20A) are listed as impaired for fecal coliform and turbidity; Pell Creek is impaired for turbidity; Dutch Charlie Creek is impaired for turbidity and fish bioassessments; and Devils Run Creek is impaired for fish bioassessments.[94]

There are no DNR designated wildlife lakes or Migratory Waterfowl Feeding and Resting Areas in Cottonwood, Murray, or Redwood Counties.[95]

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.

Federal Emergency Management Agency (FEMA) designated floodplains maps indicate that there are approximately 1,100 acres of 100-year floodplains within the Project Area that are associated with Dutch Charley Creek, Dry Creek, Highwater Creek, Des Moines River, Plum Creek, Pell Creek, Judicial Ditch 3, and two unnamed tributaries (Table 6).[96] None of the proposed turbines, substation or access roads are located within a FEMA designated 100-year floodplain (Figures 6a and 6b).

Table 6 FEMA Floodplains

County	Associated Streams	Acres
Cottonwood	Dutch Charley Creek Judicial Ditch 3 Dry Creek Unnamed tributary to Dry Creek Highwater Creek	471.7
Murray	Des Moines River Unnamed tributary to Dutch Charley Creek Dutch Charley Creek Plum Creek	135.0
Redwood	Pell Creek Plum Creek Highway Creek Dutch Charley Creek	500.1
Total		1,106.8

[94] SPA, at pp. 88-90.
[95] Ibid.
[96] Ibid.

During construction of the Plum Creek wind farm, there is the potential for sediment to reach surface waters due to ground disturbances from vegetation clearing, excavation, grading, and construction traffic. Potential impacts to surface water resources from construction of access roads, turbine sites, and collection lines when the ground is disturbed by excavation, grading, trenching, and construction traffic could include erosion from increased surface water runoff, sedimentation, discharges from groundwater dewatering, and diversion of watercourses. However, these impacts will be temporary during construction of the wind farm and will be minimized to the extent possible through the use of BMPs. Impacts to surface waters are expected to be negligible. If access roads cross waterbodies, they will be designed to maintain stream flow by using culverts.

The wind farm project will add up to 86.6 acres of new impervious surfaces from turbine pads, access roads, and the two collector substations. New impervious surfaces (up to 86.6 acres) will be distributed across the Project Area (approximately 73,000 acres). Each turbine will have less than one acre of impervious surfaces; the collector substations will have approximately 10 acres each. Turbine siting and general site design will reduce impacts to surface waters. Optimal turbine locations are those which are topographically elevated from their surroundings. Ideally, turbines are located on elevated uplands where they are not expected to affect streams or surface water bodies directly.

Generic 414 MW Wind Farm

The primary source of impacts to surface water from a generic 414 MW wind farm, site elsewhere in Minnesota, would be erosion and runoff during construction. Generally, mitigation strategies would be similar to those of the proposed project. In areas where a surface water body is identified as impaired, the SWPPP would provide detailed mitigation to prevent or reduce impacts to impaired water bodies.

Generic 414 MW Solar Farm

Similar to wind farms, potential impacts to surface waters from a solar farm occur during the construction phase; there is the possibility of sediment reaching nearby surface waters and wetlands as the ground is disturbed by excavation, grading and construction traffic. The potential for impacts to surface waters is affected by the solar farm's design and proximity to surface water features.

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

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. Since the Project will disturb more than 50 acres and Project facilities are proposed within one mile of impaired waters (the Des Moines River, Plum Creek, Pell Creek, Dutch Charlie Creek, and Devils Run Creek), Plum Creek Wind

will submit the SWPPP to MPCA for review and approval prior to construction and obtaining coverage under the General Construction Stormwater Permit. 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. Plum Creek Wind will coordinate with MPCA on design and implementation of sediment and erosion control measures such as silt fence, biologs, and wattles, and, if necessary, around the collector substations, infiltration systems/retention ponds. In addition to erosion control measures, fueling and lubricating construction equipment away from waterways will ensure that fuel and lubricants do not enter waterways.

Estimating stormwater retained for development of the NPDES/ SDS construction stormwater permit 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, the calculation may be done using the disconnected impervious credit described in the MPCA's methodology and guidelines.[97] For solar installations, the remaining water quality volume after applying the credit will still need to be treated using more traditional stormwater management practices.

Site permits issued by the Commission require permits and approvals from the DNR, USFWS and/or Army Corps of Engineers (USACE) for any access roads constructed across 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 can readily flow to the lower portions of the watershed.

3.3.2.5 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.[98] 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.[99]

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 publicly available resource

[97] https://stormwater.pca.state.mn.us/index.php?title=File:Solar_panels_1.png.
[98] DNR. *Wetlands*. http://www.dnr.state.mn.us/wetlands/index.html.
[99] Ibid.

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 (i.e., access roads, turbine sites, substation sites, and collection lines) associated with development of 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.

Plum Creek Wind Farm

Wetlands are not a common feature at the site. There are scattered wetlands and wetland complexes associated with watercourses across the site. Most are classified as freshwater emergent with some shrub/scrub and forested wetland types.

There are approximately 2,267.1 acres of NWI-mapped wetlands in the Project Area, which constitutes approximately 3.1 percent of the Project Area. More than 78 percent (1,776 acres) of the NWI wetland acreage is mapped as palustrine emergent wetlands (PEM). Palustrine forested wetlands (PFO) comprise 10.9 percent (246.5 acres) of the NWI wetland acreage. Riverine wetlands comprise 5.3 percent (120.7 acres) of the NWI wetland acreage. The remaining 6.4 percent are freshwater pond/lake (91.6 acres) and palustrine scrub-shrub wetlands (PSS; 32.1 acres).[100]

Figures 7a and 7b illustrate the NWI wetlands in the Project Area. Table 7 list the NWI wetland types in the Project Area.

[100] SPA, at pp. 91-93.

Table 7. NWI Wetland Types within the Project Area[101]

NWI Type	Acres	Percent of Project Area
Freshwater Emergent Wetland (PEM)	1,186	2.3%
Freshwater Forested/Shrub Wetland (PFO/PSS)	337	0.7%
Freshwater Pond (Open Waters)	57	0.1%
Riverine Waters	12	0.0%
Total	1,592	3.1%

The LGU (counties) administer the Wetland Conservation Act (WCA), with oversight by the Board of Water & Soil Resources (BWSR). Generally, a Replacement Plan is required by the WCA for an impact that wholly or partially drains or fills a wetland. Wetlands are also federally protected under Section 404 of the Clean Water Act. A wetland permit from the USACE is required when discharging dredged or fill material into jurisdictional wetland and/or non-wetland Waters of the United States. A permit and/or preconstruction notification may also be required by the local watershed district depending upon the location, size and type of impact.

Turbines and meteorological towers for the wind farm will be sited and built in upland, higher elevation areas to maximize the wind resources and, in doing so, will avoid direct impacts to wetlands and surface waters. Access roads and operation facilities will 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 will also be minimized by siting to avoid wetland features. Installation of underground utilities will decrease impacts by boring under PWI wetlands as necessary.[102]

Access roads and project infrastructure will be designed and sited to avoid or minimize permanent impacts to wetlands to the greatest extent feasible. Temporary impacts to wetlands may occur based on construction easement extents. Field work to delineate wetlands is ongoing so that wetland areas can be avoided. In the event that permanent wetland impacts cannot be avoided during the siting of project infrastructure, Plum Creek will coordinate with the appropriate agencies including USACE, WCA, BWSR, and the counties Cottonwood, Murray, and Redwood.[103]

Permanent and temporary impacts to NWI-mapped wetlands are summarized in Table 8.18-2. The maximum estimate of wetland impacts is for the V162 layout.[104]

[101] Ibid, Table 8.18-1.
[102] SPA, at pp. 91-93.
[103] Ibid.
[104] Ibid.

Table 8. Summary of NWI Wetland Impacts (acres)[105]

NWI Wetland Type	V162		SG170	
	Permanent	Temporary	Permanent	Temporary
Palustrine Emergent Wetland (PEM)	-	19.2	0.3	10.8
Palustrine Forested Wetland (PFO)	-	3.5	-	0.6
Riverine	-	1.3	-	0.6
Freshwater Pond/Lake	-	-	-	-
Palustrine Scrub-shrub Wetland (PSS)	-	0.9	-	-
Total	**-**	**24.9**	**0.3**	**12.0**

Turbine layouts under consideration are expected to have minimal impacts to wetlands based on completed field surveys of proposed turbine locations, access roads, and the O&M site, and desktop review of NWI data of collection lines and crane path areas associated with the wind farm.[106]

Generic 414 MW Wind Project

The primary source of impacts to wetlands from a generic 414 MW wind farm, sited elsewhere in Minnesota, would be similar to those for the Plum Creek Wind 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 of the generic project.

Generic 414 MW Solar Farm

Construction and maintenance of a solar facility 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. 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.

[105] Ibid, Table 8.18-2.
[106] Ibid.

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 to those of the Plum Creek Wind Farm, however the extent and degree of these strategies would be dependent on site specific features of the generic project.

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 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 would 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 would 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.

Development of a Vegetation Management Plans (VMPs) are typically required in Commission permits 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.

3.3.3 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. This EIS examines impact from the handling, generation, and storage of solid and hazardous wastes and materials as required by Minnesota Rule 7849.1500, subpart 2.

Plum Creek Wind 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.[107] Older farmsteads may also contain lead-based paint, asbestos-containing building materials (e.g. shingles and siding), and polychlorinated biphenyls ("PCBs") in electrical transformers. Unmarked farmstead waste dumps which may contain various types of wastes are also commonly found in rural settings.

The wind 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 wind farm is not expected to generate significant quantities of solid and hazardous waste materials. Small quantities of hydraulic oil, lube oil, grease, and cleaning flush 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.

Plum Creek 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.[108] Plum Creek also reviewed the MPCA's *What's in my Neighborhood* (WIMN) database to identify any potential contaminated sites in the Project Area.

Review of the FRS and WIMN databases identified 39 licensed feedlots, one licensed feedlot/solid waste generating site, one inactive hazardous waste generator (automotive repair shop), two active solid waste generating sites, one licensed septic installer, and six open stormwater permits in the Project Area. No Superfund sites were identified within the Project Area.[109]

Prior to construction, Plum Creek will conduct an American Society for Testing and Materials conforming Phase I Environmental Site Assessment within the site to identify potential existing environmental hazards.[110]

Generic 414 MW Wind Farm

A generic 414 MW wind farm, sited in an agricultural setting, would have potential solid and hazardous waste historic impacts similar to the proposed project. As with the proposed project, the construction and operation of the wind farm would generate solid waste (scrap wood, plastics, cardboard and scrap metals).

[107] SPA, at p 69-70.
[108] SPA, at pp. 69-71.
[109] Ibid.
[110] Ibid.

Operation of the wind farm is not expected to generate significant quantities of hazardous waste materials.

Generic 414 MW Solar Farm

As with a wind farm, a solar farm will generate solid waste during construction (e.g., 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.

Mitigation

Hazardous materials and any waste generated 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 facility should be maintained at the O&M facility.

It is not anticipated that either the wind or solar 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).

The Phase I ESA will be used to identify and avoid potential hazardous waste sites within the site.[111]

3.3.4 Natural Resources

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.

3.3.4.1 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[112]

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

[111] SPA, at pp. 69-71.
[112] DNR *Ecological Classification System*, http://www.dnr.state.mn.us/ecs/index.html.

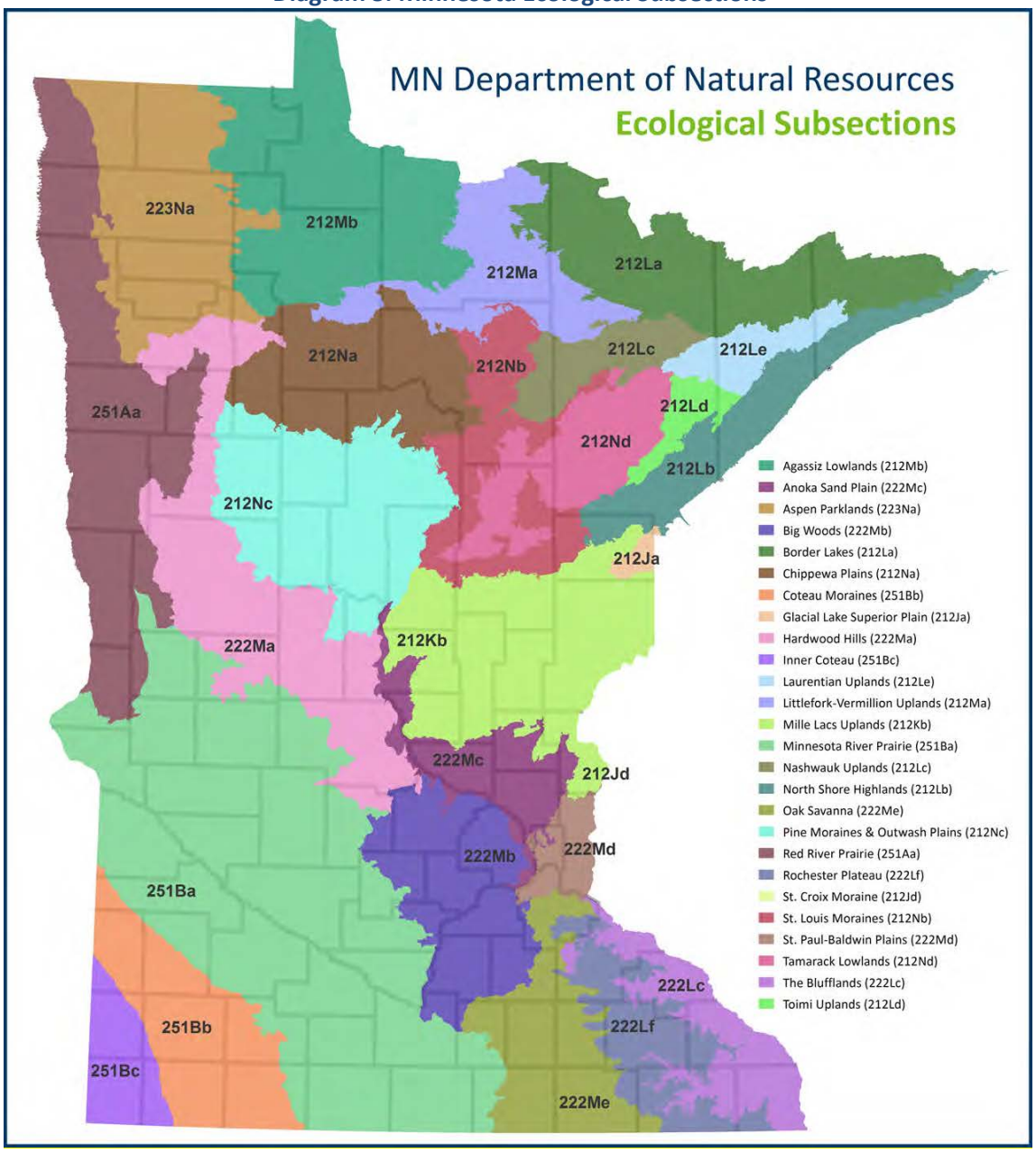
ECS enables resource managers to consider ecological patterns for areas as large as North America or as small as a single timber stand and identify areas with similar management opportunities or constraints relative to that scale. There are eight levels of ECS units in the United States. Map units for six of these levels occur in Minnesota: Provinces, Sections, Subsections, Land Type Associations, Land Types, and Land Type Phases. Diagram 5 represents the Ecological Subsections in Minnesota.

Plum Creek Wind Farm

The Project Area is in both the Minnesota River Prairie and Coteau Moraines subsections of the North Central Glaciated Plains Section in the Prairie Parkland Province, as defined by the ECS of Minnesota. Historically, tallgrass prairie covered most of this area and wet prairies covered a smaller proportion of the landscape. Forest were similarly restricted to floodplains along the Minnesota River and other streams. As a result of settlement in the mid- 1800s, the area was converted to farmland, with only a few remnants of pre-settlement vegetation remaining.[113]

[113] SPA, at pp. 93-94.

Diagram 5. Minnesota Ecological Subsections[114]



Plum Creek reviewed aerial photographs and land use/land cover database information to determine the various land uses in the Project Area; the majority of the land area is cultivated crops (**Figures 8a and 8b**).[115] Corn and soybeans are the dominant agricultural crops by acreage in all three counties

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

followed by forage crops in Cottonwood and Murray Counties and sugar beets in Redwood County (Table 9).

Soils in the region are characterized by six soils associations; a soil association has a distinctive pattern of soils, relief, and drainage (Table 10, Figures 9a and 9b).[116] Generally, the soils within the site are characterized by silty clay loams that are deep, poor to moderately well drained and underlain by firm glacial till. In addition to soil associations, the United States Department of Agriculture, Natural Resources Conservation Service identifies areas that are important to agricultural use, such as prime farmland and farmland of statewide importance. Prime farmland is land that has the best combination of physical and chemical characteristics for producing food, feed, forage, fiber, and oilseed crops; these could be cultivated land, pastureland, forestland, or other land. Ninety-one (91) percent of the soils in the Project Area are classified as prime farmland (Table 11).

Table 9. Land Cover Types and their Relative Abundance in the Project Area[117]

Land Cover	Acres	Percent of Project Area
Cultivated Crops	66,564	91.2%
Developed	2,542	3.5%
Hay/Pasture	1,302	1.8%
Emergent Herbaceous Wetlands	1,223	1.7%
Grassland/Herbaceous	630	0.9%
Deciduous/Mixed Forest	521	0.7%
Woody Wetlands	101	0.1%
Barren Land	53	0.1%
Open Water	30	<0.1%
Shrub/Scrub	2	<0.1%
Total	**72,968**	**100%**
Source: 2016 NLCD (Yang et al., 2018)		

Generic 414 MW Wind Farm

A generic 414 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 greatest wind resources (Diagram 3), which also tend to be in agricultural areas of the state with similar ecological features.

[116] SPA, at pp. 81-83.
[117] SPA, at p. 94, Table 8.19-1.

Table 10. Soil Associations in the Project Area[118]

Soil Association	Area (acres)
Wilmonton-Letri Everly (s3714)	51,156
Delft-Clarion (s3558)	11,035
Mayer-Estherville-Biscay (s3510)	4,166
Webster-Ves-Normania-Canisteo (s3529)	3,289
Webster-Nicollet-Clarion-Canisteo (s1750)	2,922
Marysland-Egeland-Arvilla (s3536)	400
Total	**72,968**

Table 11. Prime Farmland within the Project Area (acres)[119]

Prime Farmland Classification	Acres	Percent of Project Area
Prime Farmland1	66,154	90.7%
Farmland of Statewide Importance	3,692	5.0%
Not Prime Farmland	3,122	4.3%
Total	**72,968**	**100%**

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

Generic 414 MW Solar Farm

While the site selection criteria for wind farms and solar farms share some common prerequisites (i.e., point of interconnect, adequate roadways and stakeholder concerns), there are sufficient contrasts to expect different siting outcomes (environmental setting).

Site identification analysis for solar farms takes into account the suitability of the specific sites and may include such factors as:

- Quality of terrain – Sloped land, excessively rocky or sandy terrain, uneven land etc., can all significantly add to the cost of installing a solar farm. Degree of forest clearing, or tree removal must be low.
- Local weathering factors – Desert conditions often coincide with excessive dust fall, flooding and flash flooding, high erosion, etc., and these can limit the viability of a site and in many cases can make a site non-viable.
- Proximity to Grid connection- One of the biggest hidden costs of a solar farm is the distance required to connect to the grid.
- Local Transmission Capacity – Careful study must be done if the power grids will be able to handle the excess capacity that a solar farm would introduce.
- Proximity to Main Roads - Proximity of a solar farm to a main road is considered an economic

[118] SPA, at p. 82, Table 8.15-1.
[119] SPA, at p. 83, Table 8.15-2.

factor as the transportation costs affect the overall cost benefits.

- Conservation and Environmental Impact Issues – Large tracts of undeveloped land too often coincide with sensitive or protected areas or protected species. Often the presence of a single protected species of plant or animal can halt or completely alter the development plans for a solar farm.
- Local Regulations and Ownership – Objections from the stakeholders, conflicts with current land use and zoning, and removal of agriculturally productive land.
- Flood Risk Assessment – The desire to avoid conflicts with agriculture may result in low lying sites subject to flooding concerns.
- Prime Farmland-since by rule, 0.5 acres of prime farmland per megawatt of net generating capacity cannot be removed from agricultural production (7850.4400, subpart 4), unless there are no feasible and prudent alternatives. It is likely that a solar facility of scale needed to generate 414 MW, would be limited in terms of site selection in areas with significant amounts of prime farmland.

3.3.4.2 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 utilize the available habitat in and adjacent to the project area for forage, breeding and shelter.

Studies have shown that placement of turbines and auxiliary structures can result in decreased densities of songbirds and other species. Species of grassland birds, such as various grouse species, are particularly susceptible to displacement due to their high site fidelity.[120] The potential for habitat avoidance by wildlife in response to wind turbines and associated infrastructure is highly variable depending on the species, seasonal and annual variation in weather, migration patterns, and individual behavior patterns. Based on these studies of existing wind power projects in the United States and Europe, the impact to wildlife would primarily occur to avian and bat populations.[121]

Plum Creek Wind Farm

Historically, the Plum Creek wind farm site and surrounding region contained a variety of natural communities and habitat that supported diverse species of wildlife. As the historic vegetation has been converted to agricultural use, the wildlife species that occupy the landscape reflect the changes in habitat type and availability. The most common species within the site tend to be generalists and are able to utilize rural, urban or agricultural habitats. According to the general distribution of wildlife

[120] 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.
[121] Ibid.

in the region and their habitat preferences, a variety of common and widespread species have the potential to occur within the site at some time during the year. The majority of migratory wildlife species are birds, including waterfowl, raptors and songbirds and migratory bat species.[122]

Local and migratory species use the grasslands, farm woodlots, wetlands and other areas for food and cover. Mammals common to this landscape include opossum, skunk, squirrels, rodents, rabbits, deer, fox, coyotes, and raccoons. Reptiles and amphibians are associated with wetlands, waterways and forested stretches throughout the project area. Reptiles and amphibians include snakes, turtles and frogs. Several species of birds and bats are also known to occur in this landscape, including grassland birds, migratory birds, raptors and waterfowl.[123]

Based on results from Plum Creek's Tier I and Tier II (USFWS WEG) studies, several types of wildlife habitats including native prairie, Waterfowl Production Areas (WPAs), Wildlife Management Areas (WMAs), Native Plant Communities (NPCs), USFWS National Wildlife Refuges (NWRs) and conservation easements, and Sites of Biological Significance (SOBS) ranked as moderate, are located within and adjacent to the Project Area (**Figures 10a and 10b**).[124]

These conservation lands are non-participating landowners and are treated as such with respect to setbacks from turbines and associated facilities. At a minimum, wind turbines will be placed at least five rotor diameters or three rotor diameters, depending on wind direction and property location, from identified management areas within and adjacent to the Plum Creek wind farm.[125]

Based on the results of the Tier 1 and Tier 2 studies, Plum Creek Wind Farm, LLC, contracted with WEST to conduct USFWS Tier 3 field studies to obtain additional data on birds and bats.[126] These activities serve to inform Plum Creek of the types and extent of wildlife present within and adjacent to the project; survey results will also inform the project developers on infrastructure siting.

The surveys include the following:

- 2018 – 2020 general avian and eagle use surveys,
- 2018/2019 raptor and eagle nest surveys, including nest monitoring surveys,
- 2019 general acoustic bat surveys, and
- 2019 northern long-eared acoustic bat surveys

Birds

The potential for habitat fragmentation impacts as a result of the wind farm is low because the proposed project is sited in an agricultural landscape and much of the remaining habitat is disturbed.

[122] SPA, at pp. 96 – 112.
[123] Ibid.
[124] Ibid.
[125] SPA, at pp. 111-112.
[126] SPA, at Appendix G.

The wind farm is designed to avoid placing turbines and access roads in DNR-mapped native prairie, native plant communities, and sites of biodiversity significance.

The wind farm has the potential to cause displacement of some bird species from the site due to increased human activity or the presence of tall structures, though clearing of habitat will be minimal. Many of the most-observed bird species within the site are common, disturbance-tolerant species, similar to the results of surveys at other wind energy facilities in the region (Odell, Red Pine and Lakefield wind farms).[127]

Birds observed during the Plum Creek Avian Surveys (June 2018 – August 2019) include upland game birds (ring-necked pheasant, mourning dove, wild turkey), ducks and geese (Canada goose, mallard, blue-winged teal, northern shoveler, wood duck), raptors (bald eagle, northern harrier, red-tailed hawk, American kestrel), shorebirds (killdeer, upland sandpiper, Wilson's snipe), woodpeckers (downy woodpecker, hairy woodpecker, northern flicker), and songbirds (wrens, sparrows, blackbirds, swallows). These species are similar to those observed during pre-construction surveys at Odell, Red Pine, and Lakefield.[128]

It can be expected that, similar to other LWECS projects in the region, there is a high likelihood that individual bird and bat fatalities will occur at the Plum Creek wind Farm project.[129] Based on the results of post-construction monitoring at similar facilities located on agricultural landscapes in southern Minnesota, estimated bird carcass rates at the Plum Creek Wind Farm would be expected to be within the range reported from studies at other wind facilities in the region (Table 12). Figure 11 illustrates the location of windfarms in the region. No single species or group is expected to experience a disproportionate amount of estimated mortality or impacts of a magnitude to affect the local or migratory population.[130]

Studies of bird fatalities near wind farms indicate that fatalities will occur and that they will vary with bird type (e.g., raptor, waterfowl, passerine), habitat availability, and other resources available within the site. At this time, it is unclear how these fatalities will impact avian populations on a broader scale. 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.[131]

[127] SPA, at p. 102.
[128] SPA, at pp. 103-106, Table 8.20-1.
[129] SPA, at p. 108.
[130] SPA, at p. 107.
[131] USFWS. *Migratory Birds Program. Wind Turbines*, https://www.fws.gov/birds/bird-enthusiasts/threats-to-birds/collisions/wind-turbines.php.

Table 12. Avian Fatalities Estimates – Huso Estimator[132]

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

Migratory Waterfowl Feeding and Resting Areas (MWFRAs) were authorized by the Minnesota legislature in 1969 to protect migratory waterfowl from disturbance. During the waterfowl season, electric motors are either prohibited or limited in size, depending on the MWFRA. In 2011, 30 MWFRAs were designated across the state. MWFRA are typically nominated by local conservation groups for the MNDNR to consider and approve or deny. No MWFRAs are within or adjacent to the Project Area, and thus no impacts or mitigation is anticipated.[133]

Important Bird Areas (IBAs) are created under voluntary, non-regulatory, international conservation effort that identifies critically essential habitats for birds, designates these habitats as IBAs, monitors the IBAs for changes in avian distribution and abundance, and conserves IBAs to protect birds in the long- term. In Minnesota, the IBA program is led by the MNDNR's Nongame Wildlife Program and Audubon Minnesota. No IBAs are within or adjacent to the Project Area, and thus no impacts or mitigation is anticipated.[134]

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.

Forty-Seven (47) bald eagle observations were recorded during Tier 3 field surveys and 20 observations were recorded incidentally at the project site. No golden eagles have been recorded at the project site. Bald eagle use was highest during spring, followed by fall, and winter; no use was recorded during summer. One hundred five bald eagle exposure minutes were recorded based on the

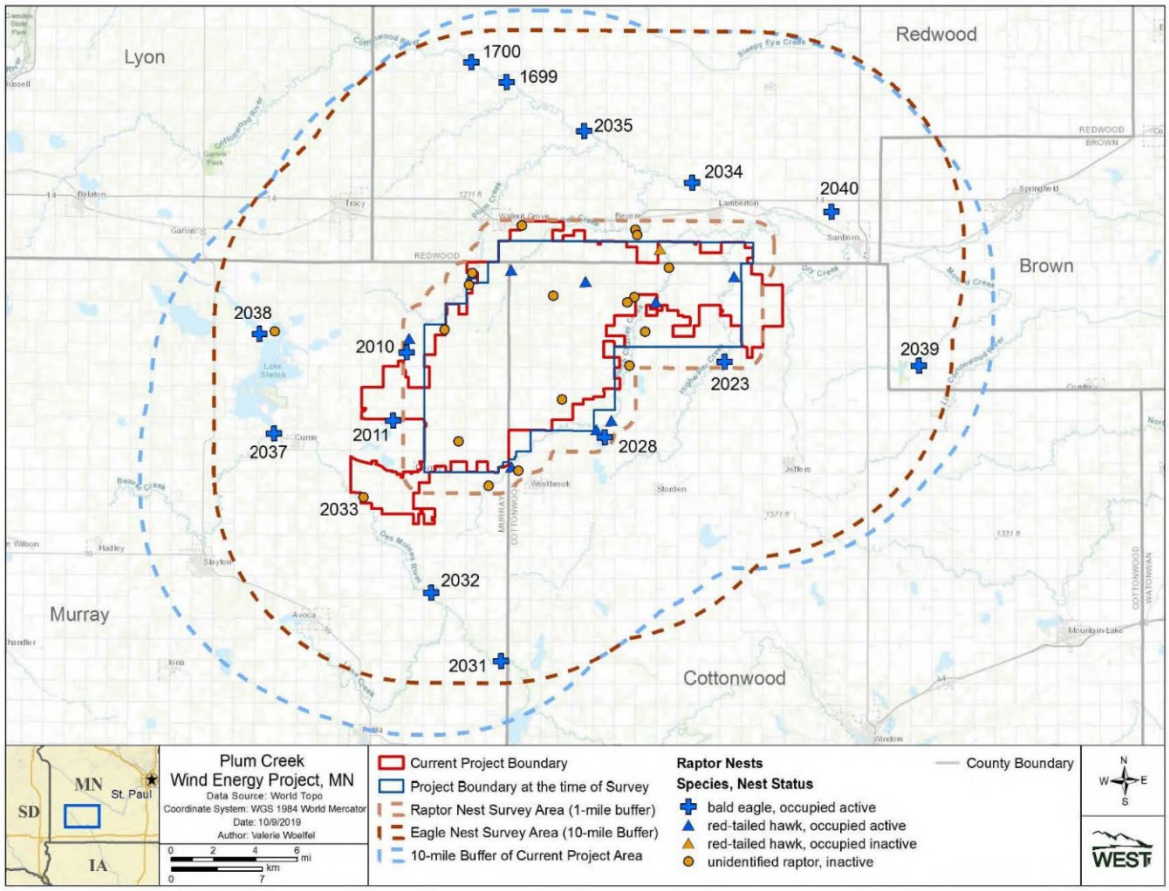
[132] SPA, at pp. 108 – 111.
[133] SPA, at pp. 112-113.
[134] SPA, at p. 113.

47 bald eagle observations recorded during surveys. Bald eagles were observed more frequently in the western portion of the project site.[135]

WEST conducted aerial nest surveys (from March 27th – 29th, 2018 and from March 25 – March 26, 2019). The principal objective of the surveys was to document the presence of bald eagle nests; the surveys also documented the presence of other raptor stick nests within the study area.

The initial nest survey (2018) detected 43 raptor nests representing three identified raptor species. Fourteen occupied active bald eagle nests, nine occupied active red-tailed hawk (*Buteo jamaicensis*) nests, one occupied inactive red-tailed hawk nest, two occupied active great-horned owl (*Bubo virginianus*) nests, and seventeen inactive unknown raptor nests were identified (Diagram 6). One inactive unknown raptor nest was consistent in size and shape with a bald eagle nest.

Diagram 6. Locations of Raptor Nests (2018 Raptor Nest Survey) Map[136]

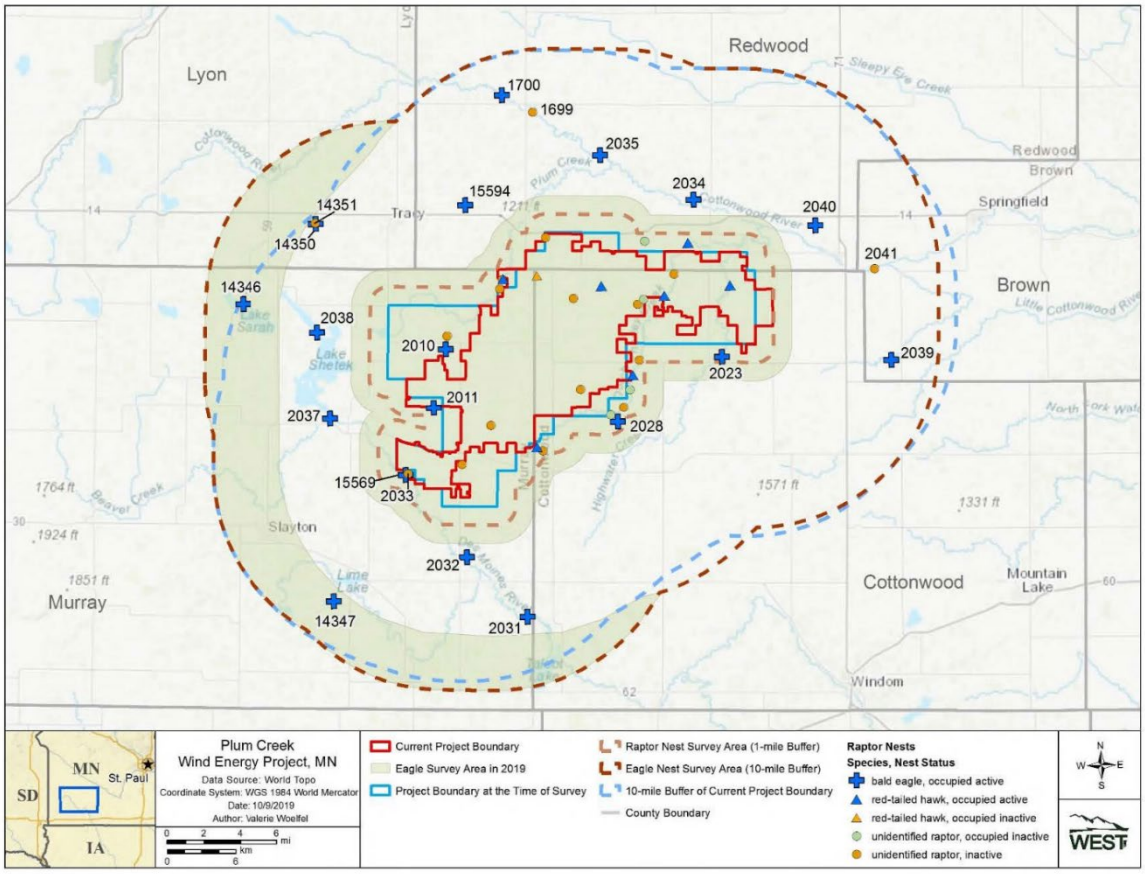


[135] SPA, at Appendix G.

[136] SPA, at Appendix G, Map 6a.

Follow-up aerial raptor and eagle nest surveys were conducted (2019) to accommodate the expanded Project Area boundary. As in 2018, a 1-mile buffer was surveyed for all raptor nests. For eagles, a 2-mile buffer of the expanded Project Area boundary was surveyed, plus all areas within 10 miles of the expanded Project Area Boundary that were not surveyed in 2018. All previously documented eagle nests within the 10-mile buffer were also surveyed in 2019. WEST detected 47 raptor nests representing two identified species. Eighteen occupied active bald eagle nests were documented during the 2019 surveys. Four inactive nests of unidentified species were consistent in size and structure with bald eagle nests. Additional nests documented during the survey included seven occupied active red-tailed hawk (*Buteo jamaicensis)* nests, one occupied inactive red-tailed hawk nest, four occupied inactive raptor nests of unidentified species, and 13 inactive nests of unidentified species (not consistent in size and structure with bald eagle nests). There are no active occupied bald eagle nests within the current Project Area boundary; five active occupied bald eagle nests were recorded within a 2-mile buffer of the current Project Area boundary (Diagram 7).

Diagram 7. Locations of Raptor Nests (2019 Raptor Nest Survey) Map[137]



[137] SPA, at Appendix G, Map 6b.

Bats

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 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.[138]

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. Project-specific acoustic surveys (July 2019) for northern long-eared bats appear to confirm the absence of the species.[139]

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 the Plum Creek wind farm would be expected to be within the range reported from studies at other wind facilities in the region (Table 13).

Table 13. Bat Fatalities Estimate – Huso Estimator[140]

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

Rare and Unique Natural Resources

Plum Creek reviewed the USFWS and MNDNR (Natural Heritage Information System) 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 proposed Project Area, including a one mile buffer

[138] 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.
[139] SPA, at Appendix G, pp.18-19.
[140] SPA, at pp. 108 – 111.

(Figures 10a and 10b).[141] Based on Plum Creek's review, there was one special status bird (upland sandpiper) and one special status amphibian (Great Plains toad) recorded within the Project Area and two special status birds (Wilson's phalarope and trumpeter swan) within the one-mile buffer (Table 14).[142] The NHIS data show two records (2007) of the upland sandpiper (Minnesota watch list species) within the Project Area and associated with Dutch Charley Creek and a wetland complex.[143]

Table 14. Federal and State Listed Species Documented Within One Mile of the Project Area[144]

Type	*Federal Status	*State Status	Scientific Name	Common Name	NHIS Records within the Project Area (#)	NHIS Records within one Mile of Project Area Boundary (#)	Year of Most Current Observation
Bird	--	T	*Phalaropus tricolor*	Wilson's Phalarope	0	1	2006
	--	SPC	*Cygnus buccinator*	Trumpeter Swam	0	1	2009
	--	W	*Bartramia longicauda*	Upland Sandpiper	2	0	2007
	--	E	*Ammodramus henslowii*	Henslow's sparrow	--	--	**2019
Insect	E	E	*Oarisma poweshiek*	Poweshiek Skipperling	1	0	1975
Amphibian	--	SPC	*Anaxyrus cognatus*	Great Plains Toad	1	0	2008

MNDNR, 2019d
*E=Endangered, T=Threatened, SPC=Species of Special Concern, W=Watch list
** Avian survey 2019

In addition to rare and sensitive species, the MNDNR also maps Sites of Biological Significance (SOBS), rare and unique plant communities (e.g., prairie) and higher quality examples of more common plant communities (e.g., wet meadow).[145] Table 15 lists these sites that occur within the Project Area. Along with these SOBS, native prairies and native plant communities may also provide essential habitat for rare species of fauna.[146]

[141] SPA, at pp.113 – 123.
[142] Ibid.
[143] Ibid.
[144] SPA, at pp.114 – 117, Table 8.21-2.
[145] SPA, at pp. 121-123.
[146] Ibid.

Table 15. Native Prairie, Native Plant Communities, and SOBS within the Project Area[147]

Native Prairie Type		Acres
Dry Hill Prairie (southern)		291.4
Mesic Prairie (southern)		24.3
Total		**315.7**
Native Plant Community Type		**Acres**
Basswood - Bur Oak - (Green Ash) Forest		1.6
Southern Wet-Mesic Hardwood Forest		8.2
Prairie Wetland Complex		50.2
Dry Hill Prairie (Southern)		291.4
Mesic Prairie (Southern)		24.3
Southern Seepage Meadow/Carr		5.2
Seepage Meadow/Carr		2.2
Total		**383.1**
Site of Biodiversity Significance Rank	**Number of Sites Within Project Area**	**Acres**
Below	11	530
Moderate	16	604
High	0	0
Outstanding	0	0
Total	**27**	**1,134**

The Minnesota Biological Survey (MNDNR) designates and assigns rankings to SOBS, based on landscape context, native plant community, and occurrence of rare species populations.[148] There are four biodiversity significance ranks: outstanding, high, moderate, and below. Within the Project Area, several small areas have been evaluated as SOBS by the MBS. These sites within the Project Area are ranked as either "below" or "moderate"; there are no sites ranked with "high" or "outstanding" biodiversity significance within the Project Area.[149]

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

[147] SPA, at pp.120 – 123, Tables 8.21-3, 8.21-4, and 8.21-5.
[148] https://www.dnr.state.mn.us/mbs/index.html.
[149] SPA, at pp. 121-123.

acres of native prairies ranked good to excellent remain in Minnesota.[150] Based on a review of the MNDNR data base, one record of native prairie was documented in the Project Area in 1977 (a Dry Hill Prairie - Southern Type); native prairie data for the Project Area includes approximately 316 acres of dry hill prairie (southern) and mesic prairie (southern).

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.[151]

Based on the current design, co-located collection lines and crane paths may temporarily impact 2.5 acres and 0.1 acre of SOBS ranked below and moderate, respectively, for the V162 layout. Similarly, the design for the SG170 layout may temporarily impact 1.6 acres of below SOBS, also with co-located collection lines and crane paths.[152]

Plum Creek states that it will continue to coordinate with the MNDNR and State agencies on potential impacts to native prairies, native plant communities, and SOBS as the Project design advances, and work on development of minimization measures such as narrower temporary construction corridors, boring collection cables, and implementing a native seed mix.

Generic 414 MW Wind Farm

Because impacts to wildlife would depend upon specific site characteristics, it is difficult to assess wildlife impacts for a generic 414 MW wind farm located elsewhere in Minnesota. As discussed above, impacts to birds and bats are the primary concern with wind projects. Information about local bird and bat populations within Minnesota is incomplete and different sites provide varying habitat and foraging areas for different species of birds and bats.

Generic 414 MW Solar Farm

As with wind farms, impacts to wildlife from solar farm development 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 414 MW solar farm likely would be sited on agricultural land and similar types of wildlife common to disturbed areas, such as the proposed Plum Creek Wind Farm, would be expected. It is assumed that these species' use of agricultural lands is largely limited to occasional foraging in the fields and shelter within wooded areas that may surround the fields.

[150] https://www.dnr.state.mn.us/rys/pg/dryprairie.html.
[151] https://www.dnr.state.mn.us/npc/index.html.
[152] SPA, at pp. 122-123.

Wildlife that resides within the construction zone would likely be temporarily displaced to adjacent habitats during the construction process. The wildlife species found near these agricultural lands do not generally require specialized habitats and are able to find suitable habitat nearby and would only be displaced a short distance for a limited time (during construction activity).

The majority of the potential impacts to wildlife are due to the relatively large footprint of a solar farm and the corresponding changes to the habitat (i.e., loss and fragmentation). Once restoration of the facilities is established after construction, the existing agricultural landscape that is 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.

The solar farm is typically enclosed by a fence, limiting movement by animals. Solar facilities permitted by the Commission typically have fences designed to allow small animals to enter the property. Although a variety of birds, small mammals, reptiles and amphibians are likely to still be able to gain access to the property to use the habitats under and around the solar arrays, access will be limited for larger wildlife. Fencing around facilities may also disturb wildlife movement corridors. With or without openings, the habitat of the land changes significantly. Hiding spots, preying strategy, food availability will all be affected.

A generic 414 MW solar farm would have fewer impacts on avian and bat species than a wind farm due to its low profile and near-static nature of the component parts. A National Fish and Wildlife Forensics Laboratory report[153] has identified some avian risks associated with PV facilities. 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.

Mitigation

Plum Creek states that it has designed both turbine option layouts to minimize avian impacts by siting turbines in cultivated crop lands and avoiding high use wildlife habitat (woodlands adjacent to farmsteads), using tubular towers to minimize perching, placing electrical collection lines underground as practicable, and minimizing infrastructure.[154] Additionally, turbines have been sited outside northern-long-eared-bat connected-habitat buffer (1,000 feet from forested areas). In doing so, the Project design minimizes impacts to bats, particularly along riparian areas associated with Dutch Charley Creek and Highwater Creek in the western portion of the Project Area. The proposed site layout avoids permanent impacts from all Project components (e.g., turbines, access roads,

[153] Kagan et al. 2014. *Avian Mortality at Solar Energy Facilities in Southern California: A Preliminary Analysis*. USFWS Forensics Lab., https://www.ourenergypolicy.org/wp-content/uploads/2014/04/avian-mortality.pdf
[154] SPA, at pp. 122 – 123.

permanent met towers, collector substations, and O&M facility) on MNDNR-mapped native prairie, native plant communities and SOBS.[155]

Wildlife mitigation strategies for wind farm sites generally incorporate a combination of micro-siting and best management practices. Specific to the Plum Creek Wind Farm, and in conjunction with the Applicant's on-going efforts, including among other efforts, the placing of all turbines and project infrastructure outside of sensitive areas (native prairies, native plant communities, SOBS), Plum Creek will implement the following measures:[156]

- 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 in the Project Area.
- Avoid siting turbines within a 1,000-foot habitat connectivity buffer of forested areas associated with Highwater and Dutch Charley Creeks.
- Avoid or minimize disturbance of individual wetlands or drainage systems during Project construction. Wetland delineations will be conducted prior to construction to identify the limits of wetland boundaries in the vicinity of Project activities.
- Conduct ~~one~~ two 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[157] 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

[155] SPA, at pp. 122 – 123.
[156] SPA, at pp. 111-112, 118, 120, and 123.
[157] SPA, at Appendix G.

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.[158] Curtailment of turbines has been found to effectively reduce bat fatalities by a minimum of 50 percent by raising operational cut-in speeds.[159] Recent Commission issued site permits for wind farms include curtailment provisions.

The most likely impacts to wildlife due to the development of solar farms arise from the changes to the existing habitat (vegetation loss, species composition, and fragmentation) and displacement (i.e., altered species behavior) from the areas on and around development.

The siting of solar facilities in locations that avoid or minimize impacts to known wildlife movement corridors can minimize impacts to wildlife; requiring Biological and Natural Resource Inventories for the identification of any known wildlife movement corridors should be considered.

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.

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

3.3.4.3 Vegetation

Construction and operation of large energy projects may cause short-term and long-term impacts to vegetation. Short-term impacts are associated with construction; once the construction activity (i.e., 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 wind turbines and associated facilities, such as collector and feeder lines, access roads, and O&M building.

[158] Arnett et al. *Effectiveness of Changing Wind Turbine Cut-In Speeds to Reduce Bat Fatalities at Wind Facilities*. (2009), http://www.batsandwind.org/pdf/Curtailment_2008_Final_Report.pdf.
[159] Ibid.

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.

Plum Creek Wind Farm

Based on the United States Geological Society's National Land Cover Database, land cover in the project area is primarily cultivated crops (Figures 8a and 8b), which account for 91.2 percent of the land cover in the Project Area (Table 9). Forested areas are primarily surrounding residences as windbreaks and riparian areas along Highwater and Dutch Charley Creeks in the eastern portion of the Project Area. Hay/Pasture and grassland/herbaceous lands are present primarily in the western portion of the Project Area. Wetlands are generally associated with streams. The grassland and wetland areas within the Project Area may contain potential remnant native prairie areas, native plant communities and SOBS as discussed under the Rare and Unique Natural Resources heading.

There are many kinds of vegetated areas that are not native plant communities. These include places where native species have largely been replaced by exotic or invasive species such as smooth brome grass, buckthorn, and purple loosestrife, and planted areas such as orchards, pine plantations, golf courses, and lawns. Other areas not considered to be native plant communities include areas where modern human activities such as farming, live-stock grazing, logging, and development have greatly altered the vegetation.

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

In both turbine option layouts, cultivated cropland comprises over 95 percent of the permanent and temporary impacts. A summary of vegetation impacts is provided in Table 16. Vegetation will be permanently removed and replaced by wind turbines, access roads, and substation components. Temporary vegetation impacts will be associated with crane walkways, the installation of underground

collection lines, workspace around turbines, wider access roads, and contractor staging and laydown areas. The turbines and access roads are sited to avoid forests and groves to maximize turbine output and avoid tree removal. Less than one quarter of one percent of the Project Area will be permanently converted to sites for wind turbines, access roads, and facilities.

