August 4, 2023

COMBINED CERTIFICATE OF NEED and ROUTE PERMIT APPLICATION

for the Northland Reliability Project

MPUC Docket No. E015, ET2/CN-22-416 | MPUC Docket No. E015, ET2/TL-22-415

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1.1 Introduction

Minnesota Power and Great River Energy (together, the "Applicants") submit this application to the Minnesota Public Utilities Commission ("Commission") for a Certificate of Need and Route Permit ("Application") to construct the Northland Reliability Project ("Project" or "Northland Reliability Project"). The Project is needed to maintain transmission system reliability and optimize regional transfer capability as coal-fired generation ceases operations in northern Minnesota and significant renewable generation comes online in the upper Midwest. The Applicants propose a route that is located along existing high-voltage transmission lines for more than 85 percent of its length. By locating the Project next to existing high-voltage transmission lines and other existing rights-of-way, the Project can leverage existing corridors rather than creating new ones. As described in the Application, locating the Project along existing transmission line rights-of-way minimizes the potential impact of the Project within the Project Route. Based on this use of existing high-voltage transmission line rights-of-way, the Project is eligible for the Alternative Process for the route permit. Minn. Stat. § 216E.04, subd. 2(5).

The Project consists of two major segments:

1) Segment 1: construction of a new, approximately 140-mile long, double-circuit 345 kilovolt ("kV") transmission line connecting the existing Iron Range Substation, a new Cuyuna Series Compensation Station (described below), and the existing Benton County Substation; and

2) Segment 2: replacement of two existing high-voltage transmission lines.

    a) Replace an approximately 20-mile 230 kV line with two 345 kV circuits from the Benton County Substation to the new Xcel Energy Big Oaks Substation[1] along existing high-voltage transmission right-of-way on double-circuit 345 kV structures; and

    b) Replace an approximately 20-mile 345 kV line from the Benton County Substation to the existing Xcel Energy Sherco Substation in Sherburne County along existing high-voltage transmission right-of-way using double-circuit 345 kV structures.

The Project will also involve the following improvements to the power grid:

1) Expansion of the existing Iron Range Substation, located near Grand Rapids, and expansion of the existing Benton County Substation, located near St. Cloud, and

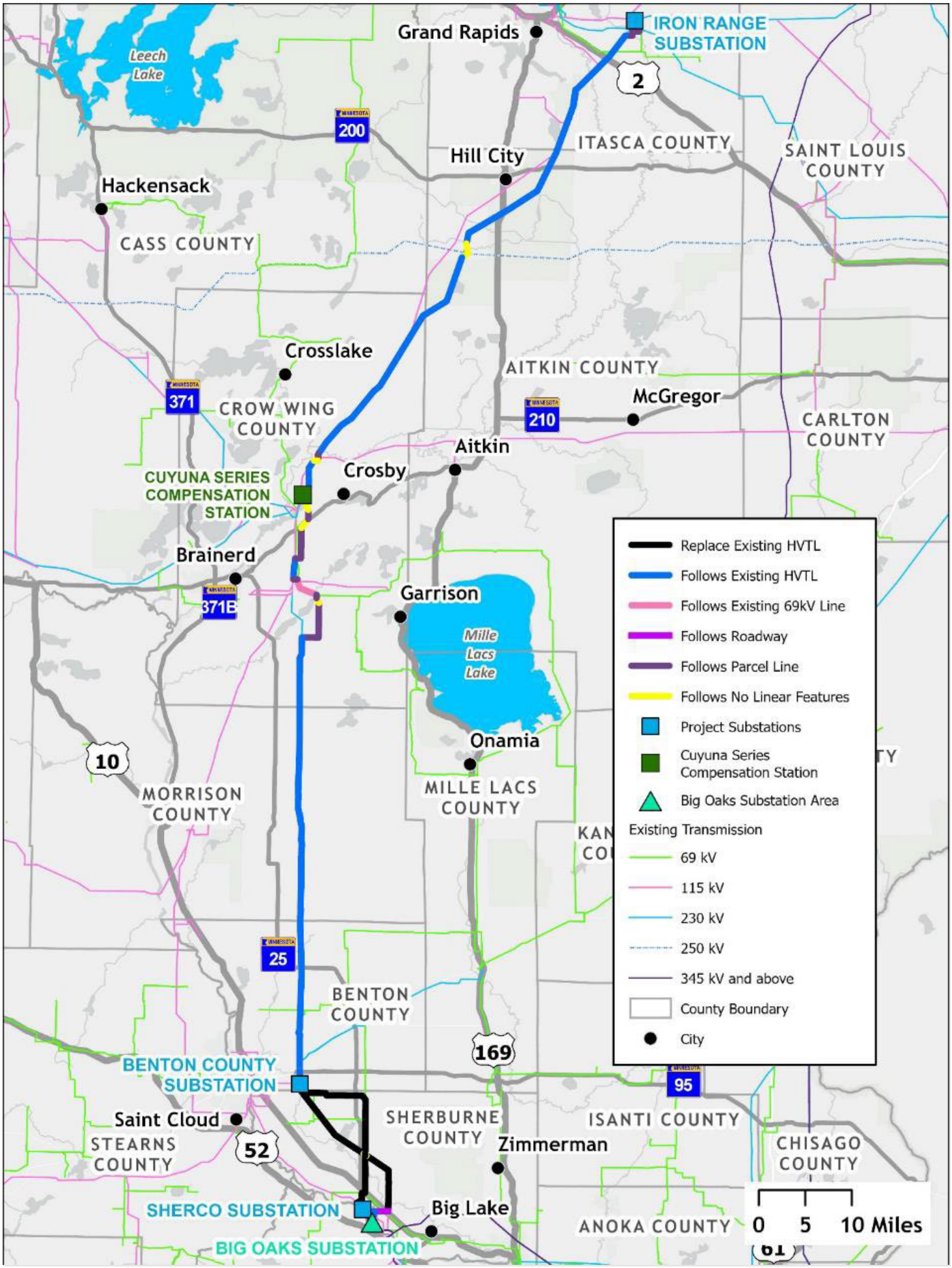
[1] *In the Matter of the Application for a Certificate of Need for the Big Stone South - Alexandria - Big Oaks 345 kV Transmission Line Project*, Docket No. E017,ET2,E002,ET10,E015/CN-22-538; *In the Matter of the Application for a Route Permit for the Alexandria to Big Oaks 345 kV Transmission Project in Central Minnesota*, Docket No. E002,ET2,ET10,E015,E017/TL-23-159.

rerouting existing transmission lines at the Iron Range Substation and Benton County Substation; and

2) Construction of a new Cuyuna Series Compensation Station near the existing Riverton Substation and rerouting an existing transmission line in the Riverton area.

The Project is shown in **Map 1-1**.

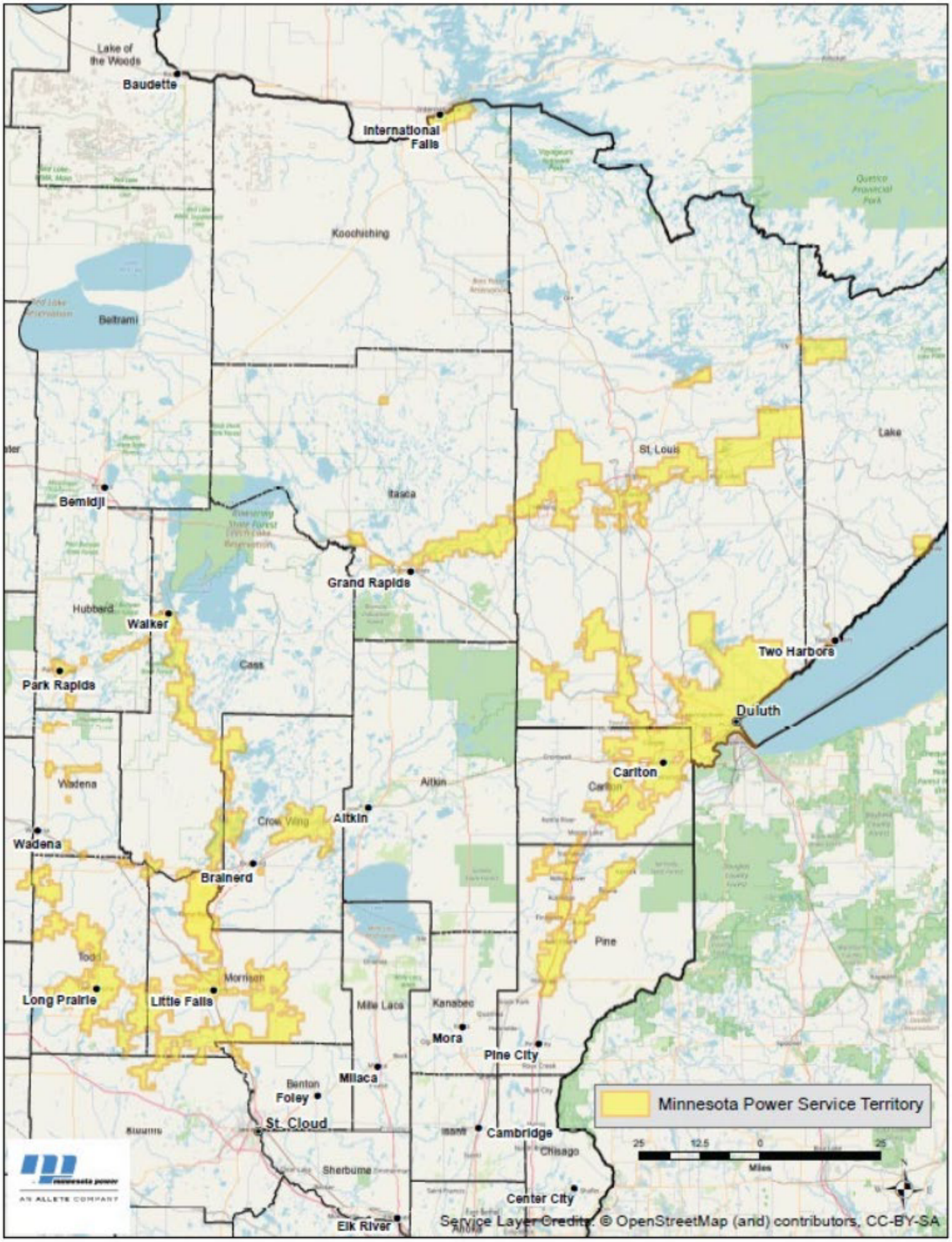
Map 1-1. Northland Reliability Project



Minnesota Power and Great River Energy will co-own the new double-circuit 345 kV line between the Iron Range Substation, the Cuyuna Series Compensation Station, and the Benton County Substation. Minnesota Power will own the Iron Range Substation expansion and the Cuyuna Series Compensation Station. Great River Energy will own the Benton County Substation expansion and the two transmission lines to be replaced between the Benton County Substation and the Big Oaks and Sherco substations.

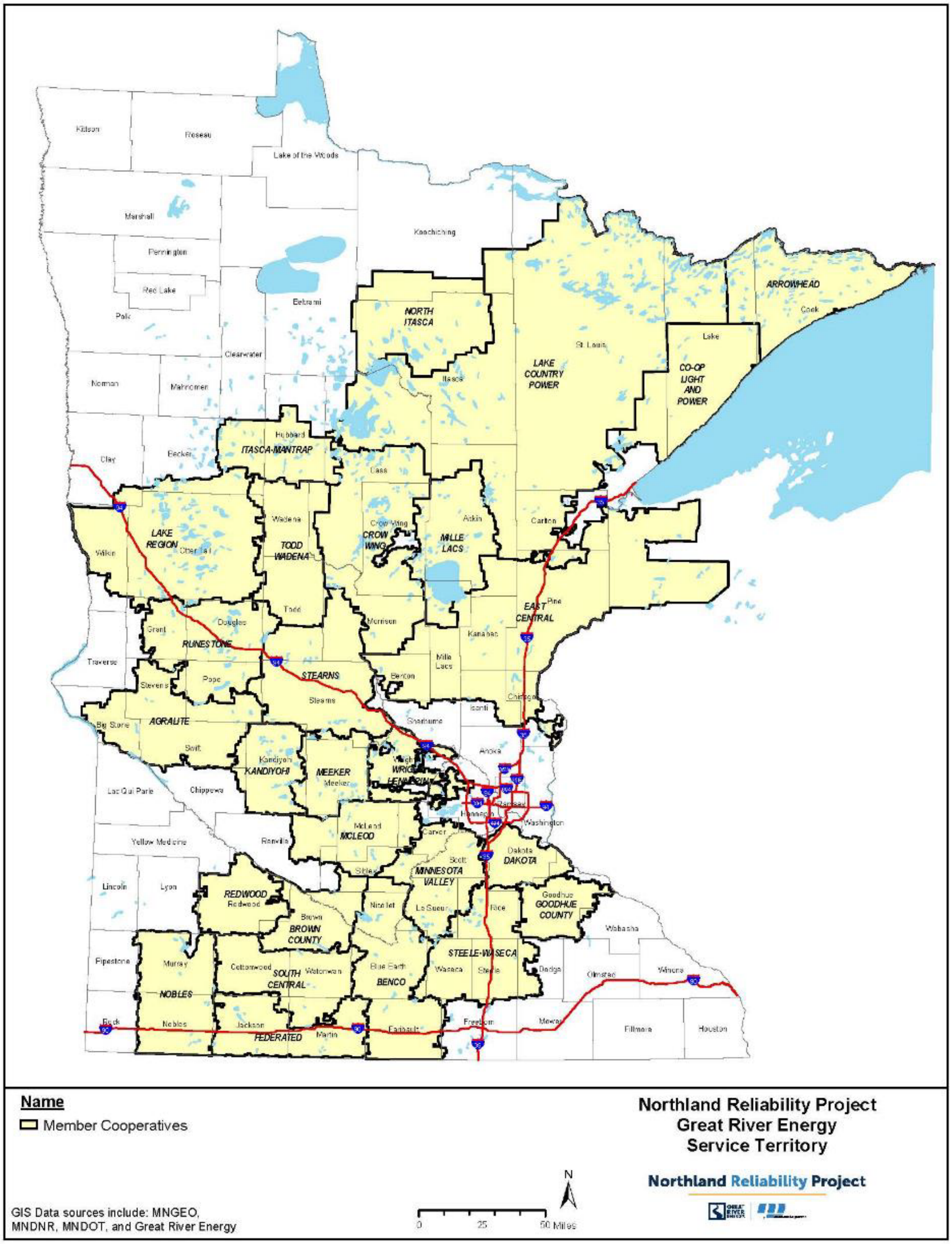
Minnesota Power is an investor-owned public utility headquartered in Duluth, Minnesota. Minnesota Power supplies retail electric service to 150,000 retail customers and wholesale electric service to 14 municipalities in a 26,000-square-mile electric service territory located in northeastern Minnesota. Minnesota Power generates and delivers electric energy through a network of transmission and distribution lines and substations throughout northeastern Minnesota. Minnesota Power's transmission network is interconnected with the regional transmission grid to promote reliability and Minnesota Power is a member of the Midcontinent Independent System Operator, Inc. ("MISO") and the Midwest Reliability Organization ("MRO"). Minnesota Power provides electricity to customers in northern Minnesota. Minnesota Power's service area is shown in **Map 1-2**.

Map 1-2. Minnesota Power Service Area



Great River Energy is a not-for-profit wholesale electric power cooperative that provides electricity to approximately 1.7 million people through its 27 member-owner cooperatives and customers. Through its member-owners, Great River Energy serves two-thirds of Minnesota geographically and parts of Wisconsin. Great River Energy's transmission network is interconnected with the regional transmission grid to promote reliability, and Great River Energy is a member of MISO and the MRO. Great River Energy is based in Maple Grove, Minnesota. Great River Energy's member cooperatives are shown in **Map 1-3**.

Map 1-3. Great River Energy Service Area



Both Minnesota Power and Great River Energy provide safe, reliable, and competitively-priced energy to those they serve.

1.2 Project Need and Purpose

The Northland Reliability Project is needed to address some of the most challenging transmission system reliability issues in northern and central Minnesota related to the region's transition away from coal-fired generation. These reliability issues have been analyzed for a decade and include serious regional voltage and transient stability issues identified by the Applicants and MISO. The Project addresses these issues and also provides voltage support, improves system strength, and provides local sources of power delivery. The Project also increases the ability to move power between regions which helps ensure Minnesota has access to resources during extreme weather events.

The Project was studied, reviewed, and approved as part of the Long-Range Transmission Plan ("LRTP") Tranche 1 Portfolio ("LRTP Tranche 1 Portfolio") by MISO's Board of Directors in July 2022 in its annual MISO Transmission Expansion Plan 2021 ("MTEP21") report.[2] Additional information on the need for the Northland Reliability Project is provided in **Chapter 3**.