Table 16. Summary of Land Cover Impacts (acres) in the Project Area[160]

Land Cover Type	Vestas V162		Siemens Gamesa SG170	
	Permanent	Temporary	Permanent	Temporary
Cultivated Crops	79.6	1,864.1	82.8	1,876.0
Developed (all categories)	3.7	72.6	3.7	76.1
Emergent Herbaceous Wetlands	<0.1	15.0	0.1	3.0
Hay/Pasture	-	4.4	<0.1	1.9
Grassland/Herbaceous	-	1.7	-	1.0
Deciduous/Mixed Forest	-	3.3	-	1.0
Woody Wetlands	-	0.7	-	1.0
Total	**83.3**	**1,961.8**	**86.6**	**1,960.0**

Generic 414 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 414 MW wind farm located elsewhere in Minnesota without a full understanding of the specific project's environmental setting and site-specific information.

Generic 414 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).[161] 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.

[160] SPA, at p. 95, Table 8.19-2.

[161] *North Star Solar EA.*

Mitigation

In both wind farm and solar farm projects the potential impacts to vegetation 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, is a common requirement of Commission issued site permits. If sensitive plants or communities are identified during plant surveys, individual avoidance (i.e., 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 (i.e., harvestable crops, and grazing).[162] Apiary operations have also been collocated with solar facilities. There have been successful examples where solar facilities are co-located with these types of agricultural operations.[163]

3.3.5 Human and Social Environment

Wind farms 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 this wind project is being proposed to be set is rural and predominately agricultural. From a larger landscape perspective there are already a number of commercial wind turbines operating to the east, south, and southwest of the proposed project (**Figure 11**).

3.3.5.1 Comprehensive Planning and Project Compatibility

[162] Macknick et al. (2013). *Overview of Opportunities for Co-Location of Solar Energy Technologies and Vegetation*. National Renewable Energy Laboratory, NREL/TP-6A20-60240.

[163] Overview of opportunities for co-location of solar energy technologies and vegetation, Jordan Macknick, National Renewable Energy Laboratory, January 2014.

A comprehensive plan is an official public document that translates community input and ideas into policies or actions and is approved by a decision-making body, such as a board or commission. Comprehensive plans can affect budgets, direct zoning, lead to the development of ordinances, and is a primary tool for directing future growth and development in an area (e.g. county, municipality, or city). Comprehensive plans are based on detailed analyses of economic, social, demographic, and land and natural resources present in the community. Comprehensive plans provide a "road map" not only for growth and development but for decision makers; land developers; existing and prospective residents; employees; and business operators.

Plum Creek Wind Farm

The proposed wind farm is consistent and compatible with Cottonwood, Murray, and Redwood counties' respective comprehensive plan goals (Table 17) to conserve farmland and natural resources and support economic and sustainable development. The proposed wind farm will be compatible with the rural and agricultural character of the counties.

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

The Comprehensive Plan for Murray County (2016) states that the goal of economic development in Murray County is "To promote sustainable economic development and opportunity, foster effective communication and transportation systems, enhance and protect the environment, and balance resources through sound management of development." The Economic Development section of the plan goes on to list renewable energy development (e.g., wind and solar) as one of the key development opportunities for future economic growth.

Redwood County's Comprehensive Plan (2007) notes that future economic development in the county will focus on utilization of the existing resources available in rural areas of the county to create a ". . . community where natural resources are cherished and valued and utilized in a sustainable manner to support a growing economy." The plan lists a number of initiatives that would help the county meet its economic development goals; two of the initiatives apply directly to energy production and wind energy development.

Generic 414 MW Wind Farm

Unless a county has assumed permitting authority (delegation) for wind farm, a permit from the Commission supersedes county zoning. 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.

Generic 414 MW Solar Farm

A 414 MW solar farm would require a site permit from the Commission. Although the Commission permit supersedes local zoning, solar farms would be reviewed for compatibility with local land uses.

Table 17. Comprehensive Plan Inventory for Local Governments[164]

Governing Body[1]	Name of Plan	Year Adopted	Development Plan
Cottonwood County	Cottonwood County Zoning Ordinance	2016	Comprehensive Land Use Plan (2005)
Murray County	Murray County Zoning Ordinance	2014	Comprehensive Plan (2016)
Redwood County	Redwood County Zoning Ordinance (Draft as of March 2, 2018)	Unknown	Comprehensive Plan (Final Draft Document, 2007)
1 Townships in the Project Area are included in the comprehensive plans for their respective counties.			

Mitigation

No mitigation is proposed for the Plum Creek wind farm in regard to zoning. The wind farm is compatible with existing land use and zoning. Meeting all set back requirements and properly siting a wind farm in areas zoned for wind mitigates impacts to zoning. Alternate turbine locations provide some flexibility in micro-siting and if necessary, can be used to mitigate setback requirements.

Depending on location, a generic (wind or solar) facility's compatibility with local land use and zoning requirements may vary.

3.3.5.2 Demographics

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

[164] SPA, at p. 32, Table 8.2-1.

beneficial or adverse. This section also addresses whether any social group is disproportionally impacted and identify possible mitigation measures to avoid or minimize any adverse impacts.

Plum Creek Wind Farm

The Plum Creek wind farm site is located in southwestern Minnesota in a rural agricultural region in Cottonwood, Murray, and Redwood Counties. The 2010 census population for Cottonwood was 11,687, while the U.S. Census 2017 American Community Survey (ACS) population estimate for Cottonwood County was 11,320, representing a decrease of approximately 3.1 percent.[165] The 2010 census population for Murray County was 8,725, while the U.S. Census 2017 ACS population estimate for Murray County was 68,344, representing a decrease of approximately 4.4 percent.[166] The 2010 census population for Redwood County was 16,059, while the U.S. Census 2017 ACS population estimate for Redwood County was 15,278, representing a decrease of approximately 4.9 percent.[167]

The 2010 census population for Minnesota was 5,303,925, while the U.S. Census 2017 population estimate for Minnesota was 5,577,487.

The total number of housing units in the counties in the Project Area is 5,412 in Cottonwood County, 4,556 in Murray County, and 7,272 in Redwood County (U.S. Census Bureau 2010 data). The average number of persons per household in Cottonwood, Murray, and Redwood Counties is 2.35, which is slightly lower than the state average of 2.48.[168]

The top three industries of employment in the State of Minnesota are education, health, and social services at 25.0 percent, manufacturing at 13.5 percent, and retail trade at 11.1 percent (U.S. Census Bureau, 2017). The top three industries of employment in the counties and townships within the Project Area vary slightly from the state level, with agriculture, forestry, fishing, and hunting, and mining playing a larger role than retail trade in this area of southwestern Minnesota.[169]

Over 90 percent of the population in the Project Area identifies as Caucasian, while at the state level of 85.3 percent of the population identifies as Caucasian. The percentage of total minority residents in Cottonwood, Murray, and Redwood Counties is significantly lower than the state level.[170]

The population densities within five miles of the Project Area boundary range from 9.6 people per square mile in Shetek Township in Murray County, which is northeast of the Project Area, to 3.6 people per square mile in Holly Township, which is within the northeastern portion of the Project Area

[165] SPA, at p. 28, Table 8.1-1.
[166] Ibid.
[167] Ibid.
[168] SPA, at pp. 26 – 31.
[169] Ibid.
[170] Ibid.

in Murray County (2010 U.S. Census data). The townships within the Project Area have an average population density of 5.44 people per square mile.[171]

There are 205 residences within the Project Area. There is no indication that any minority or low-income population is concentrated in any one area of the Project, or that the wind turbines will be placed in an area occupied primarily by any minority population.[172]

Generic 414 MW Wind Farm

The potential impacts on the host community of a generic 414 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 similar land requirements (73,000 acres in the case of the Plum Creek project). This large, unobstructed land requirement dictates a rural, agricultural setting, which should approximate that found in the Plum Creek project area.

Generic 414 MW Solar Farm

As with a wind farm, impacts on the host community of a 414 MW solar farm would be dependent on the social and economic characteristics of the local population and surrounding area.

Mitigation

No mitigation measures are proposed for the Plum Creek Wind Farm; the project is compatible with current land uses and the socioeconomic impacts associated with the project are generally expected to be positive.

3.3.5.3 Local Economy

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.[173] Minnesota is also home to wind–related manufacturing facilities that supply turbine components and other parts to the industry supply chain and that contribute to the state's economy.

Because utility scale wind developments are usually located in rural areas, they can provide noticeable economic impacts on the smaller, rural communities that host them. At the local level, wind energy projects provide short-term construction wages to workers and increased spending in the local economy for food, lodging, fuel, and incidental expenditures. Over the long-term, while the project is

[171] SPA, at pp. 26 – 31.
[172] Ibid.
[173] American Wind Energy Association, *Factsheet: Wind Energy in Minnesota* (https://www.awea.org/Awea/media/Resources/StateFactSheets/Minnesota.pdf).

operating, the project owner pays production tax revenues to local government; and lease payments to landowners. The project also provides long-term jobs for a small number of permanent operation and maintenance 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.

This section provides an overview of the regional economy based on available data, a summary of several potentially relevant studies that examine the economic impacts of energy projects on local economies, including the impact of the local and non-local labor, and a discussion of the potential short-term and long-term economic impacts of the Plum Creek Wind Farm.

Labor Impacts and Regional Economies

The proposed wind farm is located in Minnesota's Economic Development Region 8. Region 8 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 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.[174]

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 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.[175]

[174] https://mn.gov/deed/assets/rp_edr8_2019_tcm1045-133260.pdf.
[175] Ibid.

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.[176]

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.[177]

Wind Farm Construction Labor

Construction of the wind farm will require different types of skilled and non-skilled construction workers. In 2010, the US Bureau of Labor and Statistics profiled careers in the wind energy industry. The profiles include job types, education and training requirements, and wages. 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.[178] Types of construction jobs, median wages, and training are included in Table 18.

Impact of Wind Farms on Local Economies

Several case studies have examined the economic impact of utility-scale wind power development on local economies.[179] These studies have used a variety of methodologies (modeling, observation, 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;
- the ownership structure of the project (locally developed and owned, compared to non-local

[176] https://mn.gov/deed/assets/rp_edr8_2019_tcm1045-133260.pdf.
[177] Ibid.
[178] 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.
[179] 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).

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.[180] 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.[181] The same study did find overall economic benefits to rural communities because of utility scale wind development.

Table 18: General Types of Labor, Wages, and Education

Labor Type/Occupation	National Median Annual Wage[182]	MN Prevailing Wage[183]	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

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

[180] Constani, 2004.
[181] Slattery et al., 2011.
[182] Ibid.
[183] 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.

projections, the common input/output models such as IMPLAN and JEDI appear to provide reasonable projections regarding the economic impacts of a project.

Construction Period Impacts

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 Jedi 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.[184]

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, 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.

Educational and training opportunities for those seeking careers in wind energy and other trades are offered through Minnesota State Colleges and Universities, the North American Building Trades Union, and local unions. These programs train the next generation of tradespeople in energy and other fields including energy technologies and natural resources, architecture and construction, and various certification programs.[185]

Operation and Maintenance Impacts

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

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

[185] Minnesota State Colleges and Universities (https://www.minnstate.edu/campusesprograms/index.html) and the North American Building Trades Union (https://nabtu.org/school-resources/).

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.[186]

Plum Creek Wind Farm

During construction, the project will require approximately 250 temporary construction workers. Plum Creek anticipates construction of the wind farm will take approximately 12 months from the time a permit is issued to in-service date.

While some of these workers will be from the local area (within 150 miles), some portion is likely to be from outside the region and will only remain in the counties over the duration of construction (approximately 12 months). It is anticipated that most of the wages earned by local workers will circulate through the local economy. Non-local workers will also inject money into the local economy for food, lodging, fuel, and incidental expenditures. Local contractors and suppliers will be used for portions of the construction. Additional income will be generated for the county and state economy through the circulation and recirculation of dollars paid out by the developer for business expenditures and for state and local taxes. Payments for equipment, fuel, operating supplies, and other products and services benefit local and regional businesses.

Once operational, the wind farm will need approximately 14 permanent operations and maintenance staff.

During operations the wind project owner will make lease payments to local landowners as well as production tax payments to local government. On average, each turbine only requires 0.5 acres to 1 acre of land for the turbine foundation and access road. Annual lease payments compensate for potential financial losses due to small areas of land being removed from agricultural production and the inconvenience of farming around the new obstacles in the farm fields. All participating landowners will receive compensation for facilities constructed on their land, as will landowners who signed a setback waiver.

The energy production tax payment is $0.0012 per kWh of electricity produced. For the Plum Creek Wind Farm, the annual wind energy production tax payment is estimated to be between $1,750,000 to $2,000,000.[187]

[186] *Catching the Wind: The impact of local vs. non-local hiring practices in construction of Minnesota wind farms,* at pp. 9 10
[187] SPA, at p. 80.

Generic 414 MW Wind Farm

The economic benefits of a generic 414 MW wind farm would be similar to those of the proposed project.

Generic 414 MW Solar Farm

During construction, a 414 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.[188]

The 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.

3.3.5.4 *Aesthetic Impact and Visibility Impairment*

Large energy projects can pose an impact aesthetically or on visual resources. This EIS examines potential aesthetic impacts; additionally, impairment of visibility as required by Minnesota Rule 7849.1500, subpart 2.

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

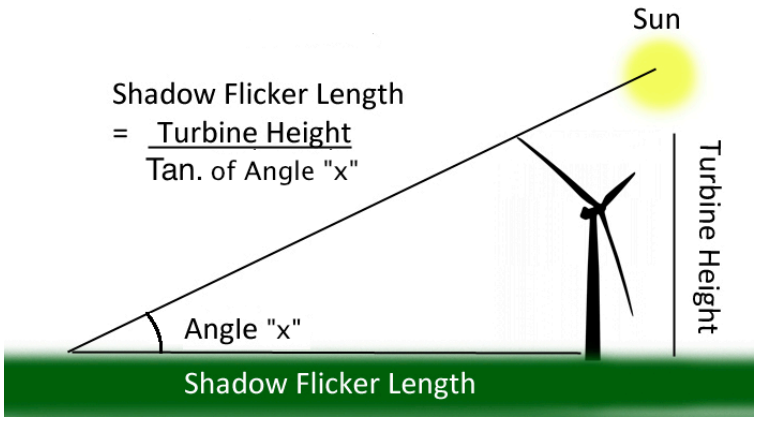
[188] *North Star Solar EA.*

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.

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.

Shadow flicker (Diagram 8) 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. Federal Aviation Administration obstruction lighting (pulsing red or white lights at night) is another aesthetic issue associated with wind farms, and one that may result in some of the greatest aesthetic concerns.

Diagram 8. Shadow Flicker[189]



Plum Creek Wind Farm

The wind farm would alter the current 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

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

contribute to how a wind energy facility is perceived. The wind farm would be located in a predominantly rural, agricultural area characterized by flat to gently undulating topography.

The topography of the Project Area is glaciated, gently rolling plains with elevations ranging from 1,086 to 1,614 feet above sea level. Elevations increase in a northeast to southwest direction; the highest elevations are in the southwest corner of the Project Area. Agricultural fields, farmsteads, and gently rolling topography visually dominate the Project Area. The landscape can be classified as rural open space.

Viewsheds in this area are generally broad and uninterrupted, with only small scattered areas where they are defined by trees or topography. The settlements in the vicinity are residences and farm buildings scattered along rural county roads. The area is also shaped by a built environment. Horizontal elements, such as highways and county roads, are consistent with the long and open viewsheds in the area. Vertical elements such as transmission lines and wind turbines are visible from considerable distances and are the tallest and often the most dominant visual feature on the landscape. The Jeffers Wind Energy Center (Figure 11), located approximately five miles south of the Project Area, consists of 20 turbines that are visible to residences within the Plum Creek Project Area.

Residences with turbines and associated infrastructure closest to their homes are those that are participating in the Project by signing easements. The closest turbine to a participating residence in the Vestas V162 layout is 1,046 feet and in the SG170 layout is 1,246 feet. The closest turbine to a non-participant residence in the Vestas V162 layout is 2,496 feet and in the SG170 layout is 2,124 feet.[190]

While people living in or traveling through the area are accustomed to viewing wind turbines, the Project will add to the cumulative visual impacts by adding up to 74 new turbines in the area. The Project will be located within the viewshed of MNDNR-managed Wildlife Management Areas (WMAs), Lake Shetek State Park, USFWS Waterfowl Production Areas (WPAs), USFWS NWR lands, or other natural areas and may be visible by people using those areas (Figures 12a and 12b). The degree of the visual and unavoidable impact on public resources will vary based upon the distance from the Project, obstructions such as trees between the public resource and Project, a viewer's orientation to the Project (i.e., facing towards or away), and the viewer's personal preferences. As an example, a person utilizing the state trail at Lake Shetek State Park may see the wind turbines in open areas of the trail, but not in areas with trees immediately adjacent to the trail or when the trail travels away from the Project.

All turbines will be set back from public lands based on a minimum of the 3 RD by 5 RD setbacks from all non-leased properties per the Commission siting guidelines. To the extent public resources are utilized at night, turbine lighting may be visible.

[190] SPA, at p. 44.

The FAA requires obstruction lighting or marking of structures more than 200 feet above ground to provide safe air navigation. 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. Lighting at the O&M facility, the Plum Creek Collector Substations, and other installations will be minimized and designed so that light is directed downward (toward the access or work area) and will be hooded to prevent light from shining into the sky.

Shadow flicker caused by wind turbines is defined as alternating changes in light intensity at a given stationary location (receptor), such as the window of a home. In order for shadow flicker to occur, three conditions must be met: 1) the sun must be shining with no clouds to obscure it; 2) the rotor blades must be spinning and must be located between the receptor and the sun; and 3) the receptor must be close enough to the turbine to be able to distinguish a shadow.

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 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 (in Minnesota, this is generally applied to non-participating landowners). 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:[191]

- 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 (e.g., 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.

[191] 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.

- 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.

The Applicant conducted a shadow flicker assessment on the proposed site layouts to determine impacts. The Shadow Flicker Report provides details regarding the methodology (WindPRO modeling) and results of the assessment.[192]

Shadow flicker frequency calculations for the Project were modeled for 461 residences (receptors) and the two layout options; all non-participating residences are expected to experience below 30 hours per year of shadow flicker (Table 19).

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.[193] The frequency of shadow flicker due to wind turbines is a function of the rotor speed and number of blades, and it is generally no greater than approximately 1.5 Hz (i.e., 1.5 flashes per second), which is below the frequency range that is thought to trigger seizures.

Table 19: G Maximum Shadow Flicker (hours/year)[194]

Turbine Model	Maximum Shadow Flicker (hours/year)	
	Participating	Non-Participating
Siemens Gamesa SG170	99.6	28.5
V162	119.9	28.4

Generic 414 MW Wind Farm

The potential impacts of a generic 414 MW wind farm located elsewhere in Minnesota would have similar impacts if sited in an agricultural setting with other wind farms, such as Plum Creek. The impacts could vary in other settings or be perceived as more impactful, such as in a more populated area.

Generic 414 MW Solar Farm

Because they are generally large facilities (footprint) with numerous highly geometric and sometimes highly reflective surfaces, solar energy facilities may create visual impacts; however, being visible is not necessarily the same as being intrusive. The installation of a solar farm will result in visible landscape changes and given that the footprint 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.

[192] SPA, at Appendix C.
[193] https://www.epilepsysociety.org.uk/wind-turbines-and-photosensitive-epilepsy#.XjmIb2dYbcs.
[194] SPA, at p. 48, Table 8.5-4.

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.

Typically, 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 may 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, modern 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 should 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.

Perimeter fencing for solar farms in Minnesota are typically eight-foot wood pole and woven wire fence (i.e. deer fence or an agricultural fence) that shield or minimize the visual impacts.

Mitigation

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 rotor diameters (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.

Specific to the Plum Creek project concerning means to minimize potential aesthetic impacts, the Applicant has stated that it will implement the following measures:[195]

- Wind turbines will exhibit visual uniformity in the shape, color, and size of rotor blades, nacelles, and towers.
- Collection cables or lines on the site will be buried in a manner that minimizes additional surface disturbance (e.g., collocating them with access roads, where feasible).

[195] SPA, at pp. 44-45 and 49.

- For ancillary buildings and other structures, low-profile structures will be chosen whenever possible to reduce their visibility.
- Turbine foundations and roads have been designed to minimize and balance cuts and fills.
- Facilities, structures, and roads will be located in stable fertile soils to reduce visual contrasts from erosion and to better support rapid and complete regrowth of vegetation
- Lighting for facilities will not exceed the minimum required for safety and security, and full-cutoff designs that minimize upward light pollution will be selected.
- Plum Creek has stated that it will install aircraft detection lighting system (see 3.3.5.5) that are off until aircraft approach.
- Commercial messages and symbols on wind turbines will be avoided.

The most practical solutions to shadow flicker issues include:

- Design the development to minimize potential effect– usually by adjusting turbine size or position.
- Provide screening (blackout curtains, vegetation planting) to limit the view of the offending turbine(s).
- Shut down the offending turbine(s) during the periods where shadow flicker effects can occur.

The best strategy will depend on the constraints for each individual development.

Mitigating the visual or aesthetic impacts from a PV solar farm usually involves screening the site with a combination of perimeter fencing, vegetation, and berms depending on the setting. Shadow flicker is not produced by solar panels and is not applicable.

3.3.5.5 Facility and Turbine lighting

Large electric generating 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.[196] 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.

[196] 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

Plum Creek Wind Farm

The wind farm will have some non-turbine facilities (e.g. O&M facility and Collector Substation) which must be lit at times to allow for worker safety. Lighting of the wind turbines will be consistent with FAA guidelines and is similar to that for other tall structures in rural areas, such as communication towers.

Generic 414 MW Wind Farm

A generic 414 MW wind farm located elsewhere in Minnesota would have lighting impacts similar to the Plum Creek Wind Farm.

Generic 414 MW Solar Farm

Because of the relatively low profile of PV solar farms FAA lighting requirements are not applicable to solar farms.

Temporary lighting would be expected during the construction phase of any solar farm project. After construction, any temporary service poles/lights would be removed. Permanent motion-activated lighting is anticipated to be installed near O&M areas, security gates and in perimeter areas. Standard downward lighting should be utilized to minimize impacts to adjacent land uses.

Mitigation

All non-turbine facilities should only be lit when workers are present, or at other times when lighting is absolutely necessary. Additionally, downward facing lights should be used at non-turbine facilities.

Plum Creek must submit and receive FAA approval of lighting plan. A lighting plan will be provided prior to construction. Plum Creek has stated that it will coordinate with the FAA on potential implementation of an Aircraft Detection Lighting System (ADLS) for the Project.[197]

The FAA-has approved commercial operation of 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.[198] The ADLS can be designed for a single wind farm, or to serve multiple wind farms (Diagram 9).

[197] SPA, at p.69.

[198] 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.

Approval was received from the Federal Communications Commission (FCC) and FAA Spectrum Office for the Vestas Intelilight system on January 11, 2017. The Vestas InteliLight system was installed at a wind park near Hancock, Maine in October 2017.[199]

Diagram 9. Aircraft Detection Lighting System[200]

3.3.5.1 Noise

Large electric generation facilities produce noise. Potential human impacts due to noise include hearing loss, stress, annoyance, and sleep disturbance. This EIS examines noise impacts from the construction and operation as required by Minnesota Rule 7849.1500, subpart 2.

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 as in 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 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 (e.g., mid-level frequencies) and less weight on those that humans do not perceive as

[199] Patterson, James; Canter, Garrison. *Performance Assessment of the Vestas InteliLight X-Band System as an Aircraft Detection Lighting System (ADLS)*. FAA. 2018. https://www.airporttech.tc.faa.gov/Products/Airport-Safety-Papers-Publications/Airport-Safety-Detail/ArtMID/3682/ArticleID/165/Performance-Assessment-of-the-Vestas-InteliLight%E2%84%A2-X-Band-System-as-an-Aircraft-Detection-Lighting-System-ADLS.

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

well (e.g., very high and lower frequencies). Noise levels depend on the distance from the noise source and the attenuation of the surrounding environment. Table 20 below provides an estimate of decibel levels of common noise sources.

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

In a residential setting, for example, noise restrictions are more stringent than in an industrial setting. Rural residential homes are considered NAC 1 (residential), while agricultural land and agricultural activities 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 21 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.[201]

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.[202]

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.[203]

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

[201] Minnesota Pollution Control Agency (MPCA). 2015. *A Guide to Noise Control in Minnesota: Acoustical Properties, Measurement, Analysis and Regulation*. pca.mn.us.
[202] 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.
[203]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.

when sound levels are 165 dB or above at 2 Hz and 145 dB or above at 20 Hz. (Massachusetts 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.[204]

Table 20. Common Noise Sources and Levels (A-weighted Decibels)[205]

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

[204] 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.

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

Table 21. 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

Plum Creek 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).[206] 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). These sounds can have a rhythmic modulation due to the spinning of the turbine blades. Impacts due to these sound characteristics are subjective (i.e., human sensitivity, especially to low frequency sound, is variable). However, low frequency sounds may cause annoyance and sleep disturbance for more sensitive individuals.

The site is located in a predominately rural agricultural landscape. The ground cover is primarily farmland and open fields, with residential dwellings interspersed throughout the area. Typical 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.

Plum Creek conducted a preliminary noise assessment of the proposed project, which models (Cadna/A sound level calculation software) the anticipated sound levels that will be experienced at noise-sensitive receptors throughout the project area.[207]

Plum Creek has incorporated the 2019 LWECS Application Guidance and sited turbines so that turbine-only noise is < 45 dB(A) at non-participating residences and ≤ 47 dB(A) at participating residences. The layouts have been modeled to help ensure cumulative impacts from all wind turbines, and maximum calculated noise levels for all turbine models are below the MPCA's nighttime L50 noise limit of 50 dB(A) at residential receptors (Table 22).

[206] Minnesota Department of Health, *Public Health Impacts of Wind Turbines*. 2009, http://www.health.state.mn.us/divs/eh/hazardous/topics/windturbines.pdf.
[207] SPA, at pp. 37 – 41, and Appendix B.

Maximum calculated total sound levels at all residential receptors for all turbine models are below the nighttime L50 noise limit of 50 dB(A). The maximum calculated sound level, based on assumptions incorporated into the Cadna-A model and the turbine layouts, results in a 46 dB(A) L50 at the nearest noise-sensitive receptor (maximum Project-related L50 range from 40 to 46 dB(A)). Average Project-related sound levels at residences for all turbine models range from 30 to 35 dB(A), on an hourly L50 basis.

Table 22. Summary of Noise Assessment[208]

Turbine Model	Noise Source	Statistic	Residence Classification		
			dB(A) Levels at All Residences	dB(A) Levels at Participating	dB(A) Levels at Non-Participating
SG170	Turbine-Only Noise	Avg L50 Modeled	30	35	27
		Max L50 Modeled	46	46	41
		Min L50 Modeled	11	17	11
	Total Sound (Background + Turbine)1	Avg L50 Modeled	42	43	42
		Max L50 Modeled	47	47	45
		Min L50 Modeled	42	42	42
V162	Turbine-Only Noise	Avg L50 Modeled	30	35	28
		Max L50 Modeled	45	45	40
		Min L50 Modeled	12	19	12
	Total Sound (Background + Turbine)1	Avg L50 Modeled	42	43	42
		Max L50 Modeled	47	47	44
		Min L50 Modeled	42	42	42

1 The average Project nighttime sound was monitored at 42 dB(A) (L50)

[208] SPA, at pp. 40-41, Table 8.4-3.

The Plum Creek project will also produce noise related primarily to the construction phase, as a result of heavy equipment operation and increased vehicle traffic associated with the transport of construction materials and personnel to and from the work area

Generic 414 MW Wind Farm

A generic 414 MW wind farm would have noise impacts and mitigation similar to the proposed project. Depending on location relative to receptors, surrounding vegetation, topography, and turbine selection, impacts from noise could be more or less than those expected of the proposed Project.

Generic 414 MW Solar Farm

Noise concerns for a generic 414 MW PV 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 other solar projects before the Commission, it is anticipated that construction activities will only occur during daylight hours.

During operation of the PV 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; as in the North Star Solar docket, the anticipated inverter noise was predicted to produce 65 dBA at the source and to dissipate rapidly with distance.[209]

Noise from the PV 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.

Mitigation

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.[210] For rural residential of the area, this means sound levels must meet an L50 standard of 50 dBA.

Plum Creek has incorporated into the project design a minimum 1,000 feet from residences plus the distance required to comply with the MPCA limit of a 50 dB(A) nighttime L50 noise level. The closest turbine to a non-participant residence in the V162 layout is 2,496 feet and in the SG170 layout is 2,124

[209] *North Star Solar EA*

[210] Minn. Rules 7030.0040, Noise Standards, https://www.revisor.leg.state.mn.us/rules/?id=7030.0040.

feet. The closest turbine to a participating residence in theV162 layout is 1,046 feet and in the SG170s layout is 1,246 feet.[211]

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.[212]

Mitigation for noise impacts associated with construction for both wind and solar farm development beyond BMPs (limit idling of equipment, limit to day light hours) is not anticipated to be warranted.

3.3.5.2 Property values

Large electric generation facilities 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 the project 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, electric and magnetic fields, etc.), and
- potential interference with agriculture or other land uses.

Plum Creek Wind Farm

The impacts on property values due to the development of the Plum Creek 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.

[211] SPA at p. 40.

[212] 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 eDocket, https://www.edockets.state.mn.us/EFiling/edockets/searchDocuments.do?method=showeDocketsSearch&showEdocket=true&userType=public, enter "09" for year and "845" for number

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.[213]

Southern and southwestern Minnesota have experienced the greatest development of wind energy facilities in the state and several wind farms exist in the region – there are 20 existing wind turbines associated with the Jeffers Wind Energy Center in central Cottonwood County within 10 miles of the Project Area (**Figure 11**). 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. [214]

Generic 414 MW Wind Farm

A generic 414 MW wind farm would have property value impacts similar to that of the proposed project. If a generic 414 MW wind farm were constructed and operated in an area of the state with minimal or no wind energy facilities 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.

Generic 414 MW Solar Farm

Electrical generating facilities have the potential to impact property values. Often, negative effects from these facilities are the result of impacts that extend beyond the immediate footprint. Examples include noise, emissions and visual impacts. Unlike fossil-fueled electric generating facilities however, a PV solar farm 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 building, would be more limited.

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[213] 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.

[214] 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.

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 recently permitted Aurora Distributed Solar and North Star Projects involve the first utility-scale PV facilities across Minnesota, comparable sales data are just becoming available. Very initial results from Chisago County (North Star) show no impact.

As the industry continues to develop comparable data should become available.

Mitigation

Negative impacts to property value due to the development of the Plum Creek 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. Impacts to property values can be mitigated by reducing aesthetic impacts (i.e., micro-siting turbines, education concerning the perceived health risks, and reducing encumbrances to future land use).

For PV solar facilities, property values can also be mitigated through proper siting, BMPs (restoration and vegetation management) and screening the site (berms, deer fencing, and vegetation).

3.3.6 Public Health and Safety

Construction and operation of large energy facilities may have the potential to impact human health and safety. This section discusses potential health and safety concerns.

3.3.6.1 Electromagnetic Fields

Electromagnetic fields (EMF) are invisible regions of force resulting from the presence of electricity. EMF is often raised as a concern with 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.

Although EMF is often raised as a concern with electrical transmission projects, the Commission has consistently found that there is insufficient evidence to demonstrate a causal relationship between EMF exposure and human health effects.

Plum Creek Wind Farm

EMF related to the associated transmission project is discussed in Section 6.5.1. EMF from underground electrical collection lines dissipates close to the lines because they are installed below ground, geometrically close to each other, and wound with copper wires in their jackets. The electrical fields around these lines are negligible and the small magnetic field directly above the lines dissipates within 20 feet on either side of the installed cable, based on engineering analysis. Collection lines will be buried underground to a depth of at least 42 inches (with the exception of junction boxes) and will be located no closer than 160 feet from a residence. EMF associated with the transformers within the nacelle dissipates within 5 feet, so the 1,000-foot turbine setback from residences will be adequate to avoid any EMF exposure to homes.[215]

Generic 414 MW Wind Farm

A generic 414 MW wind farm will generally require transmission facilities to an interconnection point, similar to those of the proposed project. EMF impacts from collector and feeder lines located within the wind farm are expected to be negligible.

Any transmission lines and substation associated with the generic 414 MW wind farm would likely be similar to those of the Plum Creek Wind Farm. Depending on the size of the transmission line, it is likely that the associated transmission line would be subject to review via the Power Plant Siting rules.

Generic 414 MW Solar Farm

As with wind farm, a generic 414 MW PV solar farm would also require the installation of similar infrastructure (transmission lines and substation) beyond on-site facilities (i.e., PV arrays, including electrical cables and conduit, electrical cabinets, step-up transformers, SCADA systems and metering equipment, and access roads) to deliver the generated power to the overall grid.

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.[216] It is the inverters, collection wires, substation, and the transmission conductors delivering the AC electricity to

[215] SPA, at pp. 66 – 68.
[216] 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 grid that produces the *non-stationary* EMF (aka, extremely low frequency (ELF) EMF), which is often a subject of public concern.

The strength of ELF-EMF present at the perimeter of a solar facility is significantly lower than the typical American's average EMF exposure.[217] Researchers in Massachusetts measured magnetic fields 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.[218][219] 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.

Mitigation

The Plum Creek Wind Farm will design, construct, and operate all electrical equipment, including turbines, transformers, collection lines, and transmission lines in accordance with applicable codes, manufacturer specifications, and required setbacks.

Because no impacts due to EMF are anticipated to be associated with the construction or operation at either wind farm or solar sites, no mitigation is warranted.

3.3.6.2 Stray Voltage

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 (i.e. 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

[217] 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.
[218] 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.
[219] Ibid.

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. Data analysis has determined that there does not appear to be any link between the distance between a farm (residence) and substation, or the electrical magnitude of the primary power line, leading to increased risk of stray voltage impacts.[220]

Plum Creek Wind Farm

Potential impacts from stray voltage can result from a person or animal coming in contact with neutral-to-earth voltage. Stray voltage does not cause electrocution and is not related to ground current, EMF, or earth currents. Where distribution lines have been shown to contribute to the propagation of stray voltage on farm facilities, the distribution system was either directly under or parallel to an existing transmission line. These factors are considered in design and installation of transmission lines and can be readily mitigated. Potential impacts to animal agriculture are discussed in Section 3.3.9.

Problems related to distribution lines are also readily managed by correctly connecting and grounding electrical equipment. 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. Wind energy collection systems mitigate any such issue by running a continuous bare ground conductor from the furthest turbine to the substation.

There is one dairy operation in the Project Area. Plum Creek has sited turbines in both layouts nearly one mile from this operation. Similarly, collection lines, at their closest (V162 layout) are over half-mile from this dairy farm. These distances are adequate such that there will be no stray voltage impacts to this dairy operation.[221]

Generic 414 MW Wind Farm

A generic 414 MW wind farm will generally require transmission facilities to an interconnection point, similar to those indicated for the Plum Creek Wind Farm. Stray voltage concerns from collector and feeder lines located within the wind farm are addressed in the design of these systems.

[220] Wisconsin Public Service. *Answers to Your Stray Voltage Questions: Backed by Research*. 2011. http://www.wisconsinpublicservice.com/business/pdf/farm_voltage.pdf.
[221] SPA, at p.68.

Generic 414 MW Solar Farm

As with wind farm, a generic 414 MW PV solar farm 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, and access roads) to gather the power produced from the individual components (PV arrays, turbines).

As with wind farm, stray voltage concerns from collector and feeder lines located within the solar farm are addressed through project design of these systems.

Mitigation

Due to low risk, mitigation measures are not proposed.

3.3.7 Associated Electrical Facilities and Existing Infrastructure

Electric generation facilities (fossil fuel power plants, wind farms, and solar farms) typically require construction of electrical facilities beyond the project boundaries, such as transmission lines and substations to deliver the generated power to the overall grid.

Impacts associated with construction of new transmission lines and substations can include impacts to plants and animals due to the loss of vegetation, habitat fragmentation, potential migratory bird collisions with the transmission line, visual impacts due to placement of poles or structures, and concerns over additional impacts to farmland.

Plum Creek Wind Farm

Impacts from the 345 kV transmission project associated with the Plum Creek Wind Farm are discussed in Chapter 6.

Generic 414 MW Wind Farm

A generic 414 MW wind farm may require construction of transmission facilities to an interconnection point or may require new transmission infrastructure at existing facilities.

Generic 414 MW Solar Farm

As with wind farm, a generic 414 MW PV solar farm would also require the installation of similar infrastructure (substations, switching stations, and transmission lines) beyond the necessary on-site facilities such as PV arrays, electrical cables and conduit, electrical cabinets, step-up transformers, SCADA systems and metering equipment, and access roads, in order to deliver the generated power to the overall grid. Impacts associated with construction of new transmission lines and substations can include impacts to plants and animals due to the loss of vegetation, habitat fragmentation, potential migratory bird collisions with the transmission line, visual impacts due to placement of poles or structures, and concerns over EMF exposure.

Mitigation

The primary measures to reduce the potential impacts from the construction and operation of these associated facilities is avoidance. This is accomplished largely through siting and routing, to the extent practicable, followed by the implementation of BMPs to minimize potential impacts and finally, the mitigation (e.g. restoration, direct compensation, wetland banking) of those impacts which are unavoidable.

Potential impacts and mitigation strategies would be similar to those for any energy project. The extent of impacts would be determined by the length and voltage of the transmission line required to connect the electric generating facility to the transmission grid. A relatively longer line or higher voltage would increase the potential construction and operation impacts.

3.3.7.1 *Infrastructure*

The Project is located in rural southeastern Minnesota. A network of roads and utilities provide access, electricity, water supply, and telephone service to rural residences, farmsteads, small industry, and unincorporated areas. Water wells and septic systems (SSTS) are typically used within the Project Area to provide household needs.

Roads

Electric generation facilities (fossil fuel power plants, wind farm, and solar farms) typically require that the existing transportation infrastructure to be adequate, or improvable, to handle heavy loads and oversized vehicles delivering large equipment or structures (turbine generators, tower segments, blades, etc.) to the site. Delivery of such equipment may require roadways to be upgraded or repaired post-delivery.

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

Plum Creek Wind Farm

Cottonwood, Murray, and Redwood Counties have an established transportation network of state, county and township roads. County and township roads generally follow section lines. Private roads, mostly used for agricultural purposes, are also common.

The Minnesota Department of Transportation (MNDOT) conducts traffic counts on roads in Minnesota. The functional capacity of a two-lane paved rural highway is in excess of 5,000 vehicles per day, or Annual Average Daily Traffic (AADT). Based on 2019 data, the highest existing AADT in the

Project Area is 1,100 vehicles per day along Minnesota Highway 30 immediately south of Dovray. Along the county highways, the AADTs are below 770 vehicles per day and range from 15 to 770 vehicles per day.[222]

Plum Creek estimates that there will be 475 large truck trips per day and up to 950 small-vehicle (pickups and automobiles) trips per day in the area during peak construction periods.[223] The functional capacity of a two-lane paved rural highway is in excess of 5,000 vehicles per day. Currently, the heaviest traffic is on Minnesota Highway 30 located immediately south of Dovray at 1,100 AADT. Since many of the area roadways have AADTs that are currently well below capacity, the addition of 1,425 vehicle trips during peak construction would be perceptible, but similar to seasonal variations such as spring planting or autumn harvest.[224]

Depending on final turbine location and established haul routes, intersections may be temporarily widened to accommodate oversize loads. Any improvements to existing roads would consist of re-grading and filling of gravel surfaces. Any temporary modifications to the existing road system would be restored following construction.

Equipment and materials used in construction of wind farms can be extremely heavy and/or oversized loads. Therefore, increased wear and tear of local roads may be expected from delivery of materials and equipment. Possible weight related impacts to roads include physical damage to the structure of the road itself and/or damage to culverts and bridges. Any damage to the existing road system would be restored following construction.[225]

Impacts to traffic will be short-term, intermittent, and occur during the construction phase of the Plum Creek wind farm. Impacts will be from the transport of project components to the project site and from the movements of construction workers.

Constructing the Project will require approximately up to 31 miles of gravel access roads, depending on the size of turbine selected and final design. The access roads will be located to facilitate both construction access (cranes) and access by operation and maintenance crews while inspecting and servicing the wind turbines. The access roads will be between towers, with one road required for each string of wind turbines. The roads will be approximately 20 feet wide and of low profile to allow cross-travel by farm equipment.[226]

The Dakota, Minnesota, and Eastern Railroad is immediately adjacent to the northern portion of the Project Area between Walnut Grove and Revere. No railroads are located within the Project Area.

[222] SPA, at pp. 51 – 53.
[223] SPA, at p. 131.
[224] SPA, at pp. 51 – 53.
[225] Ibid.
[226] Ibid, at pp. 131 – 132.

Generic 414 MW Wind Farm

A generic 414 MW wind farm will generally require similar utilization of regional roadways to those identified for proposed project. Impacts and mitigations associated with the use of available roadways for the generic 414 MW wind farm would be similar to those identified for the Plum Creek Wind Farm.

Generic 414 MW Solar Farm

As with wind farm, a generic 414 MW PV solar farm would also require utilization of regional roadways for delivery of employees, materials and equipment to the solar farm site.

Mitigation

The Applicant will coordinate with the applicable local and state jurisdictions to ensure that the weights being introduced to area roads are acceptable.[227]

The applicant must obtain, file and submit all required MnDOT permits, including permits to complete the necessary work in MnDOT's right-of-way, such as transportation of turbines and equipment to and from the site.[228]

Site permits issued by the Commission require the permittee, prior to the start of construction, to make satisfactory arrangements with the appropriate state, county, or township governmental body having jurisdiction over roads to be used for construction of the project, for the maintenance and repair of roads that may be subject to increased impacts due to transportation of equipment and project components.[229]

Airports and Aviation

Airports are valuable transport, tourism, employment, and business assets for the local and national economy. The development of large energy projects needs to consider the potential impacts to air service and operations (airports, landing strips, crop spraying activities, etc.) within a project area. Developments around airports and under flightpaths can constrain operations, either directly where they conflict with safety/operational requirements, or indirectly where they interfere with radar or other navigational aids.

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

[227] SPA, at pp. 52 – 53.
[228] Ibid.
[229] PUC Staff Briefing paper, Application Acceptance, December 26, 2019. eDocket No. 201912-158610-01.

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.[230] Minnesota has approximately 150 agricultural aircraft pilots.[231] 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.[232]

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.[233] 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.[234]

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.[235]

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 (i.e., height of corn and sunflower), weather conditions (i.e., wet, saturated soils subject to compaction), areas requiring split applications of fertilizer (i.e., for groundwater protection), and where timing is urgent (i.e., 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.

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[230] National Agricultural Aviation Association. 2019. *Industry Facts*, https://www.agaviation.org/industryfacts, accessed March 26, 2019.
[231] Minnesota Agricultural Aircraft Association. https://mnagaviation.com/.
[232] National Agricultural Aviation Association. 2019. *Industry Facts*, https://www.agaviation.org/industryfacts, accessed March 26, 2019.
[233] 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
[234] Minnesota Agricultural Aviation Association, Comment Letter November 1, 2018. eDocket No. 201811-148027-08
[235] Illinois Agricultural Aviation Association. 2019. *Wind Farms.* https://agaviation.com/wind-farms/

A Purdue University study shows ground applicator rigs damage approximately 1.5 to 5 percent of soybean crops.[236] 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.[237]

Meteorological towers (MET), (Diagram 10) used to collect wind data at wind farm sites, can pose a special threat. These towers are typically 197 feet, which fall just under the requirements for FAA lighting and marking.

Diagram 10. Typical Meteorological Tower[238]

The type of MET towers that are used in development and siting (pre-construction) typically consist of sections of galvanized tubing that are assembled at the site and raised and supported using guy wires. These towers can be erected or removed in as little as a few hours. The tower may be at one location for a short period of time and then moved to a different location, as the wind developer checks the area for the best wind conditions for the placement of wind turbines. The fact that these towers are narrow, unmarked and grey in color makes for a structure that is nearly invisible under some atmospheric conditions. The temporary and mobile nature of these MET towers makes their location difficult to maintain in a database. In some cases, a wind company may install a temporary met tower to gather information on a potential site without general public knowledge. In some cases, the landowner's contract requires the landowner to keep this information confidential.

Post-construction MET towers are used to transmit to the control center the meteorological situation in the location and it has a principal importance for the management of the site. The type used during

[236] 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.
[237] Gaspar, Russ. 2015. *Agriculture, Aerial Applicators, and Airports.* Agricultural Aviation. September-October 2015. http://www.agaviationmagazine.org/agriculturalaviation/september_october_2015?pg=54#pg54.
[238] Meteorological (MET) Tower Installation and Wind Data Collection Services. https://www.prlog.org/10197661-meteorological-met-tower-installation-wind-data-collections-services.html.

the operation of a wind conversion facility is built heavier and may or may not use guy wires; they usually still fall under the height required for FAA lighting and marking.

The major risk factor for pilots is that the dull metal used for the tower, and the supporting guy wires, are difficult to see from the air (**Diagram 11**). The tower and wires easily blend into the surroundings, making them a hazard to pilots of low-flying aircraft.

Plum Creek Wind Farm

There are two public airports and two private airports/heliports within 10 miles of the Project Area (**Table 23**). The nearest airport is the Sanford Westbrook Clinic Heliport, located approximately 1.3 miles south of the Project. These airports have runway approaches and restricted airspace for aircraft to approach and take off from.

Table 23. Airports within 10 Miles of the Project Area

Airport Name	City	County	Distance/ Direction1	Runway Information2	Runway Elevation (feet)3
Sanford Westbrook Clinic Heliport4	Westbrook	Cottonwood	1.3 miles south	Heliport	--
Tracy Municipal Airport	Tracy	Lyon	6.4 miles northwest	Asphalt/turf, good	1340
Ewen Landing Field4	Jeffers	Cottonwood	7.1 miles southeast	Turf, good	1483
Slayton Municipal Airport	Slayton	Murray	9.1 miles southwest	Asphalt, good	1623

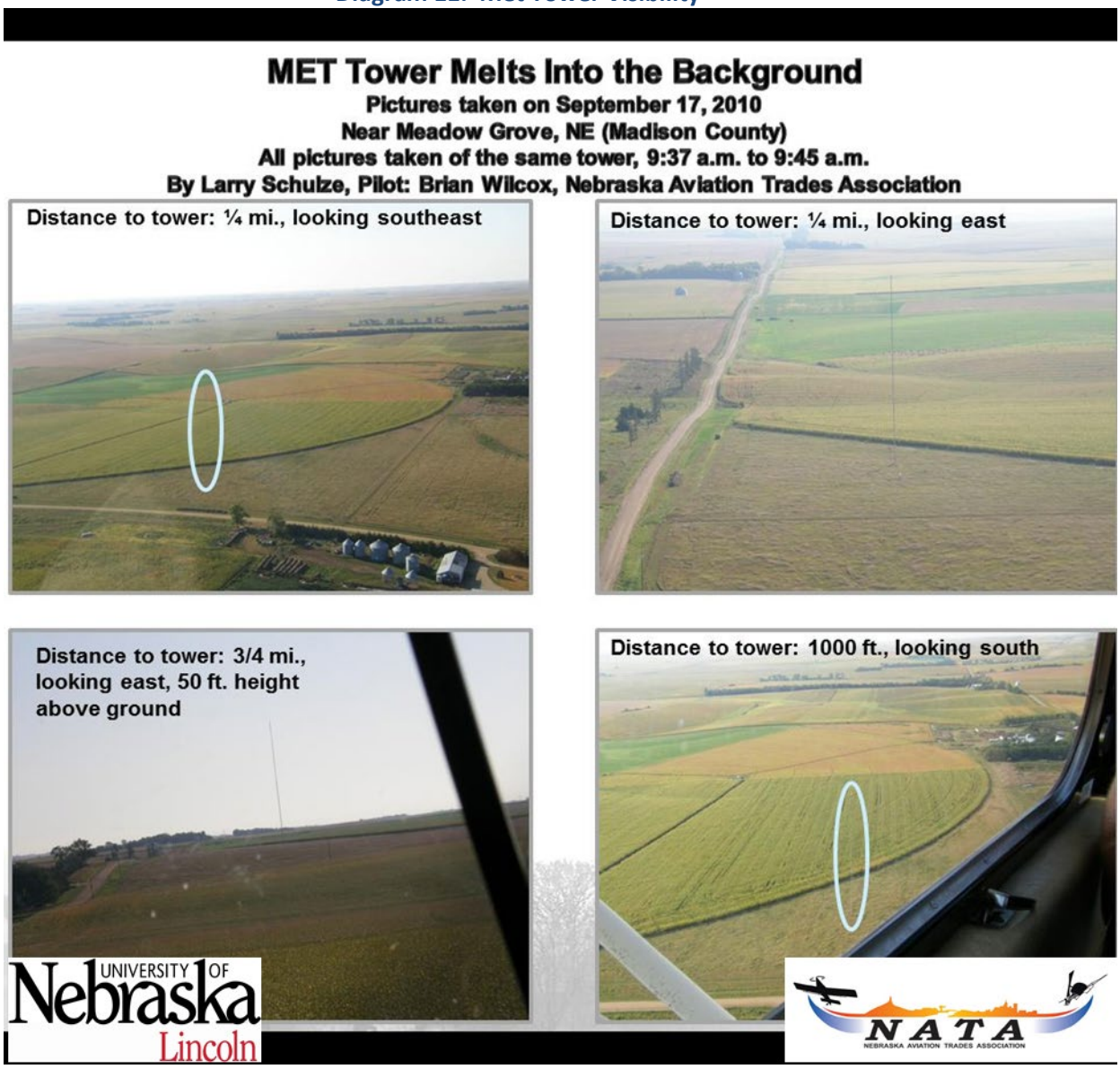
1 Distance in miles from the nearest portion of the Plum Creek Wind Project boundary.
2 Runway surface type and condition.
3 Elevation in feet at the highest point on the centerline of the useable landing surface. Measured to the nearest foot with respect to mean sea level.
4 Private airport/heliport.

The closest public airport to the proposed Project is the Tracy Municipal airport, located approximately 6.4 miles from the Project Area and outside of the six-mile buffer from public use airports that Plum Creek has established for this Project.

In addition to air traffic to and from the public and private airports/heliports identified above, air traffic may also be present near the Project Area for crop dusting of agricultural fields; small private runways associated with crop dusting activities may exist near the project area.

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. [239] 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.

Diagram 11. Met Tower Visibility[240]



[239] https://www.law.cornell.edu/cfr/text/14/77.9.

[240] Nebraska Institute of Agriculture and Natural Resources. *Wind Measurement (MET) Towers.* https://cropwatch.unl.edu/bioenergy/met-towers

Generic 414 MW Wind Farm

A generic 414 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.

Generic 414 MW Solar Farm

Because of the relatively low profile of PV solar farms, FAA lighting requirements would not be anticipated to be necessary; however, appropriate siting of PV solar projects is necessary to ensure they do not cause safety problems for aviation or otherwise interfere with aeronautical and airport activities. Specifically, the FAA wants to ensure solar systems do not create glint or glare conditions (glint is a momentary flash of bright light, and glare is a continuous source of bright light). The FAA has determined that glint and glare from typical ground-mounted solar energy systems, in the vicinity of airports, could result in an ocular impact to pilots and/or air traffic control facilities and compromise the safety of the air transportation system. While the FAA supports PV solar energy systems near, and even on airports grounds, the FAA seeks to ensure safety by eliminating the potential for ocular impact to pilots and/or air traffic control facilities due to glare from such projects.[241]

It is anticipated that an FAA review of a generic 414 MW solar farm, with proper site prescreening, would result in a "No Hazard" determination.

Mitigation

Site permits granted by the Commission contain requirements for the design and siting of meteorological towers (Appendix B). Permanent towers for meteorological equipment are required to be free standing (no guy wires). Permanent meteorological towers shall not be placed less than 250 feet from the edge of the nearest public road right-of-way and from the boundary of the Permittee's site control, or in compliance with the county ordinance regulating meteorological towers in the county the tower is built, whichever is more restrictive. Meteorological towers shall be placed on property the Permittee holds the wind or other development rights. Meteorological towers shall be marked as required by the Federal Aviation Administration.

Project planning, construction, and operation will be coordinated with the FAA, local airports and state air traffic agencies to ensure public safety is not negatively impacted by the Project. The Applicant will follow FAA guidelines for marking towers and implement the necessary safety lighting. Notification of construction and operation of the wind farm will be sent to the FAA and steps will be taken to ensure compliance with FAA requirements.[242]

[241] Kandt, A; Romero, R. *Implementing Solar Technologies at Airports*. NREL. 2014. https://www.nrel.gov/docs/fy14osti/62349.pdf.
[242] SPA, at pp. 68 – 69.

3.3.7.1 *Communication Systems*

Large electric generation facilities have the potential to impact electronic communications (radio, television, internet, cell phone, and microwave). This section discusses potential impacts on communications systems due to the operation of a large electric generation facility in the Project area.

Plum Creek Wind Farm

Wind turbines can cause interference with electronic communications by obstructing the reception of communication signals. Wind turbines do not impact digital signals (digital television, internet, cell phones), unless the turbines directly obstruct the signal, such as being located in the line-of-sight.[243] Analog signals (e.g., amplitude Modulated (AM) and frequency modulated (FM) radio, microwaves) can be interfered with by direct obstruction and by indirect signal interference, resulting in ghosting of television pictures or signal fading.

Radio

Land mobile and radio facilities are wireless communication systems intended for use by users in vehicles, such as those used by emergency first responder organizations, public works organizations or companies with large vehicle fleets or numerous field staff. FM radio is not impacted by wind turbines or transmission facilities; AM radio can be impacted near transmission facilities, e.g., signal fading underneath a transmission line.

Plum Creek commissioned a communication tower study by Comsearch, which identified three communication tower structures and twelve communication antennas in the Project Area (**Table 24**).[244] These three tower structures are registered with the Federal Communications Commission (FCC). The twelve antennas may be located on a variety of structure types such as guyed towers, monopoles, silos, rooftops, or portable structures. Additionally, five of the antennas are located on two of the communications towers within the Project Area; some towers host multiple antennas.[245]

Comsearch also provided a report on AM and FM Radio broadcast stations in the Project vicinity whose service could potentially be affected by the Project.[246] The closest AM station to the Project is over 18.6 miles southeast of the Plum Creek Wind Project. Similarly, the nearest FM station to the Project is nearly 8.7 miles southeast of the Project. There are no AM or FM Radio station towers in the Project Area.

Turbines sited within 1.9 miles of an AM broadcast station can cause impacts to AM broadcast coverage. The closest AM station to the Project is more than 19.7 miles from the Project Area.

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[243] Polisky, Lester. *Post Digital Television Transition - The Evaluation and Mitigation Methods for Off-Air Digital* Television Reception in-and-around Wind Energy Facilities. Wireless Pulse, December 2009; http://acvamoonqa.comsearch.com/newsletter/archiveWP/WirelessPulseDec09.html

[244] SPA, at Appendix D.

[245] Ibid.

[246] Ibid.

Consequently, impacts to AM broadcast stations are not anticipated. The coverage of FM stations is generally not susceptible to interference caused by wind turbines. The closest FM station to the Project is approximately 8.7 miles; impacts to FM stations are not anticipated.

Table 24. Communication Towers and Antennas in the Project Area[247]

Communication System Type		Number of Towers
Antenna1	Microwave	5
	Land Mobile	5
	Cellular	2
Tower	Communication	3

1 There are five antennas on two of the three tower locations in the Project Area; there are 10 unique tower and antenna locations. Some towers hold multiple antennas.
Source: Comsearch (SPA Appendix D)

Microwave Beam Paths

Wind turbines can interfere with microwave paths by blocking or partially blocking the line-of-sight path between microwave transmitters and receivers. Microwave bands are a telecommunication system that provides long-distance and local telephone service, backhaul for cellular and personal communication service, data interconnects for mainframe computers and the Internet, network controls for utilities and railroads, and various video services. To prevent disruption of the microwave beam path, turbines should not be sited the centerline of a beam path.

Comsearch conducted a Licensed Microwave Study for Plum Creek.[248] Plum Creek has sited the Project's turbines in a manner that avoids all identified microwave beam paths and communication systems (Figures 13a and 13b). The Electromagnetic Interference Analysis examined microwave beam paths in the vicinity of the Project and identified ten microwave beam paths that cross into the site. As such, impacts to microwave beam paths are not anticipated.

Radar

The federal government has a large number of departments and agencies that operate a set of communication systems that are not part of any public databases. The United States Department of Commerce National Telecommunications and Information Administration (NTIA) coordinates government communication systems for all departments and agencies.

Modern radars differentiate between stationary and moving objects using a phenomenon called "Doppler shift." When wind turbines are in the radar line of sight, the radar detects the Doppler shift of the rotating turbine blades and this interferes with the radar system.[249] Interference from wind

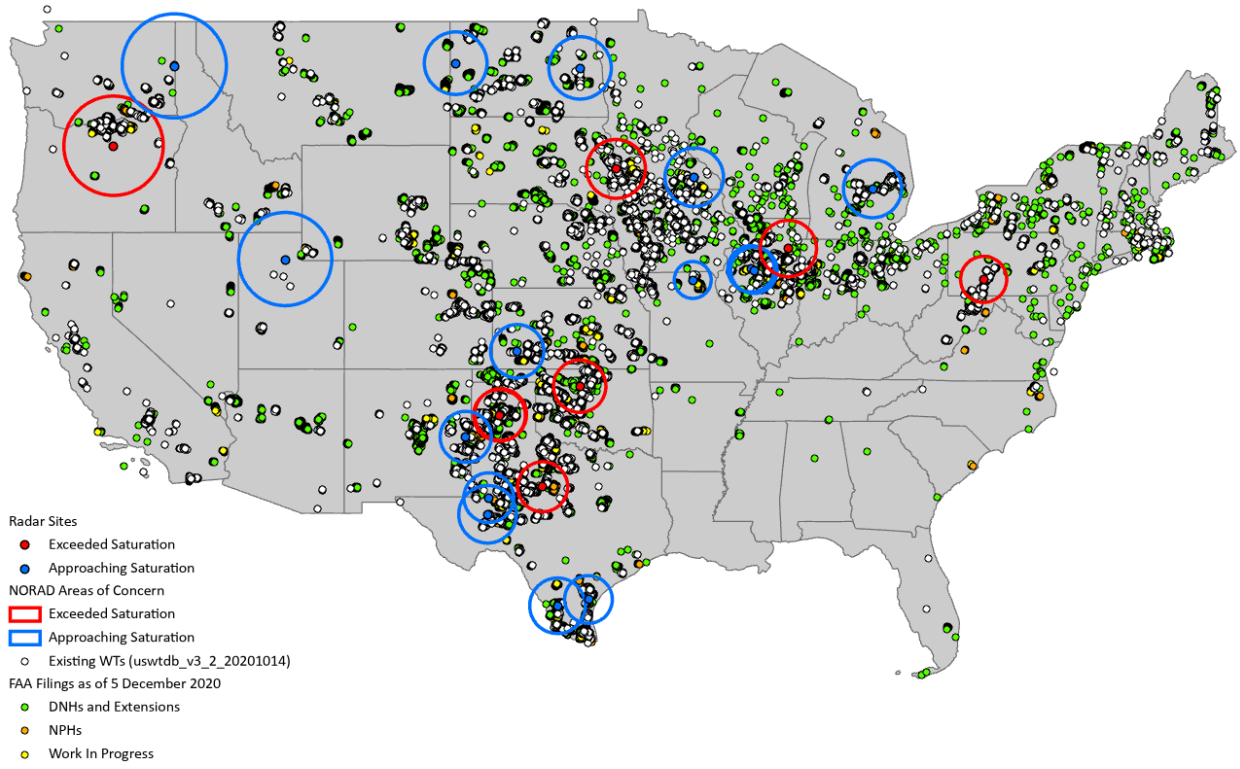
[247] SPA, at p. 53, Table 8.6-1.
[248] SPA, at Appendix D.
[249] The mission compatibility evaluation process annual report to congress, 2013. USA000657-14_TAB_B_RTC_FINAL AS SIGNED.pdf (osd.mil).

turbines, specifically reductions in the radar's performance (ability to identify and track aircraft within the "clutter" created by the wind turbine interference), and the creation of radar "false targets" (from interference from rotating wind turbine blades within the radar line of sight) have been documented.[250]

Proposed wind farms within line-of-sight of a North American Aerospace Defense Command (NORAD) radar require a developer to engage in Mitigation Response Team (MRT) discussions with the Air Force and NORAD. Projects within the line-of-sight of one or more of the 23 radar sites identified by NORAD (Diagram 12) are at increasing risk of receiving an agency objection, noting that the proposed project potentially rises to an unacceptable risk to national security.

On October 27, 2020, the Department of Defense (DoD) Military Aviation and Installation Assurance Siting Clearinghouse informed Plum Creek that the DoD has found that the wind farm will have an adverse impact to NORAD missions for the Tyler MN Common Air Route Surveillance Radar (CARSR) system, if constructed as proposed.

Diagram 12. NORAD Saturation and Areas of Concern[251]



[250] The mission compatibility evaluation process annual report to congress, 2013. USA000657-14_TAB_B_RTC_FINAL AS SIGNED.pdf (osd.mil).

[251] NORAD Saturation, Existing Mitigation, and Need for Short-Term Mitigation, Westslope Consulting, LLC. December 11, 2020.

Plum Creek anticipates that informal negotiations between their consultant (Capital Airspace) and NORAD will be ongoing through early 2021, and that Plum Creek will submit a formal proposal to the MRT once they reach an informal resolution.

Telephone Service

Telephone service in the Project Area is provided both through landlines and wireless signals. Landline telephone service in the area is provided to farmsteads, rural residences and businesses by Spectrum and CableOne. Cellular services in the Project Area are provided by many carriers including AT&T, DISH network, Sprint, Standing Rock Telecommunications, TerreStar, T-Mobile, and Verizon. There are five land mobile antennas in the Project Area.[252]

Operation of the wind farm is not anticipated to impact the telephone service in the Project Area; however, physical damage to underground telephone lines may incidentally occur during construction of the wind farm. In order to avoid potential physical impacts to underground telecommunication lines, all lines will be located using a utility locate service, and collection line locations will be coordinated with local telecommunications providers to ensure there will be no direct impacts to existing telephone lines. If inadvertent impacts identified during or after construction, Plum Creek will address these impacts on a case-by-case basis.[253]

Land mobile systems are designed with multiple base transmitter stations; therefore, any signal blockage caused by the wind turbines would not perceptibly degrade their reception. Construction and operation of the proposed wind farm is not expected to impact telephone service to the area.

Broadcast Facilities

There is a possibility that broadcast facilities (HDTV and digital television) would be impacted by the wind farm. Outdoor antennas pointed through the turbine area, "rabbit ear" antennas or older HDTV receivers would be more likely to experience signal disruption (in the form of pixilation or “freezing” of a picture).[254] Interference would be more likely to occur where there is direct interference with digital broadcast paths of local television stations. Occasionally, multipath interference from one or more turbines can cause video failure in HDTV receivers, especially if the receiver location is in a valley or other place of low elevation.

Television reception at residences relying on cable or satellite television service will not be impacted by construction or operation of the Project.

The Comsearch study also identified 218 off-air television stations within 93.2 miles of the Project Area. TV stations at a distance of 93 miles or less are the most likely to provide off-air coverage to the

[252] SPA, at Appendix D.
[253] SPA, at p. 57.
[254] SPA, at Appendix D.

Project Area and neighboring communities. Of these 218 stations, only 151 are currently licensed and operating; the other 67 stations are either in construction or have applied for a construction permit. Of the 151 licensed and operating stations, 139 are low-power stations or translators. Translator stations are low-power stations that receive signals from distance broadcasters and retransmit the signal to a local audience. These stations serve local audiences and have limited range, which is a function of their transmit power and the height of their transmit antenna. The other 12 licensed and operating stations are digital television broadcast stations.[255]

GPS

Global positioning systems (GPS) use satellite signals to determine locations on the earth's surface and are commonly used to guide agricultural operations. Because GPS uses multiple digital satellite signals, interference with the signals or subsequent uses is not anticipated. Obstruction of any one satellite signal would require direct line-of-sight obstruction due to a wind turbine. Such an obstruction would be temporary (i.e., there is concurrent GPS receiver movement, satellite movement, and wind turbine blade movement such that the obstruction should be resolved).

Wireless Broadband Internet

It is unclear if there are impacts to wireless broadband internet signals due to operation of a wind farm. For a previous wind project, the Department contacted engineers at the local wireless broadband internet service provider (StarCom/StarNet) for further information.[256] StarCom representatives stated that it is possible that a wind turbine operating along the "line of sight" between a broadband signal tower and residential antenna can cause intermittent signal loss, but that such cases were rare.

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

Generic 414 MW Wind Farm

A generic 414 MW wind farm would have communications impacts similar to the proposed project depending on a variety of factors such as the proximity of homes in relation to the project, number of turbines and the number of communication facilities and types in the area. Mitigation efforts at a generic 414 MW wind farm for impacts to communication services would also be similar to the mitigation efforts at the Plum Creek Wind Farm.

[255] SPA, at pp. 55 – 56.

[256] Elm Creek II Wind Project, Environmental Report, P. 30, eDocket ID: 200911-44359-01.

Generic 414 Solar Farm

Given the relatively low profile of PV solar farms, no impact to digital signals (digital television, internet, cell phones) or analog signals (AM and FM radio, microwaves) would be anticipated. However, if O & M building components or associated transmission line towers were to be constructed within the "line of sight" between a line-of-sight signal and residential antenna, it is possible the customer could experience intermittent signal loss.

Mitigation

Permittees for these large energy projects (wind farms and solar farms) conduct microwave beam path analysis, off-air television analysis, and radio blockage reviews (NTIA) to aid in the siting of project components in a manner that does not interfere with communication systems.

If interference to a residence's or business's television service is reported, Plum Creek will work with affected parties to determine the cause of interference and, when necessary, reestablish television reception and service.[257]

Plum Creek states that on November 12, 2019, the National Telecommunications and Information Administration informed the Applicant that no agencies have reported issues with the Project layout,[258] however, the DoD has informed Plum Creek that a potential conflict does exist with the Tyler Minnesota Common Air Route Surveillance Radar system. Discussions are ongoing. Possible mitigative options considered by NORAD during the MRT process include:[259]

- Change the project to lower, move, or remove offending wind turbines;
- Overlapping coverage from adjacent radar sites;
- Radar Adverse-impact Mitigation (including stealth coating, adaptive clutter filters, the installation of gap filler radars, radar processing techniques, and the use of adaptive scanning in the radar antennas).
- Curtailment
- Accept level of impacts

Plum Creek is planning to initially propose the removal of primary turbines and substitution with alternate positions. Plum Creek intends on focusing the dropped primary positions on the turbines in the southwest portion of the project.

3.3.8 Fuel Availability

[257] SPA, at pp. 53-57.
[258] SPA, at p. 54 and Appendix A.
[259] NORAD Saturation, Existing Mitigation, and Need for Short-Term Mitigation, Westslope Consulting, LLC. December 11, 2020.

Large electric power generating facilities require some type of fuel. Depending upon the amount and type of fuel required and the location of the fuel relative to the proposed project, the project can create impacts related to harvesting and delivery of the fuel. This EIS examines the sources of fuel as required by Minnesota Rule 7849.1500, subpart 2.

Plum Creek Wind Farm

Wind farms rely on wind, a renewable energy source, to generate electricity. Wind turbine blades extract kinetic energy as the wind passes through the blades and creates turbulence downstream. To operate effectively, turbines must be setback from other turbines to compensate for this turbulence known as wake loss.[260]

Wind capacity varies across Minnesota. Extensive wind measurements have been taken and analyzed by the Minnesota Department of Commerce (Diagram 4). Local data collection suggests the mean annual wind speeds at the turbine locations is approximately 8.2 to 8.5 m/s.[261] Power generation by the Plum Creek project depends not only on wind speed (how much energy it contains), but also the frequency of attaining optimal wind speeds. Wind turbines generate power only when the wind is blowing, and the developer anticipates a net capacity factor of approximately 40 percent to 48percent annually. Additionally, the projected average annual output of between approximately 1,450,000 and 1,740,000 megawatt hours (MWh) is anticipated for the wind farm.[262]

Generic 170 MW Wind Project

To be economically feasible, a 414 MW wind farm sited elsewhere in Minnesota would need to be sited in an area with sufficient wind resources to meet generation projections. Few areas of the State have wind resources that are equal to the southern portion of the State where the Plum Creek project is sited. Although areas with the highest areas of good wind resources are located in southwestern Minnesota (Diagram 4), due to transmission constraints in that region, as well as advances in turbine technology, wind projects have become operational, and more have been proposed throughout the state. Productive, undeveloped wind resources in Minnesota are still available.

Generic 414 MW Solar Farm

PV 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. 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

[260] https://www.awea.org/wind-101/basics-of-wind-energy.
[261] SPA, at p. 122.
[262] Certificate of Need Application, at p. 21.

flow of electrons, or, a continuous flow of electric current. Solar farms of varying sizes are operational and in development throughout many regions of the state.

PV panels generate power only when the sun is shining, and typically have a net capacity factor of approximately 24.0 percent annually.

Mitigation

Renewable energy is energy that is collected from renewable resources (fuel), which are naturally replenished on a human timescale, such as sunlight, wind, rain, tides, waves, and geothermal heat. Renewable energy plays an important role in reducing greenhouse gas emissions. When renewable energy sources are used, the demand for fossil fuels is reduced. Unlike fossil fuels, non-biomass renewable sources of energy (hydropower, geothermal, wind, and solar) do not directly emit greenhouse gases.

Overall, using wind to produce energy has fewer effects on the environment than many other energy sources. Wind turbines do not release emissions that can pollute the air or water, and they do not require water for cooling.

Solar energy does not produce air or water pollution or greenhouse gases, although present technology requires large areas of land. Solar energy can have a positive, indirect effect on the environment when using solar energy replaces or reduces the use of other energy sources that have larger effects on the environment.

3.3.9 Agriculture

Large generation facilities in agricultural areas will have impacts on cropland and possibly on livestock operations.

3.3.9.1 Cropland

Wind farms placed in cultivated areas do take a limited amount of acreage out of production for turbine placement, access roads, Collector Substations, and the O&M facility. However, agricultural cropping and "wind farming" are generally compatible uses. Solar farms, on a MW basis, require large "footprints" and if site in crop lands (or on prime farmland) will potentially remove more acres from agricultural production.

Plum Creek Wind Farm

Land use within the Project Area is primarily agricultural and is the use that accounts for approximately 66,654 acres, or approximately 91.2 percent of the site (Figures 8a and 8b). An additional 1.8 percent (1,302 acres) of land is indicated as hay/pasture/herbaceous land cover, much

of which is used for livestock grazing.[263] Table 25 provides a summary of land cover impacts anticipated as a result of constructing the Plum Creek Wind Farm.

According to the USDA's 2012 Census of Agriculture, the average farm size in Cottonwood, Murray, and Redwood Counties was similar, averaging 454 acres, and generally larger than the average size of all Minnesota farms, 349 acres.[264]

Table 25. Summary of Land Cover Impacts (LWECS Project)[265]

Land Cover Type	SG170		Vestas V162	
	Permanent	Temporary	Permanent	Temporary
Cultivated Crops	82.8	1,876.0	79.6	1,864.1
Developed (all categories)	3.7	76.1	3.7	72.6
Emergent Herbaceous Wetlands	0.1	3.8	<0.1	15.0
Hay/Pasture	<0.1	1.9	-	4.4
Grassland/Herbaceous	-	1.0	-	1.7
Deciduous/Mixed Forest	-	1.0	-	3.3
Woody Wetlands	-	1.0	-	0.7
Total	**86.6**	**1,960.0**	**83.3**	**1,961.8**

Crop revenue accounts for the majority (larger percentage) of the total market value of agricultural products contrasted to livestock sales in Cottonwood County ($234 million vs. $140 million, annually), Murray County ($233 million vs. $133 million, annually), and in Redwood County ($365 million vs. $153 million, annually).[266] Corn and soybeans being the dominant agricultural crops by acreage in the three counties, with forage crops in Cottonwood and Murray Counties and sugar beets in Redwood County coming in second. Cattle, hogs and pigs, and sheep and lambs are the dominant livestock raised in all three counties.[267]

Approximately 91 percent of the total Project Area is classified as prime farmland, while approximately 5.0 percent is classified as farmland of statewide importance. Additionally, approximately 4.3 percent of land within the Project Area is not prime farmland.[268] The Plum Creek project is compatible with restrictions in rule concerning the development of energy projects in areas with prime farmland.

The Plum Creek Wind Farm is not expected to significantly impact agricultural land use or the general character of the area. An estimated 0.7 acres of land per turbine will be taken out of agricultural

[263] SPA, at p.71.
[264] Ibid.
[265] SPA, at p. 95, Table 8.19-2.
[266] SPA, at pp. 71-75.
[267] Ibid.
[268] SPA, at p. 93, Table 8.15-2.

production for the life of the project to accommodate the turbine pad and access roads. Additionally, land will also be taken out of agricultural production for the collector substations and O&M facility, which together would total approximately 21 acres. Landowners may continue to plant crops near, and graze livestock up to the gravel roadway around each turbine pad.

The primary permanent impact to active agricultural land will be the reduction of crop production on a total of approximately 83.3 acres (V162) and 86.6 acres (V162) of cultivated crop in the Project Area.[269] Collector lines will not result in permanent impacts as they will be installed entirely underground below the plow zone. Large-scale impacts to agriculture or agricultural lands are not anticipated with the placement of turbines, access roads, and ancillary facilities in agricultural fields.

Enrollment in the CRP and CREP is voluntary. Based on publicly available data, there are approximately 1,689 acres (approximately two percent) of the Project Area in Cottonwood and Murray Counties currently enrolled in CREP and RIM easements, which are also shown on **Figures 12a and 12b**. There are no CREP or RIM easements mapped in the Redwood County portion of the Project Area. The Plum Creek project design for both the V162 and SG170 layouts avoids impacts to NWR, FSA, CREP, and RIM conservation easements.

The USFWS holds easements in the Project Area for three FSA parcels and an easement for an access road to a National Wildlife Refuge (NWR) parcel, all of which total 35 acres (less than 0.1 percent) of the Project Area in Murray and Cottonwood Counties (Figures 12a and 12b). There are no USFWS wetland or grassland easements in the Project Area.

Generic 414 MW Wind Farm

Impacts to farming at a generic 414 MW wind farm would be similar to those of the proposed project if placed in a predominantly agricultural area.

414 MW Solar Farm

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).[270] Given the larger footprint required for solar farms, it would be expected that the impacts to croplands (or prime farmlands if present) would be significantly greater than an equivalent capacity wind farm if sited in a predominantly agricultural area; most likely exceeding the allowable use of prime farmland per Minn. Rule 7850.4400, subpart 4.

Mitigation

[269] SPA, at p. 95, Table 8.19-2.
[270] *North Star Solar EA*.

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[271] 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.

As opposed to a solar farm, farming activities can continue on the land surrounding turbines and access roads in a wind farm.

3.3.9.2 Livestock

Large electric generation facilities 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.

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. The primary concern with stray voltage has been its potential effect on farm animals that are confined in areas where electrical distribution systems supply the farm (See Section 3.3.6.2 for additional discussion on stray voltage). A great deal of research on the effects of stray voltage (neutral to earth voltage) on dairy cows has been conducted over the past 40 years.[272]

With respect to agriculture, stray voltage is defined by the U.S. Department of Agriculture (USDA) as a small voltage (less than 10 volts) measured between two points that can be contacted simultaneously

[271] PUC Staff Briefing Paper, Site Permit Template, October 30, 2019, eDocket No. 201910-158610-01.
[272] Reinemann, Douglas. *Literature Review and Synthesis of Research Findings on the Impact of Stray Voltage on Farm Operations. Ontario Energy Board. 2*008 https://www.oeb.ca/oeb/Documents/EB-2007-0709/report_Reinemann_20080530.pdf.

by an animal.[273] For example, this effect is experienced when livestock come into contact with two metal objects between which a voltage exists, such as feeders, water troughs, or stalls, thereby causing a small current to 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. Factors that could influence the intensity of stray voltage include wire size and length, the quality of connections, the number and resistance of ground rods, and the current being grounded.

The direct effect of animal contact with electrical voltage can range from mild behavioral reactions indicative of sensation, to involuntary muscle contraction (or twitching), to behavioral responses indicative of pain. The indirect effects of these behaviors can vary considerably depending on the specifics of the contact location, level of current flow, body pathway, frequency of occurrence, and other factors related to the daily activities of the animals. Common situations of concern in animal environments include the following:[274]

- Animals avoiding certain exposure locations that may result in reduced water or feed intake if painful exposure occurs while accessing watering or feeding devices or locations.
- Difficulty of moving or handling animals in areas of annoying voltage/current exposure.
- Release of stress hormones produced by contact with painful stimuli.

Studies have been conducted to investigate the potential direct physiological effects that may produce behavioral changes. Research has also been conducted to describe the potential effects that may result from the animal's exposure to voltages less than those which produce sensation and behavioral responses. Reinemann conducted a detailed literature review and synthesis of research findings on the impact of stray voltage on farm operations.[275] Through different controlled and field experiments, these studies have found that sensitive dairy cows may experience mild behavioral modifications at current levels exceeding 2 milliamps and voltages exceeding 1 to 2 volts.

Plum Creek Wind Farm

Livestock in and adjacent to the site 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 MPCA is the state agency charged with regulating animal feedlots in Minnesota. One dairy operation has been identified in the Project Area; the Plum Creek turbines (both layouts) are sited

[273] Wisconsin Public Service. *Answers to Your Stray Voltage Questions: Backed by Research*. 2011. http://www.wisconsinpublicservice.com/business/pdf/farm_voltage.pdf
[274] Reinemann, Douglas. *Literature Review and Synthesis of Research Findings on the Impact of Stray Voltage on Farm Operations. Ontario Energy Board. 2*008. https://www.oeb.ca/oeb/_Documents/EB-2007-0709/report_Reinemann_20080530.pdf.
[275] Ibid.

approximately one mile from this operation.[276] This distance is adequate such that there will be no stray voltage impacts to this dairy operation.

The electrical collection system proposed for the Plum Creek Wind Farm is designed to be a separately derived system as defined in the NESC. The system would 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.[277]

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.

Generic 414 MW Wind Farm

A generic 414MW wind farm located elsewhere in Minnesota would have impacts to livestock similar to the proposed project.

Generic 414 MW Solar Farm

While offering some siting and design challenges, solar farms can be compatible with livestock operations.[278] 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 solar facilities in some states.[279]

Mitigation

Mitigation of potential stray voltage impacts would include that all safety requirements are met during the construction and operation of the project. There are a number of strategies for mitigating stray voltage, including improved grounding.[280] Good electrical connections and choosing proper wiring materials for wet and corrosive locations will improve grounding and reduce stray voltage levels.

The Draft Site Permit (Appendix B) has specific conditions requiring the protection of 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.

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[276] SPA, at p.68.
[277] SPA, at Section 6.0.
[278] 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/.
[279] Sheep Grazing to Maintain Solar Energy Sites in Pennsylvania (psu.edu).
[280] Wisconsin Public Service. *Answers to Your Stray Voltage Questions: Backed by Research*. 2011. http://www.wisconsinpublicservice.com/business/pdf/farm_voltage.pdf.

3.4 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 subpart 1F). This section describes the feasibility and availability of alternatives to the Plum Creek Wind Farm.

Plum Creek Wind Farm

The Plum Creek Wind Farm is located in a rural area with a primarily farm-based economy. Wind projects have typically been well integrated into similar settings. Wind 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, with the need to construct approximately 31 miles of new transmission facilities, including the two-collector substations.

The proposed wind farm is feasible and available to be implemented once interconnection details and designs have been completed and the DoD concerns have been addressed.

Generic 414 MW Wind Farm

An alternative to the Plum Creek wind farm 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 414 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; in the past transmission access has been a constraint for the development of wind energy in Minnesota.[281]

Generic 414 MW Solar Farm

A 414 MW Solar Farm is potentially feasible, however a site with adequate space and interconnection to the grid has not been identified as part of this review process. 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); additionally, two projects, the 100 MW Regal Solar Project (eDocket No. 19-395) and the 80 MW Elk Creek Solar Project (eDocket No. 19-495) are currently under review.

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

[281] Minnesota Renewable Energy Integration and Transmission Study, October 31, 2014. https://mn.gov/commerce-stat/pdfs/mrits-report-2014.pdf.

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.[282]

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.[283]

From a land-use perspective, a MW of solar requires more land be used for the life of the project to achieve the same number of MW. Additionally, crop production with the proposed project will not be significantly impacted, whereas for a solar facility a large area of land would be taken out of production for the life of a solar plant.

3.4.1 No-build Alternative

The no build alternative is feasible and available.

The Plum Creek states that the Project 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.[284] 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.[285] In addition to Minnesota's renewable energy objective, there is a regional need and desire for wind energy. It is not clear what the effect of a no-build alternative would be on meeting Minnesota and regional demand for electric power and for renewable generation in particular.

It should be noted that testimony[286][287] provided in the record by the Department's Division of Energy Resources (DER) concluded that the Applicant has not provided sufficient evidence to meet the requirements of Minnesota Rule 7849.0120 A-1 (the accuracy of the applicant's forecast of demand

[282] Minnesota Department of Commerce. 2018. *Minnesota Renewable Energy Update*. https://mn.gov/commerce-stat/pdfs/2017-renewable-energy-update.pdf
[283] 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.
[284] Minn. Statute 216B.1691
[285] Minnesota Department of Commerce. 2018. *Minnesota Renewable Energy Update*. https://mn.gov/commerce-stat/pdfs/2017-renewable-energy-update.pdf
[286] Department-DER Direct Testimony, Michael N. Zajicek, September 28, 2020. eDocket No. 20209-166875-02.
[287] Department-DER Surrebuttal Testimony, Michael N. Zajicek, November 12, 2020. eDocket No. 202011-168259-02.

for the type of energy that would be supplied by the proposed facility). However, the Department did agree generally with the Applicant's reasoning that the Project's large size and construction timeline will provide economies of scale and reduce costs through currently available federal tax incentives that favor the size and timing of the Project. Also, DER concluded that the Project's proposed Gen-Tie line is reasonably sized.

4 Proposed Transmission Project and System Alternatives

Plum Creek proposes to connect the wind farm to the electrical grid through approximately 31 miles (depending upon the route selected) of new 345 kV transmission line between the wind farm and the existing Brookings-to-Hampton 345 kV transmission line in Redwood County (**Figure 2, Appendix D**). The transmission line would originate at a new Collector Substation-2 in Ann Township (northwestern Cottonwood County), then travel northeast for approximately five miles to the new Collector Substation-1. The HVTL will then connect Collector Substation-1 to the proposed Switching Station approximately 26 miles to the north (Vesta Township, Redwood County). Both collector substations are located within the LWECS Project Area boundaries.[288]

This portion of the document reviews potential impacts and mitigation from a 345 kV transmission project as well as system alternatives (no-build, other voltages, and alternative endpoints) to the proposed 345 kV transmission project. The Commission's decision on the certificate of need will determine whether a transmission line is needed and, if needed, the size and type of the line.

4.1 Proposed 345 kV Project

The proposed transmission project includes construction of the 345 kV transmission line and the Plum Creek Wind Farm collector substations. The Switching Station will be constructed by the transmission owner to connect the proposed transmission line to the existing Brookings to Hampton 345 kV transmission line; the transmission owner will be separately permitting the Switching Station through Redwood County.[289]

This section discusses the design, construction, operation and maintenance of these elements of the proposed transmission project.

4.1.1 Engineering and Design

Plum Creek proposes to use steel single circuit (carrying one three-phase conductor set) monopole structures for the transmission project. This section describes the structures and configurations that may be used for this transmission project.

4.1.1.1 Transmission Lines

Alternating Current (AC) transmission lines, such as that proposed by Plum Creek, consist of three separate phases, each phase requiring a conductor to carry the electrical power. A phase consists of one or more conductors: single, double, or bundled. For higher voltage transmission lines, such as

[288] *Route Permit Application (RPA)*, at p. 4.
[289] Ibid.

that proposed by Plum Creek, multiple sub-conductors are often bundled together in each phase. Although final conductor selections have not been made, Plum Creek anticipates using aluminum conductor steel reinforced (ACSR) cable, consisting of 2-bundled "Cardinal" (954 kcmil) or 2-bundled "Bittern" (1,272 kcmil). The 345 kV conductors will have a capacity equal or greater to 1,992 amperes (AMPs).[290]

Plum Creek anticipates installing either optical ground wire or 3/8 inch extra high strength steel as shield wires strung above the phases to prevent damage from lightning strikes. The shield wire could also include a fiber optic cable that allows substation protection equipment to communicate with other terminals on the line.

4.1.1.2 Structures

Plum Creek proposes to use steel single circuit (carrying one three-phase conductor set) monopole structures for the majority of the transmission line's length (Diagram 13). The steel structures will be either galvanized or weatherizing steel. As proposed, structure heights range from 110 to 125 feet above ground, depending upon terrain, span length (approximately 650 feet), and the location (angle structures or structures located with road right-of-way may be taller).

Diagram 13. Example of 345 kV Structures

[290] CNA, at p. 22.

Commonly, tangent structures will be directly embedded; angled and dead-end structures will have concrete foundations between 18 and 45 feet deep, depending on soil conditions, geotechnical analysis, and the structures' function (i.e., heavy-angle and dead-end structures typically require deeper foundations).[291] Table 26 summarizes the four typical monopole structure designs for the line. Specialty structures, such as H-frame structures, may be required in certain situations such as longer spans to avoid environmentally sensitive resources including wetlands complexes.

Table 26. 345 kV Structure Design Summary[292]

Structure Type	Structure Material	Typical Right-of-way Width (feet)	Structure Height (feet)	Structure Base Diameter (inches)	Foundation Diameter (feet)	Average Span Between Structures (feet)
Tangent	Steel	150	125	80	N/A	650
Small Angle	Steel	150	120	80	8	650
Heavy Angle	Steel	150	115	80	9	650
Dead End	Steel	150	110	80	9	650

4.1.2 Route Width, Right-of-Way and Anticipated Alignment

When the Commission issues a route permit, it approves a route, a route width, and an anticipated alignment within that route width.

- Route: The path the transmission line will follow between the DCW Substation to the Byron Substation. Under Minnesota Statute 216E, subd. 8, the route may have a variable width of up to 1.25 miles.
- Right-of-Way (ROW): The ROW is the physical land area within a route that is needed to construct and operate an energy facility.
- Route Width: The area along the route within which the actual ROW will be placed. The route width is typically larger than the ROW to provide flexibility to address engineering, human and environmental concerns that arise after the permit has been issued.
- Anticipated Alignment: A representation of the location of the poles and conductors within the ROW. In many cases, the poles would be placed in the center of the ROW, but in some areas, such as along certain roads, DCW proposes to place the structures within, but near the edge of existing road ROW, outside of the travel lanes.

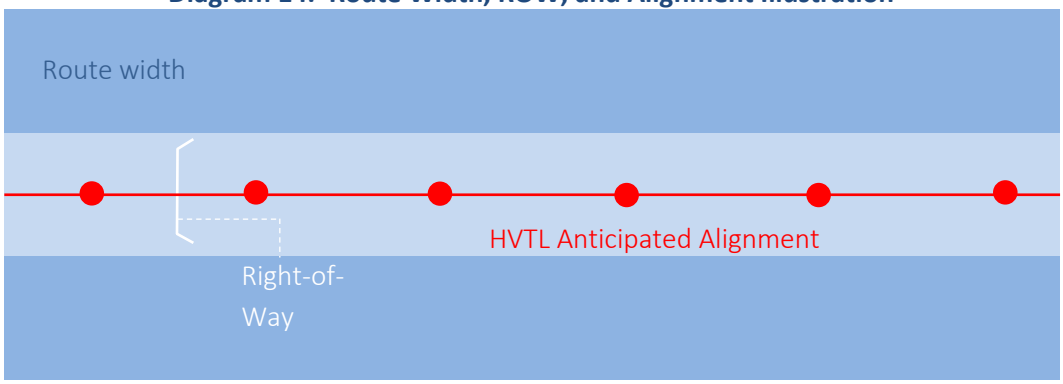
[291] RPA, at pp. 8 – 10, Appendix E.
[292] RPA, Table 2.3-1.

The Commission may include conditions in a route permit (see sample route permit in **Appendix C**). These conditions address the route width or anticipated alignment in a specific area of the project, for example, requiring the alignment of a specific portion of the route to be north rather than south of a road, or requiring that the route width be narrower than initially requested in certain areas.

4.1.2.1 Route Width

The route width is typically larger than the actual ROW needed for the transmission line (**Diagram 14**). This additional width provides flexibility in constructing the line yet is not of such extent that the placement of the line is undetermined. The route width allows Plum Creek to work with landowners to address their concerns and to address engineering issues that may arise after a permit is issued. The route width, in combination with the anticipated alignment, is intended to balance flexibility and predictability.

Diagram 14. Route Width, ROW, and Alignment Illustration



When the Commission issues a HVTL route permit, a specific route and anticipated alignment are designated, and construction and maintenance conditions are specified. The HVTL permit anticipates that the right-of-way will generally conform to the anticipated alignment as identified within the route permit, unless changes are requested by individual landowners or unforeseen conditions are encountered. Any right-of-way modifications within the designated route shall be located so as to have comparable overall impacts relative to the factors in Minn. R. 7850.4100, as the alignment identified in the permit, and shall be specifically described and documented in and approved as part of the plan and profile deliverable. Should such modification in the alignment require deviation outside of the designated route, the permittee shall follow the requirements of Minnesota Rule 7850.4900 (Amendment of Permit Conditions) to seek approval.

Plum Creek states in the RPA that in addition to the routing factors contained in Minnesota Rule 7850.4100, securing voluntary easements was a guiding factor that facilitated the selection of routes to be considered within the HVTL Project Study Area.[293]

[293] RPA, at p. 14.

Plum Creek developed alignments (see Detailed Route Map, Appendix D) within each of the two proposed routes required for HVTL route permit applications under the full permitting process;[294] Plum Creek identified two routes (Green and Yellow) for the HVTL running between the two collector substations, and two routes (Red and Blue) for the HVTL running from Collector Substation-1 to the proposed switching station located along the Brookings to Hampton 345 kV transmission line (Figure 1). Plum Creek has identified a route width of 1,000 feet for the entire length of the Green, Yellow and Blue routes.

For the proposed Red route, Plum Creek is requesting a varying route width from 1,000 feet up to 6,250 feet (1.2 miles) to accommodate obtaining voluntary land rights.[295] Plum Creek has requested a route width of 6,250 feet for a 1.7 mile section near the intersection of County State Aid Highway (CSAH) 5 and CSAH 4 and the Cottonwood River to provide routing flexibility crossing the Cottonwood River and its associated floodplain and wetlands. This Cottonwood River Alternative Alignment (Appendix D) was requested by the MNDNR and is approximately two miles in length and parallels property lines and roads. The proposed Red Route in this area is approximately one mile in length and parallels the western side of CSAH 5 between 180th Street and CSAH 4.[296]

At the time of Application, Plum Creek had secured 100 percent of the total necessary private easements on the Blue Route and 70 percent of the total necessary easements on the Red Route.[297] Plum Creek has not secured voluntary easements along the Cottonwood River Alternative Alignment.

4.1.2.2 Right of Way

The ROW is that specific area required for the safe construction and operation of the transmission line, where such safety is defined by the National Electric Safety Code (NESC) and the North American Electric Reliability Corporation (NERC) reliability standards. The ROW must be within the designated route and is the area for which the applicant obtains rights from private landowners to construct and operate the line.

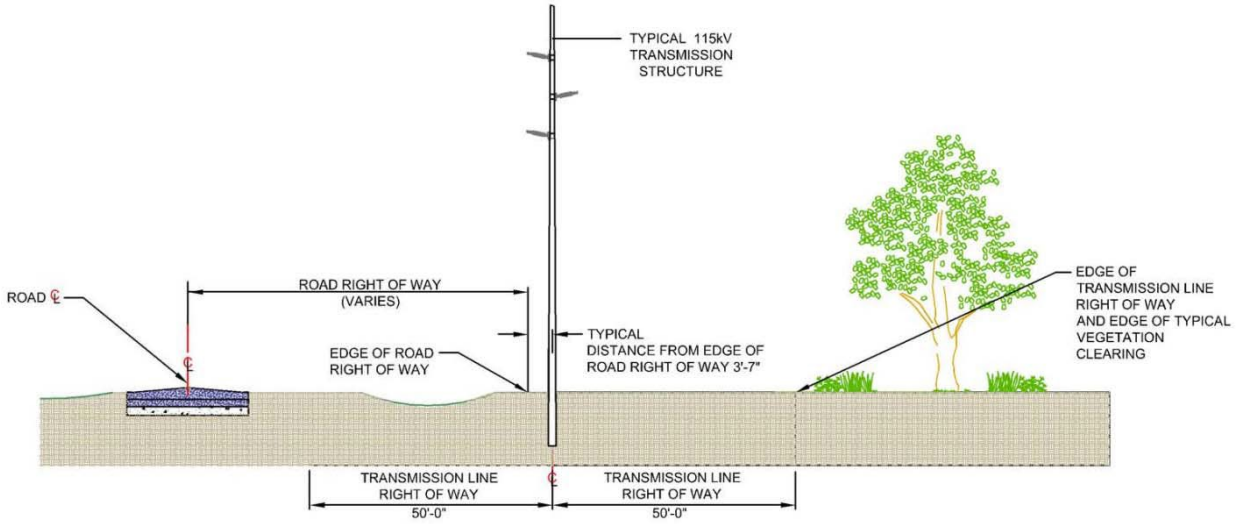
Once a route permit is issued by the Commission, Plum Creek will conduct detailed survey and engineering work, including, for example, soil borings. Plum Creek would also contact landowners to gather information about their property and their concerns and discuss how the transmission line ROW might best proceed across the property. Use of a ROW for a transmission line across private property is typically obtained by an easement agreement between the applicant and landowner.