The Applicants considered several alternatives to the Project, including: (1) new generation; (2) various transmission solutions, including upgrading other existing facilities, different conductors, different voltage levels and different endpoints; and (3) a no-build alternative. Alternatives to the Project are discussed further in **Chapter 4**.

1.3 Proposed Route

The Northland Reliability Project makes extensive use of existing high-voltage transmission line and other rights-of-way. The proposed double-circuit 345 kV transmission line follows primarily existing 230 kV transmission line rights-of-way (Minnesota Power's 92 Line and Great River Energy's Monticello Substation to Riverton Substation transmission line ("MR Line")) from the Iron Range Substation to the Benton County Substation then follows Great River Energy's Benton County Substation to Sherco Substation transmission line ("GRE-BS Line") and MR Line to the existing Sherco Substation and the new Big Oaks Substation, respectively. The Proposed Route generally deviates from following existing lines south of Riverton and near the South Long Lakes. In total, the Proposed Route is located along existing high-voltage transmission line rights-of-way for more than 85 percent of its length. The Proposed Route is shown in **Map 1-1**.

[2] The MISO Transmission Expansion Plan ("MTEP") is developed annually through an inclusive and transparent stakeholder process. MISO evaluates various types of projects through the MTEP process that, when taken together, build an electric infrastructure to meet local and regional reliability standards, enable competition among wholesale capacity and energy suppliers in the MISO markets, and allow for competition among transmission developers. The Project is identified as project number 3 in the MTEP21 LRTP Tranche 1 Portfolio.

The term "Proposed Route" includes the following infrastructure for the Project:

1) Segment 1: construction of a new, approximately 140-mile long, double-circuit 345 kV transmission line connecting Minnesota Power's existing Iron Range Substation, Minnesota Power's new Cuyuna Series Compensation Station, and Great River Energy's existing Benton County Substation;

2) Segment 2: replacement of an existing approximately 20-mile 230 kV line with a double-circuit 345 kV transmission line from Great River Energy's existing Benton County Substation to Xcel Energy's proposed new Big Oaks Substation;

3) Segment 2: replacement of an existing approximately 20-mile 345 kV line with double-circuit capable 345 kV transmission structures from Great River Energy's existing Benton County Substation to Xcel Energy's existing Sherco Substation;

4) Expansion of Minnesota Power's existing Iron Range Substation and Great River Energy's existing Benton County Substation and associated transmission line relocations at these substations; and

5) Construction of a new Cuyuna Series Compensation Station near the existing Riverton Substation and rerouting of an existing transmission line in this area.

A more detailed description of the Proposed Route is provided in **Chapter 5**.

1.4 Project Schedule and Cost

The Applicants anticipate starting Project construction in 2025. The Project is scheduled to be in service by June 2030.

The estimated cost for the Northland Reliability Project is between $970 million and $1.35 billion (2022$). Additional details regarding the schedule and cost for the Project are provided in **Chapter 2**.

1.5 Potential Environmental Impacts

The Applicants analyzed the potential environmental impacts from the Project. No significant unavoidable impacts will result from construction of the Project. Given the use of existing rights-of-way for 155 miles of the approximately 180-mile Project, the potential environmental impacts from the Project are anticipated to be limited to temporary construction impacts and incremental permanent impacts where new or expanded rights-of-way are needed. Additional information about the potential environmental impacts of the Project and proposed mitigation measures is provided in **Chapter 7**.

The Department of Commerce, Energy Environmental Review and Analysis ("EERA") is responsible for environmental review of the Project. The Certificate of Need rules require the preparation of an Environmental Report,[3] whereas the Route Permit rules for the Alternative Process require preparation of an Environmental Assessment ("EA").[4] The commissioner of the Department of Commerce may elect to prepare an EA (in lieu of preparing both an Environmental Report under the Certificate of Need rules and an EA under the Route Permit rules) for the Project that analyzes potential environmental impacts from the Project and meets all statutory and rule requirements of both the Environmental Report and the EA.[5]

1.6 Public Input and Involvement

The Applicants employed various engagement methods to provide information about the Project to the public and federal, state, and local agencies, Tribal Nation representatives, and non-government organizations. These engagement methods included in-person stakeholder workshops, virtual public open houses, in-person public open houses, direct mailings, social media posts, a dedicated email and hotline to field questions and comments, an interactive online comment map, a Project website, and detailed maps that could be downloaded and printed from the Project website. Additional information regarding the public outreach efforts conducted prior to the filing of this Application is provided in **Chapter 8**.

The public and interested stakeholders will have the opportunity to review this Application and to submit comments to the Commission about the Project. A copy of the Application will be available on the Department of Commerce's energy project website (http://mn.gov/commerce/energyfacilities) and on the Project's website at https://northlandreliabilityproject.com. Additionally, this application will be available at the following locations for the public to review:

- Grand Rapids Area Library – 140 NE 2nd St., Grand Rapids, MN 55744
- Hill City Hall – 125 Lake Ave., Hill City, MN 55748
- Mille Lacs Energy Cooperative – 36559 US Highway 169, Aitkin, MN
- Aitkin Public Library – 110 1st Ave. NE, Aitkin, MN 56431
- Jessie F. Hallett Memorial Library – 101 1st St. SE, Crosby, MN 56441
- Crow Wing Power – 17330 MN 371, Brainerd, MN 56401
- Brainerd Public Library – 416 S. 5th St., Brainerd, MN 56401
- Little Falls Great River Regional Library – 108 3rd St. NE, Little Falls, MN 56345
- Pierz Public Library – 117 S. Main St. Pierz, MN 56364
- Foley Great River Regional Library – 251 4th Ave. N, Foley, MN 56329
- Sauk Rapids Government Center – 250 Summit Ave. N, Sauk Rapids, MN 56379
- Becker Great River Regional Library – 11500 Sherburne Ave., Becker, MN 55308

Public information and scoping meetings will be held in the Project area by Commission and EERA staff after the Commission's acceptance of this Application as complete to

[3] Minn. R. 7849.1200.
[4] Minn. R. 7850.3700.
[5] Minn. R. 7849.1900, subp. 1.

answer questions about the Project and to solicit public comments and suggestions for matters to examine during environmental review. After EERA prepares an EA for the Project, public hearings will be held in the Project area, and members of the public will be given an opportunity to ask questions and submit comments. The Applicants will also present further evidence to support the need and route for the Project.

Persons interested in receiving notices and other announcements about the Project's Certificate of Need Application can subscribe to the docket by visiting https://mn.gov/puc/, clicking on "eDockets", clicking on "Go to eDockets" in the middle of the page, clicking on "eFiling Home/Login" in the left menu, clicking on the "Subscribe to Dockets" button, entering their email address and select "Docket Number" from the "Type of Subscription" dropdown box, then select "[22]" from the first Docket Number drop down box and enter "[416]" in the second box before clicking on the "Add to List" button. You must then click the "Save" button at the bottom of the page to confirm your subscription to the Project's Certificate of Need docket. These same steps can be followed to subscribe to the Project's Route Permit docket (22-415).

Persons wanting to have their name added to the Project Route Permit proceeding mailing list (Docket No. E015,ET2/TL-22-415) may register by contacting the public advisor in the consumer affairs office at the Commission at consumer.puc@state.mn.us, or (651) 296-0406 or 1-800-657-3782. Please be sure to note: 1) how you would like to receive notices (regular mail or email) and 2) your complete mailing or email address.

A separate mailing list is maintained for the Certificate of Need proceeding. To be placed on the Project Certificate of Need mailing list (Docket No. E015/CN-22-416), mail, fax, or email Robin Benson at Minnesota Public Utilities Commission, 121 7th Place E., Suite 350, St. Paul, MN 55101-2147, Fax: 651-297-7073 or robin.benson@state.mn.us.

Contact information for the Minnesota state regulatory staff for this Project are listed below:

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Craig Janezich
121 7th Place East, Suite 350
St. Paul, Minnesota 55101
(651) 296-7124
1-800-657-3782
Craig.janezich@state.mn.us
Website: www.mn.gov/puc/

Minnesota Department of Commerce EERA
Raymond Kirsch
85 7th Place East, Suite 280
St. Paul, Minnesota 55101
(651) 539-1841
1-800-657-3710
Raymond.kirsch@state.mn.us
Website: www.mn.gov/commerce

1.7 Certificate of Need Requirements

A Certificate of Need is required to be granted under Minn. Stat. § 216B.243 before a high-voltage transmission line of the voltage and lengths proposed for the Project is constructed.

The Commission has adopted rules for the consideration of applications for Certificates of Need at Minn. R. Ch. 7849. On April 19, 2023, the Applicants filed a Petition for Exemption under Minn. R. 7849.0200, subp. 6, requesting that the Applicants be exempt from certain filing requirements under Minn. R. Ch. 7849. The Commission approved the Petition in an order dated June 21, 2023 ("Exemption Order"). This Application contains the information required under Minn. R. Ch. 7849, as modified by the Commission in its Exemption Order. A copy of the Commission's Exemption Order is provided in **Appendix E**. A Certificate of Need completeness checklist is provided in **Appendix A** with cross references indicating where the information required by Minnesota statute and rules can be found in this Application.

1.8 State Routing Requirements

This Application is submitted under the alternative permitting process set forth in Minn. Stat. § 216E.04 and Minnesota Rules and Minn. R. 7850.2900 to 7850.3700 and 7850.4000 to 7850.4400. As provided for in Minn. Stat. § 216E.04, subd. 2(5), a high-voltage transmission line designed and capable of operation above 200 kV is eligible for the alternative permitting process if at least 80 percent of the distance of the line in Minnesota will be located along existing high-voltage transmission line right-of-way. The Northland Reliability Project qualifies for review under the alternative permitting process authorized by Minn. Stat. § 216E.04, subd. 2(5) and Minn. R. 7850.2800, subp. 1(E) because at least 80 percent of the Proposed Route is located along existing high-voltage transmission line rights-of-way.

The Applicants notified the Commission on July 5, 2023 that the Applicants intended to use the alternative permitting process for the Project. This letter complied with the requirements of Minn. R. 7850.2800, subp. 2, to notify the Commission of this election at least 10 days prior to submitting an application for a Route Permit. A copy of this letter is attached as **Appendix G**.

The Commission has adopted rules for the consideration of Route Permit applications in Minn. R. Ch. 7850. A Route Permit completeness checklist is provided in **Appendix B** with cross references indicating where the information required by Minnesota statutes and rules can be found in this Application.

1.9 Request for Joint Certificate of Need and Route Permit Proceeding

Minn. Stat. § 216B.243, subd. 4 and Minn. R. 7849.1900, subp. 4 permit the Commission to hold joint proceedings for the Certificate of Need and Route Permit in circumstances where a joint hearing is feasible, more efficient, and may further the public interest.

The Applicants respectfully request that the Commission order a joint regulatory review process for the Certificate of Need and Route Permit applications. A joint public hearing is feasible and more efficient than two separate proceedings and will further the public interest by having both need and routing issues to be examined in a singular proceeding.

1.10 Permittee

Minnesota Power and Great River Energy are the requested permittees for the Northland Reliability Project. Phone and e-mail addresses for the Project are:

Project Phone Number – (218) 864-6059
Project e-mail address – connect@northlandreliabilityproject.com

Minnesota Power Jim Atkinson Manager – Environmental and Real Estate 30 West Superior Street Duluth, MN 55802 (218) 355-3561 jbatkinson@mnpower.com	Great River Energy Dan Lesher Manager, Transmission Permitting and Land Rights 12300 Elm Creek Boulevard Maple Grove, MN 55369 (763) 445-5975 dlesher@GREnergy.com

1.11 Applicants' Request

The Applicants respectfully request that the Commission approve a Certificate of Need and a Route Permit for the Project along the Proposed Route. The Commission has established criteria in Minn. R. 7849.0120 to apply in determining whether a Certificate of Need should be granted for a proposed high-voltage transmission line. An applicant for a Certificate of Need must show that the probable result of denying the request would be an adverse effect on the future adequacy and reliability of the system, there is not a more reasonable and prudent alternative or combination of alternatives to meet the Project needs, the proposed facility will provide benefits to society compatible with protecting the environment, and the project will comply with all applicable standards and regulations. The Applicants have demonstrated in this Application that the Project meets all the requirements to obtain a Certificate of Need. The Northland Reliability Project will meet electrical transmission system needs by: (1) providing system support as fossil-fueled baseload generation is retired; (2) enhancing system resiliency during extreme weather events (such as during polar vortex events); (3) facilitating increased capacity to reliably deliver clean energy from where it is produced to where it is needed by customers and members, particularly during the winter season; and (4) proactively implementing a system to meet changing customer and members' power requirements due to decarbonization and electrification.

This Application also demonstrates that issuance of a Route Permit for construction of the Project along the Proposed Route effectively considers and satisfactorily addresses factors as set forth in Minn. Stat. § 216E.03, subd. 7, and Minn. R. 7850.4100. The Project will support the State's goals to conserve resources, minimize environmental and human settlement impacts and land use conflicts. In particular, the Project furthers the policy objectives in Minn. Stat. § 216E.03, subd. 7(b)(8) and (e) by locating the Project transmission line along existing high-voltage transmission line rights-of-way for more than

85 percent of the length of the Proposed Route, and ensuring the State's electric energy security through the construction of efficient, cost-effective transmission infrastructure.

2.1 Project Description

The Applicants propose to construct approximately 180-miles of double-circuit 345 kV transmission line between Grand Rapids, St. Cloud, and Becker, Minnesota. As shown in **Map 1-1**, the Project consists of two major segments.

1) Segment 1: construct a new, approximately 140-mile long, double-circuit 345 kV transmission line connecting Minnesota Power's existing Iron Range Substation, a new Cuyuna Series Compensation Station (described in more detail in **Section 2.1.5.2**), and Great River Energy's existing Benton County Substation – the proposed double-circuit 345 kV transmission line in Segment 1 is proposed to generally be located near and utilize existing high-voltage transmission line and other rights-of-way where feasible (detailed maps at **Appendix J, Detailed Mapbook, Pages 1-50**); and

2) Segment 2: replacement of existing high-voltage transmission lines (detailed maps at **Appendix J, Detailed Mapbook, Pages 51-64**).

    a) Replace Great River Energy's existing, approximately 20-mile, 230 kV transmission line with a new, approximately 24-mile,[6] double-circuit 345 kV transmission line from Great River Energy's existing Benton County Substation to the new Xcel Energy Big Oaks Substation[7] generally within the existing right-of-way;

    b) Replace Great River Energy's existing, approximately 20-mile, 345 kV transmission line with a new, approximately 18-mile,[8] double-circuit 345 kV transmission line structures from Great River Energy's existing Benton County Substation to Xcel Energy's existing Sherco Substation generally within the existing right-of-way. Initially, this transmission line will be constructed as a

[6] The difference in mileage between the existing and new transmission line is due to the uncrossing of existing transmission lines (**Section 3.5.4**) and the Proposed Route from the existing MR Line right-of-way to the Big Oaks Substation.

[7] The Big Oaks Substation will be permitted as part of the Alexandria to Big Oaks Project. *In the Matter of the Application of Great River Energy, Minnesota Power, Xcel Energy, Missouri River Energy Services and Otter Tail Power Company for a Certificate of Need for the Big Stone South - Alexandria - Big Oaks 345 kV Transmission Line Project*, Docket No. E017,ET2,E002,ET10,E015/CN-22-538; *In the Matter of the Application for a Route Permit for the Alexandria to Big Oaks 345-kV Transmission Project in central Minnesota*, Docket No. E002,ET2,ET10,E015,E017/TL-23-159.

[8] The difference in mileage between the existing and new transmission line is due to the uncrossing of existing transmission lines (**Section 3.5.4**) and the Proposed Route from the existing MR Line right-of-way to the Big Oaks Substation.

single-circuit 345 kV transmission line on double-circuit structures built to accommodate a second 345 kV circuit in the future.[9]

The Project will also involve the following improvements to the power grid:

1) Expansion of the existing Iron Range Substation, located near Grand Rapids, and expansion of the existing Benton County Substation, located near St. Cloud, and rerouting existing transmission lines at the Iron Range and Benton County substations; and

2) Construction of a new Cuyuna Series Compensation Station near the existing Riverton Substation and rerouting an existing transmission line in the Riverton area.

2.1.1 Proposed Route

The Proposed Route between the Iron Range Substation to the Cuyuna Series Compensation Station to the Benton County Substation generally follows an existing 230 kV line (Minnesota Power's 92 Line and Great River Energy's MR Line). From the Benton County Substation, the Proposed Route then follows Great River Energy's 345 kV GRE-BS Line and 230 kV MR Line to the Sherco Substation and the Big Oaks Substation, respectively.

In Segment 1 from the Iron Range Substation, the Proposed Route turns south for one mile and then turns west for 0.75 miles, south for 0.5 miles, and west for 0.75 miles, before joining Minnesota Power's 230 kV 92 Line right-of-way. The Proposed Route then follows Minnesota Power's 92 Line right-of-way for approximately 30 miles. The Proposed Route expands to the east where it passes an Enbridge pumping station and crosses Minnesota Power's ±250 kV high-voltage direct-current ("HVDC") transmission line. The Proposed Route then continues to follow the 92 Line right-of-way for approximately 27 miles. Approximately one mile south of the Mississippi River crossing in Wolford Township, the Proposed Route deviates southerly from the 92 Line and then turns west for one mile to minimize impacts to residences. The Proposed Route then rejoins the 92 Line right-of-way for 3.75 miles to the new Cuyuna Series Compensation Station.

South of the Cuyuna Series Compensation Station, the Proposed Route extends to the southeast and south along new right-of-way for 7.8 miles before joining Great River Energy's 230 kV MR Line right-of-way. The Proposed Route then turns south along the MR Line for approximately two miles before turning east along new right-of-way for 0.5 miles. The Proposed Route then turns southeast along Great River Energy's 69 kV RW Line for three miles before turning south then west along new right-of-way for 6.5 miles.

[9] Great River Energy will also replace and upgrade, in part, to 115 kV standards approximately 10 miles of Great River Energy's existing 69 kV transmission line ("EW Line") that shares a common transmission structure with facilities being replaced in Segment 2 of the Project. This replacement will continue to be operated at 69 kV, and additional material modifications would be required before the line could be operated at 115 kV.

The Proposed Route then continues to follow Great River Energy's MR Line for 48 miles to Great River Energy's Benton County Substation.

In Segment 2, the Proposed Route primarily centers around the existing Great River Energy's 230 kV MR Line and 345 kV GRE-BS Line from the Benton County Substation to Xcel Energy's new Big Oaks Substation and Xcel Energy's Sherco Substation, respectively. For the final 2.5 miles of the Proposed Route into the Big Oaks Substation the Proposed Route will deviate from the existing MR Line and primarily follow roads.

2.1.2 Route Width

The route width is the area in which the Commission authorizes a permittee to place the proposed transmission line facilities. The right-of-way, on the other hand, is the specific area that is required for the final easement for the transmission line. By requesting a route width that is wider than the right-of-way, Applicants will have some flexibility to make alignment adjustments during final design to work with landowners, avoid sensitive natural resources, and to manage construction constraints as practical.

In general, where the Proposed Route follows or replaces an existing high-voltage transmission line or other lower voltage transmission lines, the Applicants are requesting a route width of 500 feet on either side of the existing transmission line centerline for a minimum total of 1,000 feet. In areas where the Proposed Route follows more than one existing transmission lines, the route width requested is 500 feet from each outermost existing line (1,000 – 1,120 feet wide).

Where the Proposed Route uses new right-of-way, the Applicants are requesting a route width of 1,500 feet on either side of the proposed centerline for a total of 3,000 feet. Additional detail about specific route widths requested, by segment, is provided in **Chapter 5**. (**Appendix J, Detailed Mapbook, Pages 1, 25-27, 28-31, 50-51, and 59**). The wider route width is requested to allow for flexibility to minimize impacts to resources and to work with landowners.

The Applicants are requesting wider route widths in specific areas along the existing transmission line rights-of-way. These areas, as shown on **Appendix J, Detailed Mapbook, Pages 1, 12-13, 23-25, 48-49, 50-51, 56-59, and 62**, include the following:

- South of the Iron Range Substation – the Applicants request a route width of one mile to allow for flexibility in entering and exiting the substation in Sections 19 and 20 of Trout Lake Township in Itasca County.

- Minnesota Power's HVDC line – where the Proposed Route crosses Minnesota Power's existing ±250 kV HVDC line in Section 31 of Macville Township in Aitkin County, Applicants request a route width of 4,400 feet. An Enbridge pumping station and associated 230 kV tap line owned by Great River Energy are located east of the 92 Line and the Proposed Route would need to cross over both the HVDC line and tap line. The Applicants are requesting a wider route width in this area to provide flexibility to cross the HVDC line at mid-span, thus minimizing the height of the structures and to avoid the existing infrastructure in the area.

- River Road in Wolford Township – South of the Mississippi River near River Road and Cole Lake Way northwest of Crosby in Section 21 of Wolford Township in Crow Wing County, Minnesota Power's 13 Line joins the 11 Line and 92 Line from the east. The Applicants are requesting a route width of up to one mile (expanding to the east) on the east side of the existing lines to provide flexibility to avoid impacts to existing residences.

- Cuyuna Series Compensation Station – to allow for the siting of the new Cuyuna Series Compensation Station and flexibility in routing the Project transmission lines into and out of the new Substation in Sections 5, 6, 7, and 8 of Irondale Township in Crow Wing County, the Applicants request a route width of 1.25 miles.

- Golden Spike Road – the Applicants request that the route width be expanded to the east by 400 feet, to a total route width of 1,400 feet, to allow for routing the Project to minimize impacts to residences located near the existing lines, proximity to Elk River, and allows for a more perpendicular crossing of Golden Spike Road in Section 2 of Minden Township in Benton County.

- North of the Benton County Substation – the Applicants request a route width of 0.75 mile to allow for flexibility in entering and exiting the substation in Section 35 of Minden Township in Benton County.

- GRE-BS Line and MR Line Crossing – the Applicants request a route width of 2,500 feet where the existing MR Line and GRE-BS Line cross in Section 1 in Becker Township in Sherburne County to allow for the uncrossing of those lines when they are rebuilt.

- North of County Road 23 SE – the Applicants request a route width of 1,450 feet to potentially shift the existing centerline to minimize the crossing of an unnamed lake north of County Road 23 SE in Section 7 of Becker Township in Sherburne County.

- North of County Road 24 – the Applicants request a route width of 1,850 feet to potentially shift the existing centerline to the east to minimize the crossing of an unnamed lake in Section 28 and 29 of Becker Township in Sherburne County.

- Big Oaks Substation – to ensure a sufficient area is identified to interconnect the Project with the future Big Oaks Substation in Sections 7 and 18 of Becker Township in Sherburne County, the Applicants request a route width of 4,960 feet.

2.1.3 Transmission Line Right-of-Way

The Project requires a 150-foot-wide right-of-way (75 feet on each side of the centerline). However, to the extent practicable, the new double-circuit 345 kV transmission line in

Segment 1 will be co-located with existing high-voltage transmission lines or other rights-of-way, thereby facilitating the partial sharing of right-of-way and lessening the overall easement required from landowners for the Project. Segment 2 is intended to primarily follow the existing centerline of the high-voltage transmission lines, with the majority of the new line utilizing the existing right-of-way, except as discussed in **Section 2.1.1**.

2.1.4 Transmission Structure and Conductor Design

The double-circuit, 345 kV structures will be tubular steel, self-weathering, monopole structures with V-string insulators. The benefits to this structure design include a reduced footprint due to the monopole and reducing right-of-way needs by vertically orienting the two circuits using V-string insulators to limit conductor blowout. **Appendix K** includes technical drawings and the dimensions of the proposed transmission structures.

In Segment 2, approximately six miles of the existing Benton County Substation to Big Oaks Substation line (also referred to as the MR Line) from about 12th Street SE to Section 1 of Becker Township and approximately four miles of the Benton County Substation to Sherco Substation line (also referred to as the GRE-BS Line) from Section 1 of Becker Township to the south side of State Highway 10 will be designed and constructed on triple-circuit capable structures with a 69 kV underbuild position to accommodate the existing Great River Energy EW Line. The triple-circuit 345 kV/345 kV/69 kV structures will be tubular steel, self-weathering, monopole structures with V-string insulators for the 345 kV conductors and I-string insulators for the 69 kV conductors. The 69 kV portion that is carried on the triple-circuit structures will be constructed to 115 kV standards, but will not be capable of operating above 69 kV due to the remainder of the EW Line remaining at its existing 69 kV design capacity.

As further described in **Section 2.1.5.4** and **Section 3.5.4**, there may be various locations along the Proposed Route where the existing transmission lines will need to be realigned, relocated, reconfigured, or replaced. The structure types to be used at these locations include, but are not limited to, typical wood or steel and typical monopole or H-frame structure types. The structure designs will be driven by an effort to minimize impacts to landowners to the extent practicable.

The Applicants are evaluating two different conductor types for the Project: a horizontally bundled twisted pair-type aluminum conductor steel reinforced ("T2-ACSR") type and a horizontally bundled aluminum conductor steel supported ("ACSS") type. Both conductor types must be capable of carrying 3,000 amps per the needs identified by MISO. These conductor types will meet or exceed the emergency capacity needed for the Project.

A horizontally bundled twisted pair conductor will likely be used south of the proposed Cuyuna Series Compensation Station because, historically, the portion of the Project south of the proposed Cuyuna Series Compensation Station has experienced wind and ice events that encourage conductor galloping. Conductor galloping is a phenomenon where the conductor oscillates vertically in a high amplitude and low frequency. This galloping motion can cause nearby conductors to make contact, flashover, and cause unplanned outages. In addition, conductor galloping can create significant loading on the transmission line structures causing hardware failures or failures of structural components. Twisted pair conductor is more resistant to conductor galloping than traditional conductor types.

A horizontally bundled ACSS conductor may be used north of the proposed Cuyuna Series Compensation Station where wind and ice events have not historically caused galloping.

Project conductors for the realignment sections will likely be a typical ACSR or T2-ACSR conductor type. As the Applicants continue to evaluate the conductors for the Project, the specific conductors that will be used remain subject to change.

For the purposes of audible noise, electric field, and magnetic field calculations, the Applicants assumed a typical conductor size based on conductors used on similar projects in the region.

Typical tangent type structures are shown in **Appendix K**.

Table 2-1 summarizes the key specifications of the expected, proposed transmission structures.

Table 2-1. Typical Structure Design Summary

Line Type	Structure Type	Structure Material	Right-of-Way Width (feet)	Structure Height (feet)	Foundation	Foundation Diameter (feet)	Average Structure Span (feet)
Double-Circuit 345/345 kV	Monopole	Steel	150	130-170	Concrete Pier	7-10	800-1,000
Single-Circuit 230 kV	H-frame	Wood	150	65-90	Direct Embed**	NA	700-900
Single-Circuit 115 kV	H-frame	Wood	100	60-80	Direct Embed	NA	600-800
Single-Circuit 69 kV Rebuild*	Monopole	Wood	100	60-80	Direct Embed	NA	300-500
Triple-Circuit 345/345/69 kV	Monopole	Steel	150	140-180	Concrete Pier	8-10	600-800

Note: The values in the table above are typical values expected for the majority of tangent structures based on similar facilities. Actual values may vary.

* *Single-circuit 69 kV transmission line will be replaced in Segment 2 of the Project for the EW Line from West Becker Switch and West End Substation, where the FW Line will be built to 115 kV capable. There is approximately 1,345 feet of single-circuit 69 kV replacement to 115 kV capable within the uncrossing area between the Benton County Substation to Big Oaks Substation line (also known to as the MR Line) and the Benton County Substation to Sherco Substation line (also known as the GRE-BS Line). GRE's 69 kV EW Line easement width varies from 70- to 100-feet in width.*

** *Certain specialty or storm structures may be necessary. These structures may be concrete pier foundations instead of direct embed.*

2.1.5 Associated Facilities

2.1.5.1 Iron Range 500 kV/345 kV Substation Expansion

The existing Minnesota Power Iron Range 500 kV Substation will be expanded by approximately 15 acres entirely on Minnesota Power-owned property to facilitate interconnection of the Project at its northern endpoint. The existing 500 kV bus will be modified to incorporate four additional 500 kV circuit breakers in a ring bus configuration. The new five-position ring bus will accommodate the existing Dorsey – Iron Range 500 kV international transmission line, Iron Range 500 kV/230 kV transformer, and Iron Range 500 kV capacitor bank, as well as two new positions for interconnection of the 500 kV/345 kV transformers required for the Project. The existing fence line will need to be extended on the southeast side of the substation to accommodate the ring bus expansion. New 500 kV overhead bus will connect the existing 500 kV substation yard to the new 345 kV substation yard. The new 345 kV yard will include two 500 kV/345 kV transformer banks (each consisting of three single phase transformers with a common installed spare) with rated capacity of 1,200 MVA as well as a four-position 345 kV bus interconnecting the two new transformers and the new double-circuit 345 kV transmission line. Each of the new 345 kV transmission lines will also require new 345 kV shunt reactors at each line entrance. The 15-acre expansion is an estimation and the size, shape and precise location could potentially change per engineering design standards. A figure depicting the Iron Range 500 kV/345 kV Substation Expansion Siting Area is provided in **Appendix J, Detailed Mapbook, Page 1**.

2.1.5.2 Cuyuna 345 kV Series Compensation Station

The Project requires a new series compensation station near the midpoint of each new Iron Range – Benton 345 kV transmission line. A series compensation station inserts a capacitor bank in series with each of the phases of a high-voltage transmission line and includes an integrated, custom-designed system including many power capacitors and their associated protective bypass equipment. A series compensation station differs from a substation in that there are no transformers or other power transformational equipment to modify the voltage of the high-voltage transmission system. Minnesota Power's new Cuyuna Series Compensation Station will include the 345 kV series capacitor banks necessary for the reliable operation and optimal performance of the Project. In the original Project concept approved by MISO in July 2022, the series compensation station was expected to be located at the existing Minnesota Power Riverton 230 kV/115 kV Substation. Upon further analysis of the site, Minnesota Power determined that there was not sufficient space for the siting of the new series compensation station at the Riverton Substation due to physical and environmental constraints.

A new site was identified approximately two miles north of the existing Riverton Substation and land has been acquired by Minnesota Power. The new 25-acre 345 kV Cuyuna Series Compensation Station will be located on this new site. In addition to the series capacitor banks for each of the new 345 kV lines, the Cuyuna Series Compensation Station will include new 345 kV bus and breakers and associated equipment necessary to facilitate the interconnection and operation of the Project. A portion of the site will also be developed as a construction laydown yard and permanent material storage yard due to its advantageous location near the midpoint of the Project. Development of these facilities will take place entirely on property owned by Minnesota Power. A figure depicting the Cuyuna Series Compensation Station site is provided in **Appendix J, Detailed Mapbook, Pages 25-26**.

2.1.5.3 Benton County 345 kV Substation Expansion

The existing Great River Energy Benton County Substation will be expanded by approximately 8.5 acres – the current footprint is approximately nine acres – to facilitate interconnection of the Project. The expansion will take place entirely on property owned by Great River Energy, likely to the west of the existing substation. A figure depicting the Benton County Substation expansion siting area is provided at **Appendix J, Detailed Mapbook, Pages 50-51**.

The existing Benton County 345 kV bus will be converted to a breaker-and-a-half configuration to accommodate the installation of four new 345 kV transmission lines, the relocation of one existing 345 kV transmission line, and the reconfiguration of the bus topology of two existing 345 kV/230 kV power transformers. Two new 345 kV lines will go to Minnesota Power's expanded Iron Range Substation, two new 345 kV lines will go to Xcel Energy's new Big Oaks Substation, and the existing 345 kV line to Xcel Energy's existing Sherco Substation will be re-terminated. The bus topology reconfiguration of the two existing 345 kV/230 kV power transformers will include splitting the 345 kV & 230 kV buses for each transformer into separate 345 kV and 230 kV bus positions (today 345 kV and 230 kV bus positions are shared). The Project will also include the installation of two 345 kV shunt reactors, one for each of the new 345 kV transmission lines to the Iron Range Substation and a new electrical equipment enclosure with high security equipment. The existing fence will be replaced with a high security fence.

2.1.5.4 Relocation, Reconfiguration, and Realignment of Existing Transmission Lines

There are several locations along the Project route where existing transmission lines will be realigned or relocated to make room for Project transmission lines or substation facilities.

2.1.5.4.1 Relocations and Reconfigurations

At Minnesota Power's existing Iron Range Substation, existing Minnesota Power 115 kV and 230 kV transmission lines (also referred to as the 11 Line and 92 Line, respectively) will be rerouted around the site for the proposed 500 kV/345 kV expansion of the substation. At the new Cuyuna Series Compensation Station, an existing Minnesota Power 230 kV transmission line will be relocated and/or reconfigured around the site for the proposed 345 kV series compensation station to avoid establishing new 345 kV over 230 kV line crossings. Both of these relocations are proposed to take place on property owned by Minnesota Power. These reroutes will occur within the Proposed Route as shown in **Appendix J, Detailed Mapbook, Pages 1 and 24-25**.