Plum Creek anticipates constructing the new single-circuit 345-kV transmission line and structures using a design and span lengths that require a 150-foot-wide right-of-way. When paralleling existing

[294] Minnesota Rule 7850.1900, Subpart 1, Item C.
[295] Ibid, at Section 2.2.
[296] Ibid, at pp. 7 – 8.
[297] RPA, at p. 14.

road rights-of-way, Plum Creek proposes to place poles on adjacent private property, within approximately 10 feet of the existing road right-of-way (Diagram 15). These pole placements allow the transmission line right-of-way to share existing road rights-of-way to the greatest extent feasible and will reduce the overall size of the easement required from the private landowner along roads. Pole placement and offset distances may vary in areas such as highway interchanges due to county or state design requirements and in areas of planned future road expansion.

Diagram 15. Alignment Sharing Road ROW[298]



4.1.2.3 Anticipated Alignment

The anticipated alignment is the anticipated placement of the transmission line within the route and ROW, i.e., where the transmission line is anticipated to be built.

After coordinating with landowners and completing detailed engineering plans, the applicant will establish the final alignment for the project and designate pole placements. These final plans, known as "plans and profiles," must be provided to the Commission so that the Commission can confirm that Plum Creek's plans are consistent with the record the Commission has based its decision, the route permit and all permit conditions prior to construction of the project.

In a letter dated April 8, 2020, the Minnesota Department of Transportation submitted comments on the proposed alignment of the 345 kV transmission line along Highway 14 (an approximately one mile long section located in Section 28 of North Hero Township) within the Blue Route.[299] MnDOT expressed concern about poles potentially being located in the clear zone.

[298] RPA, at p. 47.

[299] Minnesota Department of Transportation Scoping Comments, April 8, 2020. eDocket No. 20204-161915-01.

Plum Creek's proposed alignment along Highway 14 is approximately 10 to 15 feet outside the Highway 14 right of way. The proposed design for this line segment is a delta configuration. Given MnDOT's concerns, Plum Creek has revised the proposed alignment in this section, adding two options: (1) using the proposed horizontal configuration and shifting the alignment approximately 20 feet away from the edge of the highway right-of-way edge, and (2) using a vertical design coupled with more minor pole shifts, in the 10-feet range.

4.1.3 Transmission Line Construction and Maintenance Procedures

Construction of the project would not begin until all necessary federal, state, and local approvals have been obtained, easements have been acquired for rights-of-way, and final plans and profiles have been approved by the Commission. The precise timing and order of ROW clearing and construction along the line would depend on the receipt of all necessary approvals for each segment of the line being constructed, system loading issues, and available workforce.

4.1.3.1 Right-of-Way Acquisition

Plum Creek has secured all necessary easements for the Green, Yellow, and Blue Segments, and, 70 percent of the easements for the Red Segment.[300]

The right-of-way evaluation and acquisition process began early in Plum Creek's planning and design process for the HVTL Project. The evaluation and acquisition process included environmental and cultural reviews (including the built environment), a title examination, initial owner contacts, survey work, document preparation, and easement payments.

Although the timing of the easement acquisitions is somewhat earlier in the process than is usual, the overall transmission acquisition process is typical. Plum Creek engaged a title company to search the public records for targeted parcels to identify all persons and entities with a recorded interest in the parcel. Plum Creek then prepared a title report for each parcel to document the legal description, owners of record, easements, liens, restrictions, encumbrance, and other conditions of record. Once ownership is determined, a ROW agent from Plum Creek contacted each landowner or landowner representative. During the initial meeting, the ROW agent described the transmission project and the proposed impact to the particular property and the agent and landowner review specific landowner concerns or issues regarding the construction, operation, and maintenance of the transmission line on the property.[301]

Additionally, Plum Creek met with federal, state, and local agencies, including county departments, as part of the outreach program for the HVTL Project. Plum Creek developed a Geographic Information

[300] RPA, at p. 14.
[301] Ibid, at pp. 24 - -25.

System (GIS) database that contained information gathered from publicly available data resources and from on-site field review efforts. Segments were refined based on agency and public input.[302]

Prior to the acquisition of easements, Plum Creek collected land value data. The Applicant offered compensation for the fair market value of the easement for those who would potentially participate in the HVTL Project. Plum Creek also sought information from landowners about the details of their property and any potential construction concerns.[303] Following these meetings with the relevant owner parties for parcels along the proposed segments, final documents were prepared for the owner(s) to sign and participate in the HVTL Project. Plum Creek prepared a Transmission Easement Agreement for each parcel along the proposed segments, which includes a diagram showing the location and the dimensions of the easement for the HVTL Project. The acquisition process for the Wind Farm collector substations and Switching Station sites was also completed with executed purchase options. The exact location of the Wind Farm collector substations and Switching Station within each site will be determined after final design is complete.[304]

Eminent Domain

It should be noted that in cases where the transmission proposer has the power to exercise eminent domain pursuant to Minnesota Statutes, Chapter 117, the proposer may acquire an easement through the exercise of the power of eminent domain (also referred to as condemnation) if a negotiated settlement could not be reached with a landowner. If Plum Creek and a landowner are unable to negotiate an easement for the HVTL right-of-way, Plum Creek reserves the right to evaluate whether the use of eminent domain is appropriate under Minn. Stat. Ch. 117, based on specific circumstances. ~~Plum Creek has not indicated whether they can exercise the power of eminent domain.~~

Before commencing condemnation, the proposer would provide the landowner with a copy of each appraisal it had obtained for the property interests to be acquired. To begin the formal condemnation process, the proposer would file a petition in the district court where the property is located and serve that petition on all owners of the property.

If the court grants the petition, the court would appoint a three-person condemnation commission to determine the compensation for the easement. The condemnation commission would schedule a viewing of each parcel identified in the petition. Next, the condemnation commission would schedule a valuation hearing where the project proposer and landowner present testimony and evidence about the just compensation for acquiring the easement. The condemnation commission would then make an award of just compensation and file it with the court. The applicant and the landowner would both be bound by the award. At any point in this process, the case could be dismissed if the parties reach a settlement.

[302] RPA, at p. 13.
[303] RPA, at p. 24.
[304] Ibid.

There may be instances where a landowner elects to require the proposer to purchase their entire property rather than acquiring only an easement for the transmission facilities. The landowner is granted this right under Minnesota Statutes section 216E.12, subdivision 4. This statute, sometimes referred to as the "Buy-the-Farm" statute, applies only to transmission lines with a voltage of 200 kV or more and to properties that meet certain other criteria; thus, this statute could apply to many of the properties crossed by the proposed 345 kV transmission line.

Once a ROW is acquired, and prior to construction, the ROW agent would contact each landowner to discuss the construction schedule and requirements. To ensure safe construction, special considerations may be needed for fences, crops, or livestock. Fences or livestock, for example, may need to be moved or temporary or permanent gates may need to be installed. In each case, the ROW agent would coordinate with the landowner, who would be compensated for any project-related construction damages.

4.1.3.2 Right-of-Way Access

Access to the ROW is typically made directly from existing roads or paths that run parallel or perpendicular to the route. However, in some locations improvements to existing access (temporary culverts) or construction of new access could be required to accommodate construction equipment. Plum Creek would evaluate construction access opportunities by identifying existing transmission line easements, roads, or trails adjacent to the permitted route.

Where feasible, Plum Creek indicates it would limit access and construction activities to the ROW acquired for the project to minimize impacts to landowner and adjacent properties. In some situations, however, private field roads, trails, or farm fields may be used to gain access to construction areas. Where no current access is available, where existing access is inadequate, or when access requires incorporation of areas outside the ROW, permission from landowners would be obtained prior to using any of these areas to access the ROW for construction.[305]

4.1.3.3 Equipment and Staging Area

Construction activities will require the use of many different types of equipment, including, but not limited to, tree removal equipment, mowers, cranes, backhoes, line trucks, drill rigs, dump trucks, front-end loaders, bulldozers, flatbed trucks, concrete trucks, helicopters, cranes, and various trailers for hauling equipment. Excavation equipment is often set on wheel or track-driven vehicles.[306]

Staging areas for the transmission project will be selected for their proximity to the route, ease of access, security, ability to efficiently and safely store supplies, and sites that require minimal grading

[305] RPA, at p.26.
[306] Ibid.

or excavation. To the extent practicable, staging areas would be located on previously disturbed sites and would be used as receiving locations for delivery and storage of construction materials and equipment until they are needed for the project. For staging areas outside the project ROW or not located on property owned by Plum Creek, rights to use these areas would be obtained individually from affected landowners through separate construction easement agreements.[307]

4.1.3.4 Construction

Plum Creek estimates that construction of the transmission project will take approximately one year and employ approximately 30 construction workers at peak.[308]

Construction would begin after all necessary federal, state, and local approvals are obtained and where property and rights-of-way are acquired for a specific segment of the permitted route. Construction in areas where approvals are not needed or where already obtained could proceed while approvals for other areas were in progress. Construction would progress, generally, as follows:

- Survey marking of the ROW, pole locations, and environmental constraints (e.g. wetlands).
- Establishment of laydown and staging areas.
- ROW clearing and access preparation.
- Grading or filling as necessary.
- Excavation of holes for structures, and Installation of culverts and concrete foundations for select structures.
- Installation of poles, insulators, and hardware.
- Conductor stringing.
- Installation of any markers required by state or federal permits on conductors or shield wires.

Given the transmission project's setting in a largely agricultural area, tree clearing, and extensive route excavation is expected to be minimal. In areas of difficult terrain (>10 percent grade), more extensive leveling using bulldozer or front-end loaders may be required to provide a level location for equipment operation. Structure foundations will be installed after the structure pads are stabilized.

After ROW clearing and access preparation has been completed, pole and foundation installation can begin. DCW anticipates that most structures would be direct embedment (tangent structures). Concrete piers are anticipated for dead-end or angle structures in locations where guying is not feasible.[309] For the direct-embed steel pole structures, a hole of approximately 5 to 6 feet in diameter and 20 to 30 feet deep will be augured or excavated. For locations where structures require concrete piers, holes would be 8 to 12 feet in diameter and 25 to 50 feet deep. The actual diameter and depth of a foundation depends on geotechnical analysis and structure design.

[307] RPA, at p.26.
[308] RPA, at p. 52.
[309] RPA, at pp.25 – 27.

Once foundations are constructed, structures (poles), insulators, hardware, clamps, and grounding equipment are moved from staging areas and delivered to the foundation locations. Steel arms and/or insulator assemblies, mast arms for shield wires, additional hardware and pulling blocks will all be attached to the structures while on the ground. After attachment of component parts, structures are lifted into place with a crane or similar heavy-lift equipment and secured. Holes will be backfilled with aggregate or concrete delivered from a local batch plant.

Once structures are in place, conductors are strung. Stringing setup areas are established to store spools of conductor cables approximately every two miles. Where conductors cross streets, roads, or highways, temporary guard or clearance poles will be used to ensure that conductors do not obstruct or otherwise interfere with traffic. Conductor pulling lines are secured through stringing blocks suspended from insulators on the poles either by helicopter or ground crews. The conductors are pulled through each block by the pulling lines. Once final sag is established conductors are clipped by workers in bucket trucks or helicopters. Conductor-marking devices (bird flight diverters) will be installed, as necessary, once conductors are in place. Shield wire is installed in a similar manner.

Some soil conditions and environmentally sensitive areas may require unique construction techniques. The most effective way to minimize impacts to these areas is to avoid placing structures in these areas by spanning the transmission line over wetlands, streams, and rivers. When spanning sensitive areas is not feasible, one or more of the following practices may be required by the Commission's route permit to minimize impacts:

- Using the shortest route to access wetlands
- Assembling structures in upland areas before transporting to site for installation
- Constructing during frozen ground conditions.
- Using construction mats when winter construction is not possible and wetlands and other sensitive areas could be impacted.
- Avoiding equipment fueling and maintenance activities in or near environmentally sensitive areas.
- Implementing the best management practices in the project's Stormwater Pollution Prevention Plan (SWPPP), which may include use of silt fences, bio logs, erosion-control blankets embedded with seeds, and other measures.

Wherever large construction projects require the clearing of existing vegetation, the potential for unwanted plant species to invade and establish themselves is a general concern. The Minnesota Noxious Weed Law defines a noxious weed as an annual, biennial, or perennial plant that the Commissioner of the Minnesota Department of Agriculture's (MDA) designates to be injurious to the public health, the environment, public roads, crops, livestock, or other property. Plum Creek states it

will limit the spread of noxious and invasive weeds by cleaning construction equipment before it enters the construction work area and by using only invasive-free mulches, topsoil, and seed mixes.[310]

4.1.3.5 Restoration

Plum Creek indicates that construction crews would attempt to minimize ground disturbance during construction, consistent with BMPs required as part of the SWPPP and other permits and approvals.[311] Nonetheless, parts of the project area would be disturbed during the normal course of construction. Plum Creek indicates that once construction is completed in an area, disturbed areas not needed for maintenance access would be re-graded and restored to their original condition to the maximum extent feasible.[312] In accordance with Minnesota Pollution Control Agency (MPCA) construction permit requirements, temporary restoration before the completion of construction in some areas along the ROW could be required.

Once construction is complete and restoration activities have commenced, a Plum Creek representative will contact the landowner to discuss any damage that has occurred as a result of project construction.[313] If fences, drain tile, or other property have been damaged, DCW says it (or a contractor) will repair damages or provide the landowner reimbursement for repairs, consistent with the conditions in the easement agreement.[314] Commission HVTL route permits require permittees to compensate landowners for damage to crops and drain tile (Appendix C).

Once construction of the transmission project is complete, temporary road approaches, access roads, and staging areas will be removed, revegetated, and restored to their original condition to the extent practicable, and as negotiated with each landowner or responsible agency/official.

Areas where vegetation is disturbed or removed during construction will be allowed to naturally reestablish to pre-disturbance conditions. Resilient species of common grasses and shrubs typically reestablish with few problems after disturbance. Areas with significant soil compaction and disturbance from construction activities may require assistance to reestablish vegetation and control soil erosion. Commonly used methods to accomplish this include, but are not limited to, prompt reseeding of disturbed areas, erosion control blankets, silt fences, and weekly inspection of construction sites for compliance. Reseeding of non-cropped areas disturbed during construction will be done with a seed mix free of noxious weeds, similar to that which was removed. Vegetation that is consistent with substation site operation outside the fenced area would be allowed to reestablish naturally at substation sites.[315]

[310] RPA, at p. 102.
[311] Ibid, at pp. 27 – 28, and pp. 101 – 102.
[312] Ibid, at pp. 27 – 28.
[313] Ibid, at p. 27.
[314] Ibid.
[315] Ibid.

Construction activities on agricultural land would be conducted in accordance with an Agricultural Impact Mitigation Plan (AIMP) developed in coordination with the Minnesota Department of Agriculture.[316]

4.1.4 Collector Substations

Plum Creek proposes to construct two new collector substations (Collector Substation-1 and Collector Substation-2) in northwestern Cottonwood County (Ann Township), within the wind farm site. The two collector substations (**Figure 2**) will consist of switch gear, metering, transformers, electrical control and communications systems, and other high-voltage equipment needed to convert the electricity generated by the Project from 34.5 kV to 345 kV. Final specification of the substations will be determined by the agreements the Project has with MISO, as well as the transmission owner and power purchaser. The collector substations will be approximately 10 acres each, including the graded area, which may be larger than the area actually fenced.[317]

Following survey and staking of the substation locations, erosion control BMPs (e.g. straw wattles, silt fencing, and erosion control blankets/mats) will be implemented. Site access will also be prepared, including installation of any necessary culverts in adjacent road drainages. Due to its location in an agricultural field, minimal vegetation clearing is anticipated. The site of the substations will be graded and fenced. Concrete pads and footing for equipment will be installed and aggregate will be spread throughout the fenced area. Equipment will be delivered to the site and generally stored inside the fenced area to the extent feasible; some materials may need to be stored on the property outside the fence due to size or safety considerations. Equipment such as circuit breakers, bus work, capacitors, and dead ends will be assembled and installed. Transformers will be delivered to the site and installed. Substation control house and supervisory control and data acquisition equipment will be installed. Upon completion of construction activities, disturbed areas outside the fence will be restored and erosion control measures removed.

4.1.5 Switching Station

The interconnecting utility will construct a Switching Station that will tie-in the Plum Creek Wind Farm to the existing electrical grid (**Figure 2**). The Switching Station will require a construction workspace of approximately 15.0 acres, with the final fenced-in area anticipated to be approximately 500 feet by 500 feet. Because the Switching Station will be constructed by the interconnecting utility, the exact location and size of the fenced in area is pending. For the purposes of the Application, Plum Creek assumed permanent impacts to the 15.0- acre construction workspace. The Switching Station components will be mounted on concrete pads. For electrical and fire safety, the Switching Station will be graveled to maintain the area free of vegetation. The area will be fenced to prevent

[316] RPA, at p. 76.
[317] SPA, at p. 130.

unauthorized entry by individuals and wildlife. Once construction is complete, the Switching Station will be maintained and operated by the interconnecting utility.[318]

4.1.6 Operations and Maintenance

Transmission lines and substations are designed to operate for decades and require only moderate maintenance, particularly in the first few years of operation. Nationwide, the electric transmission system is very reliable. The average annual availability of transmission infrastructure is in excess of 99%. Protective relaying equipment automatically take a transmission line out of service when a fault is sensed on the system. Both system faults and scheduled maintenance are infrequent.

Plum Creek would be responsible for the operation, maintenance, and, when necessary, repair of the transmission project. Plum Creek, or its agents, will periodically access to the ROW to perform inspections, conduct maintenance, and repair damage over the life of the Project. The principal operating and maintenance cost for transmission facilities is the cost of inspections, which will be performed monthly by either truck or by air. Inspections will be conducted to ensure that the transmission line is fully functional, and that no vegetation has encroached so as to violate NESC prescribed clearances.[319]

Annual operating and maintenance costs for 345 kV transmission lines in Minnesota and the surrounding states are expected to be approximately $500 per mile per year. Actual line-specific maintenance costs depend on the setting, the amount of vegetation management necessary, storm damage occurrences, structure types, materials used, and the age of the line

Generally, vegetation within the ROW that has the potential to interfere with the O&M of the Project will removed. Native shrubs that will not interfere with the safe operation of the Project will be allowed to reestablish in the ROW. Clearing needs are determined from annual ROW inspection. When necessary, problem vegetation will be cleared through a combination of mechanical and hand clearing, along with herbicide application where allowed to remove or control vegetation growth.

Typically, utilities will use commercial pesticide applicators licensed by the MDA to apply herbicides approved by the U.S. Environmental Protection Agency (EPA) and the MDA. If during post-construction monitoring of the restored ROW a higher density and cover of noxious weeds on the ROW is noted when compared to adjacent off-ROW areas, the utility will obtain landowner permission and work to mitigate noxious weed concerns.

A certain amount of maintenance would be required at substations to ensure proper operation within NESC and NERC standards. Transformers, circuit breakers, batteries, protective relays, and other

[318] RPA, at p. 11.
[319] RPA, at p. 28.

equipment would need to be serviced periodically in accordance with the manufacturer's recommendations. The substation sites must be kept free of vegetation, and adequate drainage must be maintained.

4.1.7 Transmission Project Decommissioning

Because the transmission project is designed, operated, and constructed solely to deliver the output of the Plum Creek Wind Farm to the electric grid[320], the anticipated lifespan of the transmission project is considered to be the same as for the wind farm – 30 years.

At the end of the LWECS's useful life, it is anticipated that the project owner will disconnect the Project from the grid and decommission the HVTLs; the overhead electrical lines associated with the LWECS project connect the voltage step-up substation(s), located within LWECS project footprint, to the interconnection switching station north of the Project. Plum Creek states that all poles, conductors, switches, and lines associated with the interconnection link will be removed and hauled off-site to a recycling facility or disposal site.[321] 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 and re-vegetated to pre-construction conditions.[322]

The interconnection substation will continue to be owned by the transmission line owner.[323]

It should also be noted that in practice, because they have few mechanical elements and are designed and constructed to withstand the weather extremes typical of the region, high-voltage transmission lines are seldom completely retired. It is possible that, following the retirement or decommissioning of the wind farm, another entity may seek to leave the transmission line in place to support other transmission activities and the wind energy facility and the transmission line could be decommissioned separately.

4.1.8 Project Costs

Plum Creek estimates the total cost for the transmission project to be approximately $48 million (based on 2019 dollars), depending on route combination selected (Table 27). The variation in cost between routes is due to the length of the transmission line.

[320] CNA, at p.30, (5.3.1.9).
[321] SPA, at p. 137.
[322] Ibid.
[323] Ibid.

Table 27 Estimated Total HVTL Project Costs[324]

Segment	Costs	
	2019$	$ escalated to anticipated year spend
Green Segment	$4,642,000	$5,060,000
Yellow Segment	$4,220,000	$4,600,000
Blue Segment	$23,000,000	$25,070,000
Red Segment	$23,300,000	$25,397,000

Once the transmission project becomes operational, Plum Creek ~~DCW~~ anticipates annual maintenance costs of approximately $900 per mile, based on similar transmission lines.[325]

4.1.9 Project Schedule

An anticipated permitting and construction schedule for the HVTL Project is provided in Table 28. This schedule is based on information known as of the date of filing and may be subject to change as further information develops or if there are delays in obtaining the necessary federal, state, or local approvals that are required prior to construction.

Table 28 Anticipated HVTL Project Schedule[326]

Activity	Estimated Activity Dates
Minnesota Certificate of Need and Route Permit Issued	Q1 2021
Survey and Transmission Line Design Begins	Q4 2020
Minnesota Certificate of Need and Route Permit Issued	Q1 2021
Other Federal, State, and Local Permits Issued	Q4 2020
Start Right-of-Way Clearing	Q1 2021
Start HVTL Project Construction	Q2 2021
HVTL Project In-Service	Q3 2022

It is anticipated that the Commission would make decisions on the applicant's CN, site, and route permit applications in late 2021 ~~early 2020~~. Plum Creek ~~DCW~~ anticipates completing all permitting requirements and land acquisition in early 2022~~0~~, with construction of the transmission project occurring mid 2022 ~~between May and October 2020~~. Plum Creek ~~DCW~~ anticipates both the wind farm and transmission project will have an in-service date in 2022 ~~of October 2020~~.[327]

4.2 Transmission – System Alternatives

[324] RPA, at Table 2.7-1.
[325] Ibid.
[326] RPA, at Table 2.7-1.
[327] Ibid, at Table 2.6-1

The proposed transmission line project is one possible solution to the get the power from the wind farm to the electrical grid. There may be other alternatives— system alternatives—that also address this problem. The alternatives discussed here are those noted in the scoping decision for this EIS (Appendix A), including the no-build alternative and transmission lines of a different size or with different endpoints. The discussion here assumes that the need for the project is to transport the power from the wind farm to the electrical grid. Project alternatives for the wind farm are discussed in Section 3.2.

4.2.1 No build alternative

Under the no build alternative, the transmission project would not be constructed. The no build alternative would not meet the need for the project. If a transmission line is not built the generation would have no outlet; the wind farm would not be financially viable, and the project would not be built.

There would be no direct human or environmental impacts as a result of this alternative; there may be indirect impacts as a consequence of not building the wind farm (Section 3.2.3). The no build alternative would avoid the potential impacts of the transmission project, as they are described in Chapter 6.

4.2.2 Transmission line of a different size or type

Under this alternative, the need for the transmission project would be met by a transmission line of a voltage other than 345 kV or a different type.

4.2.2.1 Transmission lines of a different size

According to Plum Creek the Transmission Line must provide sufficient capacity to serve an up to 414 MW wind farm; Plum Creek evaluated higher and lower voltage lines and determined that amperage of at least 1,992 AMPs would be required.[328]

An amperage of 1,992 AMPs limits the voltage of the transmission line to those of 230 kV and higher, therefore, Plum Creek has determined that lower voltage 69 kV and 115 kV facilities would not meet the need. Plum Creek evaluated a 230 kV voltage transmission and found that since there are no 230 kV facilities in the area, a 230 kV transmission line would require transformation to 345 kV for the interconnection to the Brookings to Hampton 345 kV transmission line.[329]

[328] CNA, at pp. 30 – 31 (5.3.1.11).
[329] Ibid.

Additional issues favoring a 345 kV transmission line include:[330]

- The 345 kV regional backbone system reinforced by the CapX2020 lines;
- The higher operating voltage and resulting increased thermal capacity of a 345 kV generation-tie line offer an improved efficiency relative to a lower voltage line;
- A 345 kV generation-tie line requires less land to deliver equivalent amounts of power compared to lower voltage options. A single circuit or double 345 kV line can be constructed in a 150- foot right-of-way and carry three to six times more energy than a single circuit or double circuit 161 kV line. To provide equivalent capacity, three double circuit 161 kV lines would be required for a combined right-of-way exceeding 200 feet.
- The higher the voltage of a line, the more reliable the line is during low voltage ride through (LVRT) events and transmission faults; higher voltage lines generally utilize high speed protections that clear faults faster than lower voltage lines, which supports LVRT passage.

DER concluded that the Project's proposed Gen-Tie line is reasonably sized.[331][332]

4.2.2.2 Double Circuit Transmission

There is no existing transmission line that is located to deliver the energy from the Plum Creek Wind Farm to the Brookings to Hampton 345 kV transmission line, and, thus, the double circuiting of an existing transmission line is not feasible. Plum Creek also considered double circuiting the proposed 345 kV Transmission Line and determined that a single circuit line provided sufficient capacity for the Wind Farm and additional capacity for future use.

4.2.2.3 DC Transmission Line

Historically, the transfer of electricity between regions of the United States has been over high voltage alternating current (AC) transmission lines, which means that both the voltage and the current on these lines move in a wave-like pattern along the lines and are continually changing direction. In North America, this change in direction occurs 60 times per second (defined as 60 hertz [Hz]). The electric power transmitted over AC transmission lines is the same as the power we use every day from AC outlets, but at a much higher voltage.

Unlike an AC transmission line, the voltage and current on a direct current (DC) transmission line are not time varying, meaning they do not change direction as energy is transmitted. DC electricity is the constant, zero-frequency movement of electrons from an area of negative (-) charge to an area of positive (+) charge.

[330] CNA, at pp. 30 – 31 (5.3.1.11).

[331] Department-DER Direct Testimony, Michael N. Zajicek, September 28, 2020. eDocket No. 20209-166875-02.

[332] Department-DER Surrebuttal Testimony, Michael N. Zajicek, November 12, 2020. eDocket No. 202011-168259-02.

DC transmission lines are typically used to deliver generation over a long distance (generally hundreds of miles) to a load center. The DC technology is not a feasible solution to deliver 414 MW of power from a wind project to a nearby switching station, such as the Brookings to Hampton 345 kV transmission line, located less than 30 miles from the power source.

4.2.3 Alternative Endpoints

During its initial project development, Plum Creek considered alternative points of interconnection and concluded that no other alternative terminal or substation studied offered the same benefits as the proposed substations and switching station.[333] The two newly constructed collector substations will serve as the point of initiation and are the necessary origination point for the generation-tie line. A switching station on the Brookings to Hampton 345 kV transmission line is the proposed end point and provides a path for the wind energy to be delivered to transmission designated by MISO as an MVP. The point of interconnection is the closest and most efficient terminal for the closest high-voltage line capable of transmitting the energy from the Wind Farm.

[333] CNA, at p. 31 (5.3.1.13).

5 Transmission Project - Routing Alternatives

Under Minn. Rule 7850.1900, subpart 2.C. an application for a route permit must contain at least two proposed routes. In accordance with rule, Plum Creek proposed two routes (Blue Route and Red Route) to connect the wind farm Collector Substation-1 to the grid (via the Brookings-to-Hampton 345-kV line), and two routes (Green Route and Yellow Route) to connect the wind farm Collector Substation-2 to Collector Substation-1, within the wind farm.

Prior to Plum Creek's submittal of the HVTL Route Permit Application, the DNR requested that the Applicant evaluate an *alternative route segment* where the proposed Red Route crosses the Cottonwood River; the DNR's alternative would lie outside the original planned route width of the Red Route. In response to the DNR's request, the Applicant widened the portion of the Red Route (to 6,250 feet) near the intersection of County State Aid Highway (CSAH) 5 and CSAH 4 and the Cottonwood River. Expanding the requested route width allows flexibility in crossing the Cottonwood River and its associated floodplain and wetlands along the Red Route.

The DNR's request was included in the Department's Scoping Decision (in this case as the *Cottonwood River Alternative Alignment*).

The scoping process gives stakeholders an opportunity to suggest additional alignment alternatives, route segment alternatives, and/or alternative routes for consideration. During the scoping process no additional alignment alternatives, route segment alternatives, or routes were proposed for evaluation.

In its Order of October 30, 2020, the Commission ordered that a route segment (Blue E) formerly rejected by the Applicant[334] be included in the scope of the EIS and held over for further analysis in the EIS.[335]

All of these routing options for the transmission project are discussed here.

5.1 Alternatives Evaluated

Figure 2 illustrates an overview of the four proposed routes contained in the RPA. Detailed maps of these four routes are shown in the maps in Appendix D. Should the Commission find the EIS adequate and determine to grant Plum Creek a Certificate of Need and a HVTL Route Permit, it will need to select a route; either the Yellow or Green route to connect the wind farm's Collector Substations together and either the Blue Route (with or without the E alternative segment) or the Red Route (with or without the Cottonwood River Alternative) to connect the wind farm to the Switching Station (grid).

[334] RPA, at pp. 13-19, Appendix F.
[335] Commission, Order Identifying Route Alternatives and Issuing a Draft Site Permit, October 30, 2020, eDocket ID: 202010-167812-01.

5.1.1 Blue Route[336]

The Blue Segment is approximately 26.1 miles long and connects Wind Farm Collector Substation 1 to the Switching Station. The Blue Segment begins at Wind Farm Collector Substation 1 in Ann Township, Cottonwood County. The segment runs north through North Hero, Johnsonville, and Granite Rock Townships before reaching the Switching Station in southern Vesta Township in Redwood County. In general, much of the Blue Segment is sited along CSAH 10 in Redwood County. Where the Blue Segment deviates from CSAH 10, it is due to landowner preference (siting the transmission line along the back of the house versus the front and/or field edges) and to skirt around the town of Lucan.

Approximately 84 percent of the Blue Segment is co-located with roads; the other 14 percent of the Blue Segment is located along property lines and field edges.

From Wind Farm Collector Substation 1, the Blue Segment follows 340th Avenue north for one mile before turning west on 210th Street for one mile. The segment turns north again at 330th Avenue for one mile before turning west for half mile to Eagle Avenue. The Blue Segment follows Eagle Avenue north for two miles to U.S. Highway 14 and then turns east for one mile to CSAH 10. The Blue Route turns north on CSAH 10 for four miles to 160th Street where the route turns west for half mile to a private driveway on the north side of the road. The route then follows the private driveway for one quarter of a mile before turning back east along the field edge for half mile to CSAH 10. The Blue Route follows CSAH 1 north for 1.75 miles to 180th Street. At 180th Street, the Blue Route turns west for one quarter of a mile, then north along a parcel line for half mile, before turning back east for one quarter of a mile to CSAH 10. At CSAH 10, the Blue Route turns north again for 1.5 miles to 200th Street where the route turns west for half mile before following a parcel line/field edge north for two miles (220th Street). The Blue Route turns east for half mile back to CSAH 10 and continues north for two more miles to Minnesota Highway 68 where the route turns west for one mile. The Blue Route then turns north along Eagle Avenue for the final four miles before reaching the Switching Station.

5.1.2 Red Route[337]

The Red Route is approximately 26.8 miles long and connects Wind Farm Collector Substation 1 to the Switching Station. The Red Route begins at Wind Farm Collector Substation 1 in Ann Township of Cottonwood County. The route continues north and slightly west through North Hero Township, on the border of Springdale Township, and through portions of Johnsonville, Gales, and Granite Rock Townships prior to connecting to the Switching Station in southern Vesta Township, all within Redwood County. The Red Route is heavily co- located with roads, as approximately 92 percent of the Route parallels roads. The other eight percent (2.2 miles) follow property lines and/or field edges.

[336] RPA, at p. 21.
[337] RPA, at pp. 21 – 22.

From Wind Farm Collector Substation 1, the Red Route follows 340th Avenue north for one mile before turning west on 210 Street for one mile. The route turns north again at 330th Avenue for one mile before turning west for 1.5 miles to Duncan Avenue. The Red Route turns north on Duncan Avenue for three miles before turning west on 130th Street for one mile and north again on CSAH 5 for five miles. At the intersection of CSAH 5 and 180th Street, the Red Route turns west for half mile before turning north along the property line for one mile to CSAH 4. The route turns east for half mile to CSAH 5 and turns north again for one mile to 200th Street. At 200th Street, the Red Route turns east for half mile before following a parcel line north for one mile and turning east along 210th Street to Duncan Avenue. The Red Route follows Duncan Avenue north for five miles to 260th Street before turning east for one mile to Eagle Avenue. The Red Route then turns north along Eagle Avenue for the final two miles before reaching the Switching Station.

5.1.3 Green Route[338]

The Green Route is approximately 5.5 miles and connects Wind Farm Collector Substation-2 to Wind Farm Collector Substation-1. It begins at Wind Farm Collector Substation 2 in Ann Township, Cottonwood County before traveling north and east through Ann Township, along road and parcel boundaries before reaching Wind Farm Collector Substation-1.

From Collector Substation-2 the route travels north along 300th Avenue for one mile before turning east along 230th Street for one mile. The Green Route then turns north along CSAH 7 for about 0.75 mile before turning east for 0.5 mile, then south again for 0.25 mile along the field edge. The route then turns east again and follows parcel boundaries for 1.5 miles. At this point, the route crosses 340th Avenue, turns north, and parallels the east side of the road for 0.5 mile before reaching Collector Substation 1.

5.1.4 Yellow Route[339]

The Yellow Route is approximately 5.0 miles and also connects Wind Farm Collector Substation-2 and Wind Farm Collector Substation-1. It begins at Wind Farm Collector Substation-2 in Ann Township, Cottonwood County before traveling east and north through Ann Township, along roads before reaching Wind Farm Collector Substation-1.

From Collector Substation-2, the Yellow Route travels east along CSAH 11 for one mile before CSAH 11 turns to the north. The Yellow Route continues traveling east, now along 240th Street, for one mile before turning north along 330th Avenue for one mile. At the intersection of 330th Avenue and CSAH 11, the route turns east for one mile, crosses 340th Avenue, then turns north again and parallels 340th Avenue on the east side of the road for one mile before reaching Collector Substation-1

[338] RPA, at pp. 20.
[339] Ibid.

5.1.5 Cottonwood River Alternative Alignment

The Cottonwood River Alternative Alignment (**Appendix D**) lies within the Red Route. It was requested by the MNDNR during Plum Creek's planning and development stage; it is approximately two miles in length and parallels property lines and roads. The proposed Red Route in this area is approximately one mile in length and its alignment parallels the western side of CSAH 5 between 180th Street and CSAH 4.[340]

To accommodate the Cottonwood River Alternative Alignment, Plum Creek has requested a wider route width to accommodate obtaining voluntary land rights in this area.[341] Plum Creek has requested a route width of 6,250 feet for the 1.7 mile section near the intersection of County State Aid Highway (CSAH) 5 and CSAH 4 and the Cottonwood River to provide routing flexibility crossing the Cottonwood River and its associated floodplain and wetlands (**Diagram 16**).

At the intersection of CSAH 5 and 180th Street, the Cottonwood River Alternative Alignment turns west for half mile before turning north along the property line for one mile to CSAH 4. The alignment then turns east for half mile to rejoin the Red Route and CSAH 5.

5.1.6 Blue E Alternative Route Segment

In general, much of the Blue Route is located along CSAH 10 in Redwood County. The Blue Route deviates from CSAH 10 between 160th Street and 170th Street, avoiding the Fagen Farms, LLP properties (PID 56-033-4020 and 56-034-3060) which straddle CSAH 10 (**Diagram 17**). The Blue Route around these two parcels is approximately 1.25 miles in length.

The Blue E alternative route segment would continue north along CSAH 10, between the two Fagen Farm properties, for approximately 1,200 feet before once again being joined with the Blue Route.

5.2 Alternatives Not Carried Forward for Full Analysis

No specific route (HVTL) alternatives or system alternatives (CN) were proposed for consideration in the EIS during the scoping comment period.

[340] Ibid, at pp. 7 – 8.
[341] Ibid, at Section 2.2.

Diagram 16. Cottonwood River Alternative Alignment

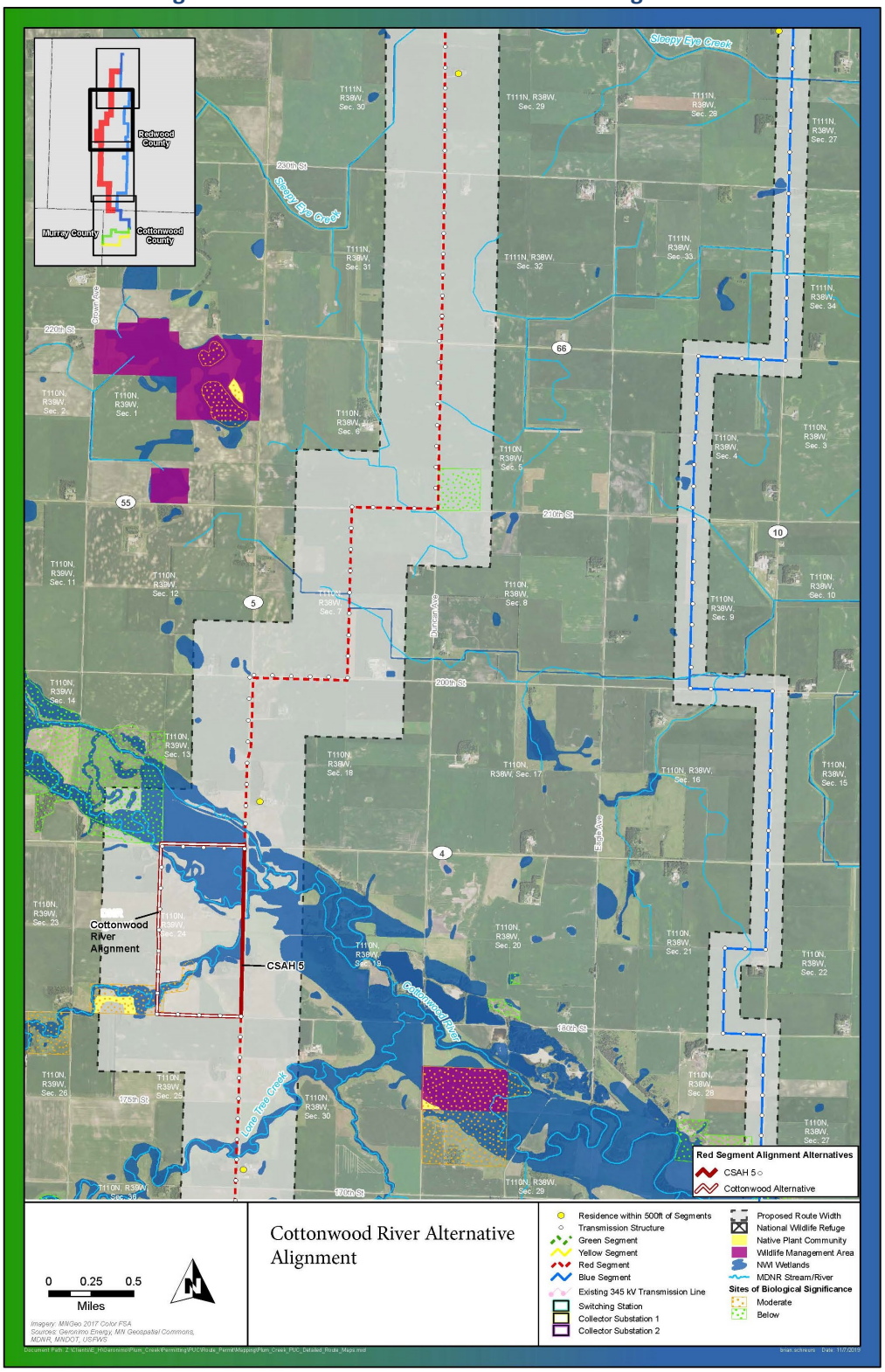
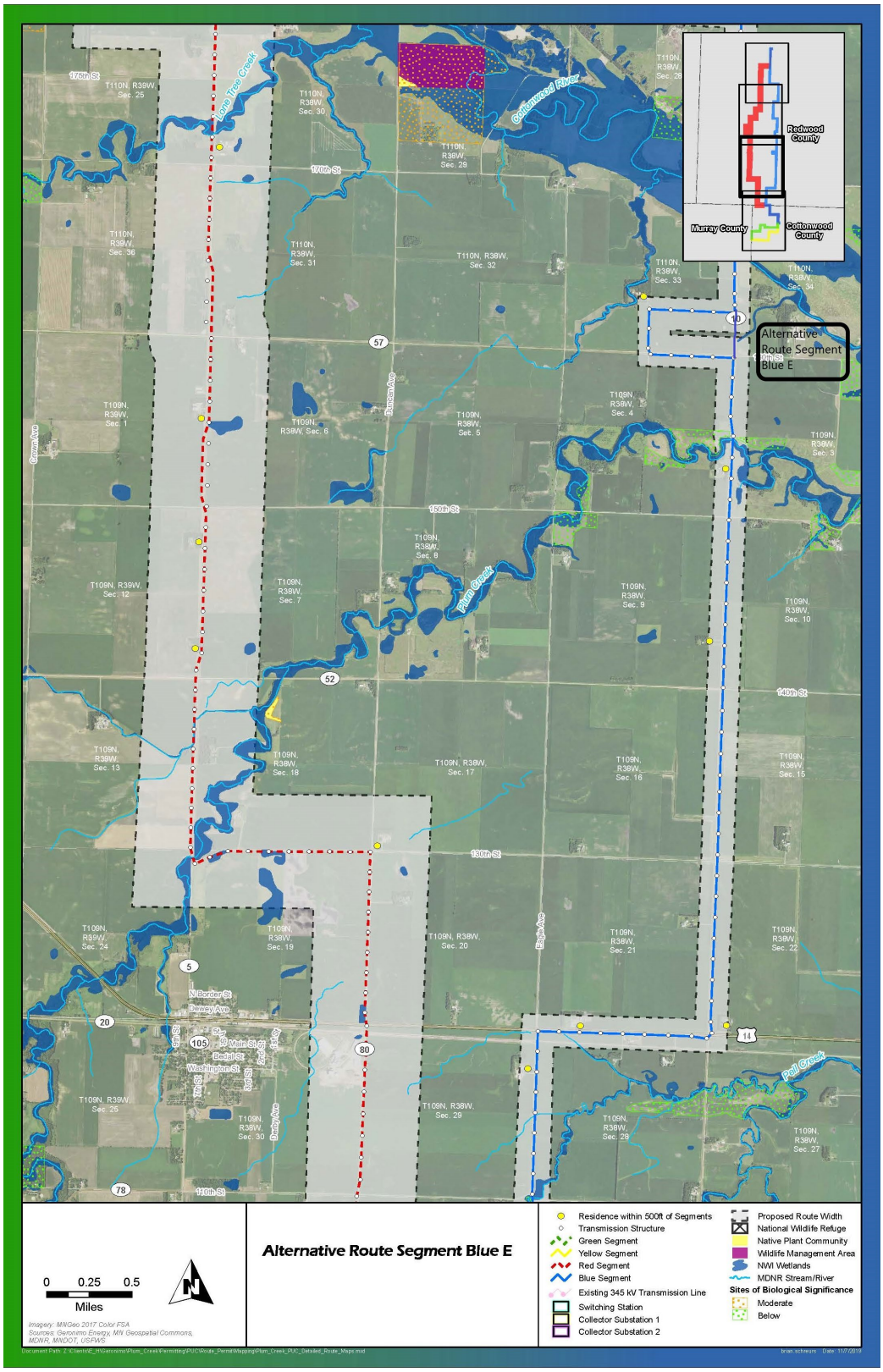


Diagram 17. Alternative Route Segment Blue Route E



5.3 Alternative Alignments and Route Segments – Discussion of Impacts

A comparison of potential impacts between the alternatives and the corresponding portions of the proposed route is presented below.

5.3.1 Cottonwood River Alternative Alignment

The Cottonwood River Alternative Alignment is anticipated to create a number of incremental increases in impacts relative to the corresponding portion of the proposed Red Route in this area. This section discusses this routing option with respect to the routing factors identified in Minnesota Rule 7850.4100. This evaluation is summarized in Table 29.

The corresponding segment of the proposed Red route is half the length of the Cottonwood River Alternative Alignment and crosses fewer acres of cultivated crop land; the corresponding total number of poles that would be installed in cultivated crop land is less (four vs. 11, respectively). Similarly, the amount of prime farmland within the 150-foot right-of-way of the proposed Red route is approximately half of the total within the right-of-way of the Cottonwood River Alternative Alignment. Both alignment alternatives are 100 percent co-located with linear features; the proposed Red Route is co-located with CSAH 5 for the entirety of its length while the Cottonwood River Alternative Alignment is co-located with property lines for the majority of its length. The proposed Red Route alignment is within 151 to 300 feet of one residence, while the Cottonwood River Alternative Alignment is not within 500 feet of any residences.

The proposed Red Route alignment crosses the Cottonwood River 6 times due to the winding path of the river in this location, while the Cottonwood River Alternative Alignment crosses the Cottonwood River only one time, just south of CSAH 4. The 150-foot right-of-way of the Cottonwood River Alternative Alignment crosses more wetlands, including forested wetlands, than the Red Route alignment, and more acres of FEMA-designated 100-year flood zone, as well. In addition, the Cottonwood River Alternative Alignment crosses two designated Sites of Biodiversity Significance (SOBs) while the proposed Red Route alignment avoids SOBs. No other conservation easements or designated lands are crossed by either alignment alternative.

5.3.2 Alternative Route Segment Blue E

The Alternative Route Segment Blue E is anticipated to create less in impacts relative to the corresponding portion of the proposed Blue Route in this area. This section discusses this routing option with respect to the routing factors identified in Minnesota Rule 7850.4100. This evaluation is summarized in Table 30.

The corresponding portion of the proposed Blue Route begins about 0.3 mile north of the intersection of County State Aid Highway (CSAH) 10 and CSAH 57. This portion of the proposed Blue

Route is 1.3 miles in length and travels west from CSAH 10 for about 0.5 mile, crosses a private drive, then turns to the south and parallels the private drive for about 0.3 mile, crosses CSAH 57, then turns to the east and parallels CSAH 57 for about 0.5 mile until it reaches CSAH 10 just south of the intersection of CSAH10 and CSAH 57. The Alternative Route Segment Blue E is 0.3 mile in length and continues to travel south, paralleling the western side of CSAH 10, until it eventually ties back into the proposed Blue Route just south of CSAH 57.

This portion of the proposed Blue Route is 1.0 mile longer than Alternative Route Segment Blue E and crosses more acres of cultivated crop land. Because the proposed Blue Route is longer, the total number of poles that would be installed in cultivated crop land is more (12 vs. 3, respectively). Similarly, the amount of prime farmland within the 150-foot right-of-way of this portion of the proposed Blue Route is approximately 17 acres greater than the total within the right-of-way of Alternative Route Segment Blue E. Both alignments are 100 percent co-located with linear features; the proposed Blue Route is co-located with property lines for more than half of its length and with CSAH 57 for the remainder of its length while Alternative Route Segment Blue E is co-located with CSAH 10 for the entirety of its length.