At the Benton County Substation, relocation and/or reconfiguration of existing transmission lines may be required on property owned by Great River Energy to accommodate the proposed incoming double-circuit 345 kV transmission lines. These relocations will occur within the Proposed Route as shown in **Appendix J, Detailed Mapbook, Pages 50-51**.

2.1.5.4.2 Realignments

Along the Proposed Route, there are six locations in Segment 1 where existing transmission lines will be realigned to make room for the Project 345 kV double-circuit transmission line. These realignments are proposed to enable the Project to minimize impacts to residences, or other structures, along with other sensitive features without establishing new 345 kV over 230 kV line crossings. The importance of avoiding these line crossings is discussed in **Section 3.5.4** and **Section 4.6**. The six Segment 1 realignment locations are described below:

- In Section 31 of Blackberry Township and Section 6 of Splithand Township, Itasca County, the Proposed Route is located on the east side of Minnesota Power's existing 92 Line. At this point, the existing 115 kV 11 Line crosses the 230 kV 92 Line from the west to the east, then crosses back to the west about 1.5 miles to the south. To avoid additional line crossings, the 115 kV 11 Line will be routed in a new 100-foot right-of-way that stays on the west side of the 230 kV 92 Line for approximately 1.5 miles and the Proposed Centerline will continue on the east side of the 92 Line. This realignment is shown in **Appendix J, Detailed Mapbook, Pages 4-5**.

- In Granite Township, Morrison County, the Proposed Centerline is located on the west side of the MR Line. In Section 19, to avoid impacting a grove of trees, which provides screening for a home on the west side of the MR Line, the Proposed Centerline will be shifted to the current MR Line right-of-way and the MR Line will be shifted east to a new 150-foot right-of-way for approximately 0.55 miles. This realignment is shown in **Appendix J, Detailed Mapbook, Pages 38-39**.

- In Section 31 of Granite Township, Morrison County, the Proposed Centerline and the MR Line will be shifted to the east because of an existing agricultural building west of the current MR Line right-of-way. The Proposed Centerline will be shifted to the current MR Line right-of-way and the MR Line will be shifted east to a new 150-foot right-of-way for approximately 0.7 miles. This realignment is shown in **Appendix J, Detailed Mapbook, Page 39**.

- In Section 23 of Pierz Township, Morrison County, the Proposed Centerline and the MR Line will be shifted to the east because of existing agricultural buildings and a farmstead just west of the current MR Line right-of-way. The Proposed Centerline will be shifted to the current MR Line right-of-way and the MR Line will be shifted east to a new 150-foot right-of-way for approximately 0.65 miles. This realignment is shown in **Appendix J, Detailed Mapbook, Pages 40-41**.

- In Sections 26 and 35 of Buckman Township, Morrison County, the Proposed Centerline and the MR Line will be shifted to the east because of existing agricultural buildings and two farmsteads just west of the current MR Line right-of-way. The Proposed Centerline will be shifted to the current MR Line right-of-way and the MR Line will be shifted east to a new 150-foot right-of-way for approximately 0.95 miles. This realignment is shown in **Appendix J, Detailed Mapbook, Pages 43-44**.

- In Section 2 of Minden Township, Benton County, the Proposed Centerline is west of the existing MR Line and Great River Energy's BP Line. At the crossing of Golden Spike Road, the existing MR Line and BP Line will be shifted to the east to allow the Proposed Centerline to avoid impacting a residence just west of the existing lines and to minimize impacts to the Elk River. The existing lines will be shifted to 250 feet of new right-of-way east of the Proposed Centerline for approximately 0.35 miles. This realignment is shown in **Appendix J, Detailed Mapbook, Pages 48-49**.

2.1.6 Design Options to Accommodate Future Expansion

The Project is designed to meet current and projected future needs of the local and regional transmission network.

2.1.6.1 Segment 2 – Benton County to Sherco 345 kV Transmission Line Double-Circuit Capability

Initially, the proposed Benton County to Sherco transmission line will be constructed as a single-circuit 345 kV transmission line on the double-circuit capable structures built to accommodate a future second 345 kV circuit when conditions warrant. This configuration provides future optionality to double the transmission capacity of the Benton County to Sherco transmission line with no additional right-of-way or structures and with minimal impacts at the time additional transmission capacity is needed.

Maximizing the use of existing transmission or other rights-of-way is especially prudent given the presence of agricultural center-pivot irrigation, residential development, and proposed solar generation. The proposed double-circuit capable structures between the Benton County Substation and the Sherco Substation results in a marginal incremental cost, approximately 20 percent, compared to single-circuit 345 kV structures as shown in **Table 2-2**. However, should the second circuit be added in the future, it is projected to save at least 30 percent relative to a stand-alone option,[10] as shown in **Table 2-2**.

[10] Comparison is conservative as it ignores impacts of inflation and incremental costs associated with future economic development in the area.

Table 2-2. Cost Comparison of Benton County to Sherco Transmission Line Single- Versus Double-Circuit 345 kV Capability[11]

Single-Circuit 345 kV Cost ($ millions) (2022$)	Single 345 kV – Double-Circuit Capable Cost ($ millions) (2022$)	Cost to add Second Circuit to Double-Circuit Capable Structure ($ millions) (2022$)	Total Cost for Double Circuit Build-out ($ millions) (2022$)	Two Parallel Single-Circuit 345 kV Cost ($ millions) (2022$)
$73.4	$89.5	$9.7	$99.2	$146.8

2.1.6.2 Segment 2 – 69 kV Upgrade to 115 kV Future Operation

Approximately ten-miles of the proposed 345 kV transmission line between the Benton County Substation and the Sherco Substation and the 345 kV transmission line between the Benton County Substation and the new Big Oaks Substation are proposed to be designed to carry a 115 kV circuit on triple-circuit structures. The existing Great River Energy 69 kV EW Line will be co-located on these structures. To meet potential future load growth, the Applicants propose to design and build the 69 kV to 115 kV standards. This line will be operated at 69 kV and will not be capable of being operated at a voltage higher than 100 kV until further significant modifications outside of the scope of the Project are constructed as the remainder of the EW Line will not be reconstructed at this time to 115 kV standards. Accordingly, it is not a "high-voltage transmission line," and neither a certificate of need nor a route permit is required for the proposed configuration.[12]

This design provides future optionality to increase the local load serving transmission capacity with no new right-of-way or structures within the Proposed Route. This will also minimize damage and disturbance to the underlying property by not needing to replace the conductor in the future. In addition, constructing the lines to a 115 kV standard provides greater working clearances for line maintenance.

2.1.6.3 Substations

Options to accommodate future expansion will be incorporated into the design of Project substations. Space will be reserved at the Iron Range Substation, Cuyuna Series Compensation Station, and Benton County Substation to accommodate future 345 kV line interconnections as necessary for future development of the regional transmission backbone. Additional space will also be reserved at the Iron Range Substation and Cuyuna Series Compensation Station to accommodate future 345 kV/230 kV transformer interconnections to support the underlying 230 kV system. These future expansion

[11] Costs are mid-range estimates
[12] *See* Minn. Stat. § 216B.2421, subd. 2(3); Minn. Stat. § 216E.01, subd. 4.

options will require additional modifications and site development that are outside the scope of the Project.

2.2 Project Costs

2.2.1 Construction Costs

The estimated cost to construct the Project is approximately $970 million to $1.3 billion (2022$). The low end of this range is based on the scoping cost estimate used by MISO for review of the Project as part of the LRTP Tranche 1 and is the cost basis upon which it was approved by the MISO Board of Directors in July 2022. The range includes mid- and high-end estimates that have been developed by the Applicants based on the route and scope of the Project presented in this Application and incorporating the best-available cost estimate information at the time of filing. The cost estimate is broken down by the individual Project components in **Table 2-3**. All costs are presented in 2022 dollars and include permitting, engineering, materials, land rights and right-of-way, and construction costs.

If the Commission selects a route other than the Proposed Route or imposes non-standard construction conditions, the Project cost estimates may change. These cost estimates assume that the Applicants will pay prevailing wages for applicable positions for the construction of the Project.

Table 2-3. Current Project Cost Estimates

Project Component	Low[13] ($Millions) (2022$)	Mid ($Millions) (2022$)	High ($Millions) (2022$)
Iron Range 500 kV/345 kV Substation Expansion	$70.4	$95	$108.9
Iron Range – Cuyuna 345 kV Double-Circuit	$312	$368.1	$420.7
Cuyuna 345 kV Series Compensation Station	$80	$99.3	$113.9
Cuyuna – Benton County 345 kV Double-Circuit	$312	$336.6	$384.7
Benton County 345 kV Substation Expansion	$25.5	$31.4	$36
Benton County – Big Oaks 345 kV Double-Circuit	$97.6	$133.9	$153
Benton County – Sherco 345 kV Line	$72.4	$92.8	$106.1
Realignments and Reroutes	-	$17	$19.5
Asset Retirements	-	$8.5	$9.8
Project Cost Totals	**$970**	**$1,182**	**$1,353**

2.2.2 Operation and Maintenance Costs

Operations and maintenance ("O&M") costs for the Project consist of three components: the new transmission lines, substation expansions, and new series compensation station. Relevant O&M considerations for each of these components are described below.

Once constructed, O&M costs associated with the new transmission lines will be initially driven by controlling regrowth vegetation within the right-of-way. The Applicants anticipate a post-construction annual maintenance cost of approximately $7,500 per mile for the Project. The majority of this cost is related to vegetation management. The Applicants also perform other general maintenance on their transmission facilities, such as conducting regular right-of-way patrols and repairing aged or worn equipment or facilities. The specific O&M costs for an individual transmission line vary based on the location of the line, the number of trees located along the right-of-way, the age and condition of the line, the voltage of the line, and other factors.

Over the life of the new substation facilities, inspections will be performed regularly to maintain equipment and make necessary repairs. Transformers, circuit breakers, batteries, protective relays and other equipment need to be serviced periodically in

[13] The low-range estimate is based on the scoping cost estimate used by MISO and did not include cost estimates for realignments and reroutes or asset retirements.

accordance with the manufacturer's recommendation. Routine compliance inspections will be performed and the sites must also be kept free of vegetation and drainage maintained. Minnesota Power's substation maintenance costs typically range from $50,000-$100,000 annually. Great River Energy's substation maintenance costs typically range from $100,000 – $200,000 annually.

The Cuyuna Series Compensation Station has more specialized equipment compared to a standard transmission substation. An effective O&M program includes regular planned outages for inspection and maintenance of series compensation equipment and ancillary systems. During scheduled outages, additional staff will be needed to support operations. Costs related to O&M will be less during the warranty period (the first three to five years of operation depending on final construction contract terms) due to the limited scope of outages and parts will be replaced under warranty. After the warranty period, outages become more time intensive and additional maintenance is needed based on age of equipment. Regular maintenance, regardless of age, includes periodic inspections (daily, weekly, monthly, etc.), equipment testing, cybersecurity, compliance support, and vegetation management. The annual series compensation station O&M costs are anticipated to be approximately $175,000 annually.

2.2.3 Effect on Rates

The Commission's rules require an applicant to provide the annual revenue requirements to recover the costs of a proposed project. Applicants requested an exemption from this rule requirement for Great River Energy. Instead, Great River Energy committed to provide an explanation of how MISO will allocate the cost of the Project based on wholesale electricity use and a general estimate of rate impact of the Project on Minnesota customers as well as the general financial effects of the Project on Great River Energy's member cooperatives.

2.2.3.1 MISO Cost Allocation

The Project is part of the MISO LRTP Tranche 1 Portfolio, which has been determined by MISO to meet the criteria for being designated a Multi-Value Project ("MVP") according to the MISO tariff. Therefore, the Project, along with all other projects in the LRTP Tranche 1 Portfolio, qualifies for regional cost allocation. MISO has determined that the LRTP Trance 1 portfolio will be allocated to transmission customers in the MISO Midwest Subregion[14], where the portfolio is located and provides proximate benefits. The allocation of the Project's costs to transmission customers is governed by Schedule 26-A, Multi-Value Project Usage Rate, in MISO's tariff. The annual revenue requirement for the Project is determined pursuant to the formula rate in Attachment MM-MVP Charge in the MISO tariff. Withdrawing Transmission Owners[15] in the MISO Midwest Subregion pay the annual revenue requirement through Schedule 26-A charges assessed based on actual monthly energy consumption by customers. Minnesota customers' allocated share

[14] The MISO Midwest Subregion includes MISO transmission customers in Minnesota, Montana, North Dakota, South Dakota, Iowa, Wisconsin, Missouri, Illinois, Indiana, Michigan, and Kentucky. MISO South Subregion transmission customers are excluded in the allocation and recovery of Project costs.
[15] These are defined in the MISO Tariff.

of the annual revenue requirement is determined by the percent of total MISO energy used by Minnesota utilities, which has been estimated at approximately 15 to 20 percent based on MISO's posted 2021 energy withdrawal data.

Table 2-4 summarizes the estimated cost allocation for the Project to each local balancing authority area in the MISO Midwest Subregion.

Table 2-4. Estimated Cost Allocations based on Attachment MM of the MISO Tariff[16]

Local Balancing Authority Area	Cost Allocation Zone	Local Balancing Authority Area Allocation
ALTE	2	2.9%
ALTW	3	3.8%
AMIL	4	8.9%
AMMO	5	7.3%
BREC	6	2.0%
CIN	6	7.8%
CONS	7	9.1%
CWLD	5	0.3%
CWLP	4	0.3%
DECO	7	10.1%
DPC	1	1.3%
GLH	4	0.0%
GRE	1	2.9%
HE	6	0.7%
HMPL	6	0.1%
IPL	6	2.8%
MDU	1	0.7%
MEC	3	6.4%
MGE	2	0.7%
MUIP	2	0.6%
MP	1	2.4%
MPW	3	0.2%
NIPS	6	3.7%
NSP	1	9.0%
OTP	1	2.9%
SIGE	6	1.2%

[16] LRTP Tranche 1 Appendix A-4 Schedule 26A Indicative.xlsx, *available at* https://cdn.misoenergy.org/LRTP%20Tranche%201%20Appendix%20A-4%20Schedule%2026A%20Indicative625788.xlsx.

Local Balancing Authority Area	Cost Allocation Zone	Local Balancing Authority Area Allocation
SIPC	4	0.3%
SMP	1	0.3%
UPPC	2	0.2%
WEC	2	6.0%
WPS	2	2.7%
Exports and Wheel-Throughs	N/A	2.6%

Great River Energy has load in multiple local balancing authority areas: GRE, NSP, OTP, MP, ITCM, and SMP. Minnesota Power has load solely in the MP local balancing authority area. To calculate costs allocated to Great River Energy and Minnesota Power, each local balancing authority area allocation is multiplied by Great River Energy's and Minnesota Power's individual load ratio share.

Great River Energy's allocated cost will be approximately 3.9 percent using allocations from **Table 2-4** and 2023 projected MISO ("12CP") average load share based on April 2023 MISO zonal rates and determinants file[17] as shown in **Table 2-5**.

Table 2-5. Share of Allocated Costs – Great River Energy

Pricing Zone	Project Local Balancing Authority Area Allocation	Load Ratio Share per Local Balancing Authority Area	GRE Share of Local Balancing Authority Area Allocation
GRE	2.9%	77.1%	2.2%
NSP	9.0%	9.1%	0.8%
ALTW	3.8%	4.1%	0.2%
MP	2.4%	12.5%	0.3%
SMP	0.3%	1.3%	0.0%
OTP	2.9%	12.6%	0.4%
TOTAL			**3.9%**

[17] MISO Transmission Settlements and Pricing *available at* https://www.misoenergy.org/markets-and-operations/settlements/ts-pricing/#nt=%2Ftspricingtype%3AZonal%20Rates&t=10&p=0&s=Updated&sd=desc.

Minnesota Power's allocated cost will be approximately 2.1 percent using allocations from **Table 2-4** above and 12CP average load share based on April 2023 MISO zonal rates and determinants file[18] as shown in **Table 2-6**.

Table 2-6. Share of Allocated Costs – Minnesota Power

Pricing Zone	Project Local Balancing Authority Area Allocation	Load Ratio Share per Local Balancing Authority Area	MP Share of Local Balancing Authority Area Allocation
MP	2.4%	87.5%	2.1%

The Applicants will collectively be allocated approximately six percent of the total costs for the Project with the rest of the costs being allocated to load in the remaining MISO Midwest Subregion. The initial levelized annual revenue requirement for the low-end Project estimate based on MISO indicative forecasts[19] is estimated to be approximately $118 million per year. Of an $118 million in annual revenue requirement approximately $4.6 million (3.9 percent) would be allocated to Great River Energy and approximately $2.5 million (2.1 percent) would be allocated to Minnesota Power at current energy withdrawal values. For reference, the current total annual revenue requirement for the entire state of Minnesota is over $1.1 billion.

2.2.3.2 Rate Impacts – Great River Energy Member Cooperatives

As a not-for-profit transmission and generation cooperative, Great River Energy's costs are allocated to Great River Energy's 27 member-owner distribution cooperatives based on a board approved formula rate methodology. This formula rate methodology allocates power supply and transmission costs by agreed upon applicable billing determinants. Each Great River Energy member-owner distribution cooperative develops their own rates based on individual costs, including allocated costs from Great River Energy, for their member-consumers via applicable customer rate class.

2.2.3.3 Rate Impacts – Minnesota Power Customers

Table 2-7 summarizes the estimated Minnesota jurisdictional revenue requirements and rate impacts by customer class for the first expected in-service year beginning July 1, 2030. The estimated impacts are provided using the indicated capital cost ranges. The total revenue requirements were estimated using the approved rate of return in the Company's recently completed rate case (Docket No. E015/GR-21-335). The revenue requirements incorporate property tax based on the range in capital cost and reflect current assumptions for Minnesota property tax treatment. The gross revenue requirements are offset by the expected estimated net MISO Schedule 26A revenue and

[18] MISO Transmission Settlements and Pricing (misoenergy.org) *available at* https://www.misoenergy.org/markets-and-operations/settlements/ts-pricing/#nt=%2Ftspricingtype%3AZonal%20Rates&t=10&p=0&s=Updated&sd=desc.
[19] MISO LRTP Tranche 1 MTEP21 Appendix A-4 Schedule 26A *available at* https://cdn.misoenergy.org/LRTP Tranche 1 Appendix A-4 Schedule 26A Indicative625788.xlsx.

expenses for the project. The net Minnesota jurisdictional and class requirements were derived by multiplying the total Minnesota Power customer revenue requirements by Minnesota Power's current CC-TRAN (D-02) Transmission Demand jurisdictional and class allocators reflecting the outcomes of the Company's recently completed rate case.

For the average residential customer, the rate impact for the first twelve months following in-service would range from approximately $0.82 to $1.14 per month. If compared to the estimated average current 2023 residential rate reflecting the outcomes of the recently completed rate case, this would represent an increase of approximately 0.78 to 1.08 percent. For Large Power customers, the estimated rate impact for the first twelve months following in-service would range from approximately 0.110¢ to 0.152¢ per kilowatt-hour ("kWh") of energy. If compared to the estimated average current 2023 Large Power rate reflecting the outcomes of the recently completed rate case, this would represent an increase of approximately 1.18 to 1.63 percent. These estimates would also be impacted by any future changes in Minnesota Power's authorized rate of return and the CC-TRAN (D-02) Transmission Demand jurisdictional and class allocators. In addition, the net MISO Schedule 26A revenue and expense allocations for the project will differ as Attachment MM inputs change from MISO's indicative values to actual values and as variations occur between the Company's actual load relative to that of other members in the MISO Midwest Subregion.

Table 2-7. Estimated Retail Rate Impact for Minnesota Power Customers

For the twelve months ending	6/30/31	6/30/31	6/30/31
	Low-Range	Mid-Range	Upper-Range
MN Jurisdictional Revenue Requirements	$8,569,528	$10,348,834	$11,831,806
Rate Class Impacts 1/			
Residential			
Average Current Rate (¢/kWh)	14.894	14.894	14.894
Increase (¢/kWh)	0.116	0.141	0.161
Increase (%)	0.78%	0.94%	1.08%
Average Impact ($/month)	$0.82	$1.00	$1.14
General Service			
Average Current Rate (¢/kWh)	14.943	14.943	14.943
Increase (¢/kWh)	0.116	0.141	0.161
Increase (%)	0.78%	0.94%	1.08%
Average Impact ($/month)	$3.25	$3.92	$4.48
Large Light & Power			
Average Current Rate (¢/kWh)	11.960	11.960	11.960
Increase (¢/kWh)	0.116	0.141	0.161
Increase (%)	0.97%	1.18%	1.34%
Average Impact ($/month)	$285.87	$345.23	$394.70
Large Power			
Average Current Rate (¢/kWh)	9.361	9.361	9.361
Increase (demand + energy combined) (¢/kWh)	0.110	0.133	0.152
Increase (%)	1.18%	1.42%	1.63%
Average Impact ($/month)	$53,043	$64,056	$73,235
Lighting			
Average Rate (¢/kWh)	31.964	31.964	31.964
Increase (¢/kWh)	0.116	0.141	0.161
Increase (%)	0.36%	0.44%	0.50%
Average Impact ($/month)	$0.19	$0.23	$0.26

Notes:

1/ Average current rates are 2022 Final General Base Rates without riders per the 2023 Commission Order in Docket No. E015/GR-21-335 adjusted to include current rider rates. Current rider rates include the Transmission Cost Recovery Rider rates, Renewable Resources Rider rates, Solar Renewable rates, Conservation Program Adjustment rates, and the Fuel and Purchased Energy Adjustment with True-Up. The increase (¢/kWh) shown above is the increase associated with the Project.

2.3 Project Schedule

The anticipated permitting and construction schedule for the Project is provided in **Table 2-8**. This schedule is based on information known as of the date of the filing of this Application and may be subject to change.

Table 2-8. Anticipated Project Schedule

Activity	Anticipated Date
Application Filed	August 2023
Public Information and Scoping Meetings	Fall/Winter 2023-2024
Environmental Assessment Issued	Winter/Spring 2024
Public Hearings	Spring/Summer 2024
Certificate of Need and Route Permit Issued	Summer 2024
Land Acquisition Begins	Winter/Spring 2024[20]
Project Construction Begins	Summer/Fall 2025
Project In-Service	June 2030[21]

[20] Some property acquisition was commenced in conjunction with the filing of the Application.

[21] While the in-service date of Segment 1 of the Project and the portion of Segment 2 from the Benton County Substation and Sherco Substation are within the control of the Applicants, the final in-service date for the Benton County Substation to Big Oaks Substation portion of the Project in Segment 2 will align with the in-service date of the proposed Big Oaks Substation, which is part of a separate project (Docket Nos. E017,ET2,E002,ET10,E015/CN-22-538 and E002,ET2,ET10,E015,E017/TL-23-159).

3.1 Chapter Overview

The Northland Reliability Project resolves regional reliability constraints resulting from the transition from fossil-fueled baseload generation to renewable energy generators, optimizes the ability to move power from one area to another, and contributes to significant regional transmission benefits associated with the MISO LRTP Tranche 1 portfolio. The Project is a foundational component of positioning the power system in northern Minnesota and the surrounding region for the clean energy transition, and it addresses some of the most challenging transmission system reliability issues from ceasing coal-fired operations and transitioning the baseload generator fleet, including serious regional voltage and transient stability issues identified by the Applicants and MISO. This chapter provides a comprehensive discussion of the background and need for the Project, including nearly 10 years' worth of analyses by the Applicants and MISO supporting the Project.

The General Background section (**Section 3.2**) provides a review of power system basics and fundamental concepts that are necessary to understand the need for the Project, including voltage stability and transient stability.

The Baseload Generator Fleet Transition & Regional Reliability section (Section 3.3) provides background on baseload generator fleet transition in northern Minnesota followed by detailed discussion of the specific regional reliability constraints – voltage and transient stability issues, as well as transmission line overloads – arising from these changes in baseload generation which are mitigated by the Project. In summary:

- The Project addresses severe regional voltage stability constraints associated with baseload generator fleet transition that have been identified in a multitude of studies over the course of the last decade. Without the Project, coal-fired baseload generation in northern Minnesota may need to continue operating to prevent significant reliability impacts from voltage stability constraints, including the need to potentially reduce northern Minnesota load by up to 1,000 megawatts ("MW") in some cases.

- The Project addresses significant transient stability constraints associated with baseload generator fleet transition and contributes to improved transient stability performance of the regional grid.

- The Project addresses transmission line overloads related to baseload generator fleet transition. In the Applicants' analysis, the Project relieves transmission line overloads on 83 circuits totaling 1,334 miles.

The MISO LRTP section (**Section 3.4**) provides background on MISO's role in planning the interstate (regional) transmission grid, the reliability implications of the Midwest's changing generation fleet, and the purpose and process for the MISO LRTP study, followed by detailed discussion of MISO's analysis and justification of the LRTP Tranche 1 Portfolio, including its specific evaluation of the Project. MISO identified that the Project is both a critical component of the regionally-beneficial LRTP Tranche 1 Portfolio and the most cost-effective solution to maintain reliability in central and northern Minnesota following the cessation of coal-fired operations at legacy fossil fuel units. The LRTP Tranche 1 Portfolio was approved by the MISO Board of Directors in July 2022.

The Additional Project Needs & Benefits section (**Section 3.5**) provides an overview of the Project's beneficial impacts on regional transfer capability, expected economic benefits in the energy market, resiliency and transmission source reliability, and future flexibility and electrification. The Project provides many additional benefits to Minnesota Power's customers and Great River Energy's members, as well as the regional power system.

The remaining sections in **Chapter 3** address specific Certificate of Need requirements including load forecast, losses, and impact of delay.

3.2 General Background

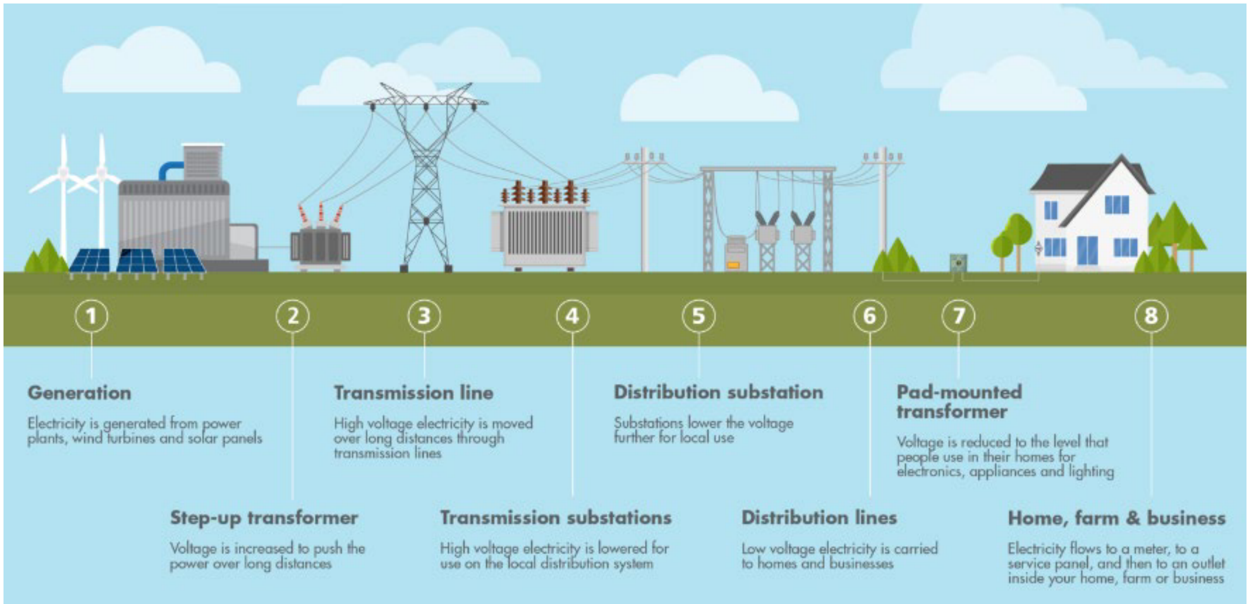
The electric grid is a set of interconnected wires connecting places where energy is generated to where it is used. Over time, the grid has become smarter, more dynamic, and increasingly interconnected due to rising reliability expectations and advancements in technology, along with additional wind and solar energy resources.

Electricity is produced at generating stations using a variety of sources or fuels, including solar, wind, hydro, biomass, biofuels, natural gas, coal, and nuclear. Unlike other consumables, where excess product can be easily and economically stored for future use, electricity must largely be generated simultaneously with its consumption, so generators connected to the system must instantaneously adjust their electric output to respond to changes in customer demand. While energy storage technologies, including battery energy storage, are advancing, there is not currently a commercially viable large-scale energy storage alternative that could meet the needs of the Project.

Electricity from these generators, located at places like power plants and wind farms, is pushed along high-voltage transmission lines often at voltages in excess of 100,000 volts (e.g., 115 kV, 230 kV, 345 kV, 500 kV). One kV equals 1,000 volts ("V"). Voltage on transmission lines is higher than what is ultimately used by the consumer because moving electricity over longer distances at higher voltages reduces electrical losses on the system; this means that more of the energy that is generated reaches the ultimate customer. Once the electricity reaches the community to which it will be used, it is "stepped down" to lower, more usable levels at a substation. Then, the electricity is sent along smaller distribution lines to be delivered to neighborhoods and businesses.

A diagram showing the transfer of electricity from generator to consumer is shown below in **Figure 3-1**.

Figure 3-1. How Electricity Gets to Consumers[22]



3.2.1 Transmission System Overview

The bulk electric transmission system is comprised of high-voltage transmission lines, which can carry electricity long distances and deliver power to distribution systems to meet customer needs in specific locations, and bulk transformers at 100 kV and above. Transmission lines are made up of conductors, which complete a three-phase circuit and are usually accompanied by a shield wire on top that provides protection from lightning strikes. The shield wire can also include fiber optic cable which provides a communication path between substations for transmission line protection equipment. These conductors are groups of wires, usually made from copper or aluminum, and are most commonly held up by poles or towers (commonly referred to as transmission structures) that are made from wood or steel. Transmission lines carry electricity from the generation source to the area where the power is needed. The rate at which electric charge moves through a wire is called current and is measured in amperes (amps). The force that moves the electricity through the wire is called voltage. Voltage is measured in V or kV. The wire conducting the current resists its movement. This resistance is measured in a unit called Ohms. Copper or aluminum wires conduct electricity with relatively little resistance.

3.2.2 Substations

Substations are a part of the electric generation, transmission, and distribution system and contain high-voltage electric equipment to monitor, regulate, and distribute electricity. Generally, substations allow transmission lines to connect with one another, or allow power to be transformed from a higher transmission voltage to a lower voltage for

[22] Great River Energy, How Electricity Gets to You, *available at* https://greatriverenergy.com/cooperatives-articles/how-electricity-gets-to-you/.

distribution, typically below 69 kV. Substation property dimensions depend on the project and anticipated future needs based on the physical characteristics of the site, such as shape, elevation, above and below ground geographical characteristics, and proximity of the site to transmission lines. Substation sites need to be large enough to accommodate both the fenced area and the required surrounding areas, including storm water ponds, wetlands, grading, parking and access roads, and the transmission line rights-of-way that will enter/exit the substation. The configuration of a substation may change over time to accommodate future load growth or electric system needs.

3.2.3 Transmission System Planning and Design

Electricity is a critical service and thus the transmission grid is planned to stay reliable, resilient, and affordable. Reliability in the most basic sense means “keeping the lights on” 24 hours a day, 365 days a year. To accomplish that task, the transmission system is designed to transport energy from generation to where it’s needed, during not only “normal” operating conditions (e.g., a typical day) and during times when the demand for electricity is highest, such as the hottest summer day when air-conditioners are running or conversely the coldest winter day when electric heating is at its maximum. In addition, the transmission system is designed to withstand the outage of a single generator, transmission line, transformer, or other transmission system element without major disruption to the overall power supply. Reliability is measured and assessed to federal standards which are set by the North American Electric Reliability Corporation (“NERC”).[23]

While the transmission grid remains extremely reliable, in recent years, extreme weather, wildfires, and sabotage have had an increasing impact on the power grid across the United States. As a result, owners and operators of the transmission grid, including the Applicants, are seeking new ways to increase the resilience of the transmission grid to better prevent, withstand, and recover from low probability but high impact events. Resilience efforts include the use of stronger transmission structures, new conductors which minimize icing, enhanced security measures, and other physical and non-physical improvements.

As a critical service, it’s also important that electricity remains cost effective. Due to the magnitude of the investment costs associated with the infrastructure needed to generate and transport electricity (a new transmission line or power plant is often hundreds of millions of dollars), an intensive planning process is undertaken to ensure that any needed addition to the power grid is the best option. The best option not only considers the up-front cost of the project (lower is better) but also the value provided (more is better). “Value provided” includes the ability to save money on monthly bills by having access to less expensive generators (also known as “reducing system congestion”), less public or environmental impacts, carbon reduction, and/or better flexibility to meet potential future power needs. Like any decision, each of these factors is weighed to develop the optimal solution.

[23] More information about NERC is available at https://www.nerc.com/Pages/default.aspx.