There is one residence within 500 feet of this portion of the proposed Blue Route (approximately 450' from the alignment); there are no residences within 500 feet of the Alternative Route Segment Blue E. No previously recorded archaeological sites or historic architectural structures are present within the 150-foot right-of-way of either alignment; however, the proposed Blue Route is within one mile of a previously recorded archaeological site and the Alternative Route Segment Blue E is within one mile of a previously recorded historic structure.

Neither this portion of the proposed Blue Route nor Alternative Route Segment Blue E cross farmland of statewide importance, waterbodies, public waters, National Wetland Inventory-mapped wetlands, recreation areas, conservation easements, Minnesota Department of Natural Resources mapped native prairie, native plant communities, or sites of biodiversity significance, or Federal Emergency Management Agency-designated 100-year flood zones. Therefore, these resources are not included in the Table 30.

Table 29 Comparison of Factors Cottonwood River Alternative Alignment[342]

Environmental Features	Proposed Red Route (CSAH 5 Alignment)	Cottonwood River Alternative Alignment
General		
Length (miles)	1.0	2.0
150-foot Right-of-Way (acres)	18.3	36.2
Corridor Sharing		
Paralleling Existing Transmission Line (miles)	0.0	0.0
Roads and Railroads (miles)	1.0	0.8
Property and Field Lines (miles)	0.0	1.2
No Linear Feature Sharing (miles)	0.0	0.0
Total Linear Feature Sharing (miles)	1.0	2.0
Total Linear Feature Sharing (percent)	100%	100%
Proximity to Residences		
Number of Residences 0 to 75 feet from Route Segment	0	0
Number of Residences 76 to 150 feet from Route Segment	0	0
Number of Residences 151 to 300 feet from Route Segment	1	0
Number of Residences 301 to 500 feet from Route Segment	0	0
Total Number of Residences within 500 feet of Route Segment	1	0
Agricultural Impacts		
Number of Structures in Cultivated Crop Land (estimated)	4	11
Prime Farmland		
Total All Categories of Prime Farmland W/in 150-foot ROW (acres/percent)	18.1/98.9%	35.6/98.3%
Farmland of State Importance W/in the 150-foot ROW (acres/percent)	0.2/1.1%	0.6/1.7%
Land Cover (NLCD, 2016)		
Cultivated Crop Land Within 150-foot ROW (acres/percent)	3.9/21.4%	22.3/61.6%
Hay/Pasture Land Within 150-foot ROW (acres/percent)	0.0/0%	1.5/4.1%
Emergent Herbaceous Wetlands W/in 150-foot ROW (acres/percent)	5.0/27.2%	6.7/18.6%
Herbaceous Land W/in the 150-foot ROW (acres/percent)	0.0/0%	0.0/0%
Developed Areas W/in the 150-foot ROW (acres/percent)	9.4/51.5%	5.7/15.7%
Wetlands (NWI) and Water Crossings		
Total Wetlands W/in the 150-foot ROW (acres/percent)	6.0/33%	7.0/19%
Non-Forested Wetlands W/in 150-foot ROW (acres/percent)	4.2/23%	6.6/18%
Number of Cottonwood River crossings (count)	1	6

[342] RPA, at Appendix D.

Table 30 Comparison of Factors Alternative Route Segment Blue E

Environmental Features	Proposed Blue Route Alignment	Alternative Route Segment Blue E
General		
Length (miles)	1.3	0.3
150-foot Right-of-Way (acres)	22.7	4.8
Corridor Sharing		
Paralleling Existing Transmission Line (miles)	0.0	0.0
Roads (miles)	0.5	0.3
Property and Field Lines (miles)	0.8	0.0
No Linear Feature Sharing (miles)	0.0	0.0
Total Linear Feature Sharing (miles)	1.3	0.3
Total Linear Feature Sharing (percent)	100%	100%
Proximity to Residences		
Number of Residences 0 to 75 feet from Route Segment	0	0
Number of Residences 76 to 150 feet from Route Segment	0	0
Number of Residences 151 to 300 feet from Route Segment	0	0
Number of Residences 301 to 500 feet from Route Segment	1	0
Total Number of Residences within 500 feet of Route Segment	1	0
Agricultural Impacts		
Number of Structures in Cultivated Crop Land (estimated)	12	3
Prime Farmland		
Total All Categories of Prime Farmland Within 150-foot Right-of-Way (acres/percent)	22.7/100.0%	4.8/100.0%
Land Cover (NLCD, 2016)		
Cultivated Crop Land Within 150-foot Right-of-Way (acres/percent)	17.6/77.6%	3.0/62.8%
Developed Areas Within the 150-foot Right-of-Way (acres/percent)	5.1/22.4%	1.8/37.2%
Cultural Resources		
Total Number of Previously Recorded Archaeological Sites and/or Historic Architectural Resources Within Route	0	0
Total Number of Previously Recorded Archaeological Sites and/or Historic Architectural Resources Within 1 mile of Route	1	1

6 Transmission Project - Affected Environment, Potential Impacts and Mitigation Measures

The construction and operation of the proposed transmission project will impact human and environmental resources in the project area. Some impacts will be short term and similar to those of any large construction project (noise, dust, soil disturbance). These impacts are fairly independent of the route selected for the project. However, they can be mitigated by measures common to most construction projects, for example, the use of erosion control blankets and silt fencing.

Other impacts will exist for the life of the project and may include aesthetic impacts, impacts to community development, and impacts to agriculture. These long-term impacts result from the design and location of the project, not the manner in which it is constructed. Long term impacts can be mitigated through prudent selection of the route and design of the project.

6.1 Chapter Summary

The project is anticipated to have minimal impacts on factors associated with human settlements in the project area.

- The proposed transmission project is compatible with zoning and land use requirements in the project area.
- The majority of impacts to human settlement from the transmission project –noise, changes to property values, electronic interference, railways, airports, and emergency services – are anticipated to be minimal and fairly independent of the route selected for the project.
- All of the routes (Blue and Red, and Green and Yellow) are anticipated to have minor to moderate aesthetic impacts, but in general the Blue and Green Routes are anticipated to minimize aesthetic impacts due to being generally further from homes. All routes closely follow existing infrastructure (roads and parcel boundaries).
- There are no homes within the anticipated ROW of any of the proposed routes.
- When paralleling existing road ROWs, Plum Creek proposes to place poles on adjacent private property, within approximately 10 feet of the existing road right-of-way. These pole placements allow the transmission line ROW to share existing road ROW to the greatest extent feasible and will reduce the overall size of the easement required from the private landowner along roads.

The primary land use in the Project Area is agriculture. The Blue and Red routes' ROW occupy comparable acres of cultivated crop land, while the Green Route ROW occupies more acres than the Yellow Route. No impacts to forestry or mining are anticipated from any of the proposed routes.

Impacts to known archaeological and historic resources are not anticipated. However, there is the potential to impact unknown archaeological resources during construction of the project. These impacts can be avoided or mitigated, in part, by complying with the HVTL permit conditions concerning archaeological and historic resources (Appendix C, Section 5.3.14 of the HVTL Route Permit template) during construction.

Impacts to natural resources are anticipated to be minimal to moderate for all proposed routes. It is expected that impacts can be minimized through conditions in the Commission's route permit and downstream permits.

- Impact to surface waters are anticipated to be minimal to moderate for all proposed routes. Both the Blue and Red route ROWs cross PWI systems (streams, rivers); however, the Red Route crosses one additional (Lone Tree Creek) system and has multiple crossings on others. The Green and Yellow route ROWs both cross the same number of PWI systems, all of which are intermittent streams. None of the proposed route ROWs intersect PWI lakes or ponds.
- Impacts to wetlands are anticipated to be minimal to moderate. Acres of forested wetlands crossed are comparable between the proposed ROWs for the Green and Yellow, and for the Blue and Red ROWs, however, the Red Route would require a greater number of structures to be placed within a wetland.
- Either route would create minimal to moderate impacts to vegetation; impacts on flora for all routes will primarily be associated with cultivated crop areas. Herbaceous wetlands being the second most likely land cover category impacted; these impacts are comparable between the Blue and Red Routes and minimal within the Green and Yellow routes.
- Although rare and unique natural resources exist along both the Blue and Red routes, with the Blue Route ROW crossing more acres of Sites of Biodiversity Significance, proper pole placement and use of BMPs are expected to minimize the potential for impacts to these resources.
- Use of the Cottonwood River Alternative Alignment increases ~~reduces~~ the number of crossings of the Cottonwood River.

None of the proposed routes is anticipated to provide adverse impacts to electric system reliability.

Both the Blue and Red routes follow existing infrastructure for a significant portion of their length: Approximately 84 percent of the Blue Segment is co-located with roads; the other 14 percent of the Blue Segment is located along property lines and field edges. The Red Segment is co- located with roads for approximately 92 percent of the Route. The other eight percent (2.2 miles) follows property lines and/or field edges.

6.2 Affected Environment

For purposes of analysis, the analysis of the affected environment studies different areas, or regions of influence (ROI), depending upon the resource evaluated (**Table 31**). The following terms and distances are used in this analysis.

- **Right-of-Way (ROW)** is the area required for safe operation of the transmission line. The ROW must be within the designated route and is the area for which the permittee obtains rights from landowners to construct and operate the line. Plume Creek proposes a 150-foot ROW – 75 feet on each side of the transmission line.
- **Route Width** refers to the width (area) permitted by the Commission where the transmission line could be located. For the purposes of analysis, this document uses a 1,500-foot route width (750 feet either side of the anticipated alignment). As discussed in **Section 4.1.2**, Plum Creek has requested a route width of 1000 feet for the majority of the proposed transmission line, with a larger route width of 6,250 feet where the Red route crosses the Cottonwood River and where easements had not been secured at the time of application.
- **One thousand feet**. A distance of 1,000 feet from the anticipated alignment of the line will be used as the ROI for analyzing potential aesthetic and property value impacts and impacts to electronic devices.
- **Anticipated Alignment** is the anticipated location of the structures and line within the ROW and route width. Can be considered – but NOT described as – the centerline of the project.
- **One mile**. A distance of one mile from all routing options will be used as the ROI for analyzing potential impacts to public utilities, tourism and recreation, roads, archaeological and historic resources, and rare and unique species.
- **Project Area** is used to refer to the counties through which the project passes and will be used as the ROI for analyzing potential impacts to socioeconomics, cultural values, zoning and land use compatibility, airports, emergency services, air quality.

6.2.1 Describing Potential Impacts and Mitigation

This EIS analyzes potential impacts of the 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.

- **Negligible** - Negligible means the impacts are so small or unimportant as to be not worth considering; they are insignificant.
- **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.

Table 31. Regions of Influence

Resource Type	Element	Region of Influence
Human Settlement	Displacement, Noise	Right-of-Way
	Aesthetics, Property Values, Electronic Interference	1,000 Feet
	Public Utilities, roads	One Mile
	Socioeconomics, Cultural Values, Zoning and Land Use Compatibility, Airports, Emergency Services,	Project Area
Public Health and Safety	Electric and Magnetic Fields, Implantable Medical Devices, Stray Voltage, Induced Voltage	Route Width
	Air Quality	Project Area
Land-Based Economies	Agriculture, Forestry, Mining	Right-of-Way
	Tourism and Recreation	One Mile
Archeological and Historic Resources		One Mile
Natural Environment	Water Resources, Wetlands, Vegetation, Wildlife (except birds) Wildlife Habitat	Right-of-Way
	Wildlife (birds)	Route Width
	Rare and Unique Resources	One Mile

- 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.

This EIS 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.

6.3 Environmental Setting

The transmission project is located in Cottonwood, Murray, and Redwood counties, in southwestern Minnesota. The project area is dominated by cropland and scattered rural residences, with a network of agricultural ditches and intermittent and ephemeral streams, many of which support herbaceous riparian buffers.

The three-county topography is generally described as undulating, rolling relief with approximate elevations between 1,330 and 1,125 feet above mean sea level (MSL). The topography generally slopes east towards Salem Creek, a tributary of the Zumbro River that eventually flows to the Mississippi River.

As discussed in Section 3.3.4.1 and illustrated in Diagram 5, the DNR and the U.S. Forest Service have developed an Ecological Classification System (ECS) for ecological mapping and landscape classification in Minnesota.[343]

All four routes (Green, Yellow, Blue, and Red) cross the Coteau Moraines ecological subsection in the southern portion of the HTVL Project Study Area, and the Blue and Red Routes cross into the Minnesota River Prairie ecological subsection as these routes move north.

The Coteau Moraines ecological subsection is characterized as a transition from shallow deposits of windblown silt (loess) over glacial till to deeper deposits of loess. A steep escarpment marks the northeast edge of the subsection. The depth to bedrock in this subsection is 600 to 800 feet through most of this area. Soils are loamy and well-drained with thick dark surface horizons. Annual precipitation in the Coteau Moraines subsection ranges from 24 inches in the west to 27 inches in the east and averages 145 to 150 days in length. Prior to Euro-American settlement, vegetation in this subsection was almost entirely tallgrass prairie. Wet prairies were restricted to narrow stream margins and forests were similarly restricted to ravines along a few streams, such as the Redwood River. Land in this subsection is currently used for agricultural activity and remnants of tallgrass prairie are rare.[344]

The Minnesota River Prairie ecological subsection is characterized by large till plains that are bisected by the broad valley of the Minnesota River. The Minnesota River was formed by Glacial River Warren which drained Glacial Lake Agassiz. Topography outside of the river valley in this subsection consists of level to gently rolling ground moraine. Soils in this subsection are predominantly well-to-moderately well-drained loams formed in gray calcareous till of the Des Moines lobe with some localized inclusions of clayey, sandy, and gravelly soils. Annual precipitation in this subsection ranges from 25 inches in the west to 30 inches in the east and the growing season is approximately 147 to

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

152 days in length. Prior to Euro-American settlement, vegetation in this subsection was predominantly tallgrass prairie interspersed by many islands of wet prairie and areas of deciduous forest along the margins of the Minnesota River, floodplains, and other small streams. Current land use in the subsection is dominated by agricultural activity and remnants of tallgrass prairie are rarely found.[345]

Most of the area crossed by the routes are between 1,060 and 1,280 feet above mean sea level, with elevation gradually decreasing from south to north.

6.4 Human Settlements

Transmission lines have the potential to negatively impact human settlements through a variety of means. Transmission line structures and conductors could change the aesthetics of the project area, displace homes or businesses, introduce new noise sources, lower property values, be incompatible with local zoning, and interfere with electronic communications.

Impacts to human settlements resulting from the transmission project are anticipated to be minimal.

The townships in which the proposed routes pass through are rural in nature, with farmsteads located along roads, and generally away from population centers. The Green and Yellow Routs are located two miles or more from municipalities. The municipalities nearest to the Blue and Red Routes are Walnut Grove and Lucan. The municipal boundary of Walnut Grove is crossed by the Red Route and approximately 0.9 mile west of the Blue Route. The U.S. Census indicates that the population of Walnut Grove was 871 persons in 2010. The municipal boundary of Lucan is approximately 0.4 mile east of the Blue and Red Routes which had a population of 191 persons in 2010.[346]

Outside of Walnut Grove and Lucan, human settlements in the HTVL Project Study Area consist of geographically dispersed farmsteads along county roads (**Figure 2**).

6.4.1 Aesthetics

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.

[345] DNR *Ecological Classification System*, http://www.dnr.state.mn.us/ecs/index.html.
[346] RPA, at p. 32.

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.

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.

Topography along the proposed routes is generally flat and the vegetation cover is uniformly low, making the topography vulnerable to visual disruptions. Viewsheds in this area are generally broad and uninterrupted, with only small scattered areas where they are defined by trees or topography. The settlements in the area are residences and farmsteads scattered along rural county roads. The area is also shaped by a built environment. Horizontal elements, such as highways and county roads, are consistent with the long and open viewsheds in the area. Vertical elements such as transmission lines and wind turbines are visible from considerable distances and are the tallest and often the most dominant visual feature on the landscape. There are two wind farms (Figure 11) within 15 miles of the proposed routes that may be visible depending on atmospheric conditions: the Jeffers Wind Project is located approximately 10 miles southeast of the HVTL Project Collector Substation 1 and the Marshall Wind Project is located approximately 14 miles west of the Red Segment. The proposed Plum Creek Wind Farm would be at the southern end of the HVTL Project. At the northern end of the HVTL Project near the Switching Station, the existing Brookings to Hampton 345 kV transmission line structures are focal points on the landscape.

In an effort to minimize impacts on the environment and affected landowners, early in the planning phase, Plum Creek looked for routing opportunities that would share existing rights-of-way along road and railroad rights-of-way and field and section lines. As such all of the proposed routes follow some type of existing infrastructure for the majority of their length. The 1,000 foot ROI for aesthetic resources was identified because the proposed project is most likely to be visible within this near-foreground distance zone and views of the proposed project from aesthetic resources within this distance zone have the greatest potential to result in visual impacts for sensitive viewers.

The project's transmission line structures and conductors will result in aesthetic impacts. The extent of these impacts depends upon:

- Proximity to residences, schools, churches, etc., where relatively more persons are present to experience aesthetic impacts.
- The use of existing infrastructure rights-of-way, where the project would have an incremental impact relative to existing human modifications to the landscape.
- The presence of terrain and vegetation that could shield views of the transmission line and the preservation of such vegetation.

The HVTL Project will result in an alteration of the current landscape through construction of steel poles of 110 to 125 feet. The proposed route minimizes potential aesthetic impacts by routing the transmission line in areas where it is most likely to blend into the built environment, such as, adjacent to roads and along field edges/boundaries/fence lines. Other minimization measures include crossing rivers and streams using the shortest distance possible (perpendicular to the waterbody) and with an existing road, avoiding placing structures directly in front of residences, and using construction methods that minimize damage to vegetation near the transmission line.

Construction of an up-to-15-acre Switching Station in an existing agricultural field will also present a new visual impact. The structures within the Switching Station will be 70-100 feet high at their highest for lighting protection but will on average have the profile of a single-story building and will consist of high voltage electrical equipment. In addition, down-shielded lighting will help to maintain Switching Station security while minimizing lighting impacts.

Mitigation

Aesthetic impacts can be minimized by selecting routes that are located away from residences, schools, and other buildings from which the transmission line would be visible (Table 32). While HVTL Project's structures and conductors would create aesthetic impacts, the degree of impact would be minimal for the Green, Yellow, and Blue Routes and moderate for the Red Segment as it is immediately adjacent to the town of Walnut Grove.

Table 32. Proximity of Residences to the Proposed Routes (Green and Yellow, Blue and Red)[347]

	Green Route Alignment	Yellow Route Alignment	Blue Route Alignment	Red Route Alignment
Closest Residence (feet)	173	140	192	185

[347] RPA, at p. 42, Table 6.2.3-1

6.4.2 Displacement

In the context of transmission line routing proceedings, displacement refers to the removal of a residence or building to facilitate the safe operation of a transmission line. The National Electric Safety Code (NESC) standards require certain minimum clearances between transmission lines and objects such as trees, buildings, or other structures to ensure that the transmission line can be operated safely. For electrical safety code and maintenance reasons, utilities generally do not allow residences or other buildings within the ROW of a transmission line. Any residences or other buildings located within a proposed ROW are generally removed, or "displaced."

Displacements can be avoided through several means including structure placement, the use of specialty structures, and modifications of the right-of-way width. The applicant indicates that it does not anticipate the displacement of any residences as a result of the project and notes that it will work with landowner on a case-by case basis to address potential displacements.[348] Though the general rule is that buildings are not allowed within the ROW of the transmission line, there are instances where the activities taking place in these buildings are compatible with the safe operation of the line.

All of the proposed routes cross sparsely populated rural areas that are used for agricultural production. To limit proximity to residences and other buildings, Plum Creek designed route alignments that are co-located along existing roadways and property lines; in those cases in which proposed alignments are sited near residences, Plum Creek states it has made every effort to site the transmission line on the opposite side of the road from the house or work with the landowner to route the alignment along property lines behind the house. Table 32 summarizes the closest residence to each of the proposed alignments.

Mitigation

Since no displacement is anticipated, no mitigation beyond those captured in the prudent design of the routes is warranted.

6.4.3 Noise

Noise can be defined as any undesired sound.[349] It is measured in units of decibels on a logarithmic scale. The A-weighted scale (dBa) is used to duplicate the sensitivity of the human ear.[350] A three dBa change in sound is barely detectable to average human hearing, whereas a five dBa change is clearly noticeable. A 10 dBa change is perceived as a sound doubling in loudness. Table 20 shows dBA values for several typical noise sources.

[348] RPA, at p. 42.
[349] MPCA (n.d.) *Noise Program*: https://www.pca.state.mn.us/air/noise-program.
[350] MPCA (November 2015) *A Guide to Noise Control in Minnesota*: https://www.pca.state.mn.us/sites/default/files/p-gen6-01.pdf.

Minnesota's noise standards differ based on noise area classifications (NAC), which correspond to the location of the listener (or receptor) and the time of day (Table 21).[351] Although the NACs are based on the land use activity (e.g. residential, educational, and manufacturing) of the location where the noise is heard, the NACs do not always reflect the zoning of the location. Noise standards are expressed as a range of permissible dBA over a one-hour time period. L_{10} may be exceeded 10 percent of the time, or six

The proposed project is in a rural area. Ambient noise levels in these types of locations are generally between 30 and 40 dBA during daytime hours, with higher ambient noise levels of 50 to 60 dBA expected near roadways. The primary noise receptors within the route would be residences.

Potential noise impacts from the transmission project can be grouped into three categories: construction noise, transmission line noise, and substation noise.

6.4.3.1 Construction Noise

During the construction of the transmission project, temporary, localized noise from heavy equipment and increased vehicle traffic is expected to occur along the ROW during daytime hours. Construction activity and crews would be present at a particular location during daytime hours for a few days at a time but on multiple occasions throughout the period of approximately five to seven months between initial ROW clearing and final restoration.[352] Construction equipment produces sound levels in the range of 70 to 95 dBA.[353]

Construction noise could temporarily affect residences, schools, businesses, etc., that are close to the ROW. Residences are the closest noise receptors to the transmission line ROW. All residences are greater than 75 feet from the centerline of the anticipated alignment. As sound pressure levels decrease with distance, no exceedances of MPCA daytime noise standards are anticipated.

Plum Creek indicates that these major activities are anticipated to have the following noise, measured at 50 feet from the source:[354]

- Clearing and grading: grader (85 dBA), chainsaw (84 dBA), and tractor (85 dBA);
- Material delivery: flatbed truck (74 dBA) and crane (81 dBA);
- Auguring foundation holes: augur drill rig (84 dBA); and
- Setting structures: crane (81 dBA).

[351] Minn. R, 7030.0050, https://www.revisor.leg.state.mn.us/rules/?id=7030.0050.
[352] RPA, at p. 44.
[353] Ibid., Section 5.5.3.
[354] RPA, at p.44.

Mitigation

Several means to mitigate potential construction noise impacts include:

- Limiting heavy equipment use to the shortest possible time period.
- Minimizing construction equipment idling.
- Ensuring that proper mufflers are used on equipment.
- As practicable, locating stationary equipment (e.g., compressors, generators) away from receptors or behind barriers.

6.4.3.2 Transmission Line Noise

Noise from transmission lines is due to small electrical discharges along the conductors that ionize surrounding air molecules. This phenomenon is known as corona. The level of noise from these discharges depends on conductor conditions, voltage levels, and weather conditions. Noise emissions are greatest during heavy rains, when conductors are consistently wet. However, during heavy rains, the background noise level is usually greater than the noise from the transmission line and few people are in close proximity to the transmission line in these conditions. As a result, audible noise is not noticeable during heavy rains.

In foggy, damp, or light rain conditions, transmission lines may produce audible noise higher than background levels. During dry weather, noise from transmission lines is a perceptible hum and sporadic crackling sound.

The applicant modeled and estimated noise levels for the transmission line. In its audible noise analysis for the HVTL Project, Plum Creek considered the potential noise generated by operation of single circuit configurations for the transmission line. Predictive modeling for the HVTL Project assumed a 2-bundled 954 kcmil 54/7 "Cardinal" ACSR (1.196- inch diameter) or 2-bundled 1,272 kcmil 45/7 "Bittern" ACSR (1.345-inch diameter) configuration.[355] Model results are presented in Table 33.

Table 33. Predicted Audible Noise Levels (L50 dBA) at Closest Receptors[356]

	Segment			
	Green	Yellow	Blue	Red
Distance to nearest residence from alignment (ft)	173	140	192	185
Predicted audible noise level, L50 dBA at the nearest residence				
Single Circuit Cardinal	41.70	42.70	41.19	41.37
Single Circuit Bittern	38.48	40.52	38.95	39.14

[355] RPA, at p.44.
[356] RPA, at p. 45, Table 6.2.4-5

Audible noise from the transmission line would only be expected during quiet, foggy, or rainy conditions and would be rare. Even in these rare cases, noise levels would be well below state standards.

Mitigation

Noise impacts resulting from the operation of the Green, Yellow, Blue or Red Routes is not expected, and no mitigation is proposed.

6.4.3.3 Substation Noise

The transmission project includes two new collector substations and a new Switching Station.

Noises associated with a substation result from the operation of transformers and switchgear. Transformers produce a consistent humming sound, resulting from magnetic forces within the transformer core. This sound does not vary with transformer load. Switchgear produces short-term noises during activation of circuit breakers. These activations are infrequent.

Mitigation

The two Wind Farm collector substations and Switching Station will be designed such that the MPCA noise limits identified above will be met at the edge of the boundaries of the substations and Switching Station. Accordingly, no mitigation will be required for the audible noise generated by the two collector substations or the Switching Station.[357]

Route permits issued by the Commission require compliance with Minnesota's noise standards (Appendix C, at Section 4.3).

6.4.4 Property Values

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 the project 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 transmission lines are related to three main concerns: (1) potential aesthetic impacts of the line, (2) concern over potential health effects from electric and magnetic fields (EMF), and (3) potential interference with agriculture or other land uses. Research on

[357] RPA, at p.46.

the relationship between property values and proximity to transmission lines has not identified a clear cause and effect relationship. Rather, the presence of a transmission line is one of many factors that affect the value of a specific property. The research has revealed trends which are generally applicable to properties near transmission lines:[358]

When negative impacts on property values occur, the potential reduction in property values is in the range of 1 to 10 percent.

Impacts on property values decrease with distance from the line. Thus, impacts on the sale price of smaller properties are usually greater than impacts on the sale price of larger properties. Other amenities, such as proximity to schools or jobs, lot size, square footage of a house, and neighborhood characteristics, tend to have a much greater effect on sale price than the presence of a power line.

Negative impacts appear to diminish over time. The value of agricultural property is likely to decrease if the power line poles are placed in an area that inhibits farming operations.

A recent literature review examined 17 studies on the relationship between transmission lines and property values.[359] The reviewers concluded that the studies indicate small or no effects on the sale price of properties due to the presence of transmission lines.[360]

Mitigation

Impacts to property values could be mitigated by minimizing aesthetic impacts, perceived EMF health risks, and agricultural impacts. Selecting routes and alignments that maximize the use of existing rights-of-way and that place the transmission line away from residences and out of agricultural fields could address these concerns, thus minimizing impacts to property values. Impacts can be mitigated through inclusion of specific conditions in individual easement agreements with landowners along the transmission line.

For a transmission line the size of the proposed HVTL, impacts could also be mitigated by using the protections of Minnesota Statute 216E.12, subdivision 4 (commonly known as the "Buy the Farm" statute), where available, in effect shielding property owners from potential property value impacts.

6.4.5 Socioeconomics

[358] Final Environmental Impact Statement, Arrowhead–Weston Electric Transmission Line Project, Volume I, Public Service Commission of Wisconsin Docket 05-CE-113, October 2000, p. 212-215.
[359] The Effects of Transmission Lines on Property Values: A Literature Review, Journal of Real Estate Literature, 2010, www.real-analytics.com/Transmission Lines Lit Review.pdf.
[360] Ibid.

The transmission project is located in the counties Cottonwood, Murray, and Redwood. These counties have a relatively lower per capita income than the state of Minnesota as a whole (Table 34). Unemployment rates in Murray and Redwood Counties are slightly lower than the state level of 4.3 percent, while Cottonwood County has an unemployment rate that is slightly higher than the state rate.[361]

The percentage of persons living below the poverty level in Cottonwood and Redwood Counties (15.1 percent and 11.8 percent, respectively) is higher than the state level of 10.5 percent, while the percentage of persons living below the poverty level in Murray County (8.2 percent) is lower than the state level.[362]

The percentage of minority residents in Cottonwood (7.8 percent), Murray (3.3 percent), and Redwood (10.9 percent) Counties is lower than the state level (14.7 percent).However, the total minority populations in Springdale Township and in the City of Walnut Grove are nearly double the state level.[363]

Table 34. Population and Socioeconomic Characteristics of Project Area[364]

	Per Capita Income Level (U.S. dollars)	Unemployment Rate (%)	Persons Living Below the Poverty Level (%)
Minnesota	**34,712**	4.3	10.5
Cottonwood County	27,206	5.1	15.6
Ann Township	53,922	0.0	1.4
Germantown Township	41,742	0.8	0.9
Highwater Township	30,837	0.0	0.0
Westbrook Township	35,510	3.1	13.6
Murray County	30,553	3.6	8.2
Des Moines River Township	30,087	0.0	7.4
Dovray Township	37,868	1.0	7.4
Holly Township	29,183	2.1	8.7
Murray Township	32,115	5.1	0.7
Redwood County	27,543	3.0	11.8
Lamberton Township	28,215	0.0	9.1
North Hero Township	41,526	10.0	5.7

Source: U.S. Census Bureau, 2017

[361] RPA, at pp. 48 – 52.
[362] RPA, at pp. 48 – 52.
[363] Ibid, at pp. 48 – 52.
[364] Ibid, at p.50, Table 6.2.6-1.

The top three industries employing residents in Cottonwood, Murray, and Redwood Counties are educational, health, and social services (average of 23.6 percent), manufacturing (average of 15.4 percent), and agriculture, forestry, fishing, hunting, and mining (average of 11.5 percent).[365]

Approximately 30 workers will be required for construction of the transmission project. These workers will be in the project area from approximately 1 year.[366] Construction personnel would likely commute to the HTVL Project Area on a daily or weekly basis instead of relocating to the area.

Mitigation

Since the presence of workers will likely result in a net financial gain for local economies, workers will spend money on services and supplies in the project area (food, housing), no mitigative measures are proposed.

6.4.6 Zoning and Land Use Compatibility

Transmission lines have the potential to adversely impact existing land uses and to be incompatible with future land uses. Land use in the project area is primarily agricultural.

The routing options predominantly cross areas zoned as agricultural in Cottonwood, Murray, and Redwood Counties. Though a few smaller pockets of residential zoning are crossed by the routes in each county, all of the alignment (ROWs) options are sited outside of any residential parcel boundary, and sited on the opposite side of the road of any residences, in an effort to avoid direct impacts to parcels zoned as residential. No areas zoned as commercial or industrial are crossed by any of the routing options.

Preemption of Local Zoning

This transmission project is subject to Minnesota's Power Plant Siting Act. Under this statute, the route permit issued for a transmission line is "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."[367] Therefore, the applicant is not required to seek permits or variances from local governments to comply with applicable zoning codes. Nonetheless, impacts to local zoning are clearly impacts to human settlements, and the Commission considers impacts to human settlements as a factor in selecting transmission line routes.

[365] Ibid, at pp. 48-52.
[366] Ibid.
[367] Minnesota Statutes, Section 216E.10.

The primary land cover type crossed by the routes is cultivated crop land (**Table 35**), while the next most common land cover type crossed is developed (which includes roads). NLCD land cover type crossed by the anticipated alignments (ROW) is displayed on **Figure 15**.

Green Route

Approximately 64.5 acres of cultivated crop land would be within the 150-foot ROW for the Green Route. Of the remaining 34.7 acres within the ROW, 34.0 are developed land. These developed lands are roads with which the alignment is co-located. Approximately 0.7 acre of emergent herbaceous wetland and less than 0.1 acre of herbaceous land are crossed by the Green Route right-of-way. No hay/pasture, woody wetlands, forest land, or barren land would be within the 150-foot right-of-way of the Green Segment. Typical crops grown in the cultivated crop areas along the Green Route include corn, soybeans, and forage (hay and green chop).[368]

Yellow Route

Approximately 43.1 acres of cultivated crop land would be within the ROW for the Yellow Route. The remaining 47.2 acres within the ROW is developed land, with the exception of less than 0.1 acre of herbaceous land. Developed lands are roads with which the alignment is co-located. No hay/pasture, emergent herbaceous wetlands, woody wetlands, forest land, or barren land would be within the ROW of the Yellow Route. Typical crops grown in the cultivated crop areas along the Yellow Route include corn, soybeans, and forage (hay and green chop).[369]

Blue Route

Approximately 250.4 acres of cultivated crop land would be within the ROW for the Blue Route. Of the remaining 223.2 acres within the ROW, 207.3 acres are developed land. These developed lands are roads with which the alignment is co-located. Approximately 11.2 acres of emergent herbaceous wetland are crossed by the Blue Route ROW, primarily associated with the Cottonwood River. The ROW would include approximately 3.9 acres of hay and pastureland and approximately 0.7 acre of herbaceous land. Forest lands would make up 0.1 acre of the ROW. Typical crops grown in the cultivated crop areas along the Blue Route include corn, soybeans, forage (hay and green chop), and sugar beets.[370]

Red Route

Approximately 257.3 acres of cultivated crop land would be within the ROW for the Red Route. Of the remaining 229.3 acres within the ROW, 209.9 acres are developed land. These developed lands are roads with which the alignment is co-located. Approximately 10.4 acres of emergent herbaceous wetland and 0.2 acre of woody wetland are crossed by the Red Route ROW, primarily associated with the Cottonwood River. The ROW would include approximately 5.3 acres of hay and pastureland and approximately 3.6 acres of herbaceous land. Similar to the Blue Route, the typical crops grown in the

[368] RPA, at pp. 56-64.
[369] Ibid.
[370] Ibid, at pp. 56-64.

cultivated crop areas along the Red Route include corn, soybeans, forage (hay and chop), and sugar beets.[371]

Table 35. Land Cover Types within the Route ROWs[372]

Land Cover/Use Category	Green Segment		Yellow Segment		Blue Segment		Red Segment	
	Acres	Percent	Acres	Percent	Acres	Percent	Acres	Percent
Segment Length (miles)	5.5		5.0		26.1		26.8	
150-foot Right-of-Way (acres)	99.2		90.4		473.6		486.6	
Land Cover w/in ROW								
Cultivated Crops (acres)	64.5	65.0%	43.1	47.7%	250.4	52.8%	257.3	52.9%
Hay/Pasture Land (acres)	0.0	0%	0.0	0%	3.9	0.8%	5.3	1.1%
Emergent Herbaceous Wetlands (acres)	0.7	0.7%	0.0	0%	11.2	2.4%	10.4	2.1%
Woody Wetlands (acres)	0.0	0%	0.0	0%	0.0	0.0%	0.2	< 0.1%
Herbaceous Land (acres)	< 0.1	< 0.1%	< 0.1	< 0.1%	0.7	0.1%	3.6	0.7%
Deciduous Forest (acres)	0.0	0%	0.0	0%	0.1	< 0.1%	0.0	0%
Developed Areas (acres)	34.0	34.3%	47.2	52.2%	207.3	43.8%	209.9	43.1%
Barren Land (acres)	0.0	0%	0.0	0%	0.0	0.0%	0.0	0%
Source: 2016 NLCD (Yang et al., 2018)								

Construction and operation of the HVTL is not expected to have a significant impact on land use within Cottonwood, Murray, and Redwood Counties. Existing land uses will experience minimal, short-term impacts during the period of construction. As described above, the proposed HVTL routes have been co-located with roads and property lines to minimize impacts to non-developed areas. When transmission line construction is complete, Plum Creek will restore impacted areas and land uses will continue as before.

[371] RPA, at pp. 56-64.

[372] Ibid, at pp. 56-64, Table 6.2.9-1.

Mitigation

Impacts to zoning and to current and future land uses due to the transmission project can be mitigated by selecting routes and alignments that are compatible, to the extent possible, with community zoning and land-use plans. Land-use impacts can be mitigated by minimizing aesthetic impacts of the project, to the extent that zoning and land-use plans address aesthetics (landscaping). Land-use impacts can also be mitigated by using existing rights-of-way to the maximum extent possible.

The transmission project is generally compatible with agricultural uses and zoning in the project area and is not anticipated to frustrate planned community growth or impact otherwise protected natural resources.

The likelihood of future residential, commercial, or industrial development within the alignment options is low; therefore, no mitigation measures are proposed

6.4.7 Cultural Values

Cultural values are those community beliefs and attitudes which provide a framework for community unity and animate community actions. Cultural values are informed, in part, by history and heritage. The project area has been home to a variety of persons and cultures. The HVTL project area incorporates parts of Cottonwood, Murray, and Redwood counties.

In the early to mid-1800s, the HVTL project area was populated primarily by Mdewakanton Sioux. In a treaty concluded in 1853, lands in the project area were relinquished by the Sioux to the territory of Minnesota. European settlers in the project area were of German, Norwegian, Danish, Irish, English, and Scottish heritage. Cultural values are also informed by the work and recreation of residents and by geographical features. The project area is primarily rural and agricultural. Farming and the ability to continue to farm and support livelihoods through farming are strong values in the project area. Persons in the project area have various recreational opportunities, including fishing, hunting, and snowmobiling. These opportunities are supported by a variety of natural resources, including lakes, rivers, parks, and wildlife management areas.

In addition, the history surrounding Laura Ingalls Wilder, author of the *Little House on the Prairie* children's book series, plays an important role in the cultural values of the area. The Ingalls Dugout Site (a NHRP-nominated site), is located approximately 1.5 miles north of the town of Walnut Grove and approximately 250 feet east of the Red Route along the banks of Plum Creek.

Cottonwood County was established by the Territorial Legislature May 23, 1857. Because of the Minnesota Dakota Conflict of 1862, permanent settlement of the county did not begin until 1869. County government was formally organized in 1870 and county records date from that time.[373]

Murray County was established in 1857 and formally organized in 1872. Archeological evidence confirms the existence of people in the area during the Late Prehistoric Period (1000–1700 CE). Named for the excavation site that yielded evidence of an early settlement, the Great Oasis People occupied a small woodland area surrounded by a complex of lakes in the northwestern corner of the county. The fate of this group is unknown, and the region appears to have been abandoned by 1200 CE. By the time the first white people arrived (1831) in the area, the Sisseton and Wahpeton Dakota were its primary inhabitants. The first white immigrants in the county lived around Lake Shetek.[374]

Redwood County was first established in 1862 and is one of the largest counties in southern Minnesota. At one time there was nearly 150 lakes. Steamboat travel started up the Minnesota River in 1850 and reached into Redwood County in 1853; the railroads came into the southern part of the country in 1873 and to Redwood Falls in 1878. The Lower Sioux Indian Reservation (also known as the Mdewakankton Tribal Reservation) is entirely within the county, along the southern bank of the Minnesota River in Paxton and Sherman townships.[375]

In the book, *Our Patchwork Nation*, authors Chinni and Gimpel draw on two years of research, interviews and U.S. Census data to offer regional portraits of the U.S. that look at political, social, economic, and cultural perspectives of the entire country county by county. They provide a list of 12 distinct types of communities that comprise the nation.[376] In Chinni and Gimpel's analysis, Cottonwood, Murray, and Redwood counties are characterized as *Emptying Nests* communities. These counties aren't about retirees – or just about them anyway – but they are graying fairly rapidly. Located throughout the Midwest and scattered around Florida they are homes to large numbers of 55-and-over citizens. And their connection to an older vision of America often extends beyond their population. They are not densely populated places, but rather counties full of strings of small towns – often old aging downtowns surrounded by strings of chain restaurants and stores.

Mitigation

No impacts to cultural values are anticipated as a result of the transmission project and therefore no mitigation is deemed warranted. The project will not adversely impact the work or recreation of residents in the project area that underlie the area's cultural values, nor will it adversely impact geographical features, such as the Ingalls Dugout, that inform these values.

[373] Cottonwood County Historical Society.
[374] Murray County Historical Society. *A History of Murray County, Minnesota*. Marceline, MO: Walsworth Publishing Company, Inc., 1982.
[375] Redwood County Historical Society.
[376] Chinni and Gimpel. Our Patchwork Nation: The Surprising Truth About the "Real" America. ISBN 1-101-46213-2.

6.4.8 Electronic Interference

This chapter summarizes the potential impacts of the project on electronic communications and communication devices, including radios, televisions, and microwave communications. Global positioning system (GPS)-based agricultural navigation systems are discussed in Section 6.6.1.3, and medical electronic devices are discussed in Section 6.5.2.

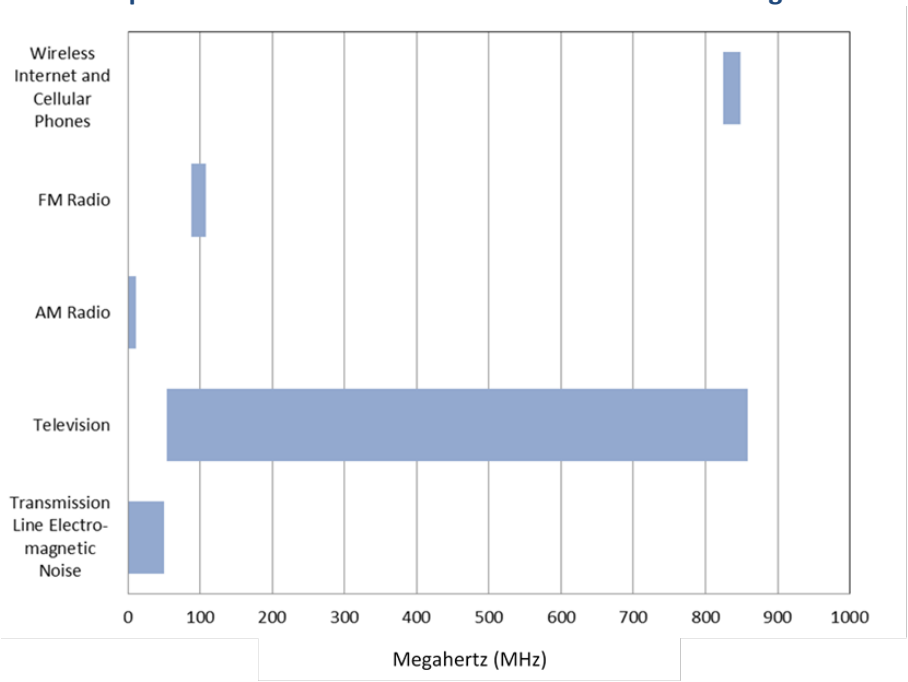
Electronic interference could result from electromagnetic noise created by the ionization of air molecules surrounding transmission line conductors. This ionization is commonly known as corona. Interference could also result from transmission line structures which block line-of-sight communications.

No impacts to electronic devices are anticipated as a result of the project. Interference due to electromagnetic noise is not anticipated. Interference due to line-of-sight obstruction could occur in select areas but could be mitigated by prudent placement of transmission line poles and electronic antennas. In situations where interference with electronic devices does occur and is caused by the presence or operation of the transmission line, route permits issued by the Commission require permittees to take those actions which are feasible to restore electronic reception to pre-project quality (Appendix C).

Electromagnetic noise from transmission lines may interfere with electronic communications when it is generated at the same frequencies as communication and media signals. This noise could interfere with the reception of these signals depending on the frequency and strength of the signal and distance from the electromagnetic noise source. Corona interference from transmission lines causes the greatest disturbance in a relatively narrow frequency spectrum, in the range of about 0.1 to 50 megahertz (MHz). Because many communication and media signals are transmitted at higher frequencies, impacts to communication signals are limited. Diagram 18 compares the spectrum of transmission frequencies for several communication and media signals to the frequencies associated with electromagnetic noise from transmission lines.

Additional discussion is provided below for each major type of media or communication signal. Plum Creek conducted online research to identify radio, television, and cell phone towers located within the HVTL Project Study Area.

Diagram 18. Frequencies of Electronic Communication and Electromagnetic Noise[377]



6.4.8.1 Radio

There are numerous AM and Frequency Modulation (FM) radio broadcasting stations such as KNSW (91.7 FM), KARZ (94.7 FM), KUSQ (95.1 FM), KKCK (99.7 FM), KWOA (730 AM), KNUJ (860 AM), KKOJ (1050 AM), and KMHL (1400 AM) that operate or can be heard within the HVTL Project Study Area.[378]

Electromagnetic interference could affect AM and FM radio receivers. However, electromagnetic noise created by transmission lines overlaps only with AM radio frequencies (Diagram 18). This interference typically occurs directly under a transmission line and dissipates rapidly to either side. Otherwise, satisfactory reception could be obtained by appropriately modifying or moving the receiving AM antenna.

FM radio receivers usually do not pick up interference from transmission lines because corona-generated electromagnetic noise is quite small in the FM broadcast band (88–108 MHz) and because FM radio systems have excellent interference rejection properties that make them immune to amplitude-type disturbances.

[377] Marshall Brain "How the Radio Spectrum Works" 1 April 2000.HowStuffWorks.com. https://electronics.howstuffworks.com/radio-spectrum.htm.
[378] RPA, at p. 67.

Two-way radios used for emergency services typically operate at frequencies greater than 150 MHz. Minnesota has moved to a statewide emergency communications system that operates at 800 MHz.[379] Corona-generated electromagnetic noise is minimal at these frequencies and no impacts to these radio systems are anticipated.

6.4.8.2 Television

There are more than 45 channels broadcast in the HVTL Project Study Area; these channels would be received from cities including Redwood Falls, Mankato, and Worthington, Minnesota.[380]

Television broadcast frequencies occur in the 54–806 MHz range and are high enough that they are relatively immune to corona-generated noise (Diagram 18). Digital television transmissions are not dependent on waveforms to transfer broadcast content, but rather on packets of binary information, which, in general, are less susceptible to corruption and can be corrected for errors. Satellite television is transmitted in the Ku band of radio frequencies (12,000–18,000 MHz) and is likewise immune to corona-generated noise.

Both digital and satellite television reception could be affected by multi-path reflections (shadowing) generated by nearby towers. An outdoor antenna might be necessary to resolve issues with multi-path reflections. Satellite television is susceptible to line-of-sight interference due to transmission line structures. However, reception can usually be restored by moving the affected satellite antenna to a slightly different location.

Cable television is a redistributed form of satellite broadcast and is generally not susceptible to interference due to the use of shielded coaxial cable. Cable broadcasts could suffer interference if the satellite broadcast suffers interference (e.g., line-of-sight obstruction).

6.4.8.3 Internet and Cellular Phones

Wireless internet and cellular phones use frequencies in the 900 MHz ultra-high frequency (UHF) range (Diagram 18)—a range for which impacts from corona-generated noise are anticipated to be minimal. If internet service at a residence or business is provided by a satellite antenna, this service could be impacted by a line-of-sight obstruction. As with other satellite reception, any interference due to an obstruction could be resolved by moving the satellite antenna to a slightly different location.

6.4.8.4 Microwave Communication

[379] Minnesota Department of Public Safety, Emergency Communication Networks https://dps.mn.gov/divisions/ecn/about/Pages/default.aspx.
[380] RPA, at p. 67.