3.2.4 System Stability Background

Stability is a key reliability attribute of the power grid. Without a stable system, otherwise isolated events may lead to unpredictable and potentially widespread and catastrophic impacts, up to and including blackouts. A stable system operates normally under all reasonably expected conditions and is able to quickly return to a normal state if there is a disturbance on the system. Unanticipated disturbances on the system may be caused by many things, such as a lightning strike on a transmission line, a transmission line structure failing, or a generator tripping offline because of a problem. Minimum federal reliability standards require that the transmission grid be designed to withstand the loss of any single element without disruption. Utilities like the Applicants also typically evaluate the impacts of events involving multiple system elements and planned maintenance outages to prevent or minimize disruptions. As the clean energy transition changes where, how, and what kind of energy is produced and transmitted to customers, the stability of the grid must continually be assessed to ensure that the power grid remains reliable.

There are several aspects to stability that must be considered when planning the power grid, including voltage stability and transient stability. Voltage stability simply refers to the ability of the system to recover from an event and rapidly restore voltage within the normal operating range. A voltage collapse is what occurs when the voltage in some part of the system cannot recover following an event, resulting in extremely low voltages and possibly causing damage to electrical devices and blackouts. Historically, centralized fossil-fueled baseload generating stations have provided voltage support to the power system to maintain acceptable operating voltages and prevent voltage collapses. As the power system transitions away from these types of resources, new solutions are becoming necessary to ensure that system voltages remain robust, predictable, and stable under all reasonably foreseeable conditions.

Transient stability refers to the short-term response of the grid during the first few seconds after a disturbance (the transient period). Typical areas of interest in the transient period are voltage and frequency response. Transient stability performance is typically measured by how severe the impact is immediately after the disturbance and how quickly the system recovers from the disturbance. If the system fails to recover to normal operating voltage or frequency, it has become unstable and transmission system elements are likely to begin tripping offline to try to stabilize the system by isolating the problem. Depending on how widespread the impacts are, this can lead to blackouts.

3.3 Baseload Generator Fleet Transition & Regional Reliability

The Project resolves regional reliability constraints resulting from baseload generator fleet transition. This section will provide background on baseload generator fleet transition in northern Minnesota followed by detailed discussion of the specific regional reliability constraints – voltage and transient stability issues as well as transmission line overloads arising from these changes in baseload generation – which are mitigated by the Project.

3.3.1 Background

One of the cornerstones of the clean energy transition is the evolution of the energy supply portfolio away from traditional fossil-fueled (dispatchable) generating resources to an increasing reliance on intermittent renewable (primarily non-dispatchable) generating resources.

In 2011, over half of the electricity generated in Minnesota came from coal-fired electric power plants. In 2021, electricity from coal reduced to 27 percent and renewables provided 29 percent of electricity generation statewide.[24] The increase in renewable energy sources was driven, in part, by state energy policies. Minnesota's original Renewable Energy Objective, adopted in 2001, directed all electric utilities in the state to "make a good faith effort" to obtain one percent of their Minnesota retail energy sales from renewable energy resources in 2005, increasing to seven percent by 2010.[25] More broadly, Minnesota had previously set a goal to reduce statewide greenhouse gas ("GHG") emissions across all sectors producing those emissions to a level at least 30 percent below 2005 levels by 2025 and to a level at least 80 percent below 2005 levels by 2050.[26] More recently, in February 2023, Governor Tim Walz signed the "100 Percent by 2040" legislation into law, which, at a high level, directs electric utilities to transition to meet the needs of Minnesota customers with 100 percent carbon-free electricity by the end of 2040.[27] The Applicants are committed to meeting these requirements. To comply with this legislation, additional sources of emission-free electric energy – like wind and solar – will be added to serve Minnesota's electrical needs.

Many of the traditional generating resources that are being displaced are baseload generators that have provided round-the-clock energy production for many decades. In MISO, for example, more than 40 gigawatts ("GW") of renewable energy has come online. The displaced baseload generators provide more than just energy production. They also provide essential reliability services to local energy consumers and the regional power system. Such services must be replaced when the generators are retired or transitioned to non-baseload operation. The NERC defines Essential Reliability Services as including frequency response, ramping, and voltage support.[28] In a broader sense, the term "essential reliability services" may also incorporate additional reliability concepts such as local power delivery, regional power delivery, and redundancy. Based on the Applicants'

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[24] U.S. Energy Information Administration, EIA - Independent Statistics and Analysis, *available at* https://www.eia.gov/state/?sid=MN#tabs-4.
[25] Minn. Stat. § 216B.1691, subds. 2 and 2a.
[26] Minn. Stat. § 216H.02, subd. 1.
[27] Minn. H.F. 7, sec. 8 (2023); *amending* Minn. Stat. § 216B.1691, subd. 8(g).
[28] Essential Reliability Services, Whitepaper on Sufficiency Guidelines, North American Electric Reliability Corporation (Dec. 2016), *available at* https://www.nerc.com/comm/Other/essntlrlbltysrvcstskfrcDL/ERSWG_Sufficiency_Guideline_Report.pdf. Helpful background and simplified explanations of these three concepts are also publicly available from the U.S. Department of Energy, Keeping the Lights On: Essential Reliability Services (Sept. 13, 2018), *available at* https://www.energy.gov/eere/articles/keeping-lights-essential-reliability-services.

experience with baseload generator retirements[29] and the analysis discussed in this section, these essential reliability services are foundational to understanding and planning to address the transmission system impacts of fleet transition.

In northern Minnesota, several coal-fired baseload generators have historically provided local energy production for Minnesota Power's customers as well as essential reliability services for the local and regional power system. The transmission system has been designed over many decades to make optimal use of the essential reliability services provided by these generators, including stability and voltage support. In recent years, most of these generators have been retired or transitioned to normally-offline operation, leaving Boswell Energy Center ("BEC") Units 3 and 4 as the only remaining large generators regularly online in northern Minnesota that can provide stability and voltage support. In Minnesota Power's latest Integrated Resource Plan ("2021 IRP"),[30] the Commission approved the ceasing of coal operations of BEC Unit 3 by December 31, 2029 and BEC Unit 4 no later than 2035. If the BEC units transition away from baseload operation, electrical solutions must be identified that can replace the essential reliability services formerly provided by the local baseload generators on a continuous basis, including voltage support and system strength, local power delivery, and regional power delivery.

The Project is a foundational component of positioning the power system in northern Minnesota and the surrounding region for the clean energy transition and the ceasing of coal-fired operations at baseload generators. The Project addresses some of the most challenging transmission system reliability issues related to baseload generator fleet transition, including serious regional voltage and transient stability issues identified by the Applicants and MISO. As discussed in more detail in this Chapter, without the Project, Northern Minnesota Load or regional north transfers would need to be reduced by 350 MW to 1,000 MW to maintain system reliability – a threshold which is not feasible.

3.3.2 Northern Minnesota Voltage Stability

The Project resolves regional voltage stability constraints that have been identified in a multitude of studies over the course of the last decade, including the Minnesota Transmission Owners' Assessment and Compliance Team ("MN TACT") reliability assessment,[31] the Applicants transmission planning studies, and various MISO regional transmission planning studies. The voltage stability constraints arise during south-to-north (north flow) transfer conditions in Minnesota and are aggravated by modest-to-high transfers from MISO to Manitoba Hydro, a lack of dispatchable generation resources in northern Minnesota (particularly if the BEC units are offline), and heavy winter peak loading in northern Minnesota. Related thermal, voltage, and transient stability constraints have also been identified in many studies, as discussed in subsequent sections. This section will cover the recent history of the voltage stability issues starting with their

[29] For example, *see* Minnesota Power's 2021 Integrated Resource Plan, Appendix F Parts 6-8 (Docket No. E015/RP-21-33) (eDocket No. 20212-170598-03) (Public Version).
[30] *In the Matter of the Integrated Resource Plan of Minnesota Power*, Docket No. E015/RP-21-33.
[31] MN TACT completes an annual assessment to ensure compliance with NERC reliability standards.

identification and evaluation in various studies: MISO's 2018 Boswell Attachment Y2 Study, Minnesota Power's 2019 Northern Minnesota Voltage Stability Study, Applicants' 2021 Northern Minnesota Beyond Baseload Study, and Applicants' analysis in support of MISO's 2022 LRTP Tranche 1 analysis.

3.3.2.1 MISO Attachment Y2 Study

As part of Minnesota Power's due diligence investigating future operating scenarios for the BEC in advance of its 2021 IRP, Minnesota Power worked with MISO to obtain an indicative assessment of transmission impacts resulting from BEC unit retirements. Due to regional reliability constraints identified in this assessment, MISO concluded that one or both of the BEC units could potentially be designated as a system support resource ("SSR") and required to continue operating if mitigation is not in place.

Regional impacts of generating unit closures on the transmission system consider transmission lines 100 kV and above owned and operated by the generation owner and neighboring utilities. MISO, the regional transmission planner and operator for much of the Midwest, requires any generating unit proposing to retire from its energy market be studied under its Attachment Y (unit retirement) process.[32]

The Attachment Y process results in a binding agreement between the generation owner and MISO to close the unit or keep it operational as an SSR for the reliability of the regional transmission system. MISO also offers a parallel investigative option, called the Attachment Y-2 process, by which a generation owner can request an information-only study of the regional reliability impacts of a generating unit retirement without entering into a binding agreement to close the unit or keep it operational.

In August 2018, Minnesota Power submitted an Attachment Y-2 Study request to MISO for a transmission system reliability assessment of various BEC retirement combinations being evaluated in the 2021 IRP. Based on the results of the Attachment Y-2 Study, MISO concluded that substantial transmission improvements would likely be required to maintain regional reliability before the retirement of the BEC units could be allowed. The Executive Summary from the MISO Attachment Y-2 Study Report is attached in **Appendix I**. Note that the Attachment Y-2 Study only identifies issues on the transmission system that need to be resolved, it does not identify energy and capacity (e.g. energy adequacy) issues that would arise from BEC unit retirements.

The most significant areas of concern identified in the MISO Attachment Y-2 Study were the impacts on regional voltage stability and related transmission line overloads in the event of an unplanned outage of the Forbes – Chisago 500 kV Line or other parallel or related north-south transmission facilities during winter peak coinciding with heavy north flows on the transmission system. Due to this, MISO concluded that one or both of the BEC units could potentially be designated as a SSR and required to continue operating, if mitigation is not in place. As a result, Minnesota Power subsequently conducted its own

[32] MISO Tariff, Section 38.2.7, Attachment Y, *available at* https://www.misoenergy.org/legal/tariff/.

investigation of the underlying voltage stability issues to gain a better understanding of the nature, severity, and primary drivers for these issues.

3.3.2.2 Minnesota Power Northern Minnesota Voltage Stability Study

Minnesota Power completed the Northern Minnesota Voltage Stability ("NOMN") Study in 2019 to build on and further understand the results from the MISO Attachment Y-2 Study and previous Minnesota Power studies. The study offered insight into the nature and significance of the regional voltage stability issues identified in the MISO Attachment Y-2 Study, providing a framework for measuring the severity of the voltage stability issues and furthering the Applicants' understanding of the underlying drivers for the issues.

The NOMN Study considered four scenarios for reliability analysis from the MISO Attachment Y-2 Study, listed below. All four cases represented a 2030 winter peak scenario with heavy north flow.

- Base Case: BEC Unit 3 and Unit 4 Online
- BEC Unit 3 Offline
- BEC Unit 4 Offline
- Both BEC Unit 3 and Unit 4 Offline

The starting power flow cases were unaltered from the MISO Attachment Y-2 Study. To understand the drivers behind the voltage stability issue noted in the MISO Attachment Y-2 Study, three different quantities were varied in each study case. The three quantities were total BEC Generation, Northern Minnesota Load, and Manitoba Hydro Import. These study variables were increased or decreased in the power flow cases to find the voltage stability limit, defined as the last point at which the case is stable following the limiting contingency (in this case, tripping of the Forbes – Chisago 500 kV Line).

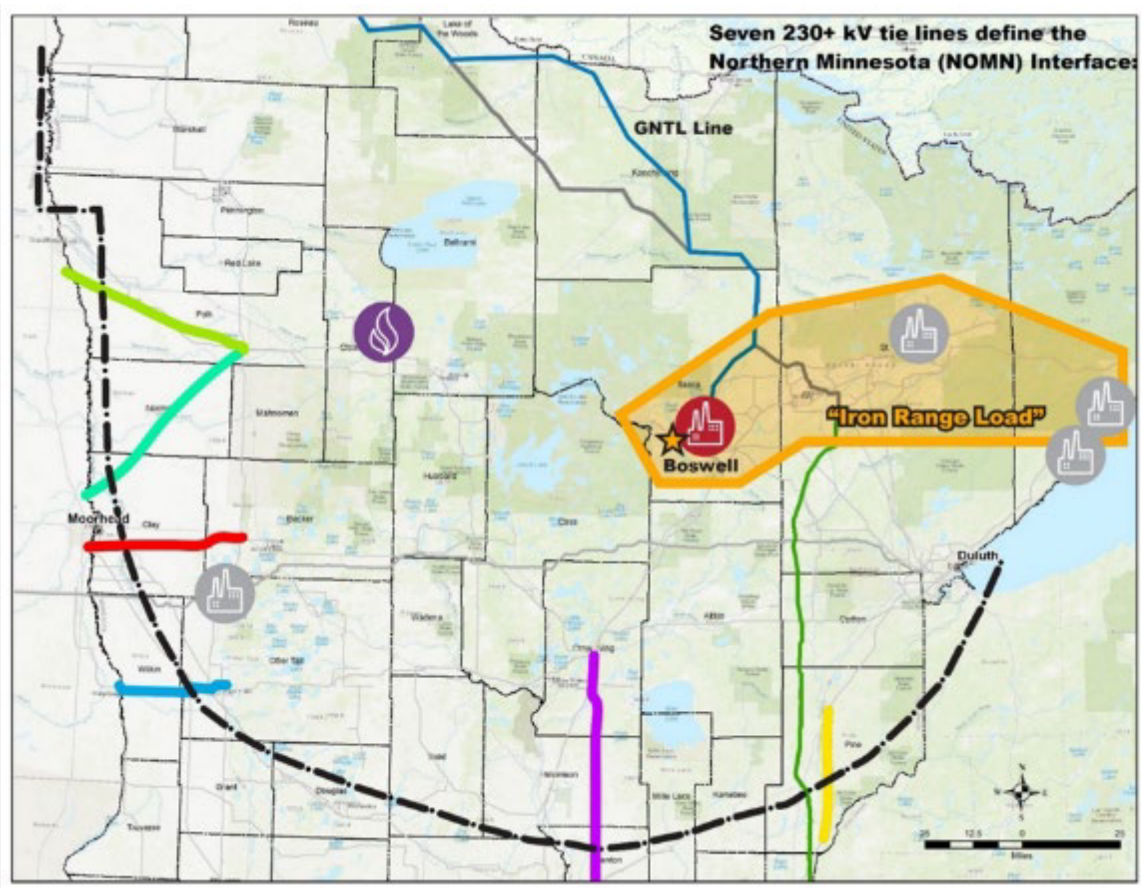
To understand and evaluate a voltage stability issue, the issue must be expressed in terms of an interface. In this case, a new NOMN Interface is needed to directly characterize the issue. The study considered several potential NOMN Interface definitions, ultimately finding that the definition shown in **Table 3-1** represents the issue most accurately and directly by encompassing the transmission line associated with the initiating contingency and the parallel tie lines that become overloaded when it trips, leading to the voltage collapse. The NOMN Interface tie lines are also shown in **Figure 3-2**.

Table 3-1. NOMN Interface Definitions

Facility	kV	Map Key (Figure 3-2)
Chisago – Forbes	500	**Green**
Rock Creek – Bear Creek	230	**Yellow**

Facility	kV	Map Key (Figure 3-2)
Benton County – Mud Lake	230	**Purple**
Wahpeton – Fergus Falls	230	**Blue**
Sheyenne – Audubon	230	**Red**
Maple River – Winger	230	**Aqua**
Prairie – Winger	230	**Lime**

Figure 3-2. NOMN Interface Tie Lines



The NOMN Interface stability limit was identified for 12 different study cases (four power flow cases, with three study variables assessed for each). Because it would not be secure to operate the system all the way to the stability limit, planning criteria require that a stability margin be maintained between the stability limit and an operating limit. The operating limit is defined as the lesser of the following: (a) 90 percent of the stability limit; or (b) the last interface transfer level at which low post-contingent voltage violations do not occur. The average NOMN Interface stability limit from the twelve study cases is 2,411 MW, and the average operating limit is 2,170 MW, with remarkably little variation across the study cases. To lend context to these numbers, **Table 3-2** provides the flow on the NOMN Interface in each of the MISO Attachment Y-2 Study cases.