Electromagnetic noise from transmission lines is not an issue for microwave communications. However, microwave communications can be physically blocked by taller transmission structures. Microwave beams are transmitted along aerial pathways between microwave communication towers. Microwave beam pathways can extend as close as 150 feet to the ground. Transmission line structures for this project would be 110 feet to 125 feet tall. Thus, obstruction of microwave beam pathways is unlikely. Any potential impacts could be avoided during project design by identifying the microwave beam pathways in the project area and siting the transmission line structures at locations where they would not interfere with any identified pathways.

Mitigation

Since no electronic interference is anticipated, no mitigation beyond those captured in the prudent design of the routes and placement of structures is warranted. Should unforeseen issues develop, the route permit contains requirements to address these issues (Appendix C).

6.4.9 Transportation

Transmission line projects have the potential to impact local transportation networks such as roadways, railroads, airports, and airstrips. Heavy equipment used during construction has the potential to damage existing road surfaces and local roadways could experience temporary road and/or lane closures during construction. The inflow of construction contractors could increase traffic volumes on local roadways. Co-location of transmission lines with existing public roads could complicate future roadway expansion or realignments and could interfere with routine maintenance of roadways. In addition, if a transmission line is sited too close to an operating railroad, it could interfere with safe operation of the railroad.[381]

The Federal Aviation Administration (FAA) and the MNDOT have both established guidelines for development of transmission lines near public airports. The FAA has developed height restrictions for development near public airports and has developed guidelines for placement of buildings and other structures near high frequency omni-directional range navigation systems

MNDOT has established zoning areas around public airports that restrict the area where buildings and other structures can be placed. Both the FAA and MNDOT guidelines apply only to public airports and are not applicable to private airstrips.

6.4.9.1 Roadways

Existing road infrastructure along the potential routes primarily consists of paved and unpaved county and township roads that typically follow section lines.

[381] RPA, at pp. 68 – 71.

The Green and Yellow Routes do not cross and are not co-located with any United States or state highways; these segments primarily cross and are co-located with CSAHs and township roadways (Table 36).

U.S. Highway 14 and State Highway 68 are the main roadways crossed by the Blue and Red Routes. U.S. Highway 14 extends east to west across southern Redwood County and passes through the Town of Walnut Grove in the HVTL Project Study Area and Revere and Tracy east and west of the HVTL Project Study Area, respectively. State Highway 68 extends east to west across central Redwood County and passes through Wabasso and Milroy east and west of the HVTL Project Study Area, respectively. Multiple paved county roads are crossed by or exist within the HVTL Project Study Area for both the Blue and Red Routes, along with numerous other paved and unpaved roads.

Table 36. Annual Average Daily Traffic on Roads Co-located with the Application Segments[382]

Segment	Road	County	AADT	Traffic Count Year	Co-located Distance (miles)
Green	CSAH 7	Cottonwood	600	2016	0.5
	340th Avenue	Cottonwood	40	2016	0.5
Yellow	CSAH 11	Cottonwood	55	Prior to 2012	2.0
	CSAH 11	Cottonwood	40	Prior to 2012	1.0
	340th Avenue	Cottonwood	40	2016	1.0
Blue	210th Street	Cottonwood	25	Prior to 2012	1.0
	CSAH 45	Cottonwood	165	2015	0.5
	U.S. 14	Redwood	1750	2017	1.0
	CSAH 10	Redwood	200-230	2015	9.25
	160th Street	Redwood	50	Prior to 2013	0.5
	220th Street	Redwood	20	Prior to 2013	0.5
	Minnesota Highway 68	Redwood	1150	2017	1.0
Red	210th Street	Cottonwood	25	Prior to 2012	1.0
	CSAH 7	Cottonwood	640	2016	1.5
	Duncan Avenue	Redwood	370	Prior to 2013	3.0
	CSAH 5	Redwood	495	2015	5.1
	County Road 74/250th Street	Redwood	80	2015	1.0

Source: Minnesota Department of Transportation (MNDOT), 2019

[382] RPA, at p. 69, Table 6.2.12-1.

Most of the roads in the project area have minimal daily traffic, so road and/or lane closures and increases in traffic associated with hauling and travel to the construction site are expected to produce localized impacts to a relatively limited number of motorists.

Right-of-way Sharing and paralleling

The Blue Route parallels U.S. Highway 14 on the south side of the eastbound lane for approximately one mile east of Walnut Grove.

Siting transmission lines along existing ROWs can minimize the proliferation of new utility ROW and the effects on private landowners. In order to share or occupy ROW, however, the applicant would have to acquire necessary approvals from the ROW owner (like the county). Any occupation of state highway right-of-way requires a Utility Permit from the MNDOT, per Minn. R. Ch. 8810.3100-3600. MNDOT's Accommodation Policy provides requirements and guidelines for the installation of utility facilities in and along MNDOT rights-of-way, which the HVTL Project was developed to meet.

In an April 8, 2020, letter MNDOT indicated that the Blue Route has the potential to cross and parallel US 14 and that the potential aerial encroachment of US 14 may not be allowed if the placement of the line cannot meet the more restrictive Clear Zone requirements in that area.[383] In testimony provided by Jordan Burmeister, Plum Creek has proposed either shifting the alignment 20 feet away from the road right-of-way or using the same alignment with a vertical single-pole configuration in this area to ensure the right-of-way for the Transmission Line does not overlap MnDOT right-of-way and avoids any impacts on the clear zone.[384]

Mitigation

The primary means of mitigating potential impacts to roadways is by coordinating with roadway authorities and by considering the need for roadways to be safely operated and maintained. Plum Creek indicates it will coordinate construction activities with MnDOT and the affected counties to develop a traffic management plan that minimizes disruption to local traffic during construction.[385] Construction and installation of utility lines within road ROW will require permits from the appropriate regulatory agencies. These permits are aimed at minimizing short-term impacts and ensuring that the transmission line does not have any long-term impacts on the safe and efficient operation of the roadways.

6.4.9.2 *Railways*

[383] MNDOT Comment Letter, April 8, 2020. eDocket No. 20204-161919-01.
[384] Direct Testimony of Jordan Burmeister, August 28, 2019. eDocket No. 20208-166266-07.
[385] RPA, at pp. 68 – 71.

The Green and Yellow Routes do not cross and are not co-located with railroads. Both the Blue and Red Routes cross one Dakota, Minnesota and Eastern (DME) Railroad east of Walnut Grove. The Blue Route overlaps this railroad for one mile between Eagle Avenue and CSAH 10 and parallel to U.S. 14. In this location, the proposed alignment (ROW) is sited immediately outside the U.S. 14 ROW, and over 300 feet from the rail line. The Red Route crosses the DME Railroad along Duncan Avenue, immediately east of Walnut Grove.

Impacts to the DME Railroad are not anticipated as a result of construction and operation of the HVTL Project. Plum Creek has stated that all of the necessary railroad crossing permits will be obtained from DME for their rail line. Additionally, Plum Creek has indicated that they will coordinate with the appropriate railroad personnel during construction to schedule electrical conductor stringing over the rail line will be for the safety of construction personnel and rail line operations.[386]

Mitigation

Similar to roadways, the primary means of mitigating potential impacts to railways is by coordinating with authorities and by considering the need for this infrastructure to be safely operated and maintained in the design of the HVTL project.

6.4.9.3 Airports and Airstrips

There are no operating public-use or private-use airports or heliports in the HVTL Project Study Area. The nearest public airport is located approximately 4.5 miles west of the HVTL Project Study Area in Tracy, Minnesota. There are no known private landing strips in the HVTL Project Study Area.

Aerial crop dusting can be an important part of agricultural activities within the HVTL Project Study Area and various fields crossed by the proposed routes may be subject to these activities.

Because there are no operating public-use or private airports or heliports in the HVTL Project Study Area impacts to airports and airstrips are not anticipated. Plum Creek will coordinate with the FAA and MNDOT to address any HVTL project-related concerns for aviation activities as the HVTL Project progresses and more detailed design information becomes available, including specific structure locations and heights above ground.

Plum Creek will mail notice of the FAA Application filing to aerial applicators registered with the Minnesota Agricultural Aircraft Association in the HVTL Project Study Area.[387]

Mitigation

[386] RPA, at pp. 68 – 71.
[387] Ibid.

No impacts to airports or airstrips are anticipated, therefore, no mitigation is necessary.

6.4.10 Public Utilities

Transmission lines have the potential to damage or interfere with the use of public utilities. The presence of a transmission line could also preclude construction and operation of new utility infrastructure.

The proposed project is in a rural area, and water and sanitary services are supplied to area residences by individual wells and septic systems. Electrical service is provided by Nobles Cooperative Electric, South Central Electric Association, and Redwood Electric Coop. Natural gas for the HVTL Project Study Area is provided by Great Plains Natural Gas Company and Minnesota Energy Resources Corporation. In addition to the Great Plains Natural Gas Company and Minnesota Energy Resources Corporation's facilities, the Blue and Red Routes also cross one Northern Natural Gas pipeline in Redwood County.

The Green and Yellow Segments do not cross existing pipelines.

With proper coordination, project construction and operation should not directly affect any of these public utilities, regardless of the route chosen. Construction of the transmission project will temporarily increase the population and workforce present within the vicinity of the Project. This increase in population may temporarily increase in individuals requesting the use of public services. However, this minimal increase in population should not create the need for more public services than already exist. Therefore, impacts to the public services system associated with a temporary increase in population are not anticipated.

Mitigation

No impacts to Public Utilities are anticipated, therefore, no mitigation is necessary.

6.4.11 Emergency Services

Emergency response services in the project area are provided by local law enforcement and emergency response agencies located in nearby communities. Cottonwood, Murray, and Redwood Counties have sheriff departments that provide services to their respective counties. Additionally, the cities of Windom, Redwood Falls, Marshall, Lamberton, and Wabasso have local police departments. Fire services within the area are provided by city and community fire departments, including Windom, Redwood Falls, Marshall, Lamberton, and Wabasso.

Ambulance response is provided by local ambulance services. The Windom Ambulance Service provides response services to a 200-square-mile region surrounding Windom, Minnesota. North Memorial Health Ambulance provides service to area surrounding Marshall, Minnesota, including

Redwood Falls. The Wabasso Ambulance Association provides ambulance service in the center of Redwood County, Minnesota.

Regardless of the route chosen, project construction should not directly affect emergency services in the project area because any temporary road closures that may affect access to emergency response services would be coordinated with local jurisdictions to ensure that safe alternative access is available for police, fire and other rescue vehicles. Any accidents that might occur during construction of the transmission project would be handled through local emergency services. Due to the relatively small number of construction workers on the project, the existing emergency services should have sufficient capacity to respond to any emergencies.

Hospitals within the HVTL project area include the Redwood Area Hospital in Redwood Falls, Windom Area Health in Windom, and Murray County Medical Center in Slayton. Smaller medical clinics or medical centers in the area include the Murray County Clinic in Fulda, Mayo Clinic Health System in Lamberton, and Sanford Tracy Walnut Grove Clinic in Walnut Grove. Sanford Tracy Medical Center in Tracy, Sanford Westbrook Clinic in Westbrook, and various eye clinics, dental offices, and chiropractors.

Mitigation

No impacts to Emergency Services are anticipated, therefore, no mitigation is necessary.

6.5 Public Health and Safety

Transmission line projects have the potential to negatively impact public health and safety during both construction and operation of the project. As with any project involving heavy equipment and transmission lines, there are safety issues to consider during construction. Potential health and safety impacts include injuries due to falls, equipment use, and electrocution. Potential health impacts related to the operation of the project include health impacts from electric and magnetic fields (EMF), stray voltage, induced voltage, impaired air quality, and electrocution.

Impacts to public health and safety resulting from the project are anticipated to be minimal. No adverse health impacts due to EMF, stray voltage, induced voltage, or air emissions are anticipated. The project would have protective devices to safeguard the public from the line if an accident occurred and a structure or conductor fell to the ground. These protective devices are circuit breakers and relays located within connecting substations. The protective equipment would de-energize the transmission line, should such an event occur.

6.5.1 Electric and Magnetic Fields

Electric and magnetic fields (EMFs) are invisible regions of force resulting from the presence of electricity and are produced by all electric devices, including transmission and distribution lines. Naturally occurring EMFs are caused by the earth's weather and geomagnetic field. Man-made EMFs are caused by electrical devices and are characterized by the frequencies at which they alternate, that is, the rate at which the fields change direction each second. All electrical lines in the United States have a frequency of 60 cycles per second or 60 Hertz (Hz). EMFs at this frequency level are known as extremely low frequency (ELF) EMF.

Electric fields on a transmission line are solely dependent upon the voltage of the line, not the current. Electric field strength is measured in kilovolts per meter (kV/m), and 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 or buildings.

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

This chapter summarizes the potential health impacts of transmission line EMF, regulatory standards, and predicted EMF levels from this project. Appendix F provides detailed background on EMF health impact research.

6.5.1.1 Magnetic Field Background Levels

The wiring and appliances located in a typical home produce an average background magnetic field of between 0.5 mG and 4 mG [388]. A U.S. government study conducted by the EMF Research and Public Information Dissemination Program determined that most people in the United States are on average exposed daily to magnetic fields of 2 mG or less.[389] Typical magnetic field strengths near common appliances are shown in Table 37.

6.5.1.2 Health Studies and Potential Health Impacts

A concern related to EMFs is the potential for adverse health effects due to EMF exposure. In the 1970s, epidemiological studies indicated a possible association between childhood leukemia and EMF levels. Since then, various types of research have been conducted to examine EMF and potential

[388] EPA. 1992. *EMF in Your Environment, Magnetic Field Measurements of Everyday Electrical Devices*. 1992. https://nepis.epa.gov/
[389] National Institute of Environmental Health Sciences. 2002. EMF *Electric and Magnetic Fields Associated with the Use of Electric Power - Questions & Answers*. June 2002. https://www.niehs.nih.gov/health/materials/electric_and_magnetic_fields_associated_with_the_use_of_electric_power_questions_and_answers_english_508.pdf.

health effects, including animal studies, epidemiological studies, clinical studies, and cellular studies. Scientific panels and commissions have reviewed and studied this research data (Appendix F). In general, these studies concur that:

- There is an association between childhood leukemia and EMF exposure. There is no consistent association between EMF exposure and other diseases in children or adults.
- Laboratory, animal, and cellular studies fail to show a cause-and-effect relationship between disease and EMF exposure at common EMF levels. A biological mechanism for how EMF might cause disease has not been established.

Because a cause-and-effect relationship cannot be established, and yet an association between childhood leukemia and EMF exposure has been shown, there is:

- Uncertainty as to the potential health effects of EMF.
- No methodology for estimating health effects based on EMF exposure.
- A need for further study of the potential health effects of EMF.
- A need for a prudent avoidance approach in the design and use of all electrical devices, including transmission lines.

Table 37. Typical Sources of Magnetic Field[390]

Source	Distance from Source (feet)			
	0.5	1	2	4
Air Cleaners	180	20	3	-
Copy Machines	90	20	7	1
Fluorescent Lights	40	6	2	-
Computer Displays	14	5	2	-
Hair Dryers	300	1	-	-
Baby Monitor	6	1	-	-
Microwave Ovens	200	4	10	2
Vacuum Cleaner	300	60	10	1

6.5.1.3 Regulatory Standards

There are currently no federal regulations regarding allowable electric or magnetic fields produced by transmission lines in the United States. A number of states, however, have developed state-specific regulations (Table 38), and a number of international organizations have adopted EMF guidelines (Table 39).

[390] EPA. 1992. *EMF in Your Environment, Magnetic Field Measurements of Everyday Electrical Devices*. 1992. https://nepis.epa.gov/

The Commission has established a standard that limits the maximum electric field under transmission lines to 8 kV/m. All transmission lines in Minnesota must meet this standard. The Commission has not adopted a magnetic field standard for transmission lines. The Commission has, however, adopted a prudent avoidance approach in routing transmission lines and, on a case-by-case basis, considers mitigation strategies for minimizing EMF exposure levels associated with transmission lines.

Table 38. State Electric and Magnetic Standards[391]

State	Area where limits applies	Field	Limit
Florida	Edge of ROW	Electric	2 kV/m (lines ≤ 500 kV)
		Magnetic	150 mG (lines of ≤ 230 kV) 200 mG (>230 kV - ≤ 500) 250 mG (>500 kV)
	On ROW	Electric	8 kV/m (≤230 kV) 10 kV/m (>230 kV - ≤ 500) 15 kV/m (>500 kV)
Minnesota	On ROW	Electric	8 kV/m
Montana	Edge of ROW(1)	Electric	1 kV/m
	Road crossings	Electric	7 kV/m
New Jersey	Edge of ROW	Electric	3 kV/m
New York	Edge of ROW	Electric	1.6 kV/m
		Magnetic	200 mG
	Public road crossings	Electric	7 kV/m
	Private road crossings	Electric	11 kV/m
	On ROW	Electric	11.8 kV/m
Oregon	On ROW	Electric	9 kV/m

(1) May be waived by landowner.

Some public health scientists have questioned whether state and international EMF guidelines sufficiently protect public health. These scientists have urged state utility commissions to be more rigorous in applying a precautionary or prudent avoidance approach. Dr. David Carpenter, a public health physician at the University of Albany, and Cindy Sage, an EMF researcher, note that there is

[391] National Institute of Environmental Health Sciences. 2002. EMF *Electric and Magnetic Fields Associated with the Use of Electric Power - Questions & Answers*. June 2002. https://www.niehs.nih.gov/health/materials/electric_and_magnetic_fields_associated_with_the_use_of_electric_power_questions_and_answers_english_508.pdf.

"strong scientific evidence that exposure to magnetic fields from power lines greater than 4 mG is associated with an elevated risk of childhood leukemia"[392].

They conclude that the evidence for effects on human health from ELF-EMF is strong enough to merit regulatory action to reduce EMF exposure levels. They suggest that "such a reduction could be achieved by setting EMF exposure goals that are lower than levels known to be associated with disease, understanding that these exposure goals are significantly lower than many current exposures." Dr. Carpenter and Ms. Sage, in collaboration with other public health researchers, have also authored the *BioInitiative Report*, which argues for a more proactive application of a precautionary approach to radio frequency and ELF-EMF.[393]

Table 39 International Electric and Magnetic Field Guidelines[394]

Organization	Electric Field (kV/m)		Magnetic Field (mG)	
	General Public	Occupational	General Public	Occupational
Institute of Electrical and Electronics Engineers	5	20	9,040	27,100
International Commission on Non-ionizing Radiation Protection	4	8	2,000	4,200
American Conference of Industrial Hygienists	-	25	-	10,000/1,000(1)
National Radiological Protection Board	4	-	830	4,200
(1) For persons with cardiac pacemakers or other medical electronic devices.				

For the Brookings County to Hampton 345 kV transmission line project (Commission docket number TL-08-1474), Dr. Carpenter testified before the Commission on behalf of a party which argued that magnetic field levels for that project would exceed safe exposure levels. Testimony was provided in opposition to Dr. Carpenter's opinion by Dr. Peter Valberg. After examining and weighing the competing testimony of Drs. Carpenter and Valberg, the administrative law judge and, ultimately, the Commission, determined that the state's current exposure standard for ELF- EMF (an electric field standard of 8 kV/m) is adequately protective of human health and safety.

Based on the predicted EMF levels for the project, no adverse health impacts from electric or magnetic fields are anticipated for persons living or working near the project. The applicant has modeled and calculated electric and magnetic fields for the project, reflecting structure configurations that may be used for the project and two electrical loading scenarios.

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[392] Carpenter, D. O. and Sage, C. *Setting prudent public health policy for electromagnetic field exposures*. Reviews of Environmental Health. 2008, Vol. 23, 2, pp. 91-117.

[393] BioInitiative Working Group. 2012. *A Rationale for Biologically based Exposure Standards for Low-Intensity Electromagnetic Radiation*. Prepared for BioInitiative Working Group. 2007. https://bioinitiative.org/.

[394] International Commission on Non-ionizing Radiation Protection. 2010. *Guidelines for Limiting Exposure to Time-Varying Electric and Magnetic Fields (1 Hz – 100 kHz)*. Health Physics. Vol. 99, 6, pp. 818-836. https://www.icnirp.org/cms/upload/publications/ICNIRPLFgdl.pdf

Predicted Electric Fields

Predicted maximum electric fields for the project vary by structure type, but in all cases are anticipated to be less than the Commission's 8 kV/m standard (Table 40 and Diagram 19). Electric field modeling was conducted based on the assumption of a 2-bundled 954 kcmil 54/7 "Cardinal" ACSR (1.196-inch diameter) or 1,272 kcmil 45/7 "Bittern" ACSR (1.345-inch diameter). The project's maximum predicted electric field, modeled at 1 meter above ground, for the single circuit "Cardinal" configuration is 6.80 kV/m at 15 feet from the centerline; for the "Bittern" configuration the maximum calculated electric field is 6.89 kV/m at 15 feet from the centerline.[395] The strength of the electric fields diminishes rapidly as the distance from the conductor increases.

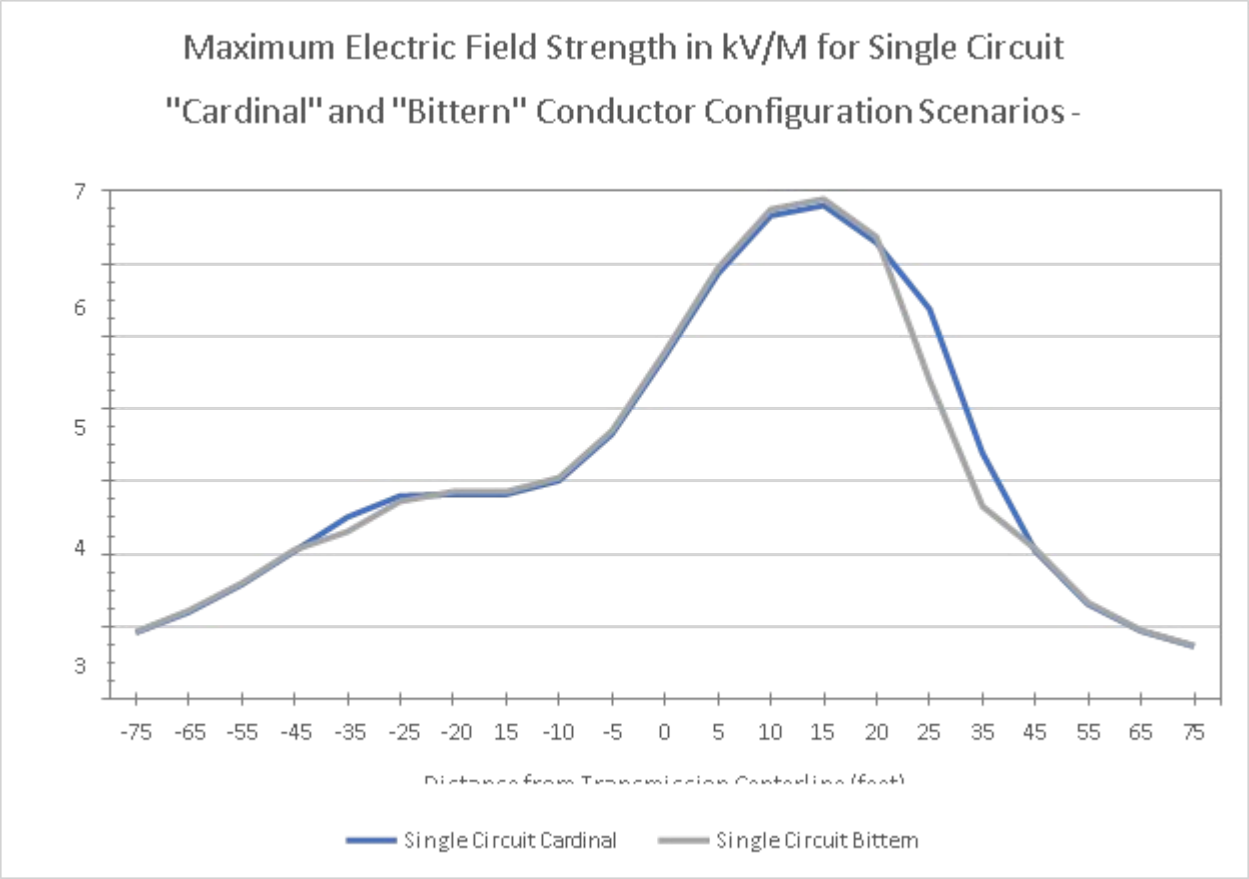
Table 40. Predicted Electric Fields for Structure Types and Configurations (kV/m)[396]

Electric Field Strength (kV/M)1 Distance from Centerline (feet)															
Configuration	-75	-65	-55	-35	-25	-15	-5	0	5	15	25	35	55	65	75
Cardinal	0.92	1.2	1.58	2.51	2.8	2.82	3.65	4.72	5.86	6.8	5.37	3.39	1.31	0.94	0.73
Bittern	0.93	1.22	1.6	2.31	2.73	2.86	3.7	4.78	5.94	6.89	4.39	2.66	1.33	0.95	0.74

1 Electric field values are the same for 207 MW and 414 MW loading

[395] RPA, at p. 34, and Appendix G.
[396] Ibid, at p. 35, Table 6.2.2-1.

Diagram 19. Predicted Electric Field[397]



Predicted Magnetic Fields

Predicted magnetic field levels depend on anticipated currents (amps) on the transmission line, which in turn depend on the electrical load served by the line. The larger the expected current flow, the higher the predicted magnetic field.

The Yellow and Green Routes, which run between Collector Substation 1 and Collector Substation 2 located inside the LWECS site boundaries, will have a maximum conductor loading of 207 MW. At a 207 MW conductor loading, the peak magnetic field from the single circuit direct-embed steel poles in delta configuration is 64.8 mG at 10 feet from the centerline. At the edge of the right-of- way (75 feet from the centerline), the peak magnetic field from the single circuit direct- embed steel poles in delta configuration is 12.60 mG.[398]

The Blue and Red Routes, which run from Collector Substation 1 to the Switching Station, has a maximum conductor loading of 414 MW. At a 414 MW conductor loading, the peak magnetic field from the single circuit direct-embed steel poles in delta configuration is 129.62 mG at 10 feet from the

[397] Ibid, at Figure 6.2.2-1.
[398] RPA, at pp. 37 – 39, and Appendix G.

centerline At the edge of the right-of-way (75 feet from the centerline), the peak magnetic field from the single circuit direct-embed steel poles in delta configuration is 25.19 mG.[399]

The magnetic field profiles for the single circuit scenarios are provided in Table 41 and Diagram 20 provides a graphic representation of the information. Magnetic field values for the "Cardinal" or "Bittern" configurations would be the same.

Mitigation

No adverse health effects from EMF are anticipated for the project. However, consistent with the Commission's prudent avoidance approach to EMF impacts, basic mitigation measures to minimize EMF exposure levels warrant consideration. Such strategies are discussed below. These strategies are discussed individually, but in some instances or for specific sections of a route, they could be combined.

Table 41. Predicted Magnetic Fields (mG)[400]

Magnetic Field Strength (mG) Negative Direction from Centerline (feet)											
	-75	-65	-55	-45	-35	-25	-20	15	-10	-5	0
Single Circuit – 207 MW (Green/Yellow Segments)	9.93	12.49	16.01	20.87	27.5	36.18	41.21	46.56	52.00	57.21	61.63
Single Circuit – 414 MW (Blue/Red Segments)	19.86	24.99	32.02	41.74	55.01	72.36	82.43	93.12	104.01	114.43	123.27
Magnetic Field Strength (mG) Positive Direction from Centerline (feet)											
	0	5	10	15	20	25	35	45	55	65	75
Single Circuit – 207 MW (Green/Yellow Segments)	61.63	64.46	64.8	62.21	57.16	50.77	38.03	28.08	21.03	16.1	12.6
Single Circuit – 414 MW (Blue/Red Segments)	123.27	128.94	129.62	124.44	114.32	101.54	76.07	56.18	42.07	32.2	25.19

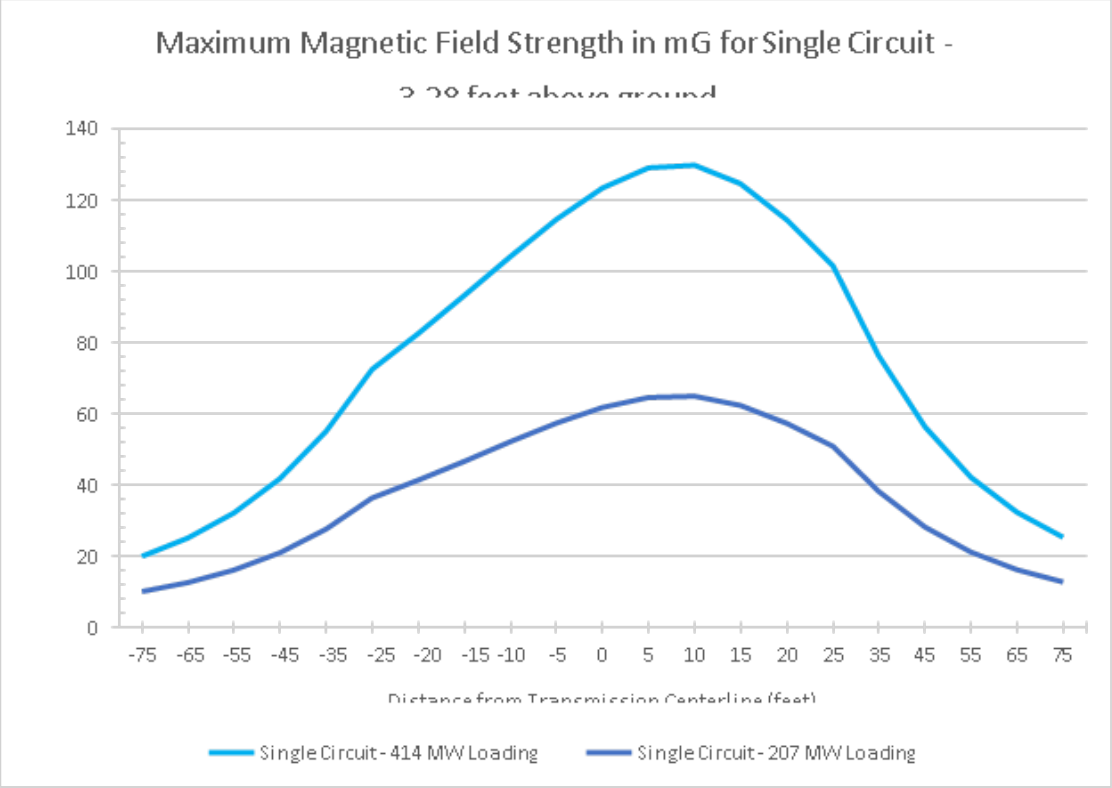
[399] Ibid.
[400] RPA, at Table 6.2.2-2, and Appendix G.

Distance

EMF levels decrease with distance from a conductor. Thus, EMF exposure levels could be reduced by selecting a route away from residences and from other places where people congregate. Distances of residences along the routing alternatives for the transmission project are shown in Table 32.

A second means of increasing distance is to use taller structures, which, by placing conductors at a greater height, reduce EMF levels at or near ground level. The 110- to 125-foot above grade, monopole structures proposed for the transmission project help reduce ground level electric and magnetic field strength.

Diagram 20. Predicted Magnetic Fields[401]



Phase Cancellation

EMF levels could be reduced by a phenomenon known as phase cancellation. Electrical power is generally transmitted along three parallel conductors, each carrying a single phase of the power being transmitted. The closer these phases/conductors are to each other, the lower the magnetic fields produced. In other words, when the magnetic fields of the individual conductors are close together, they tend to cancel each other out. The conductors can be phased within a circuit so that the EMF emitted by each can partially cancel the others; or if more lines are present on the ROW, their

[401] RPA, at p. 39, Figure 6.2.2-1.

conductors can be phased as well to allow for additional EMF cancelling. Often times, if a new line is constructed on an existing ROW, it can be phased to allow for a lower EMF post construction. Phasing will sometimes create a higher peak EMF near the center of the ROW with a lower EMF at the ROW edge; however, the edge is typically the location subject to regulatory requirements.

There are limits, however, on how close together conductors can be placed. The distance between conductors must meet National Electrical Safety Code (NESC) clearances, and there must be sufficient clearance to ensure the safety of utility workers. Placing conductors closer together would also require more transmission line structures per mile to better control conductor blowout and sag.

Another option is to alter the configuration of the line. The location of the conductors and shield-wires within the circuit can have a significant effect on EMF. For example, a vertical line has conductors higher than a horizontal line reducing their effective EMF at ground level; and a delta configuration will have a similar effect. A reduction in phase spacing generally correlates directly to a reduction in magnetic field, so the location and quantity of shield wires can also affect EMF. Hardware modifications, like the addition of V-strings that may move the conductors up and closer to the center of the ROW, can have similar effects.

In certain circumstances, it may be appropriate to install a passive shield line to reduce EMF on an existing circuit. The passive shield line is a 'dummy' line that emits EMF, which directly opposes the EMF of the transmission lines. The 'dummy' line would be a short line that forms a closed loop under each side of the transmission line of concern. Using the current induced by the magnetic field of the transmission line, it emits its own magnetic field and can be designed and phased to effectively cancel out the existing EMF. However, modifications can be visually unappealing, and would increase line losses.

Undergrounding

Placing a transmission line underground could reduce EMF exposure levels. Electric fields are reduced by the underground facilities and earth covering. Magnetic fields are not reduced by covering materials but could be attenuated by phase cancellation because underground conductors are placed closer together than overhead conductors. Though a possible EMF mitigation measure, undergrounding high-voltage transmission lines is generally not feasible for cost and reliability reasons.

Double Circuiting

Instead of placing one circuit (three conductors) on a transmission line structure, two circuits (six conductors) could be placed on each structure. The benefit of double circuiting is that the phases of the two circuits could be arranged such that their magnetic fields cancel each other out, thereby reducing the net magnetic field. As discussed in Section **4.2.2**, double circuiting is not feasible for this transmission line.

6.5.2 Implantable Medical Devices

Electromechanical implantable medical devices, such as cardiac pacemakers, implantable cardioverter defibrillators (ICDs), neurostimulators, and insulin pumps may be subject to interference from electric and magnetic fields, which could mistakenly trigger a device or inhibit it from responding appropriately.

ICD manufacturers' recommended threshold for modulated magnetic fields is one gauss. Since one gauss is five to 10 times greater than the magnetic field likely to be produced by a high-voltage transmission line,[402] research has focused on electric field impacts. A 2004 Electric Power Research Institute report states that sensitivity to electric fields was reported at levels ranging upwards from 1.5 kV/m, particularly for older (unipolar) pacemakers; some modern (bipolar) units are immune at 20 kV/m. Medtronic and Guidant, manufacturers of various implantable medical devices, have indicated that electric fields below 6.0 kV/m are unlikely to affect most of their devices.[403]

Scholten conducted a theoretical study evaluating the risk for a patient with a unipolar cardiac pacemaker under worst case and real life conditions under a high- voltage transmission line.[404] This study concluded that a life threatening situation for cardiac pacemaker patients beneath high-voltage transmission lines is very unlikely; however, an interference between the implant and the electromagnetic fields cannot be excluded. Definitive conclusions about the real risk can be drawn only by conducting additional studies with pacemaker patients.

The maximum predicted electric field strength for the project is 6.89 kV/m (Table 40). This field strength is slightly above the 6.0 kV/m interaction level for modern, bipolar pacemakers, and significantly above the 1.5 kV/m interaction levels for older, unipolar pacemakers. Electric field levels decrease with distance, however, and maximum levels at the edge of the ROW (0.93 kV/m) are anticipated to be less than 1 kV/m. Accordingly, impacts to implantable medical devices and their users are anticipated to be minimal.

In the event that a cardiac device is affected, the effect is typically a temporary asynchronous pacing (fixed-rate pacing), and the device returns to its normal operation when the person moves away from the source of the electric field.[405]

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[402] Public Service Commission of Wisconsin. 2013. *Environmental Impacts of Transmission Lines*. https://psc.wi.gov/Documents/Brochures/Enviromental%20Impacts%20TL.pdf

[403] Electric Power Research Institute. 2004. *Electromagnetic Interference with Implanted Medical Devices*.

[404] Scholten, A., Joosten, S. and Silny, J. 2005. *Unipolar cardiac pacemakers in electromagnetic fields of high voltage overhead lines*. Journal of Medical Engineering & Technology, Vol. 29, 4, pp. 170-175.

[405] Public Service Commission of Wisconsin. 2013. *Environmental Impacts of Transmission Lines*. https://psc.wi.gov/Documents/Brochures/Enviromental%20Impacts%20TL.pdf

Mitigation

Since no adverse health impacts or permanent impacts to implantable medical devices are anticipated as a result of operation of the transmission line project, no mitigative measures are warranted.

6.5.3 Stray Voltage

Electrical systems that deliver power to end-users and electrical systems within the end-user's business, home, farm, or other buildings are grounded to the earth for safety and reliability reasons. The grounding of these electrical systems results in a small amount of current flow through the earth.

Stray voltage (also referred to as neutral-to-earth voltage) could arise from neutral currents flowing through the earth via ground rods, pipes, or other conducting objects, or from faulty wiring or faulty grounding of conducting objects in a facility. Thus, stray voltage could exist at any business, house, or farm which uses electricity— independent of whether there is a transmission line nearby.

Stray voltage is, generally, an issue associated with electrical distribution lines and electrical service at a residence or on a farm. The potential for stray voltage impacts related to the wind farm is discussed in Sections 3.3.6 and 3.3.9. Transmission lines do not create stray voltage as they do not directly connect to businesses, residences, or farms. The project is a 345 kV transmission line that would not directly connect to businesses or residences in the area and would not change local electrical service. Accordingly, no impacts due to stray voltage are anticipated from the project.

However, for purposes of stray voltage, transmission lines may not be completely independent of locally distributed electrical service. Where transmission lines parallel distribution lines, they can, in the immediate area of the paralleling, cause current to flow on these lines (additional current, as the distribution lines already carry current). For properly wired and grounded distribution lines and electrical service, these additional currents are of no consequence. However, for distribution lines and electrical services that are not properly wired and grounded, these additional currents could create stray voltage impacts.

Depending on the route selected for the project, the 345 kV line could parallel existing distribution lines. If a distribution line is paralleled, this arrangement could create additional currents on the distribution line in the immediate area of the paralleling. These currents are not anticipated to cause any stray voltage issues in the project area. If, however, there is not proper grounding or wiring on the distribution system or at a nearby residence, business, or farm, these currents could point out this insufficiency.

Mitigation

In those instances where transmission lines could induce currents on inadequately grounded distribution circuits, mitigation measures for stray voltage may be required. These mitigation measures tend to be site-specific, but could include phase cancellation, transmission-to- distribution separation, isolation of the end-user neutral, and improved grounding.

6.5.4 Induced Voltage

The electric field from a transmission line could extend to a conductive (metal) object in close proximity to the line, such as a vehicle or a fence. This may induce a voltage on the object. The magnitude of this voltage depends on several factors including the object shape, size, orientation, and location along the ROW.

If the objects upon which a voltage is induced are insulated or semi-insulated from the ground and a person touches them, a small current would pass through the person's body to the ground. This might be accompanied by a spark discharge and mild shock, similar to what could occur when a person walks across a carpet and touches a grounded object or another person.

The primary concern with induced voltage is the current flow (amps) through a person to the ground. Most shocks from induced current are considered more of a nuisance than a danger, but to ensure the safety of persons in proximity to a transmission line, the NESC requires that any discharge be less than 5 milliamps. In addition, the Commission's electric field limit of 8 kV/m is designed to prevent serious hazard from shocks due to induced voltage under transmission lines. Route permits issued by the Commission require that transmission lines be constructed and operated to meet NESC standards and the Commission's electric field limit.

There are no residences within the 150-foot-wide right-of-way for any of the four route segments, and there are no structures (barns, agricultural buildings, sheds) within the 150-foot wide right-of-way for the Green, Yellow, Blue, and Red Routes. Plum Creek will work with landowners to ground fences, gates, buildings, or other structures that may be subject to induced current from the line and educate landowners on these concerns and protective measures. Should landowners identify safety concerns, Plum Creek will investigate and take corrective action.[406]

Mitigation

Grounding of metal objects under a transmission line is the best method of meeting the NESC's and Commission's standards and avoiding electrical shocks. Route permits issued by the Commission require permittees to ground all stationary metallic objects in or near the transmission line ROW.

[406] RPA, at pp. 41 – 42.

Thus, for objects that the permittee can ensure are effectively grounded (stationary objects), no impacts due to inducted voltage are anticipated from the project. However, for metallic objects where effective grounding is more difficult to achieve (machinery that is movable and operated directly under a transmission line) impacts could occur, such as a mild shock. Such impacts could occur only if a person was standing on the ground and touching the machinery while directly under a transmission line. The primary means of mitigating this potential impact is to avoid exiting and entering machinery directly under a line.

6.5.5 Air Quality

The air quality in Minnesota is generally good and, for most pollutants, has been improving. Minnesota has been in compliance with all national ambient air quality standards since 2002. Air quality trends in the project area mirror those in the state overall, with air quality generally improving over the last several years.[407]

Potential air quality impacts associated with the transmission project come from two primary sources:

- ozone and nitrogen oxide (NOX) emissions from operating the facility and
- short-term emissions from construction activities.

Ionization of air molecules surrounding the conductor (corona effect) produces a small amount of ozone and NOX, both of which are reactive compounds that contribute to smog and could adversely affect human and animal respiratory systems, crops, vegetation, and buildings. Because of their detrimental effects, air concentrations of these compounds are regulated by both the EPA and the MPCA. The state of Minnesota has an ozone limit of 0.07 parts per million (ppm) (Minnesota Rules, part 7009.0080), which matches the federal ozone limit of 0.07 ppm (8-hour limit).[408] Because the total emissions of ozone and NOX from operating a transmission line are very small, the transmission project is not expected to create any potential for concentrations of ozone that might exceed these standards.

Air emissions during construction would primarily consist of emissions from construction equipment and would include carbon dioxide, NOX, and particulate matter (PM); dust generated from earth disturbing activities would also give rise to PM. Emissions would be dependent upon weather conditions, the amount of equipment at any specific location, and the period of operation required for construction at that location. Any emissions from construction would be similar to those from agricultural activities common in the project area and would only occur for short periods of time in localized areas.

[407] MPCA. 2013. *Minnesota Air Quality Index Trends: 2003-2013.* https://www.pca.state.mn.us/sites/default/files/aq1-46.pdf.
[408] MPCA. *Ozone standard in Minnesota*. https://www.pca.state.mn.us/air/ozone-standard-minnesota.

Mitigation

Emissions from operating the proposed line are anticipated to have negligible impacts on air quality. Minor short-term air quality impacts from construction could be mitigated by equipping construction equipment with appropriate mufflers, using a water truck to reduce dust, and promptly reseeding areas of disturbed vegetation. Emissions of dust and PM can also be reduced by reducing the speed of truck traffic on unpaved roads and by covering open-bodied haul trucks.

6.6 Land Based Economies

Transmission lines have the potential to impact land-based economies. Transmission line structures are a physical long-term presence on the landscape. This presence can prevent or otherwise limit use of the landscape for other purposes, such as agriculture, forestry, and mining. Transmission line structures have a relatively small footprint, yet they can interfere with farming and mining operations. Tall-growing trees are generally not allowed in transmission line rights-of-way. This limitation can create impacts for forestry operations.

Impacts to land-based economies due to the transmission project are anticipated to be minimal.

6.6.1 Agriculture

Agriculture is the primary land-based economic resource in the project area. As noted in Section 6.5.6, the predominant undeveloped land cover type crossed by the Green, Yellow, Blue, and Red Routes is cultivated crop land (Table 42). The average farm size in the three counties is similar, averaging 454 acres, and generally larger than the average size of farms in Minnesota farms (349 acres).
Most of the soils crossed by the four routes are classified as “Prime Farmland” and “Farmland of Statewide Importance.” Approximately 95 percent of the soil crossed by the Green Route, 98 percent of the soil crossed by the Yellow Route, 94 percent of the soil crossed by the Blue Route, and 91 percent of the soil crossed by the Red Route are identified as prime farmland.

Some of the cultivated crop areas along the Green, Yellow, Blue, and Red Routes are enrolled in the Conservation Reserve Enhancement Program (CREP). The CREP is an offshoot of the Conservation Reserve Program (CRP), which is a land conservation program established by the USDA and administered by the Farm Service Agency that pays farmers a yearly rental fee for agreeing to take environmentally sensitive land out of agricultural production in an effort to improve environmental health and quality (USDA, 2019). No CREP parcels have been identified within the 150-foot ROW of the Green or Yellow Routes. Seven CREP parcels have been identified within the ROW of the Blue Route, five of which are also part of the Reinvest in Minnesota (RIM) program. Six CREP parcels have been identified within the ROW of the Red Route, two of which are also part of the RIM program.

Plum Creek estimates that the proposed Switching Station will result in up to approximately 15 acres of construction impact on agricultural land.[409]

Table 42. Summary of Impacts of the Application Segments on Agricultural Land[410]

Resource	Green Segment	Yellow Segment	Blue Segment	Red Segment
Farmland Area Comparison				
Segment Length (miles)	5.5	5.0	26.1	26.8
150-foot Right-of-Way (acres)	99.2	90.0	473.6	486.6
Cultivated Crop Land in ROW (acres)[1]	64.5	43.1	250.4	257.3
Number of Structures in Cultivated Crop Land (based on preliminary engineering design)1	45	41	212	216
Total Impact from Structures in Cultivated Crop Land (acres)	0.1	0.1	0.3	0.3
1 Agricultural land includes row crops. Pasture and hay are not included as they are classified separately. All routes are co-located with roads for the majority of their lengths, which are classified as developed. Where structures are adjacent to roads (developed), the next closest land use type was used to reflect that poles will not be placed on roadways.				

Potential impacts to agriculture due to the transmission project fall into two categories:

- Temporary impacts: Caused by construction activities and limited to the duration of construction. These activities could limit the use of fields or could affect crops and soil by compacting soil, generating dust, damaging crops or drain tile, or causing erosion. Project construction activities would typically be limited to the transmission line ROW.
- Permanent agricultural impacts: Caused by the physical presence of transmission line structures in crop, pasture, and other agricultural lands. Foundations for transmission line structures will be 9 feet in diameter, resulting in a footprint of 63 square feet per structure.[411] The footprint of the transmission line structures is land that cannot be used for agricultural production. This footprint negatively impacts farm income and property values. However, more than the footprint itself, structures can impede the use of farm equipment and can significantly limit management options for agricultural operations. Each structure must be carefully avoided during tillage, planting, spraying, and harvesting of fields. Structures may require extra time and resources for the management of weeds.

The applicant indicates that it will work with landowners to avoid and minimize agricultural impacts by identifying drain tile and other features that need to be avoided during construction. The applicant notes that it will work with landowners to remediate soil compaction and restore agricultural lands.[412]

[409] RPA, at p. 74.
[410] Ibid, at Table 6.3.1-2.
[411] Ibid, at p. 9.
[412] RPA, at pp. 74 – 76.

Commission route permits require permittees to compensate landowners for damage to crops and drain tile (Appendix C).

Plum Creek stated that it will work with the Minnesota Department of Agriculture (MDA) to develop an Agriculture Impact Mitigation Plan. This plan will outline best practices to minimize and mitigate for agriculture impacts, including measures to protect agricultural land.[413]

Mitigation

Impacts to agricultural operations could be mitigated by prudent routing, selecting routes that avoid agricultural fields by following existing rights-of-way, field lines, and property lines. Impacts to agricultural operations could also be mitigated by limiting temporary construction impacts and ensuring that any impacts (soil compaction or damage to drain tile) are promptly remediated.

6.6.1.1 Livestock Production

Crop sales account for a larger percentage of total market value of agricultural products compared to livestock sales in Cottonwood County ($234 million vs. $140 million, annually), Murray County ($233 million vs. $133 million, annually), and in Redwood County ($365 million vs. $153 million, annually). Corn and soybeans are the dominant agricultural crops by acreage in all three counties followed by forage crops in Cottonwood and Murray Counties, and sugar beets in Redwood County. Cattle, hogs and pigs, and sheep and lambs are the dominant livestock raised in all three counties[414]
These livestock operations could be temporarily affected during construction (disturbances to livestock due to construction noise).

Though no stray voltage impacts are anticipated as a result of the transmission project, stray voltage could be of concern to livestock farmers, particularly on dairy farms, due to its potential impacts on milk production and quality (Section 3.3.9). Induced voltage may be of concern to livestock farmers with buildings near a transmission line. These buildings may require grounding of their metal components to avoid induced voltages. No impacts due to induced voltage are anticipated from the project if effective grounding is implemented.

Mitigation

These temporary impacts could be mitigated through coordination with livestock farmers such that noise, dust, and other possible impacts are properly addressed. Also, assuring that entrance and egress from livestock secured areas remain secure (closing gates and addressing damage to fences).

[413] Ibid, at p. 76.
[414] Ibid, at p. 72.

6.6.1.2 Aerial Spraying

There are aerial spraying businesses that operate in the project area. These businesses apply agricultural products to fields in project area (fertilizers, pesticides). Transmission lines and structures could hinder aerial applications of agricultural products by limiting the ability of aerial applicators to reach specific fields or portions of fields by limiting those areas where applicators can safely fly.

Not all agricultural products need to be aerially applied; they can be applied on land by using a tractor and sprayer. However, some applications of agricultural products are time-sensitive (disease prevention/abatement, growth phase determinate, weather limiting), necessitating aerial application.

Mitigation

Potential impacts to agricultural production and to aerial spraying businesses could be mitigated by selecting routes that follow existing infrastructure ROW, (existing transmission lines, existing roadways) and proper informing any aerial operators serving the area.

6.6.1.3 Precision Faming Systems

Precision farming involves the use of global positioning systems (GPS) to guide farming equipment. One of the most precise types of GPS systems is known as real-time kinematic GPS (RTK GPS). Precision farming minimizes the potential for waste from, for example, duplicate row seeding or overlap in fertilizer or pesticide application.

Transmission lines have the potential to interfere with RTK and standard GPS used for precision farming in two ways:

- electromagnetic noise from a transmission line could potentially interfere with the frequencies used for RTK and standard GPS signals, and
- transmission line structures could cause line-of-site obstructions or create multi-path reflections such that sending and receiving of signals would be compromised.

Interference could occur where the spectrum of transmission line electromagnetic noise overlaps the frequency spectrum used by RTK or standard GPS systems. As discussed previously electromagnetic noise associated with transmission line conductors occurs from about 0.1 to 50 MHz. RTK GPS and standard GPS utilize relatively higher frequency ranges (greater than 300 MHz); thus, transmission line electromagnetic noise from the project is not anticipated to affect precision farming systems.

Interference due to line-of-sight obstruction or multi-path reflection could occur in two ways:

- obstruction of, or other reflection interference with, a GPS satellite signal, and
- obstruction of radio transmissions from an RTK base station to a mobile receiving unit.

GPS uses information from multiple satellite signals to determine specific locations. Interference with one signal would not cause inaccurate navigation; however, simultaneous interference with two signals could lead to inaccurate navigation. Because simultaneous interference with two signals is relatively unlikely and any line-of-sight obstruction would be resolved with movement of the GPS receiver, line-of-sight obstruction impacts to precision farming systems are anticipated to be minimal and temporary.

A transmission line structure located very near an RTK base station could cause a line-of-sight obstruction in the signal from a base station. A transmission line structure near an RTK base station (within 100 feet) could also cause multi-path reflections that interfere in the signal from a base station. Multi-path reflections can also be caused by other structures and landscape features including homes, trees, sheds, and sudden changes in ground elevation. Prudent placement of structures and prudent location (or relocation) of the base station likely would mitigate this potential impact.

Mitigation

If interference with electronic devices, including precision farming systems, does occur and is caused by the presence or operation of the transmission line, route permits issued by the Commission require permittees to take actions which are feasible to restore proper operation of these devices to pre-project quality (Appendix C).

6.6.2 Forestry

The HVTL Project will result in the removal or trimming of trees within and/or adjacent to the transmission line ROW. Vegetation management is necessary for the safe operation of the transmission line as tree branches can cause stress on transmission lines and increase the risk of outages, especially in areas with a strong wind resource, which is typical of this area of the state.

There are no forestry operations along the proposed routes ROWs. Wooded areas along the four routes consist of isolated rows of trees that are used as shelter belts or wind breaks along the edges of agricultural fields or surrounding farmsteads and in riparian areas along waterbodies. Where possible, the proposed alignments have been designed to either cross a road to avoid tree clearing or are routed on the side with fewest trees.

Mitigation

There are no known tree farms, timber plots, or other commercial forestry operations within any of the proposed ROWs. Accordingly, no impacts to forestry resources or operations are anticipated as a result of the project.

6.6.3 Mining

Mineral resources are resources that have a concentration or occurrence of natural, solid, inorganic, or fossilized organic material in such form, quantity, grade, and quality that it has reasonable prospects for commercial extraction.

Existing mines could be negatively impacted by transmission line structures if the structures interfere with access to minerals or the ability to remove them. To the extent there are potentially recoverable mineral resources in the project area, construction of the project could limit the ability to successfully mine these reserves, depending on the route selected for the project and the location of these reserves.

Mining does not comprise a major industry in the project area; however, there are several aggregate mining sites in the project area. None of these sites is within the ROW of a proposed routing option. There are two gravel pits mapped along the Cottonwood River in the area between the Blue and Red Routes. No gravel pits are mapped within two miles of the Green and Yellow Segments.

Mitigation

No impacts to existing aggregate mining operations are anticipated as a result of the project. Potential impacts can be mitigated by prudent routing, including placement of the alignment and specific structures to avoid mining operations and aggregate reserves.

6.6.4 Recreation and Tourism

Recreation in the project area consists primarily of outdoor recreational opportunities, such as hiking, fishing, camping, and snowmobiling. Recreational opportunities at public lands include USFWS National Wildlife Refuge (NWR) parcels, MNDNR WMAs and snowmobile trails, and county and city parks (Figure 16). Each of these public lands offers many recreational opportunities that attract residents and tourists.

During the initial open house, local residence identified an area along the Cottonwood River that they felt should be avoided by any new HVTL. This avoidance area covers approximately 850 acres and is used by local families for recreation (camping, fishing, and four-wheeling). The site is located adjacent to the Cottonwood River between the Blue and Red Routes; approximately 0.8-mile east of the *Cottonwood River Alternative Alignment* and approximately 0.3-mile east of the Red Route's CSAH 5 Alignment. The area lies approximately one mile west of the Blue Route (Figure 16).[415]

[415] RPA, at pp. 18 and 53.

The Laura Ingalls Wilder Museum and Gift Store is in Walnut Grove just south of the intersection of U.S. 14 and 8th Street and approximately 0.7 mile west of the Red Route. The museum is open between April and October and features collections of historical documents, quilts, and other household items that belonged to the Ingalls family, as well as memorabilia from the popular television show *Little House on the Prairie*. The museum is spread out between a number of buildings including an 1898 depot, a chapel, an onion-domed house, a dugout display, little red schoolhouse, early settler home, and a covered wagon display.

In addition to the Laura Ingalls Wilder Museum, another popular tourist attraction is the Ingalls Dugout Site, located approximately 1.5 miles north of the town of Walnut Grove and approximately 250 feet east of the Red Route along the banks of Plum Creek. The site is located on private land but is open to tourists between May and October each year.

In addition to outdoor recreation, there are a number of community events in the project area for residents and visitors alike, including various festivals associated with the museum that are held each year during the month of July including the Wilder Pageant, Family Festival, Little House TV Cast Reunion, Black Powder Shoot Rendezvous, Laura and Nellie Look-alike Contest, and bus and walking tours. The City of Lucan hosts three main public events each year: the St. Patrick's Day Parade in March, the Booster Club Golf Day held the Monday after the 4th of July, and Pretzel Days which is held the second weekend in June each year.[416]

Impacts on recreation and tourism due to construction of the transmission project are anticipated to be minimal and temporary in nature. Short-term disturbances, such as increased noise and dust, could detract from nearby recreational activities and could, depending on the timing, affect hunting by temporarily displacing wildlife. Wildlife, however, is expected to return to the area once construction has been completed.

Once constructed, the transmission project itself could impact aesthetics in the project area or at a specific recreational feature such that recreation would be less enjoyable for the average person. These long-term impacts to recreation and tourism are anticipated to be minimal. Persons using snowmobile trails in the project area may experience aesthetic impacts due to the proximity of transmission line structures.

Mitigation

The primary means of mitigating potential impacts is through prudent routing, by selecting routes as far away from recreational resources as practical.

[416] RPA, at p. 77.

6.7 Archaeological and Historic Resources

Cultural resources, including archaeological and historic artifacts and features, contribute to the record of human occupation and alteration of the landscape. Archaeological resources include historic and prehistoric artifacts, structural ruins or earthworks and are often partially or completely below ground. Historic resources include extant structures, such as building and bridges, as well as districts and landscapes.

The proposed routes are located within the Prairie Lakes Archaeological Region (Region 2), which covers most of southwestern and south-central Minnesota. Region 2 covers most of southwestern and south-central Minnesota. It includes all of Big Stone, Blue Earth, Brown, Carver, Chippewa, Cottonwood, Faribault, Freeborn, Jackson, Lac Qui Parle, Le Sueur, Lyon, McLeod, Martin, Nicollet, Redwood, Renville, Scott, Sibley, Stevens, Swift, Watonwan, and Yellow Medicine counties and portions of Douglas, Grant, Kandiyohi, Lincoln, Meeker, Nobles, Otter Tail, Pipestone, Pope, Rice, Steele, Traverse, and Waseca counties. The region extends into northeastern South Dakota and north central Iowa.[417]

The first widespread and readily visible evidence for Native American occupation of the Prairie Lakes Region occurs late in the Middle Prehistoric period. The most visible Late Prehistoric period site type in the Prairie Lakes Region are the large agricultural village sites, most of which are located on intermediate terraces of the Minnesota and Blue Earth rivers. Contact period sites in the Prairie Lakes Region are primarily associated with the Yankton Dakota at the time of contact (ca. 1700), with the Wahpeton and Sisseton Dakota by the early 1800s. Major Dakota villages were concentrated along the Minnesota River. French, English, and American fur and wintering posts were concentrated for the most part along the upper Minnesota River from 1750 to 1800. By the early 1800s they were established by American traders at wooded locations in the interior.[418]

In Minnesota, there are three primary laws regarding the protection of archaeological and historic resources:

- Minnesota Historic Sites Act. This act establishes the State Historic Sites Network and the State Register of Historic Places, and requires that state agencies consult with the Minnesota Historical Society before undertaking or licensing projects that may affect properties on the network or on the State or National Registers of Historic Places (Minnesota Statutes, section 138.661-138.669).

[417] MNDOT, Minnesota's Environment and Native American Culture History, Chapter 3. 2002. Guy E. Gibbon, Craig M. Johnson, and Elizabeth Hobbs.
[418] MNDOT, Minnesota's Environment and Native American Culture History, Chapter 3. 2002. Guy E. Gibbon, Craig M. Johnson, and Elizabeth Hobbs.

• **Minnesota Field Archaeology Act.** This act establishes the office of the State Archaeologist; requires licenses to engage in archaeology on nonfederal public land; establishes ownership, custody and use of objects and data recovered during survey; and requires state agencies to submit development plans to the State Archaeologist, the Minnesota Historical Society and the Minnesota Indian Affairs Council for review when there are known or suspected archaeological sites in the area (Minnesota Statutes, section 138.31-138.42).

• **Minnesota Private Cemeteries Act.** A portion of this legislation protects all human burials or skeletal remains on public or private land (Minnesota Statutes, section 307.08).

At a federal level, compliance with Section 106 of the National Historic Preservation Act (NHPA) is required for all projects under federal jurisdiction. The purpose of Section 106 is to compel federal agencies to consider the effects of a project on archaeological and historic resources and applies to resources that are listed on, or eligible for listing on the National Register of Historic Places (NRHP). However, at this time, no National Environmental Policy Act (NEPA) or federal Section 106 nexus has been identified for this project.

6.7.1 Previously Recorded Archaeological and Historic Architectural Resources

Plum Creek conducted background research on known cultural resources; data regarding known cultural resources information resulting from previous professional cultural resources surveys and reported archaeological sites and historic architectural resources were received from the various agencies and reviewed. This information was used to identify types of archaeological sites that may be encountered and landforms or geographic features that have a higher potential for containing significant cultural resources. The archaeological and historic architectural resources review extended to within one mile of the proposed routes and within each route's width (**Table 43**).[419]

Green Route

No previously recorded archaeological sites were identified within one mile of or within the route width of the Green Route. One previously recorded historic architectural resource was identified within one mile of the Green Route; this resource is not present within the Green Route's route width. The previously recorded architectural resource is St. Olaf Lutheran Church, located along CSAH 7 north of the Green Route. According to information obtained from OSA and SHPO, this resource was not evaluated for listing in the NRHP.[420]

Yellow Route

No previously recorded archaeological sites were identified within one mile of or within the route width of the Yellow Route. Two previously recorded historic architectural resources were identified

[419] RPA, at pp. 78 – 83, and Appendix I.
[420] RPA, at pp. 78 – 83, and Appendix I.

Table 43. Summary of Previously Recorded Archaeological and Historic Architectural Resources[421]

Cultural Resources Categories	Green Segment		Yellow Segment		Blue Segment		Red Segment	
	Within 1 Mile of Segment	Within Segment	Within 1 Mile of Segment	Within Segment	Within 1 Mile of Segment	Within Segment	Within 1 Mile of Segment	Within Segment
Total Archaeological Sites	0	0	0	0	3	0	7	1
Total Eligible for NRHP 1	0	0	0	0	0	0	1 2	0
Number of Historic Architectural resources	1	0	2	0	8	1	12	1
Total Eligible for NRHP 1	0	0	0	0	1	0	1	0
Total Previously Recorded Cultural Resources	1	0	2	0	11	1	19	2
Total NRHP-2 eligible Resources	0	0	0	0	1	0	2	0

1 The number of NRHP-eligible resources shown is a subset of the total number of archaeological sites or historic architectural resources.
2 The NRHP-nominated archaeological site within one mile of the Red Segment is the Ingalls Dugout Site (Site No. 21RW0048); this site is not within the Red Segment width.

within one mile of the Yellow Route; these resources are not present within the Yellow Route's route width. One of the historic architectural resources is St. Olaf Lutheran Church, which is northwest of the Yellow Route. The second historic architectural resource is the District School No. 43, located along CSAH 10. Neither of these previously recorded historic architectural resources was evaluated for listing in the NRHP.[422]

Blue Route

Three previously recorded archaeological sites were identified within one mile of the Blue Route. The three previously recorded archaeological sites within one mile of the Blue Route consist of two pre-contact lithic scatters and one pre-contact artifact scatter located along the Cottonwood River and Plum Creek in Redwood County. None of the previously recorded archaeological sites within one mile

[421] RPA, at p. 80, Table 6.4.1-1.
[422] Ibid.

of the Blue Route were evaluated for listing in the NRHP. No previously recorded archaeological sites were identified within the Blue Route's route width.[423]

Eight previously recorded historic architectural resources were identified within one mile of the Blue Route. The previously recorded historic architectural resources are all within Redwood County and consist of the Tellefsen Farmhouse, Trinity Lutheran Church, Brau Harness Shop, Lucan Section House, the Chicago and North Western Railroad Depot, the Sleepy Eye Milling Company Elevator, Lucan Village Hall, and Trunk Highway 14. Of these eight resources, only the Chicago and North Western Railroad Depot is listed in the NRHP. One previously recorded historic architectural resource was identified within the route width of the Blue Route. The previously recorded resource is an historic bridge, Bridge 89830; this resource was not evaluated for listing in the NRHP.[424]

Red Route

Seven recorded archaeological sites lie within one mile of the Red Route in Redwood County. Most notably, the remains of Laura Ingalls Wilder's homesite along Plum Creek lies approximately 250 feet east of the Red Route's route width (the Ingalls Dugout Site). This site preserves the collapsed foundation of the former sod house and surrounding landscape which served as the setting for Laura Ingalls Wilder's *Little House on the Prairie* book series. The site also serves as an example of earthen frontier home sites not otherwise well-preserved in the record. Due to the site's historic significance, it was nominated to the NRHP in 1978; however Plum Creek reviewed the NRHP database that is maintained by the National Park Service and the Ingalls Dugout Site is not listed in the database. The remaining sites consist of five pre-contact lithic scatters, concentrated primarily along Plum Creek, and one railroad depot (the Walnut Grove Whistle Stop). According to information obtained from OSA and SHPO, none of these resources was evaluated for listing in the NRHP. One previously recorded archaeological site lies within the route width of the Red Route. This site consists of a pre-contact lithic scatter that was not evaluated for listing in the NRHP.[425]

Twelve previously recorded historic architectural resources were identified within one mile of the Red Route. The previously recorded historic architectural resources are all within Redwood County and consist of Walnut Grove High School, Trinity Lutheran Church, Methodist Episcopal Church, Walnut Grove State Bank, Walnut Grove Cooperative Creamery, First State Bank Building, the Lantz House, the Bondeson House, Swoffer & Swoffer Grain Elevator, Bridge No. L6913, Lucan Village Hall, and Trunk Highway 14. Of these 12 recorded historic architectural resources, only the Walnut Grove Cooperative Creamery is listed in the NRHP. One previously recorded historic architectural resource was identified within the route width of the Red Route. This resource is the Welsh Farmstead in Redwood County; this historic architectural resource was not evaluated for listing in the NRHP.[426]

[423] Ibid.
[424] Ibid.
[425] RPA, at pp. 78 – 83, and Appendix I.
[426] Ibid.

Transmission lines have the potential to impact archaeological and historic resources. Archaeological resources could be impacted by the disruption or removal of such resources during the construction of a line. Historic resources could be impacted by the placement of a line in a manner that impairs or decreases the historic value of the resource.

The area surrounding the proposed routes has the potential to contain additional, previously undocumented cultural resources. Archaeological resources would most likely be located on or near elevated landforms near permanent water sources. Historic architectural resources would most likely be located near existing municipalities, farmsteads, and infrastructure such as roads and bridges. After a final route determination by the Commission, and in consideration of the information collected to date and in coordination with SHPO, Plum Creek has stated that it will conduct field surveys in high-potential areas that could host previously unrecorded cultural resources.[427] If archaeological or historic architectural resources are identified as a result of field surveys, Plum Creek will work with SHPO to identify measures to avoid, minimize or mitigate any effects to these resource.[428]

Mitigation

The primary means of mitigating impacts to cultural resources is prudent routing by avoiding known archaeological and history resources. Avoidance of resources may include minor adjustments to the project design and the designation of environmentally sensitive areas that would be left undisturbed by the project. Impacts can also be avoided by prudent pole placement within the ROW route such that resources are spanned or avoided. If archaeological resources are anticipated or known to exist within a specific part of a route, impacts to these resources can typically be mitigated by measures developed in consultation with the Minnesota State Historic Preservation Office (SHPO) prior to construction, and by training of construction workers in the recognition and managing of archaeological resources.

6.8 Natural Environment

Transmission lines have the potential to impact the natural environment. These impacts are dependent upon many factors, such as the type of transmission line and how it is designed, constructed and maintained. Other factors such as the environmental setting must also be considered. Impacts can and do vary significantly both within, and across, projects.

6.8.1 Surface Waters

Transmission lines have the potential to adversely impact surface waters though construction activities which move, remove, or otherwise handle vegetative cover and soils. Changes in vegetative cover and soils can change runoff and water flow patterns.

[427] RPA, at p. 82.
[428] Ibid, at p. 83.

Watercourses (rivers, streams, creeks, and drain ditches) are surface water features that consist structurally of a bed and bank, which creates a channel which can have both flowing and non-flowing water or may be dry depending on the time of year and recent precipitation events. Generally, watercourses have permanent inundation, which are fed by surface and/or ground water sources.

Water bodies (lakes, ponds, and larger wetlands) are characterized by a distinct basin area comprising the extent of the feature, and there is not a noticeable flow of water or channel through the water body. Water bodies are generally permanently inundated but may include areas of exposed substrate when the necessary hydrology to maintain inundation is lacking.

There are several federal and state laws that regulate watercourses and water bodies. The Clean Water Act (CWA) establishes the structure for regulating the discharge of materials into waters of the United States and for developing water quality standards for surface waters (33 U.S.C. 1344 and 1311et seq). The CWA could potentially regulate several types of activities and their impacts associated with the transmission project.

Watercourses and water bodies may be regulated under both Section 10 of the Rivers and Harbors Act (33 U.S.C. 401 et seq.) and Section 404 of the CWA (33 U.S.C. 1344). The Rivers and Harbors Act regulates activities such as excavating and dredging in, placing structures and materials on, or altering the course of Section 10-designated waterways (33 U.S.C. 403). Section 404 of the CWA prohibits discharge of dredged or fill materials without a permit. It extends to more waterbodies than the Rivers and Harbors Act, namely all waters of the United States, including navigable waters, interstate waters and wetlands (33 CFR 320.1(d); 33 CFR 328.3). The U.S. Army Corps of Engineers (USACE) holds both Section 10 and Section 404 permitting authority.

Many activities regulated under either Section 10 or Section 404 must obtain a state Section 401 water quality certification to ensure that the project would comply with state water quality standards. Section 401 of the CWA is administered by the EPA; in Minnesota, the EPA has delegated Section 401 certification to MPCA.

Some watercourses and water bodies within the project area are designated as public waters and are listed in the public waters inventory (PWI) by the State of Minnesota. The statutory definition of a public water is found in Minnesota Statute, section 103G.005, subdivision 15 and 15a. These water resources are under the jurisdiction of the DNR, and a DNR license to cross public waters is required when an activity would cross or change or diminish the course, current or cross section of public waters by any means, including filling, excavating, or placing of materials in or on the beds of public waters. Table 44 provides a summary of waterbodies crossed by the proposed routes; waterbodies are illustrated on the route maps in Appendix D.

Table 44. Waterbodies Crossed by the Proposed Route ROWs[429]

Waterbody Feature	Green Segment	Yellow Segment	Blue Segment	Red Segment
Number of Stream and River Crossings	8	4	19	19
Number of PWI Stream and River Crossings	2	2	10	13
Number of PWI Basins	0	0	0	0
Number of Shallow Lakes	0	0	0	0

Section 303 of the CWA requires all states to identify and designate water bodies that have pollution levels that exceed established water quality standards. In Minnesota the MPCA is responsible for the designation of impaired waters. Table 45 lists the impaired waterbodies crossed by each routing option.

PWI watercourses and waterbodies could potentially be impacted directly by construction equipment entering and being operated within the watercourses or waterbodies. Transmission structures being placed within watercourses or waterbodies would result in direct, permanent impacts. Construction activities in close proximity of PWI watercourses and waterbodies could result in impacts such as, riparian vegetation disturbance, surface erosion, or petroleum-based fluid leaks from construction equipment. Impaired waters are particularly vulnerable to erosion and fluid leaks.

Table 45. Impaired Waterbodies Crossed by the Proposed Route ROWs[430]

Waterbody Name	Impairment	Segment (No. of Crossings)			
		Green	Yellow	Blue	Red
Pell Creek	Turbidity	1	1	1	1
Plum Creek (Judicial Ditch 20A)	Turbidity, fecal coliform	0	0	1	1
Lone Tree Creek	Escherichia coli	0	0	0	1
Cottonwood River	Turbidity, mercury in fish tissue, fecal coliform	0	0	1	1
Sleepy Eye Creek	Chlorpyrifos, fishes bioassessments, turbidity, fecal coliform	0	0	1	1
Clear Creek	Fecal coliform	0	0	1	1

[429] RPA, at p. 92, Table 6.5.4-2.
[430] RPA, at p. 95, Table 6.5.4-3.

Green Route

The Green Route ROW crosses eight waterbodies (Appendix D). All of the waterbodies crossed are intermittent streams, of these, two are unnamed PWI waters. There are no PWI lakes, or MNDNR-designated shallow lakes crossed by the Green Route alignment. One creek crossed by the Green Route is listed as impaired on the 303(d) list (Pell Creek).

Yellow Route

The Yellow Route ROW crosses four waterbodies (Appendix D). As with the Green Row, all of the waterbodies crossed are intermittent streams. Of these streams, two unnamed streams are PWI waters. There are no PWI lakes or MNDNR-designated shallow lakes crossed by the Yellow Route alignment. One creek crossed by the Yellow Route is listed as impaired on the 303(d) list (Pell Creek).

Blue Route

The Blue Route has 19 waterbody crossings (Appendix D). These crossings include 13 intermittent and six perennial streams. Of these streams, the following nine are PWI waters: Cottonwood River; Plum, Sleepy Eye, Pell, and Clear Creeks; and five unnamed streams. There are no PWI lakes or MNDNR-designated shallow lakes crossed by the Blue Route ROW. One river and four creeks crossed by the Blue Route are listed as impaired on the 303(d) list (Cottonwood River, Pell Creek, Plum Creek, Sleepy Eye Creek, and Clear Creek).

Red Route

The Red Segment has 19 waterbody crossings (Appendix D). These crossings include 12 intermittent and seven perennial streams. Of these streams, the following are PWI waters: Cottonwood River; Plum, Sleepy Eye, Pell, Lone Tree, and Clear Creeks; and seven unnamed streams. There are no PWI lakes or MNDNR-designated shallow lakes crossed by the Red Route ROW. One river and four creeks crossed by the Red Segment are listed as impaired on the 303(d) list (Cottonwood River, Pell Creek, Plum Creek, Lone Tree Creek, Sleepy Eye Creek, and Clear Creek).

The MNDNR requested review of an alternate crossing of the Cottonwood River (Cottonwood River Alternative Alignment). Plum Creek's proposed the alignment in this location is routed along CSAH 5. MNDNR indicated the low area adjacent to the Cottonwood River along CSAH 5 provides wildlife habitat and frequently floods due to rain and spring melting. The Cottonwood River Alternative Alignment shifts the Red Route alignment west for approximately half a mile to avoid this area. Plum Creek has not secured voluntary easements along the Cottonwood Creek Alternative Alignment. A comparison of these two route alignment alternatives is provided in Table 29.

Mitigation

Mitigation measures to reduce the potential for impacts to surface waters include:

- Implementation of BMPs to reduce the potential for erosion and sedimentation will minimize construction impacts from the transmission project; prevention of erosion and sedimentation

is particularly important to minimize impacts to impaired waters. Any PWI crossings would require a DNR Permit to Cross, which will be acquired by the Applicant prior to construction. The Permit to Cross conditions and requirements will provide protections which will avoid or minimize impacts to the beds and banks of the PWI watercourses crossed.

- Minimizing removal of riparian vegetation at water crossings.
- Ensuring that construction equipment is kept out of watercourse beds and banks during construction.
- Fueling vehicles away from surface waters.

6.8.2 Floodplains

Floodplains are flat, or nearly flat, land adjacent to a river or stream that experiences occasional or periodic flooding. It includes the floodway, which consists of the stream channel and adjacent areas that carry flood flows, and the flood fringe, which includes areas covered by the flood, but which do not experience a strong current. Floodplains prevent flood damage by detaining debris, sediment, water, and ice. The Federal Emergency Management Agency (FEMA) delineates floodplains and determines flood risks in areas susceptible to flooding. The base flood that FEMA uses, known as the 100-year flood, has a one percent chance of occurring during each year.

At the state level, the DNR oversees the administration of the state floodplain management program by promoting and ensuring sound land use development in floodplain areas in order to promote the health and safety of the public, minimize loss of life, and reduce economic losses caused by flood damages. The DNR also oversees the national flood insurance program for the state of Minnesota. Floodplains are also regulated at the local level.

Table 46 provides the total acres of the Application segments' 150-foot rights-of-way that would cross FEMA-designated floodplains.

Table 46. FEMA Designated 100/500-Year Floodplain Crossed by the Proposed Route ROWs[431]

Floodplain Category 1	Alignment Crossing (150' Right-of Way)							
	Green		Yellow		Blue		Red	
	Acres	Percent	Acres	Percent	Acres	Percent	Acres	Percent
100-Year	0.0	0%	0.0	0%	14.0	3.0%	18.4	3.8%
1 None of the Application Segments cross 500-Year Floodplains								

The Green and Yellow Routes do not cross floodplains. The Blue and Red Routes cross FEMA-designated 100-year floodplain areas in Redwood County. FEMA-designated 100-year floodplain areas are associated primarily with waterbodies along the Blue and Red Routes, including the Cottonwood

[431] RPA, at p. 97, Table 6.5.4-4.

River, Plum Creek, and Pell Creek. There are no 500-year floodplain areas crossed by the proposed routes. Floodplains are displayed on **Figure 17**.

The HVTL Project may require transmission line structures to be placed within FEMA designated 100-year floodplain areas. Based on preliminary engineering design, no structures would be placed in FEMA designated 100-year floodplains along the Green or Yellow Routes. The Blue Route could potentially have 7 structures placed in FEMA designated 100-year floodplains; the Red Route could potentially have 9 structures placed in floodplains. The placement of transmission line structures in floodplains is not anticipated to alter the flood storage capacity of the floodplain based on the minimal size of individual transmission line structures; and no mitigation measures are anticipated to be necessary.

Construction and maintenance vehicles and equipment may need to access areas designated 100-year flood plain during project construction and operation, but no vehicles or equipment would be permanently placed within the designated 100-year flood plain.

Mitigation

The primary means of mitigating potential impacts in Floodplains is through prudent routing and structure placement, and BMPs to prevent soil erosion.

6.8.3 Wetlands

Wetlands are areas with hydric (wetland) soils, hydrophilic (water-loving) vegetation, and wetland hydrology (inundated or saturated during much of the growing season). Wetland types include marshes, swamps, bogs, and fens. Wetlands vary widely due to differences in soils, topography, climate, hydrology, water chemistry, vegetation, and other factors.[432]

Wetlands are important to the health of waterways and communities that are downstream. Wetlands can be one source of hydrology in downstream watercourses and water bodies, detain floodwaters, recharge groundwater supplies, remove pollution, and provide fish and wildlife habitat. Wetland health also has economic impacts because of their key role in fishing, hunting, agriculture, and recreation.

In preparing the HVTL Route Permit Application, Plum Creek reviewed both the USFWS National Wetlands Inventory (NWI) and the MNDNR PWI data bases to identify potential wetlands along the proposed routes (**Appendix D**). Wetland complexes and small isolated wetlands are scattered throughout the HVTL Project Study Area. Many of these wetlands are riverine and floodplain forest wetlands associated with the Cottonwood River. Palustrine-type wetlands are present in depressions

[432] EPA. Wetlands - Wetland Types. https://www.epa.gov/wetlands/classification-and-types-wetlands#marshes.

on moraines, till plains, lake plains, floodplains, and seeps in the HVTL Project Study Area and include emergent, forested, unconsolidated bottom, and scrub-shrub wetlands. Table 47 summarizes the acres of wetlands crossed by the proposed route ROWs.

There are no known calcareous fens, a rare and distinctive type of wetland dominated by calcium-loving plants, present within the proposed routes.

Similar to watercourses and water bodies, some wetlands are protected as USACE-regulated waters of the United States under Section 404 of in the CWA. Under Section 404 of the CWA, a permit from the USACE is required for the discharge of dredged or fill materials into wetlands. As part of the permitting process, wetlands along the entire ROW would be identified and delineated by the qualified wetland delineators. For unavoidable impacts, compensatory mitigation is required to replace the loss of wetland, stream, or other aquatic resource functions.

Table 47. Wetlands Crossed by the Proposed Route ROWs[433]

Wetland Feature	Green Route	Yellow Route	Blue Route	Red Route
Right-of-Way Acres	99.2	90.4	473.6	486.6
Total Wetlands in the ROW (acres)	1.9	1.2	9.1	15.0
Non-forested Wetlands in the ROW (acres)	1.4	1.0	7.3	14.5
Forested Wetlands in the ROW (acres)	0.5	0.2	1.8	0.9
Number of PWI Wetlands Crossed by the ROW	0	0	0	0
Number of Poles in Wetlands Based on Preliminary Engineering Design1	0	1	3	10

Minnesota has a number of state-level mechanisms protecting wetlands and the benefits they provide. The Minnesota Wetland Conservation Act (WCA)[434] is administered by the BWSR. The WCA's goal of no-net loss of wetlands requires that proposals to drain, fill, or excavate a wetland must first avoid disturbing the wetland, next minimize wetland impacts, and finally replace lost wetland acres, functions, and values. Certain activities are exempt from the WCA, allowing projects with minimal impact or projects located on land where certain pre-established land uses are present to proceed without regulation.

A second state-level program that offers protection to the state's waters and wetlands is the PWI program administered by the DNR.[435] The DNR regulates work below the ordinary high-water level of

[433] RPA, at p. 98, Table 6.5.5-1.
[434] Minnesota Rules, chapter 8420.
[435] Minnesota Statutes, section 103G.005.

PWI wetlands and waters through the public waters work permit program. Examples of work activities addressed by this program include filling, excavation, bridges and culverts, dredging, structures, and other construction activities. There are no PWI wetlands within the ROW of any of the proposed routes for the transmission project.

Temporary impacts from the transmission project would include the access of emergent wetlands with construction equipment. Permanent impacts would involve the placement of a pole structure or other project related fill material within a wetland for the life of the transmission project. Additional permanent impacts include the clearing or removal of trees within a forested wetland, or potentially the removal of shrubs within a shrub scrub wetland, along the ROW, as the removal of trees and shrubs can permanently alter the dominant vegetative community of the wetland and change the hydrologic regime of the wetland as well.

Wetland impacts can also occur if disturbed soil from construction up slope is eroded by rain or snowmelt and is transported into a wetland. The indirect filling of wetlands by up slope construction erosion and run-off could result in temporary or permanent impacts to the receiving wetland and would depend on the timing of clean up and restoration of the area.

Green Route

Of the 99.2 acres of ROW that will be needed for the Green Route, there are approximately 1.9 acres of NWI-mapped wetlands, including 0.5 acre of forested wetlands (Appendix D). No structures would be placed in wetlands along the Green Route ROW.

Yellow Route

Of the 90.4 acres of ROW that will be needed for the Yellow Route, there are approximately 1.2 acres of NWI-mapped wetlands, including 0.2 acre of forested wetlands (Appendix D). One structure would be placed in wetlands along the Yellow Route ROW.

Blue Route

Of the 473.6 acres of ROW that will be needed for the Blue Route, there are approximately 9.1 acres of NWI-mapped wetlands, including 1.9 acres of forested wetlands (Appendix D). Three structures would be placed in wetlands along the Blue Route ROW and those are isolated to wetlands associated with the Cottonwood River and its tributaries where wetland complexes are wider than the typical HVTL span length.

Red Route

Of the 486.6 acres of ROW that will be needed for the Red Route, there are approximately 15.0 acres of NWI-mapped wetlands, including 1.0 acre of forested wetlands (Appendix D). Most of the NWI mapped wetlands within the ROW can be spanned. Ten structures would need to be placed in wetlands along the Red Route ROW and those are isolated to wetlands associated with the Cottonwood River and its tributaries where wetland complexes are wider than the typical HVTL span length.

Mitigation

Wetlands located in the ROW would be spanned and placement of structures within wetlands would be avoided to the extent practicable. Where it is not possible to span a wetland, several mitigation strategies can be used to minimize impacts, including:

- Scheduling construction during frozen conditions where practicable;
- Use of construction mats when construction during frozen conditions is not feasible;
- Use of all-terrain construction equipment that is designed to minimize soil impact in damp areas;
- Use of the shortest route to the pole location in the wetland; and
- Assembling structures in upland areas, when feasible, before they are brought to the site for installation.

However, accessing forested wetland areas for construction purposes or to maintain the ROW will be permanent, as the trees will need to be removed.

Indirect wetland impacts related to up slope construction activities and soil erosion and deposition can be minimized by the use of BMPs during construction. The construction contractor must also comply with a NPDES permit, which requires the appropriate installation and maintenance of erosion control materials to protect the wetland areas in close proximity of the project construction activities.

Mitigation for those wetland impacts will be completed as specified and detailed in the federal, state, and local issued permits, and will likely include; project specific mitigation, an in-lieu fee arrangement, or the purchase of credits from a certified wetland bank location.

6.8.4 Groundwater

Minnesota is divided into six groundwater provinces based on bedrock and glacial geology. The aquifers within these provinces occur in two general geologic settings: bedrock, and unconsolidated sediments deposited by glaciers, streams, and lakes. The proposed routes cross Province 5, the Western Province, which is characterized by 100 to 600 feet of clayey glacial drift overlaying Cretaceous and Precambrian bedrock. Glacial drift and Cretaceous bedrock contain limited-extent sand and sandstone aquifers, respectively. In this province, groundwater within the fractured bedrock is usually buried deeply beneath glacial sediments and is only locally used as an aquifer.[436]

[436] DNR. *Groundwater Provinces*. https://www.dnr.state.mn.us/groundwater/provinces/index.html.

Impacts to groundwater quality and quantity as a result of the transmission line project are anticipated to be minimal regardless of the route selected. Groundwater use at the wind farm is discussed in Section 3.3.2.

Potential impacts to groundwater from the project could occur through:

- surface water impacts,
- groundwater use, and
- impacts directly to groundwater resulting from structure foundations.

Contamination of surface waters with significant quantities of petroleum-based fluids from spills or leaks related to construction could ultimately contaminate groundwater.

Impacts to surface water quantities could potentially impact groundwater quantities by reductions in surface water infiltration if surface waters are removed from the area by pumping or diversion to facilitate construction activities. Surface water removal in the form of pumping or diversion are anticipated to be limited in occurrence and duration, and when necessary the pumped or diverted waters are still likely to infiltrate within the same general groundwater catchment area.

The 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. Plum Creek conducted a search of the CWI which did not identify any water supply wells within the 150-foot right-of- way for the Green, Yellow, and Blue Routes; one water supply well within the ROW of the Red Route was identified. This supply well was located in an agricultural field and not associated with a residence.[437]

Public and non-public community water supply source-water protection in Minnesota is administered by the MDH through the Wellhead Protection Program. Wellhead Protection Areas (WHPAs) 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. A search for WHPAs in the MDH database indicated that proposed route ROWs do not cross any WHPAs. The nearest WHPA is located in the town of Lamberton, approximately seven miles east of the Blue Route.[438]

Mitigation

[437] RPA, at p. 85.
[438] RPA, at p. 86.

Implementation of BMPs, such as fueling and repairing equipment away from surface waters will minimize impacts to water quality. Potential impacts to groundwater quality can be mitigated by construction crews promptly cleaning up any spilled or leaked petroleum fluids.

6.8.5 Flora

The proposed HVTL routes cross both the Coteau Moraines and Minnesota River Prairie subsections of the North Central Glaciated Plains Section in the Prairie Parkland Province, as defined by the ECS of Minnesota (Diagram 5).[439] The Minnesota River Prairie subsection's pre-settlement vegetation was primarily tallgrass prairie, with many islands of wet prairie. Forests of silver maple, elm, cottonwood, and willow grew on floodplains along the Minnesota River and other streams. Currently, agriculture is the dominant land use. This subsection is the heart of the Minnesota corn belt. While upland prairie species are common throughout most of the subsection, remnant stands of tallgrass prairie are rare.[440]

The Coteau Moraines was historically covered by tallgrass prairie; wet prairies covered a much smaller proportion of the landscape than in the Minnesota River Prairie subsection and was restricted to narrow stream margins. Forest were similarly restricted to ravines along a few streams, such as the Redwood River. Agriculture is the most important land use in this subsection currently; there are few remnants of pre-settlement vegetation left.[441]

The Green and Yellow Routes cross only the Coteau Moraines subsection, while the Blue and Red Routes cross similar portions of the Minnesota River Prairie and Coteau Moraines subsections.

Transmission lines have the potential to impact flora through the removal or disturbance of vegetation during construction and later during maintenance activities. Additionally, flora may be impacted by the possible introduction of invasive species, or by changes in habitat (soil disturbances, water flows) that adversely impact plant growth. Potential impacts to flora due to the project are anticipated to be minimal to moderate. Moderate impacts to plant communities will be isolated to riparian areas adjacent to the streams that flow through the project area. The majority of the proposed transmission line routes will be located over lands used for agricultural purposes, and the impacts will be minimal and temporary (Table 35); other impacts to flora may be related to wind breaks, woodlots, fence rows, and landscape features.

Impacts to forested areas as a result of construction of the project and maintenance of the transmission line ROW are anticipated to be minimal. Impacts to other vegetation communities, for example agricultural fields and non-forested wetlands, are anticipated to be minimal, as vegetation

[439] MN DNR Ecological Classification System, https://www.dnr.state.mn.us/ecs/251/index.html.
[440] Ibid.
[441] MN DNR Ecological Classification System, https://www.dnr.state.mn.us/ecs/251/index.html.

within these communities does not need to be cleared for ROW purposes and can, in many instances, be spanned.

Mitigation

Impacts to flora can also be mitigated by a number of strategies, including:

- placement of the alignment and of specific structures to avoid trees and other tall-growing species (utilization/sharing of existing road ROWs to the maximum level available).
- spanning low growing plant communities.
- constructing during fall and winter months to limit plant damage.
- leaving or replanting compatible plants at the edge of the transmission line ROW.
- replanting on the transmission line ROW with low growing, native species.
- avoiding the introduction of invasive species – on equipment or through seeds or mulches.
- Revegetating disturbed areas using weed-free seed mixes and using weed-free straw and hay for erosion control.
- Removal of invasive species via herbicide and manual means consistent with easement conditions and landowner restrictions.
- Cleaning and inspection construction vehicles to remove dirt, mud, plant, and debris from vehicles prior to arriving at and leaving from construction sites.
- Minimizing disturbance to native plant communities.
- Limiting traffic through and access to weed-infested areas.

Mitigation and restoration measures for impacts to flora are standard Commission route permit conditions.

6.8.6 Wildlife

The landscape across the project area is relatively homogeneous, with agriculture representing the dominant land cover type. Forage, shelter, nesting, and stopover habitats for both resident and migratory wildlife are all available in the project area, but are mainly limited to road ditches, temporary seasonal wetland areas, riparian habitats, wildlife management areas, and conservation areas.

Resident and migratory wildlife species that typically inhabit agricultural landscapes, farmsteads, small woodlots, prairie remnants, wetlands, and riverine habitats are commonly found in the project area. These include mammals, such as squirrels, fox, and deer; birds, such as robins, killdeer, wild turkey, and wood ducks; fish, such as creek chubs, various shiner species, suckers; mussels, and reptiles and amphibians such as, snakes, turtles, frogs, and toads.

The DNR runs several wildlife management programs, including the Wildlife Management Area (WMA) program and the Shallow Lakes program, Migratory Waterfowl Feeding and Resting Areas, and State Game Refuges (Figure 18). The DNR established these areas to protect and enhance lands and waters that have a high potential for wildlife production, and, in the case of WMA's high potential for public

hunting, trapping, fishing, and other compatible recreational uses. No WMAs are within 1.0 mile of the Green and Yellow Routes. The nearest WMA to the Blue Route is the Two Rivers WMA, which is located approximately 0.4 mile east of the Blue Route's alignment. The nearest WMA to the Red Route is Gales WMA; it is approximately 0.3 mile west of the Red Segment. There are no WMAs within the 150-foot ROW of the Blue or Red Routes.

Key bird habitats in the United States are designated by The National Audubon Society (NAS) as Important Bird Areas (IBAs). The goal of IBAs is to ensure that bird populations persist by identifying and conserving significant habitats. In Minnesota. None of the proposed routes cross any IBAs. The nearest IBA to the proposed routes, the Upper Minnesota River IBA, is approximately 13.5 miles northeast of the Blue and Red Routes' northern terminus.[442]

The USFWS established Waterfowl Production Areas (WPAs) as part of the National Wildlife Refuge System in an effort preserve wetlands and grasslands that are critical to waterfowl and other wildlife. There are no WPAs located within any of the proposed routes.

Various conservation easements can be established on private lands, and these easement lands can provide establishment and protection of temporary and long-term wildlife habitats. USFWS maintains wetland, grassland, and conservation easement programs. Farm Services Agency (FSA) manages the Conservation Reserve Program (CRP) lands program, which primarily targets the reduction of soil erosion but provides the secondary benefit of establishing temporary wildlife habitat. CRP lands are generally enrolled in the program for 10 to 15 years, depending on the landowner's contract, so the wildlife habitat benefit is temporary in nature. The RIM program is administered by the Board of Water and Soil Resources (BWSR) and establishes conservation easements on private lands utilizing state funds. RIM easements are intended to provide wildlife habitat, soil conservation, and water quality benefits by establishing permanent habitat and removing marginal crop lands from agricultural production.

No CREP parcels have been identified within the 150-foot ROW of the Green or Yellow Routes. Seven CREP parcels have been identified within the ROW of the Blue Route, five of which are also part of the RIM program. Six CREP parcels have been identified within the ROW of the Red Route, two of which are also part of the RIM program.

The Migratory Bird Treaty Act makes it illegal to take, possess, import, export, transport, sell, purchase, barter, or offer for sale, purchase, or barter, any migratory bird, or the parts, nests, or eggs of such a bird except under the terms of a valid Federal permit. Additionally, the Bald and Golden Eagle Protection Act (16 USC 668-668d) prohibits taking or possession of and commerce in bald eagles

[442] RPA, at pp. 103 – 104.

(*Haliaeetus leucocephalus*) and golden eagles (*Aquila chrysaetos*), either alive or dead, or any egg, nest, or part of eagles.

Non-Avian Species

Construction activities that generate noise, dust, or disturbance of habitat may result in short-term indirect impacts on fauna. During construction of the transmission project, fauna would generally be displaced within the transmission line ROW. Clearing and grading activities could also affect small mammals that may not be able to avoid equipment. Many wildlife species would likely avoid the immediate area during construction; the distance that animals would be displaced depends on the species and the tolerance level of each animal. Because other suitable habitat is available in and near the project area, potential temporary impacts to fauna are not expected to cause permanent change in local populations.

Construction of the project may result in long-term adverse impacts on wildlife due to loss, conversion, or fragmentation of habitat. Plum Creek would permanently clear woody vegetation within the transmission line ROW. Wildlife species previously occupying forested or shrub communities in the ROW would be displaced in favor of species that prefer more open vegetation communities. Fragmentation could affect the survival of some species that depend on large areas of undisturbed habitat, and it could create barriers to daily movement. In addition, predators may pose a threat to animals that are forced out of cover to search for food, especially as the distance predators need to travel to penetrate large habitat areas decreases.

Potential long-term impacts to fauna as a result of the project are anticipated to be minimal.

Avian Species

Potential impacts to avian species (songbirds, raptors, and waterfowl) include those described above for non-avian species, but also include impacts due to electrocution and collision with transmission line conductors.