Only the Base Case with both BEC units online is stable and close to being within the operating limit.

Table 3-2. NOMN Interface Flow in Attachment Y-2 Study Cases

MISO Y-2 Study Case	NOMN Interface Flow
Base Case	2,200 MW
BEC Unit 3 Offline	2,422 MW
BEC Unit 4 Offline	2,597 MW
Both BEC Units Offline	2,891 MW

Evaluation of the individual BEC unit retirement scenarios listed in **Table 3-2** indicates that either Northern Minnesota Load or Manitoba Hydro Import would need to be reduced anywhere from 350 MW to 1,000 MW to bring NOMN Interface flow within the operating limit, depending on how much BEC generation is still online. With no reductions to the modeled load and transfer levels, a minimum of 920 MW of BEC generation is necessary in the MISO Attachment Y-2 Study models used for this study to maintain NOMN within the operating limit. Based on this analysis, Minnesota Power concluded that active monitoring and operational management of the NOMN Interface may be sufficient to prevent regional voltage stability problems and related concerns with BEC Unit 3 dispatching economically in the near-term, but a long-term permanent solution is necessary to support regional reliability and operational flexibility as the operation of the BEC units evolves and changes over the next 10-15 years, especially if one or both of the units were retired.

The Northern Minnesota Voltage Stability Study offered insight into the nature and significance of the regional voltage stability issues identified in the MISO Attachment Y-2 Study, providing a framework for measuring the severity of the voltage stability issues and furthering the Applicants' understanding of the underlying drivers for the issues. The next phase of analysis developed by the Applicants would use the knowledge gained from this study to begin developing and evaluating long-term solutions.

3.3.2.3 The Applicants' Northern Minnesota Beyond Baseload Study

The Northern Minnesota Beyond Baseload Study was initiated by Minnesota Power and Great River Energy in 2021 to evaluate alternatives and identify a preferred regional transmission solution to address voltage stability concerns in northern Minnesota following the cessation of coal-fired operations by baseload generators in the region. The study was performed for the Applicants by Siemens PTI. Based on the results of the study, the Applicants concluded that the best long-term transmission solution for northern Minnesota voltage stability concerns is to develop a double-circuit 345 kV line from the existing Minnesota Power Iron Range Substation to the existing Great River Energy Benton County Substation.

The Northern Minnesota Beyond Baseload Study consisted of three steps: (1) Voltage Stability Analysis; (2) Regional Transfer Analysis; and (3) Reactive Resource

Optimization. After a brief overview of each step, the rest of this section will focus primarily on the Voltage Stability Analysis. The primary reliability issue to be resolved in the study was the northern Minnesota voltage stability issue described in the previous sections. After baselining the voltage stability issue in the study models with the BEC and other northern Minnesota generating units offline, several potential alternatives were developed for evaluation. In Step 1, the effectiveness of each of these alternatives for resolving the voltage stability issue was analyzed. Any alternatives that did not result in a stable system following loss of the Forbes – Chisago 500 kV line at the targeted NOMN operating limit (1,900 MW, which is 90 percent of the Base Case Stability Limit shown in **Table 3-3)** were eliminated from consideration. Solutions that were found to be effective for resolving the voltage stability issues were then evaluated for robustness against sensitivities involving modifications to load growth or generation assumptions. In Step 2, the remaining solutions were evaluated to identify their effectiveness for providing incremental north-to-south regional transfer capability. Additional comparisons were made to determine the best operating voltage for the preferred solution. Discussion of alternative solutions evaluated in Steps 1 and 2 of the Northern Minnesota Beyond Baseload Study is provided in **Section 4.4** and **Section 4.5**. Based on this analysis, a preferred Iron Range – Benton County transmission line solution was selected for further optimization. Finally, in Step 3, the preferred solution was evaluated to identify optimal series and shunt reactive compensation considerations.

Voltage stability analysis was performed to evaluate the regional transmission solution alternatives that would result in a stable system following the loss of the Forbes – Chisago 500 kV line, assuming the BEC Units were offline. The primary objectives for the voltage stability analysis were to: (1) Serve winter peak load in northern Minnesota while maintaining the existing 1,398 MW firm Manitoba import limit; and (2) Achieve a NOMN interface operating limit including a ten percent stability margin consistent with planning criteria during the winter peak, heavy north flow scenario. Voltage stability results for the study Base Case with northern Minnesota generation, including the BEC units, offline and no solution additions compared to the Project ("Iron Range – Benton 345 kV Double-Circuit") are shown in **Table 3-3.**

Table 3-3. Beyond Baseload Study Voltage Stability Results

Study Case	NOMN Modeled (MW)	Stability Limit (MW)	Stability Margin
Base Case (No Solutions)	2,599	2,112	-23.1%
Iron Range – Benton 345 kV Double-Circuit	2,771	3,017	8.2%

As shown in **Table 3-3**, the Base Case is unstable by a significant margin. Tripping of the Forbes – Chisago 500 kV Line in the Base Case results in a widespread regional voltage collapse. With the addition of the Project, the stability limit increases by 905 MW, and the case is stable with a little over eight percent margin between the modeled NOMN operating point and the stability limit. Further analysis in the study demonstrated that stability margins in excess of 10-12 percent may be achieved with modest reactive resource additions to resolve low system intact voltages in the Fargo and Grand Forks areas. Sensitivity analysis demonstrated that the Project coupled with more substantial reactive resource additions or complementary transmission projects in the Red River Valley is robust enough to support at least 20 percent incremental load growth in northern Minnesota (~650 MW in the study models) before voltage stability issues become a concern again.

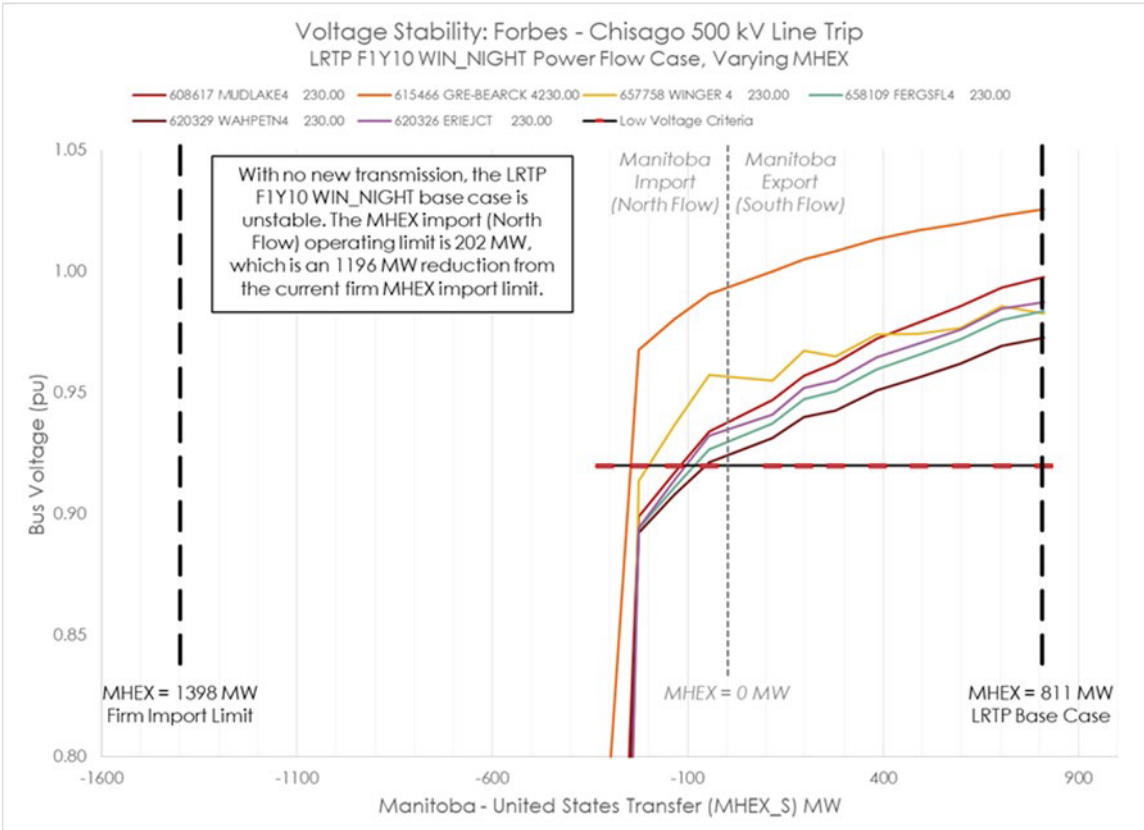
The Northern Minnesota Beyond Baseload Study demonstrated both the severity of the northern Minnesota voltage stability issues and the effectiveness of the Project for resolving those issues. Based on the results of the study, the Applicants concluded that the best long-term transmission solution for northern Minnesota voltage stability concerns is to develop a double-circuit 345 kV line from the existing Minnesota Power Iron Range Substation to the existing Great River Energy Benton County Substation.

3.3.2.4 Applicants' Analysis in Support of MISO LRTP Tranche 1

As demonstrated in the studies described so far, system conditions arising from winter peak loading and heavy south-to-north transfers ("North Flow") through northern Minnesota create significant challenges for the regional transmission system when northern Minnesota baseload generators are offline. Based on the findings of previous studies, the Applicants worked with MISO during the LRTP Tranche 1 study to ensure that these conditions were considered. The Applicants' analysis in support of MISO LRTP Tranche 1 demonstrated that previously identified regional voltage stability issues were present in the LRTP power flow cases, supported MISO's identification and analysis of the issues, and demonstrated that the Project is a highly effective solution for these issues, especially in combination with the other LRTP Tranche 1 projects.

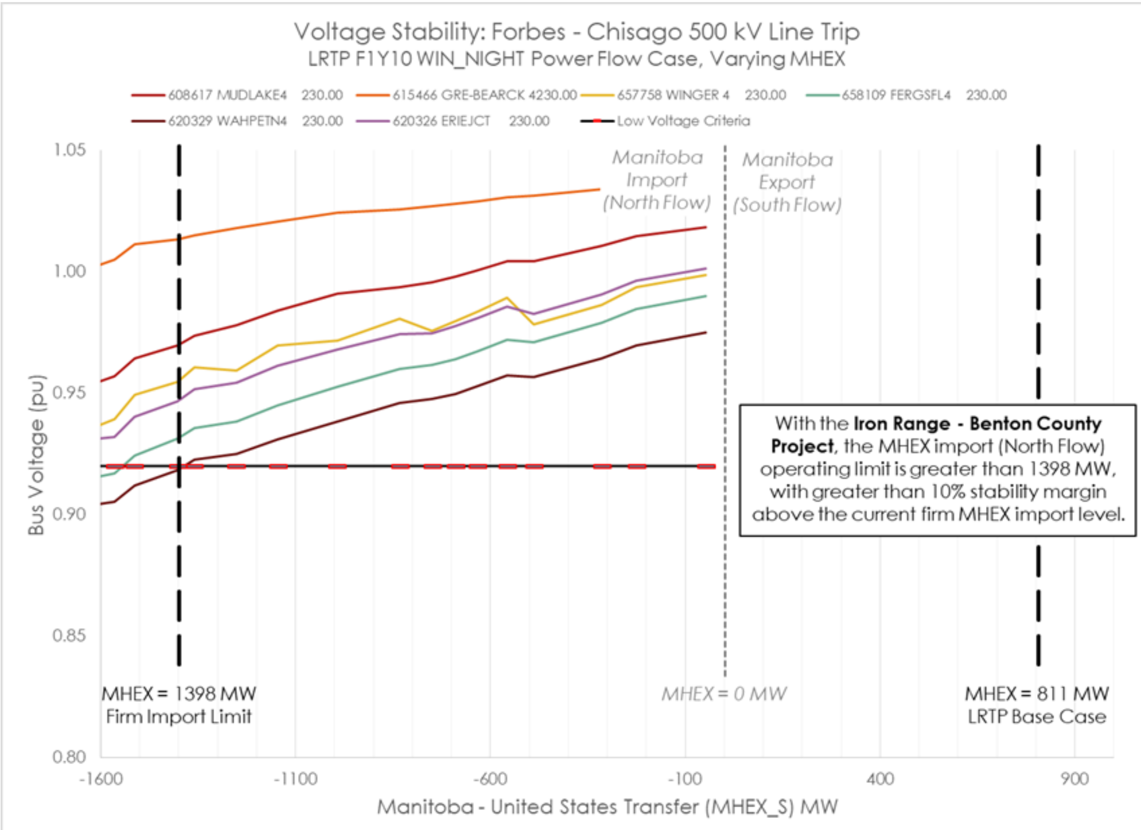
To augment and support MISO's analysis of the North Flow condition, Minnesota Power completed a voltage stability study using the original LRTP Future 1 Year 10 Winter Night case produced by MISO. This voltage stability study varied the total MISO to Manitoba Hydro Transfer Level ("MHEX") in the model to identify the point at which the previously identified voltage stability issue would arise in the MISO LRTP model. The study results demonstrated that significant low voltage and voltage stability concerns would be present if even a modest transfer from MISO to Manitoba Hydro is modeled in the LRTP Winter Night case. Low voltage violations begin to occur at 50 MW MHEX North Flow and the system is unstable past approximately 225 MW MHEX North Flow. To maintain 10 percent margin from the stability limit, MHEX would have to be limited to 202 MW, which is 1,196 MW lower than the current firm transfer limit (1,398 MW). If MHEX was scheduled higher than 202 MW during the modeled system conditions, load in northern Minnesota would have to be reduced to keep regional transfers within the stable operating range. **Figure 3-3** shows the voltage the LRTP Winter Night ("WIN_NIGHT") case at the most limiting 230 kV buses in northern Minnesota as MHEX is adjusted in the power flow case, with the point of voltage collapse (the "nose" of the curve) clearly shown on the left side of the plot where all voltages go to zero. MISO later confirmed similar findings with its own LRTP transfer analysis.

Figure 3-3. LRTP F1Y10 WIN_NIGHT Base Case Voltage Stability Curve



Minnesota Power also evaluated the addition of the Project to the same MISO LRTP power flow case with and without other LRTP Tranche 1 projects in the area. With the addition of the Project by itself, regional post-contingent voltages are very robust across northern Minnesota, the system is stable with more than 10 percent stability margin at the 1,398 MW firm MHEX North Flow transfer level, and there are no post-contingent voltage violations for loss of the Forbes – Chisago 500 kV Line until just after the firm transfer limit. **Figure 3-4** shows the voltage stability results for the WIN_NIGHT case with the addition of the Project by itself.

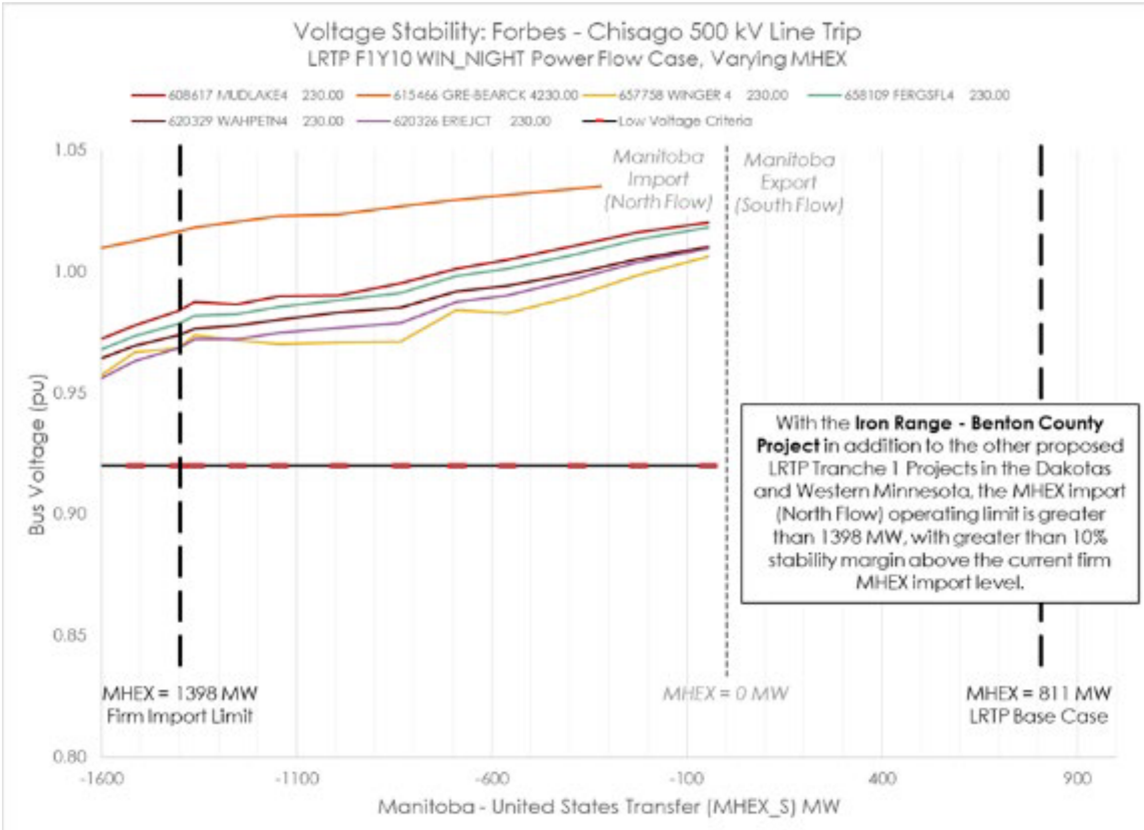
Figure 3-4. LRTP F1Y10 WIN_NIGHT Base Case Voltage Stability Curve



The results are further improved by the addition of other nearby LRTP Tranche 1 projects, specifically the Jamestown – Ellendale 345 kV Line and the Big Stone – Alexandria – Big Oaks[33] 345 kV Project. The combination of LRTP Tranche 1 projects is highly complementary, contributing to a significant increase in the voltage stability margin and dramatically improved post-contingent voltages in the Red River Valley. **Figure 3-5** shows the voltage stability results for the LRTP WIN_NIGHT case with the addition of the Project and the other LRTP Tranche 1 Portfolio projects.