Electrocution occurs when an arc is created by contact between a bird and energized lines or an energized line and grounded structure equipment. Electrocution occurs more frequently with larger bird species, such as hawks, because they have wider wingspans that are more likely to create contact with the conductors. To avoid and minimize potential electrocution of avian species, the applicants indicate that they will construct the project in accordance with the Avian Power Line Interaction Committee's safety recommendations.[443] These recommendations minimize electrocution risk by providing adequate clearance from energized conductors to grounded surfaces and to other conductors.

[443] RPA, at p. 104.

Independent of the risk of electrocution, birds may be injured by colliding with transmission line structures and conductors. The risk of collision is influenced by several factors including habitat, flyways, foraging areas, and bird size. Waterfowl, especially larger waterfowl such as swans and geese, are more likely to collide with transmission lines. The frequency of collisions increases when a transmission line is placed between agricultural fields that serve as feeding areas and wetlands or open water, which serve as resting areas. In these areas, it is likely that waterfowl and other birds would be traveling between different habitats, increasing the likelihood of a collision.

The incidence of birds colliding with transmission lines is also influenced by the number of horizontal planes in which the conductors are strung. Stringing the conductors in a single horizontal plane presents less of a barrier to birds crossing the transmission line ROW. A single horizontal plane, however, generally requires a wider structure (H-frame structure). Conversely, stringing the conductor wires in two or more planes creates a greater barrier to birds attempting to fly, not only across the lines, but over and potentially between them (monopole structure).

Mitigation

Potential impacts to fauna can be mitigated through several strategies. The primary strategy for mitigating impacts is to select route alternatives away from areas known to contain high-quality habitat or which serve as migratory corridors. Use of existing rights-of-way can minimize habitat loss and fragmentation. Impacts to fauna can also be minimized by spanning habitats and minimizing the number of structures in high-quality habitat through the use of specialty structures.

Beyond conductor configuration, bird collisions with transmission lines can also be mitigated by the use of bird flight diverters. Diverters enable birds to better see conductors during flight and avoid collisions with them. Plum Creek has stated that it will coordinate with USFWS and MNDNR as needed to identify avian movement pathways and migration flyways that may be crossed by the Application segments and to discuss areas along the transmission line that may need to be marked with avian flight diverters to minimize impacts to birds.[444]

6.8.7 Rare and Unique Resources

Plum Creek reviewed both Federal and State sources in an effort to identify any notable natural resources (endangered and threatened species, candidate species, and critical habitat/communities) within the HVTL Project Study Area. The rare and unique natural resources evaluated for potential impacts by the proposed transmission line include the following:

- Federally listed threatened and endangered species

[444] RPA, at p. 104.

- State Listed special concern, threatened, and endangered species
- Bald Eagles and Bald Eagle Nests
- Rare Plant Communities

There are a variety of rare and unique natural resources in the project area. Without careful planning, the project could impact rare plants, animals and their habitats. These impacts could result from ecosystem changes, introduction of invasive species, habitat loss, and, for avian species, collision with transmission line conductors.

Table 48 lists the Federal and State-listed species potentially present within one mile of the proposed routes.

Federally Listed Threatened and Endangered Species

There are three federally listed species that may occur in the vicinity of the proposed routes: Northern Long-eared Bat, Dakota Skipper, and Prairie Bush Clover.

Northern Long-eared Bat (Myotis septentrionalis)

The northern long-eared bat is a federally listed threatened species known to occur in HVTL project area.[445] The northern long-eared bat roosts in both live trees and snags. A habitat generalist, roost tree selection appears to be opportunistic; the species uses a variety of tree sizes and species, typically greater or equal to three inches diameter at breast height. Northern long-eared bats are generally associated with forested habitats, including mesic hardwood, floodplain, and fire-dependent forests, particularly those near water sources. Northern long-eared bats overwinter in small crevices or cracks in hibernacula (caves and mines). Migration to summer habitat occurs between early April and mid-May.[446] [447][448]

On January 14, 2016, the USFWS published the final 4(d) rule identifying prohibitions that focus on protecting the bat's sensitive life stages (i.e., hibernation and raising young) in areas affected by White

[445] USFWS Website, Endangered Species in Minnesota, County Distribution. https://www.fws.gov/midwest/endangered/lists/minnesot-cty.html.
[446] Wisconsin Department of Natural Resources. 2013. Wisconsin Northern Long-Eared Bat Species Guidance. Bureau of Natural Heritage Conservation, Wisconsin Department of Natural Resources, Madison, Wisconsin. PUB-ER-700. https://dnr.wi.gov/files/PDF/pubs/er/ER0700.pdf
[447] USFWS Website, Midwest Region Endangered Species. Northern Long-Eared Bat. https://www.fws.gov/MIDWEST/ENDANGERED/mammals/nleb/index.html
[448] DNR Website. Northern Long eared Bat, https://www.dnr.state.mn.us/rsg/profile.html?action=elementDetail&selectedElement=AMACC01150

Table 48. Federal-State-Listed Species Potentially Present W/in One Mile of the Proposed Routes[449]

Common Name	Scientific Name	Habitat	Segment	Status 1		Source
				State 2	Federal 3	
Mammals						
Northern long-eared bat	*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, 2018a)	All	SC	T	USFWS
Birds						
Forster's Tern	*Sterna forsteri*	Extensive marshes with open water and emergent vegetation interspersed. Nests on floating vegetative platforms and muskrat houses (MNDNR, 2019e)	Red	SC	None	NHIS
Insects						
Dakota skipper	*Hesperia dacotae*	Remnants of mixed and tallgrass prairie remnants (USFWS, 2019b)	Green	E	T	USFWS
Plants						
Prairie bush-clover	*Lespedeza leptostachya*	Dry to mesic prairies with gravelly soils (USFWS, 2009)	All	T	T	USFWS
Slender milk- vetch	*Astragalus flexuosus* var. *flexuosus*	Dry prairies, mesic prairies, and hill prairies across a range of topographic and moisture conditions (MNDNR, 2019f)	Red	SC	None	NHIS

1 E = Endangered, T = Threatened, SC = Special Concern
2 MNDNR, 2019d
3 USFWS, 2019

[449] RPA, at p. 105, Table 6.6.1-1.

Nose Syndrome (WNS)[450]. Cottonwood, Murray and Redwood Counties fall within USFWS-designated WNS Zone.[451]

All takes within known hibernacula are prohibited (USFWS, 2016a). Per USFWS guidance, incidental take from tree removal activities is not prohibited provided:

- It is not conducted within 0.25 miles of a known northern long-eared bat hibernacula; and
- It does not entail removing a known maternity roost tree (or trees within 150 feet of a known maternity roost tree) between June 1 and July 31.

Dakota skipper (*Hesperia dacotae*)

The Dakota skipper is protected as threatened under the Endangered Species Act (ESA), effective November 23, 2014 and is found in two types of prairies. One type is moist bluestem prairie in which three wildflower species are usually blooming when Dakota skippers are adults: wood lily (*Lilium philadelphicum*), harebell (*Campanula rotundifolia*) and smooth camas (*Zygadenus elegans*). The second type is upland prairie that is relatively dry and often found on ridges and hillsides. Bluestem grasses and needle grasses dominate these prairies; purple coneflower (*Echinacea angustifolia*) is typical of high-quality sites that support this skipper, although it also uses other flowers for nectar. Both of these habitat types are unlikely to be reestablished on a site that has been plowed. Therefore, activities that maintain the original native grass habitat are fundamental to the species' conservation.

Prairie Bush Clover (*Lespedeza leptostachya*)

Prairie bush clover is a federally listed threatened species known to occur in project area. Prairie bush clover is a member of the *Fabaceae* (Pea) family and a Midwestern endemic – known only from the tallgrass prairie region of the upper Mississippi River Valley. The Prairie bush clover can be found on dry-mesic prairies on north or northwest-facing slopes with well drained soils. Populations are primarily restricted to remnant prairies that have persisted despite widespread conversion to cropland; the majority of populations in the state are found on prairies that were historically or are presently used for pasture[452] Prairie bush clover only occurs in areas of high quality prairie on north facing slopes.

Based on available information there are no records of any federally listed endangered or threatened species within the project area, and there is no federally designated critical habitat for any listed species within the project area.

[450] USFWS, Northern Long-eared Bat Final 4(d) Rule Map. October 1, 2018. https://www.fws.gov/Midwest/endangered/mammals/nleb/pdf/WNSZone.pdf
[451] USFWS, Northern Long-eared Bat Final 4(d) Rule Map. October 1, 2018. https://www.fws.gov/Midwest/endangered/mammals/nleb/pdf/WNSZone.pdf
[452] Prairie Bush Clover Species Profile, http://files.dnr.state.mn.us/natural_resources/ets/prairie_bush_clover.pdf.

Records of documented hibernacula and roost trees are maintained in the MNDNR's NHIS. Based on a review of northern long-eared bat records, Plum Creek determined that there are no documented northern long-eared bat maternity roost trees within the 150-foot ROW or hibernacula within 0.25 mile of the proposed routes.

None of the proposed routes crosses prairie habitat for either prairie bush-clover or Dakota skipper. Therefore, impacts to these two species are not anticipated.

State Listed Special Concern, Threatened, and Endangered Species

No state-listed threatened or endangered species are documented within one mile of the proposed routes. Two records of state species of special concern are documented within one mile of the Red Route. A record of the Forster's tern from 1984, associated with the Westline WMA (see 6.9.7.4), was reported approximately 0.78 mile from the Red Route's ROW. A record of the Slender Milk-Vetch from 1998 was reported 0.05 mile from the Red Route's ROW; this occurrence was associated with a SOBS (see 6.9.7.4) ranked as moderate.

Forster's Tern (*Sterna forsteri*)

The Forster's tern is a gull-like bird with gray back and wings, black cap, white underparts, pointed wings, and forked tail. Although the range of the Forster's tern covers at least one third of Minnesota, the species does not occur as commonly on prairie marshes as it did 50 years ago. Approximately 50 active colonies have been documented since 1990, but only 11 of these included either an adult population of at least 100 birds or more than 50 nests. Much of the suitable habitat in the state is not being utilized. Studies in 1985 and 1986 found most breeding terns were limited to just four colonies in central Minnesota and one colony in northwest Minnesota. Based on the breeding population estimates from various studies, a population decline of approximately 60% has occurred since 1942. Given population declines and the continued loss and degradation of the species' prairie marsh habitat, the Forster's tern was listed as a special concern species in Minnesota in 1984.[453]

Slender Milk-Vetch (Astragalus flexuosus var. flexuosus)

The overall impression of the Slender Milk-Vetch is that of a low, sprawling plant (less than knee-high), that appears almost as a vine. It is a perennial legume that can form clumps nearly 3.3 feet in diameter, with several to many stems giving rise to the clump from a branched crown. In Minnesota, Slender Milk-Vetch is found in dry prairies and in mesic prairies, and most commonly in hill prairies, which are frequently dry-mesic in nature. Both types of prairie are dominated by grasses, but in dry prairie the mid-height and shortgrass species are prominent, while in mesic prairie, tallgrasses dominate. Slender Milk-Vetch seems to be found across quite a range of moisture and topographic conditions, from dry hill prairie to rolling mesic prairie. It can be found on level terrain, such as on flat uplands at the top of bluff lines, or on moderate and steep slopes, and it can be found mid-slope or at

[453] https://www.dnr.state.mn.us/rsg/profile.html?action=elementDetail&selectedElement=ABNNM08090.

the crest of slopes. Soils where the species is found are typically loams, including sandy loam, clay loam, and gravelly clay loam. Most of the recorded locations of Slender Milk-Vetch in Minnesota are in the Minnesota River Prairie subsection, with just a few in the Coteau Moraines subsection.[454]

Threats to slender milk-vetch include over-grazing, herbicides, non-native invasive species, and habitat conversion.

The state's designation as a species of special concern for the Forster's tern and Slender Milk-Vetch does not afford protections under the Minnesota Endangered Species Statute (Minn. Stat., § 84.0895). The Forster's tern record was observed 35 years ago (1984) and is associated with the Westline WMA, approximately 0.75 mile from the Red Route alignment. The slender milk-vetch record was observed about 20 years ago (1998) associated with the Gales 24 SOBS, approximately 0.05 mile from the Red Route alignment. It is likely that additional occurrences of these species would be limited to natural resource sites or other areas designated as having value as wildlife habitat.

The Green and Yellow Route ROWs do not cross any designated natural resource sites. The Blue Route ROW crosses two designated natural resource sites; both SOBS (Johnsonville 28 and North Hero 32) ranked below the minimum threshold for statewide biodiversity significance. The Red Route ROW crosses one SOBS, the Gales 24, where the slender milk-vetch record was documented. Overall, impacts on state species of special concern are expected to be insignificant given the limited number of occurrences within a mile of the proposed routes, the dates of these records, the limited number of natural resource sites (*see 6.9.7.4*), and the predominant land uses (agriculture and developed).

Bald Eagles and Bald Eagle Nests

Bald eagles and bald eagle nests are protected by the federal Bald and Golden Eagle Protection Act which is administered and regulated by the USFWS. Bald eagles and nests can be directly impacted by transmission line construction activities if they are within or adjacent to the project alignment. Once operational, transmission lines pose an electrocution hazard to bald eagles while they are in flight. Young bald eagles and bald eagles actively engaged in hunting while near the transmission line are a greatest risk of striking the lines and being electrocuted. Young bald eagles have larger flight feathers to allow for greater stability and control while in flight, due to increased flight feather length the young bald eagles have larger wing span, which puts them at greater risk of contracting multiple lines at the same time if they fly into the transmission lines. Additionally, young bald eagles generally have less control and stability while they are learning to fly, which also puts them at greater risk of strike and electrocution should the young eagles get to close to the transmission lines. Bald eagles that are actively hunting or in pursuit of prey tend to focus exclusively on their prey item, which can lead to an increased potential for strike and electrocution as the hunting eagle may be less aware of nearby transmission lines.

[454] https://www.dnr.state.mn.us/rsg/profile.html?action=elementDetail&selectedElement=PDFAB0F3H2.

Plum Creek conducted aerial surveys (March 2018 and March 2019) for bald eagle nests within 10 miles of the Plum Creek Wind Farm boundary; the survey area for the Wind Farm completely overlaps with the Green and Yellow Routes and partially overlaps with the Blue and Red Routes. During the surveys, one active bald eagle nest was documented within one mile of the Blue Route ROW; this nest is 0.95 mile east of the Blue Route ROW along the Cottonwood River and was observed during both years of surveys. Two active bald eagle nests were documented within one mile of the Red Route ROW. These nests were 0.95 mile and 0.6 mile from the Red Route ROW along the Cottonwood River and observed during both years of surveys.[455]

During construction of the Project no bald eagles or bald eagle nests are anticipated to be impacted. Bald eagles will have the potential to strike the proposed transmission line during the operational phase of the Project. Alignments that cross stream corridors or that are in close proximity to livestock facilities or commonly traveled roadways may pose a greater threat than alignments that are not near these features.

DNR generally requested that bird flight diverters will be installed on sections of the proposed transmission line that will be near lakes, rivers, and other areas that may attract waterfowl. Plum Creek indicates it will coordinate with DNR to determine how to best implement the request for bird flight diverter installation.[456] Bird flight diverters are intended to make the transmission line more noticeable and identifiable to birds that are flying near the transmission line. Bird flight diverters have been successful in reducing the strike and electrocution of a variety of bird species in a number of different habitat types.

Rare Plant Communities

Rare plant communities evaluated for potential impacts from the proposed project include native prairie, native plant communities (NPC), and Minnesota Biological Survey (MBS) Sites of Biodiversity Significance; these features (NPC and SOBS) are illustrated on the route maps in Appendix D.

Native prairie is defined in MN Statute Section 84.02, Subdivision 5, as areas that have not experienced plowing and is dominated by native prairie plant species that have originated from the site. Disturbed areas and unbroken pasture lands may still be classified as native prairie as long as the predominately established with native prairie plants that have originated from the site. The DNR is directed by Minnesota Statute Section 84.961 to protect identified native prairies in the State.

The vast majority, approximately 98%, of historical native prairie in southern Minnesota has been converted to agricultural cropland.[457] Larger blocks of native prairie habitat in southern Minnesota

[455] RPA, at p. 103.
[456] Ibid., at p. 104.
[457] DNR, *Minnesota Prairie Conservation Plan*, June 22, 2011. https://files.dnr.state.mn.us/eco/mcbs/mn_prairie_conservation_plan.pdf.

are generally protected within the boundaries of DNR administered Scientific and Natural Area (SNA) lands. Some linear native prairie areas still exist within former or currently active railroad track ROWs, and some native prairie areas are adjacent to roads within the ROW. The majority of native prairie areas located on private property in southern Minnesota are generally small in size. Small and linear native prairie areas are both at risk from encroachment from invasive plant species, trees, and/or shrubs, which is referred to as edge effect and has a more noticeable impact on small patches of habitat. Native prairie forb species are also highly susceptible to being impacted by drift of herbicide sprays, the decline in pollinator species, and potentially genetic isolation.

Native plant communities are intact habitat areas, of various types, and are dominated by native plant species. The vast majority of native plant communities in Minnesota have been identified and surveyed by the MBS, and these areas tend to be ranked within the frame of sites of biodiversity significance. The MBS groups and ranks SOBS for each of Minnesota's ECS subsections for the purpose of designating and cataloguing the state's most notable examples of NPCs and rare species. There are four ranks for SOBS: outstanding, high, moderate, and below.

Table 49 lists the Sites of Biodiversity Significance crossed by the proposed routes.

Green and Yellow Routes

The 150-foot ROW of the Green and Yellow Routes do not cross SOBS, NPCs, native prairie, railroad right-of-way prairie, WMAs, Scientific and Natural Areas, or state parks. Additionally, neither route crosses NWRs, wilderness areas, national wild and scenic rivers, national forests, WPAs, grassland and wetland easements, or any other natural resource sites (Figures 16 and 18).

Table 49. Sites of Biodiversity Significance Crossed by the Proposed Routes[458]

Site of Biodiversity Significance	Rank	Acres of Crossing (150-foot Right-of-Way)			
		Green Segment	Yellow Segment	Blue Segment	Red Segment
Gales 14	Below	--	--	--	0.19
Gales 24	Moderate	--	--	--	3.47
Johnsonville 28	Below	--	--	8.99	--
North Hero 32	Below	--	--	1.63	--
Total for Each Segment		**--**	**--**	**10.62**	**3.66**

Blue Route

The Blue Route ROW crosses two SOBS that are ranked below the minimum threshold for statewide biodiversity significance, Johnsonville 28 and North Hero 32 (Figure 18). The Johnsonville 28 SOBS is associated with the Cottonwood River; the North Hero 32 SOBS is associated with Plum Creek. SOBS that are ranked as below the minimum threshold are sites that may have local areas of conservation

[458] RPA, at Table 6.6.2-1.

value that may serve as native plant and animal habitat, buffers around higher-quality habitat, corridors for animal movement, open space, or areas with high potential for restoration. The Blue Route ROW does not cross other federally or state-designated natural resource sites (**Figures 16 and 18**).

Red Route

The Red Route ROW crosses one SOBS that is ranked moderate, Gales 24, and one SOBS ranked below the minimum threshold (**Figure 18**). SOBS ranked as moderate may have documented records of rare species, NPCs that are moderately disturbed, or strong potential for recovery of characteristic ecological processes and NPCs. This SOBS includes NPC/MNDNR-mapped native prairie and one NHIS record of Slender Milk-Vetch. The Red Route ROW only crosses the SOBS; it does not intersect the NPC/native prairie or the NHIS record for slender milk-vetch. The Gales 14 SOBS which is ranked below the minimum threshold is associated with the Cottonwood River north of CSAH 4. The ROW partially intersects this SOBS; one corner structure transmission pole would be placed within the SOBS. The Red Route ROW does not cross other federally or state-designated natural resource sites (**Figures 16 and 18**).

Mitigation

The preferred mitigation measure is to avoid known locations of rare and unique resources.

6.9 System Reliability

The North American Electric Reliability Corporation (NERC) has established mandatory reliability standards for the bulk power system in the United States. For new transmission lines, these standards require the utility to evaluate whether the grid would continue to operate adequately under various contingencies (e.g. weather events, equipment failure). Route permits issued by the Commission require permittees to comply with NERC standards (**Appendix C**).

In developing the transmission project, Plum Creek evaluated different voltages, different end points, and different possible routes for the project.[459] Plum Creek analyzed whether these routes created reliability concerns. Plum Creek asserts that the selection of the 345 kV line and the end point of the Switching Station at the Brookings-to-Hampton 345 kV HVTL will provide more integration of wind energy into MISO's transmission system and allow the proposed 345 kV line to preserve and enhance system reliability.[460]

Analysis of NERC transmission outages indicates that the 345 kV voltage is substantially more reliable than lower voltages, resulting in substantially fewer sustained and momentary outages than lower

[459] CNA, at 5,3.1.11, 5.3.1.12, and 5.3.1.13. RPA, at 3.2.
[460] Ibid, at 5.3.1.12.

voltages.[461] Plum Creek indicates that the proposed routes in their route permit application provide a reliable connection between the wind farm and the electrical grid.[462] No adverse impacts to electric system reliability are anticipated.

6.10 Use and Parallel of Existing Right-of-Way

Sharing ROW with existing infrastructure or paralleling existing rights-of-way minimizes fragmentation of the landscape and can minimize human and environmental impacts (e.g., aesthetic and agricultural impacts). The use and paralleling of existing rights-of-way is considered by the Commission in determining the most appropriate route for the project. To minimize impacts on the environment and affected landowners, Plum Creek looked for routing opportunities that would share existing rights-of-way along road and railroad rights-of-way and field and section lines.

ROW sharing opportunities in the project area are discussed below. These opportunities exist where the rights-of-way of the routing options would be shared with or would parallel immediately adjacent the ROW of existing infrastructure—a transmission line or road—or existing field and parcel lines not always visible on the landscape.

Green Route

The Green Route is approximately 5.5 miles and connects Wind Farm Collector Substation 2 to Wind Farm Collector Substation 1 (Appendix D). Beginning at Collector Substation 2 the Green Route travels north along 300th Avenue for one mile before turning east along 230th Street for one mile. The route then turns north along CSAH 7 for 0.75 mile before turning east for 0.5 mile, then south again for 0.25 mile along a field edge. The route then turns east again and follows parcel boundaries for 1.5 miles. From here, the route crosses 340th Avenue, turns north, and parallels the east side of the road for 0.5 mile before reaching Collector Substation 1.

Approximately 59 percent of the Green Route is co-located with roads; the other 41 percent of the Green Route is located along property lines and field edges.

Yellow Route

The Yellow Route is approximately 5.0 miles and connects Wind Farm Collector Substation 2 to Wind Farm Collector Substation 1 (Appendix D). Starting at Collector Substation 2, the Yellow Route travels east along CSAH 11 for one mile, as CSAH 11 turns to the north, the Yellow Route continues traveling east along 240th Street, for one mile before turning north along 330th Avenue for one mile. At the intersection of 330th Avenue and CSAH 11, the route turns east for one mile, crosses 340th Avenue, then turns north paralleling 340th Avenue on the east side of the road for one mile before reaching Collector Substation 1.

[461] Henry Chao - Direct Testimony, at Tables 1 and 2 eDocket No. 20193-150807-17. The analysis compares transmission lines in the 300 – 399 kV range with those in the 200 – 299 kV range; voltages less than 200 kV are generally not considered part of the bulk power system subject to NERC's jurisdiction.

[462] RPA, at 3.0.

One hundred percent of the Yellow Route is co-located with roads.

Blue Route

The Blue Route is approximately 26.1 miles long and connects the Wind Farm Collector Substation 1 to the Switching Station located at the Brookings-Hampton 345 kV transmission line (Appendix D).

Beginning at the Wind Farm Collector Substation 1, the Blue Route follows 340th Avenue north for one mile before turning west on 210th Street for one mile. The route turns north again at 330th Avenue for one mile before turning west (at the Cottonwood/Redwood county line) for half mile to Eagle Avenue. The Blue Route follows Eagle Avenue north for two miles to U.S. Highway 14 and then turns east for one mile to CSAH 10. The Blue Route turns north on CSAH 10 for four miles to 160th Street where the route turns west for half mile to a private driveway on the north side of the road.

The route then follows the private driveway for one quarter of a mile before turning back east along a field edge for half mile to CSAH 10. The Blue Route follows CSAH 10 north for 1.75 miles to 180th Street. At 180th Street, the Blue Route turns west for one quarter of a mile, then north along a parcel line for half mile, before turning back east for one quarter of a mile to CSAH 10. At CSAH 10, the Blue Route turns north again for 1.5 miles to 200th Street where the route turns west for half mile before following a parcel line/field edge north for two miles to 220th Street. Here the Blue Route turns east for a half mile back to CSAH 10 and continues north for two more miles (along CSAH 10) to Minnesota Highway 68 where the route turns west for one mile. The Blue Route then turns north along Eagle Avenue for the final four miles before reaching the Switching Station.

Approximately 84 percent of the Blue Segment is co-located with roads; the other 14 percent of the Blue Segment is located along property lines and field edges.

Red Route

The Red Route is approximately 26.8 miles long and connects Wind Farm Collector Substation 1 to the Switching Station at the Brookings-Hampton 345 kV transmission line (Appendix D).

Starting at the Wind Farm Collector Substation 1, the Red Route follows 340th Avenue north for one mile before turning west on 210 Street for one mile. The route turns north again at 330th Avenue for one mile before turning west (at the Cottonwood/Redwood county line) for 1.5 miles to Duncan Avenue.

The Blue and Red Routes diverge at the Cottonwood/Redwood county line, where Eagle Avenue breaks north (Blue Route) off of the county line and the Red Route continues a little further west to Duncan Avenue. The Red Route turns north on Duncan Avenue for three miles before turning west on 130th Street for one mile and north turns on CSAH 5 for five miles. At the intersection of CSAH 5 and 180th Street is where the *Cottonwood River Alternative Alignment* departs from CSAH 5; whereas the proposed alignment continues north along CSAH 5 across the Cottonwood River, the *Cottonwood*

River Alternative Alignment turns west along 180th Street for half mile before turning north along the property line for one mile to CSAH 4, turning east for half mile to rejoin the proposed alignment and CSAH 5. At this point the Red Route continues north along CSAH 5 for one mile to 200th Street. At 200th Street, the Red Route turns east for half mile before following a parcel line north for one mile and turning east along 210th Street to Duncan Avenue. The Red Route follows Duncan Avenue north for five miles to 260th Street before turning east for one mile to Eagle Avenue. The Red Route then turns north along Eagle Avenue (where it rejoins the Blue Route) for the final two miles before reaching the Switching Station.

Approximately 92 percent of the Red Route parallels roads; the other eight percent (2.2 miles) follow property lines and/or field edges.

6.11 Costs Dependent on Design and Route

The Commission considers the cost of the transmission project, and how this cost might vary with design and route in it determining the most appropriate route for the transmission line.

As discussed in Section 4.1.8, the cost of the transmission line is similar between the Green-Yellow Route options and the Blue-Red Route options (Table 27).

6.12 Relative Merits of Route Alternatives

The Commission is charged with locating transmission lines in a manner that is "compatible with environmental preservation and the efficient use of resources" and that minimizes "adverse human and environmental impact(s)" while ensuring electric power reliability (Minnesota Statutes, section 216E.02). Minnesota Statute, section 216E.03, subdivision 7(b) identifies considerations that the Commission must take into account when designating transmission lines routes.

Minnesota Rules, part 7850.4100 lists 14 factors for the Commission to consider in its route permitting decisions, including impacts on human settlements, impacts on land-based economies, and impacts on the natural environment:

A. Effects on human settlement, including, but not limited to, displacement, noise, aesthetics, cultural values, recreation, and public services.
B. Effects on public health and safety.
C. Effects on land-based economies, including, but not limited to, agriculture, forestry, tourism, and mining.
D. Effects on archaeological and historic resources.
E. Effects on the natural environment, including effects on air and water quality resources and flora and fauna.
F. Effects on rare and unique natural resources.

G. Application of design options that maximize energy efficiencies, mitigate adverse environmental effects, and could accommodate expansion of transmission or generating capacity.
H. Use or paralleling of existing rights-of-way, survey lines, natural division lines, and agricultural field boundaries.
I. Use of existing large electric power generating plant sites.
J. Use of existing transportation, pipeline, and electrical transmission systems or rights-of-way.
K. Electrical system reliability.
L. Costs of constructing, operating, and maintaining the facility which are dependent on design and route.
M. Adverse human and natural environmental effects which cannot be avoided.
N. Irreversible and irretrievable commitments of resources.

This chapter discusses the route alternatives and their merits relative to these routing factors. The discussion here uses text and a stoplight graphic to describe the relative merits of the route alternatives (Table 50). For routing factors where impacts are anticipated to vary with the route alternatives, the graphic represents these anticipated impacts and compares them across alternatives.

For routing factors that express the state of Minnesota's interest in the efficient use of resources (the use and paralleling of existing rights-of-way), the graphic represents the consistency of the route alternatives with these interests and compares them one to the other.

Table 50. Guide to Relative Merits of Route Alternatives

Anticipated Impact or Consistency with Routing Factor	Color/Shape
Impacts anticipated to be minimal with the conditions in the Commission's generic route permit/BMPs – OR- route alternative is very consistent with the routing factor.	
Impacts anticipated to be minimal to moderate with the conditions in the Commission's generic route permit template; special conditions may be required for mitigation – OR – route alternative is very consistent with the routing factor, but less so than other route alternatives.	
Impacts anticipated to be moderate to significant and likely unable to be mitigated – OR – route alternative is not consistent with the routing factor or consistent only in part.	

The discussion here focuses on the first 12 routing factors of Minnesota Rules, part 7850.4100 (factors A through L). Routing factors M and N—the unavoidable and irreversible impacts of the project—are discussed at the end of this chapter.

Routing factor I, the use of existing large electric power generating plant sites, is not relevant to this project and is not discussed further here. Routing factor G ("mitigate adverse environmental impacts") has several parts and speaks generally to environmental impacts. For purposes of discussion here, and with respect to routing factor G, it is assumed that all route alternatives are equal

with regard to maximizing energy efficiencies and accommodating expansion of transmission capacity. With respect to environmental impacts, the examination of such impacts suggested by routing factor G is included in the discussion of other routing factors and elements that more specifically address an environmental impact (effects on flora and fauna, routing factor E).

Finally, routing factors H and J address similar issues, the use or paralleling of existing rights-of-way. Routing factor H relates to the use or paralleling of existing rights-of-way, but also includes items that do not have a ROW—survey lines, natural division lines, and agricultural field boundaries. Routing factor J relates to the use of existing transportation, pipeline, and electrical transmission rights-of-way. For purposes here, these factors will be considered as one—the use or paralleling of existing rights-of-way, where there is infrastructure that has a ROW. However, the discussion here includes, as appropriate, comment on the use of lines and boundaries by the route alternatives.

These factors and factor elements are summarized in Table 51 and Table 52.

Table 51. Relative Merits – Blue Route and Red Route

Factor	Routing Factor / Element	Blue Route	Red Route	Summary
A	Human Settlements / Displacement			Displacement of residences or business properties is not anticipated in either the Blue or Red Routes because no home or building is located within the proposed transmission line right-of-way (within 75 feet of the Application alignments).
A	Human Settlements / Noise			Noise impacts resulting from the construction are anticipated to be minimal for both routes; potential impacts are expected to be short term. Noise impacts resulting from the operation w/in the Blue or Red Routes is not anticipated to exceed the MPCA State Noise Standards; the closest residences are 192’ and 185’from the ROW, respectively.
A	Human Settlements / Aesthetics			Both routes are anticipated to have incremental impacts on the aesthetic environment. Viewsheds w/in the area are shaped by features such as agricultural fields and farmsteads, highways and county roads, transmission lines and wind turbines.
A	Human Settlements / Property Values			The placement of infrastructure near human settlements has the potential to impact property values. Impacts on property values decrease with distance from the line. When negative impacts on property values occur, the potential reduction in property values is in the range of 1 to 10 percent.

Factor	Routing Factor / Element	Blue Route	Red Route	Summary
				The closest residence to the Blue and Red Route's ROW is 192 feet and 185 feet, respectively.
A	Human Settlements / Electronic Interference			No impacts to electronic devices are anticipated as a result of the HVTL project. Interference due to electromagnetic noise is not anticipated. Interference due to line-of-sight obstruction could occur in select areas but could be mitigated by prudent placement of transmission line poles and electronic antennas
A	Human Settlements / Cultural Values			The presence of the HVTLs, with either route, will not significantly impact the use of land for agricultural production or the general character of the area.
A	Human Settlements / Zoning Land Use			Construction and operation of the HVTL Project is not expected to have a significant impact on land use within Cottonwood, Murray, and Redwood Counties. The Routes predominantly cross areas zoned as agricultural in Cottonwood, Murray, and Redwood Counties. Though a few smaller pockets of residential zoning are crossed by the Routes in all counties, all of the ROWs are sited outside of the residential parcel boundary, and on the opposite side of the road, thereby avoiding direct impacts to parcels zoned as residential.
A	Human Settlements / Public Services			With proper coordination, project construction and operation should not directly affect any public or emergency services, regardless of the route chosen.
B	Public Health & Safety / EMF			Based on the predicted EMF levels for the project, no adverse health impacts from electric or magnetic fields are anticipated for persons living or working near the project.
B	Public Health & Safety / Air Quality			Potential air quality impacts associated with the transmission project come from two primary sources: ozone & nitrogen oxide emissions from operating the HVTL and short-term emissions from construction activities.

Factor	Routing Factor / Element	Blue Route	Red Route	Summary
				Emissions from operating the proposed line are anticipated to have negligible impacts on air quality. Air emissions during construction would primarily consist of emissions from construction equipment and would include carbon dioxide, NOX, and particulate matter (PM); dust generated from earth disturbing activities would also give rise to PM. Any emissions from construction would be similar to those from agricultural activities common in the project area and would only occur for short periods of time in localized areas.
C	Land-Based Economies / Agriculture			The overall impact on agricultural lands is anticipated to be minimal for both routes. Construction of the HVTL Project could cause temporary impacts to farmland (soil compaction and rutting, accelerated soil erosion, crop damage, temporary disruption to farm activities, and introduction of noxious weeds); compliance w/ permit conditions (BMPs, etc.) will minimize potential impacts. Direct impacts (pole placement in cropland) is estimated at 0.3 acres for each route option.
C	Land Based Economies / Extraction Industries			There are no forestry operations along the proposed Route ROW in either the Blue or Red Route. There are two gravel pits mapped along the Cottonwood River in the area between the Blue and Red Routes; there are no gravel pits within the ROW of either route.
C	Land Based Economies / Recreation Tourism			Impacts to recreation areas would mostly be related to HVTL Project construction, and will be minimal, and temporary for both routes.
D	Archaeological & Historic Resources			Three previously recorded archaeological sites were identified within one mile of the Blue Route; no previously recorded archaeological sites were identified within the Blue Route's route width. Eight previously recorded historic architectural

Factor	Routing Factor / Element	Blue Route	Red Route	Summary
				resources were identified within one mile of the Blue Route. Seven recorded archaeological sites lie within one mile of the Red Route; most notably, the remains of Laura Ingalls Wilder's homesite along Plum Creek lies approximately 250 feet east of the Red Route. Twelve previously recorded historic architectural resources were identified within one mile of the Red Route. Plum Creek designed the proposed routes to avoid any direct physical impacts to all previously documented archaeological and historic architectural resources identified during the background literature review.
E	Natural Environment / Surface Waters			Impacts to surface waters are anticipated to be minimal for both routes given compliance w/ permit conditions and BMPs at stream crossings. Each route includes 19 waterbody crossings.
E	Natural Environment/ Wetlands			The Blue Route crosses less acres (9.1) of NWI wetlands than the Red Route (15.0). Three poles would be placed in wetlands along the Blue Route, while the Red Route would have 10 poles in wetlands associated w/ the Cottonwood River. Impacts to wetlands are anticipated to be minimal with the use of BMPs (frozen construction season, wetland mats, equipment assembly on upland areas).
E	Natural Resources/ Vegetation			Vegetation impact for both routes would be minimal to moderate. Both routes contain similar amounts and landcover types; the Red Route having slightly more herbaceous cover w/in the ROW then the Blue Route (3.6 acres vs 0.7 acres).
E	Natural Resources/ Wildlife			Given that the majority of the land use along the proposed routes is cultivated cropland, it is anticipated that the potential impacts on wildlife and wildlife habitat during construction and maintenance of the HVTL Project will be minimal.
F	Rare and Unique Natural Resources			The Blue Route right-of-way crosses two SOBS that are ranked below the minimum threshold for statewide biodiversity significance, Johnsonville 28 and North Hero 32.

Factor	Routing Factor / Element	Blue Route	Red Route	Summary
				The Red Route right-of-way crosses one SOBS that is ranked moderate (Gales 24), and one SOBS ranked below the minimum threshold (Gales 14)
H & J	Use or Paralleling of Existing Rights-of-Way			Approximately 84 percent of the Blue Route is co-located with roads; the other 14 percent is located along property lines and field edges. The Red Route is heavily co-located with roads, as approximately 92 percent of the Route parallels roads. The other eight percent follow property lines and/or field edges. While both routes parallel existing features for the majority of their length, the Red Route makes relatively better use of existing infrastructure (roads).
L	Design-Route Dependent Costs			Estimated costs (2019 dollars) for the Blue and Red Route are $23,000,000 and $23,300,000, respectively.

Table 52. Relative Merits – Yellow Route and Green Route

Factor	Routing Factor / Element	Yellow Route	Green Route	Summary
A	Human Settlements / Displacement			Displacement of residences or business properties is not anticipated in either the Yellow or Green Routes because no home or building is located within the proposed transmission line right-of-way (within 75 feet of the Application alignments).
A	Human Settlements / Noise			Noise impacts resulting from the construction are anticipated to be minimal for both routes; potential impacts are expected to be short term. Noise impacts resulting from the operation of the Yellow or Green Routes is not anticipated to exceed the MPCA State Noise Standards; the closest residences are 140’ and 173’from the ROW, respectively.
A	Human Settlements / Aesthetics			Both routes are anticipated to have incremental impacts on the aesthetic environment. Viewsheds w/in the area are shaped by features such as agricultural fields and farmsteads, highways and county roads, transmission lines and wind turbines.

Factor	Routing Factor / Element	Yellow Route	Green Route	Summary
A	Human Settlements / Property Values	●	●	The placement of infrastructure near human settlements has the potential to impact property values. Impacts on property values decrease with distance from the line. When negative impacts on property values occur, the potential reduction in property values is in the range of 1 to 10 percent. The closest residence to the Yellow and Green Route's ROW is 140' and 173', respectively.
A	Human Settlements / Electronic Interference	●	●	No impacts to electronic devices are anticipated as a result of the HVTL project. Interference due to electromagnetic noise is not anticipated. Interference due to line-of-sight obstruction could occur in select areas but could be mitigated by prudent placement of transmission line poles and electronic antennas
A	Human Settlements / Cultural Values	●	●	The presence of the HVTLs, with either route, will not significantly impact the use of land for agricultural production or the general character of the area.
A	Human Settlements / Zoning Land Use	●	●	Construction and operation of the HVTL Project is not expected to have a significant impact on land use within Cottonwood County. The Routes predominantly cross areas zoned as agricultural; based on review of the zoning information for Cottonwood County, the likelihood of future residential, commercial, or industrial development within the proposed routes is low.
A	Human Settlements / Public Services	●	●	With proper coordination, project construction and operation should not directly affect any public or emergency services, regardless of the route chosen.
B	Public Health & Safety / EMF	●	●	Based on the predicted EMF levels for the project, no adverse health impacts from electric or magnetic fields are anticipated for persons living or working near the project.
B	Public Health & Safety / Air Quality	●	●	Potential air quality impacts associated with the transmission project come from two primary sources: ozone & nitrogen oxide emissions from operating the HVTL and short-term emissions from construction activities.

Factor	Routing Factor / Element	Yellow Route	Green Route	Summary
				Emissions from operating the proposed line are anticipated to have negligible impacts on air quality. Air emissions during construction would primarily consist of emissions from construction equipment and would include carbon dioxide, NOX, and particulate matter (PM); dust generated from earth disturbing activities would also give rise to PM. Any emissions from construction would be similar to those from agricultural activities common in the project area and would only occur for short periods of time in localized areas.
C	Land-Based Economies / Agriculture			The overall impact on agricultural lands is anticipated to be minimal for both routes. Construction of the HVTL Project could cause temporary impacts to farmland (soil compaction and rutting, accelerated soil erosion, crop damage, temporary disruption to farm activities, and introduction of noxious weeds); compliance w/ permit conditions (BMPs, etc.) will minimize potential impacts. Direct impacts (pole placement in cropland) is estimated at 0.1 acres for each route option. Approximately 43.1 acres of cultivated crop land would be w/in the ROW for the Yellow Route; the remaining 47.2 acres w/in the ROW is developed land. Approximately 64.5 acres of cultivated crop land would be w/in the ROW for the Green Route; of the remaining 34.7 acres w/in ROW, 34.0 are developed land.
C	Land Based Economies / Extraction Industries			There are no forestry operations along the proposed Route ROW in either the Yellow or Green Route. No gravel pits are mapped within two miles of the Green and Yellow Routes.
C	Land Based Economies / Recreation Tourism			Impacts to recreation areas would mostly be related to HVTL Project construction, and will be minimal, and temporary for both routes.

Factor	Routing Factor / Element	Yellow Route	Green Route	Summary
D	Archaeological & Historic Resources			No previously recorded archaeological sites were identified w/in one mile of or w/in the route width of the Yellow Route. Two previously recorded historic architectural resources were identified w/in one mile of the Yellow Route; these resources are not present w/in the Yellow Route's route width. No previously recorded archaeological sites were identified w/in one mile of or w/in the route width of the Green Route. One previously recorded historic architectural resource was identified within one mile of the Green Route; this resource is not present within the Green Route's route width. Plum Creek designed the proposed routes to avoid any direct physical impacts to all previously documented archaeological and historic architectural resources identified during the background literature review.
E	Natural Environment / Surface Waters			Impacts to surface waters are anticipated to be minimal for both routes given compliance w/ permit conditions and BMPs at stream crossings. The Yellow Route ROW crosses four waterbodies; all of the waterbodies crossed are intermittent streams. Of these streams, two unnamed streams are PWI waters. The Green Route ROW crosses eight waterbodies; all of the waterbodies crossed are intermittent streams. Of these streams, two are unnamed PWI waters.
E	Natural Environment/ Wetlands			The Yellow Route crosses 1.2 acres of NWI wetlands (including 0.2 acres of forested wetland) and would require one pole to be placed in wetlands. The Green Route crosses 1.9 acres of NWI wetlands (including 0.5 acres of forested wetlands) and would require no poles be placed in wetlands. Impacts to wetlands are anticipated to be minimal with the use of BMPs (frozen construction season, wetland mats, equipment assembly on upland areas).

Factor	Routing Factor / Element	Yellow Route	Green Route	Summary
E	Natural Resources/ Vegetation			Vegetation impact for both routes would be minimal to moderate. The Yellow Route contains 43.1 acres of cultivated crops w/in the ROW, while 47.2 acres are identified as developed areas. The Green Route contains 64.5 acres of cultivated crops w/in the ROW, while 34 acres are identified as developed areas. The Green Route also cross some emergent herbaceous wetlands (0.7), while the Yellow Segment does not.
E	Natural Resources/ Wildlife			Given that the majority of the land use along the proposed routes is cultivated cropland, it is anticipated that the potential impacts on wildlife and wildlife habitat during construction and maintenance of the HVTL Project will be minimal.
F	Rare and Unique Natural Resources			The ROW of the Green and Yellow Routes do not cross SOBS, NPCs, native prairie, railroad right-of-way prairie, WMAs, Scientific and Natural Areas.
H & J	Use or Paralleling of Existing Rights-of-Way			The Green and Yellow Routes do not cross and are not co-located with any United States or state highways; these segments primarily cross and are co-located with CSAHs and township roadways. Of the 5-mile-long Yellow Route, 4 miles are co-located along roadways (CSAH 11 and 340th Avenue). Of the 5.5-mile-long Green Route, 1 mile is co-located along roadways (CSAH 7 and 340th Avenue).
L	Design-Route Dependent Costs			Estimated costs (2019 dollars) for the Yellow and Green Route are $4,220,000 and $4,642,000, respectively.

6.13 Unavoidable Impacts

Transmission lines are large infrastructure projects that have adverse human and environmental impacts. Even with mitigation strategies, such as prudent routing, there are adverse impact of the transmission project that cannot be avoided. These impacts are anticipated to occur for all route alternatives. To the extent that impacts vary by alternative, these variations are discussed above.

Aesthetic impacts cannot be avoided. The transmission project would introduce new transmission line structures and conductors into the project area changing existing viewsheds with the potential to create an adverse aesthetic impact.

Temporary construction-related impacts, including construction-related noise and dust generation and disruption of traffic near construction sites, are also unavoidable.

The transmission project will also create unavoidable impacts to agriculture. Because the majority of the land across all routes is agricultural, primarily row crops, the installation of the Switching Station and transmission structures will result in the loss of tillable acreage and constraints on the layout and management of field operations. In addition, the transmission structures and conductors also may constrain some agricultural spraying by aircraft.

Finally, impacts to the natural environment cannot be avoided.

6.14 Irreversible Commitment of Resources

The commitment of a resource is irreversible when it is impossible or very difficult to redirect that resource for a different future use. An irretrievable commitment refers to the use or consumption of a resource such that it is not recoverable for later use by future generations. These types of commitments are anticipated to occur for all route alternatives and not to vary significantly among alternatives

The commitment of land for a transmission line ROW is likely an irreversible commitment. In general, lands in the rights-of-way for large infrastructure projects such as railroads, highways, and transmission lines remain committed to these projects for a relatively long period of time. Even in instances where a ROW is abandoned the land within the ROW is typically repurposed for a different infrastructure use, such as a rails-to-trails program, and is not returned to a previous land use. This said, transmission line rights-of-way can be returned to a previous use (row crop, pasture) by the removal of structures and structure foundations to a depth that supports this use.

There are few commitments of resources associated with the project that are irretrievable. These commitments include the steel, concrete, and hydrocarbon resources committed to the project, though it is possible that the steel could be recycled at some point in the future. Labor and fiscal resources required for the project are also irretrievable commitments.

7 Cumulative Effects

Cumulative potential effects are impacts on the environment that result from "the incremental effects of a project in addition to other projects in the environmentally relevant area that might reasonably be expected to affect the same environmental resources, including future projects actually planned or for which a basis of expectation haves been laid, regardless of what person undertakes the other projects or what jurisdictions have authority over the projects."[463]

Consideration of cumulative potential effects is intended to aid decision-makers so that they do not make decisions about a specific project in a vacuum. Effects that may be minimal in the context of a single project may accumulate and become significant when all projects are considered.

A review for planned projects (federal, state, or local unit of governments), in the Wind Project Area or along the transmission routes, that may affect or be affected by the proposed Project was conducted by Plum Creek. No such foreseeable projects were identified.

[463] Minnesota Rules, part 4410.0200, subpart 11a.

FIGURES

Appendix A EIS Scoping Decision

Appendix B LWECS Draft Site Permit

Appendix C HVTL Route Permit Template

Appendix D Detailed HVTL Route Maps

Appendix E HVTL Technical Specifications-Diagrams

Appendix F EMF Background Paper

Appendix G Comment Response Document