[33] In the MISO LRTP Tranche 1 Portfolio the Big Oaks Substation was provisionally named the Cassie's Crossing Substation.

Figure 3-5. LRTP F1Y10 WIN_NIGHT Base Case Voltage Stability Curve



The Applicants' analysis of the LRTP Future 1 Year 10 WIN_NIGHT power flow case demonstrated that previously identified regional voltage stability issues were present in the LRTP power flow cases and supported MISO's identification and analysis of the issues. This analysis also demonstrated that the Project is a highly effective solution for these issues, especially in combination with the other LRTP Tranche 1 projects. As discussed in **Section 3.4**, MISO later performed its own analysis to support its Tranche 1 recommendations, confirming the Applicants' findings and moving the Project forward with the rest of the LRTP Tranche 1 Portfolio.

3.3.3 Transient Stability

In addition to resolving the voltage stability constraints described in **Section 3.3.2**, the Project will resolve significant transient stability constraints associated with baseload generator fleet transition and contribute to improved transient stability performance of the regional grid. Transient stability refers to the short-term response of the grid during the first few seconds after a disturbance (the transient period). Typical areas of interest in the transient period are voltage and frequency response. Traditionally, the most severe transient impacts occur during times of high bulk power transfers across the region. In some of these scenarios, such as the North Flow scenario described in **Section 3.3.2**, high transfers correlate with periods of high local demand. In other scenarios, high transfers correlate with periods of high renewable energy output and low local demand in the Upper Midwest, leading power to flow through the regional grid to areas of greater demand further south and east.

Since baseload generators have a significant role in supporting transient stability, the Applicants commissioned Siemens PTI to evaluate transient stability performance in a future scenario where no large local baseload generators are online in northern Minnesota. Transient stability analysis considered a winter peak model with high south to north transfers through Minnesota ("Winter North Flow" case) as well as shoulder case with low load, high wind energy output, and high transfer levels, generally north to south and west to east, across regional interfaces ("Shoulder" case). Transient performance following a limited number of regional and local fault events was evaluated with all baseload generators in northern Minnesota offline prior to the addition of the Project, with the Project by itself, and with the Project plus the full LRTP Tranche 1 Portfolio.

Prior to adding the Project, the impact of baseload generators being offline leads to significantly degraded transient performance in the study Base Case. Four of the simulated fault events are not stable due to voltage collapse. One of the unstable fault events, a breaker failure at the 345 kV King Substation, occurs in the Shoulder case. The other three unstable fault events occur in the Winter North Flow case and involve disturbances at or near the 500 kV Forbes Substation that result in loss of the Forbes – Chisago 500 kV Line. These events are similar to the voltage stability constraints described in the previous section. Several stable fault events also result in transient voltage violations throughout the region in both the Shoulder and Winter North Flow cases. Even for fault events where transient voltage violations are not present, transient-period voltage recovery was found to be significantly worse when the grid is weakened by a lack of local baseload generators.

The Project will mitigate most of the transient stability issues discussed above. All four of the unstable fault events from the Base Case are stable following addition of the Project. Transient voltage violations are present following the formerly-unstable breaker failure at the King 345 kV bus in the Shoulder case and at a handful of buses following one of the formerly-unstable Forbes 500 kV events in the Winter North Flow case. The Project will mitigate all other voltage violations and transient-period voltage deviations are generally anticipated to be less severe with more rapid recovery following fault clearing. When the Project is combined with the full LRTP Tranche 1 Portfolio, all remaining transient voltage violations will be resolved based on Study results.

Transient stability results are illustrated in **Figure 3-6** and **Figure 3-7**. **Figure 3-6** shows voltage at a 115 kV bus in the northern area of the Minnesota Power system during the first 1.5 seconds following a fault event that results in loss of the Forbes – Chisago 500 kV Line in the Winter North Flow case. In the Base case, shown in **black** on the plot, the voltage at the bus goes to zero as regional voltage collapses for the unstable fault event. With the Project, shown in **blue** on the plot, voltage following the same fault event recovers rapidly to near pre-fault conditions. The addition of the rest of the LRTP Tranche 1 Portfolio with the Project, shown in **red** on the plot, also provides a marginal improvement in this case. These results demonstrate that the Project resolves significant transient stability constraints in the Winter North Flow case.

Figure 3-6. Transient Voltage at an MP 115 kV Bus (WNF, F601C)

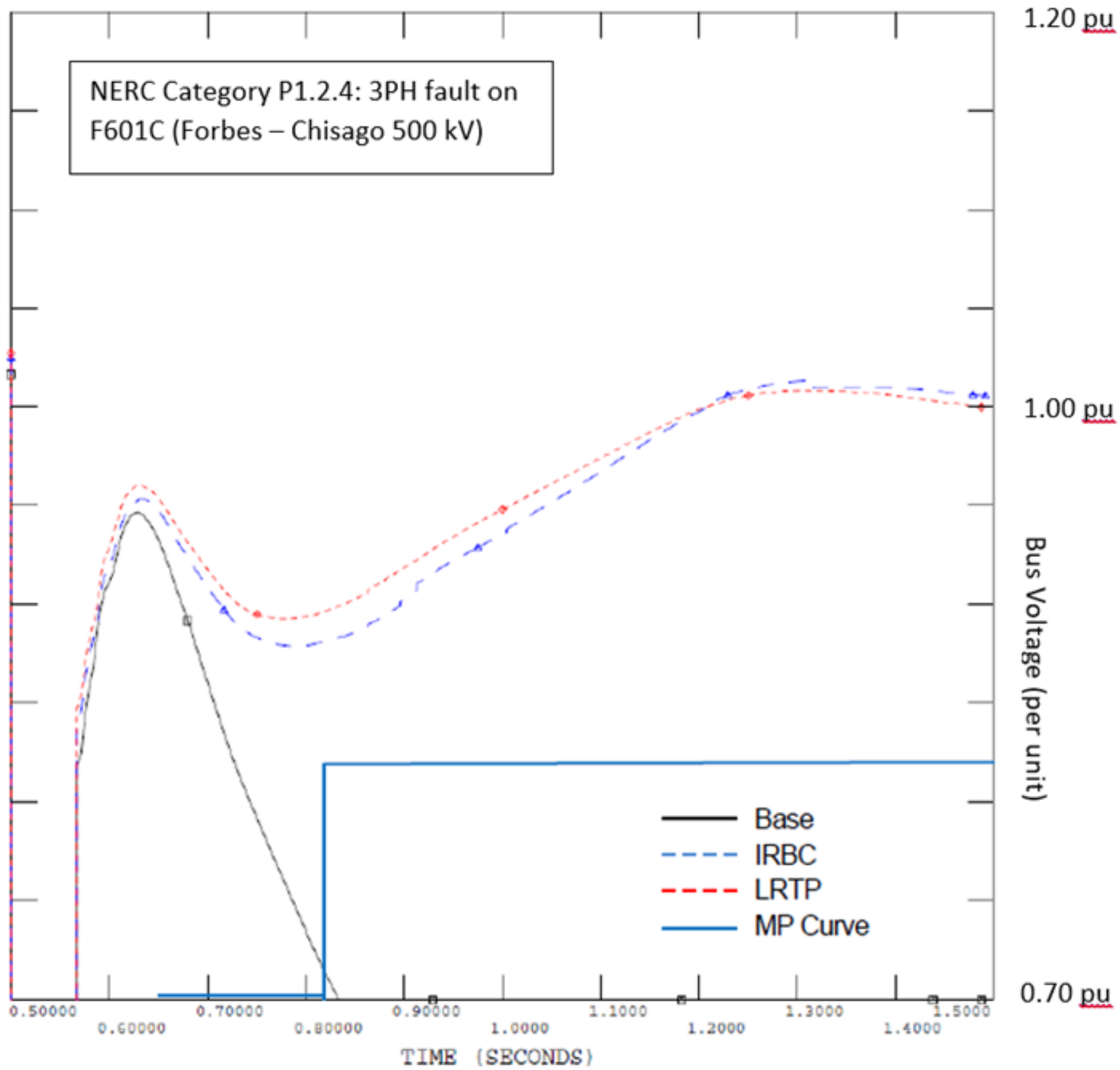
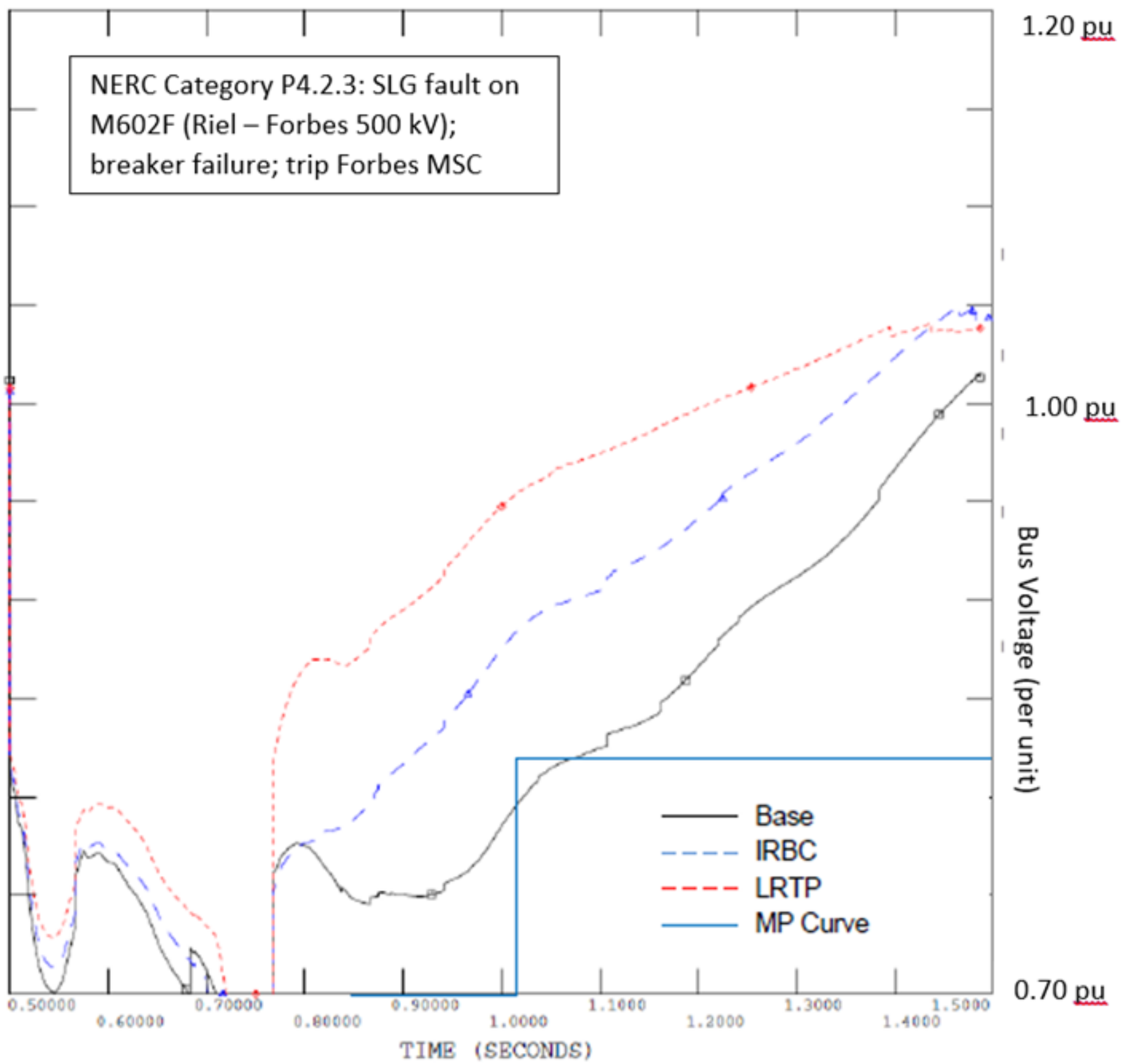


Figure 3-7 shows voltage at the same 115 kV bus in the northern area of the Minnesota Power system during the first 1.5 seconds following a fault event that results in loss of the Riel – Forbes 500 kV Line in the Shoulder case. In the Pre-Project (Base) case, shown in **black** on the plot, the fault is stable but the transient-period voltage at the bus violates Minnesota Power's criteria, as shown where the black line crosses the solid blue line (MP Curve). With the Project, shown in **blue** on the plot, voltage following the same fault event recovers more rapidly and no longer violates criteria. The addition of the rest of the LRTP Tranche 1 Portfolio with the Project, shown in **red** on the plot, results in significantly faster voltage recovery immediately following clearing of the fault. These results demonstrate that the Project resolves transient stability constraints in the Shoulder case, and that the

full LRTP Tranche 1 Portfolio has a complementary effect of improving transient period voltages following regional fault events.

Figure 3-7. Transient Voltage at an MP 115 kV Bus (SSH, M602F)



The Applicants' analysis of regional transient stability performance demonstrates that the Project resolves significant transient stability constraints associated with baseload generator fleet transition.

3.3.4 Transmission Line Overloads

The Project resolves transmission line overloads related to the underlying fleet transition and voltage stability issues discussed in the preceding sections. Transmission line overloads refer to events where the power flowing on the transmission line under normal system conditions or after outage of an adjacent transmission line exceeds the rated capacity of the line, based on the line's conductor sizing or other substation equipment limitations. The Applicants' analysis of reliability impacts from baseload generator fleet transition demonstrates that the Project will mitigate transmission line overloads on 83 circuits totaling 1,334 miles in the most stressed cases for transmission line overloads in northern Minnesota.

As generation source locations transition away from the local baseload generation, power formerly provided locally by dispatchable generators must be delivered into the local system from new sources. Often this means that power will flow into the local area from remote sources on transmission paths with limited capacity to facilitate increased power flow. In some cases, the transmission lines along these paths have started to see power flow that exceeds their rated capacity under certain conditions. The Project creates a high-voltage pathway for power to flow to and from northern Minnesota, which in turn, offloads the underlying, lower voltage transmission system and resolves transmission line overloads.

Overloads are evaluated both under normal conditions, and during contingency events. These contingency events could be either planned or unplanned outages of specific elements that impact the transmission system. Contingency analysis on typical peak and off-peak power flow cases was developed as part of the Applicants' analysis of baseload generator fleet transition impacts. While no overloads were identified under normal system conditions, there were a number of overloads identified during contingency events. These overloads were identified in a broad area across Minnesota from the Twin Cities to the Iron Range. Under study conditions, the Applicants' analysis demonstrated that the Project will mitigate transmission line overloads on 83 circuits totaling 1,334 miles, relieving stress on transmission lines impacted by changes in regional generation and load.

3.4 MISO LRTP

The Project is part of MISO's LRTP Tranche 1 Portfolio, a portfolio of regionally beneficial projects identified by MISO, the independent not-for-profit system operator for the Midwest, and approved by the MISO Board of Directors in July 2022. This section provides background on MISO's role in planning the interstate (regional) transmission grid, the reliability implications of the Midwest's changing generation fleet, and the purpose and process for the MISO LRTP study followed by detailed discussion of MISO's analysis and justification of the LRTP Tranche 1 Portfolio, including its specific evaluation of the Project. Additional details on MISO analysis and justification for the Project can be found in **Appendix I.**

3.4.1 Background on MISO

MISO is an independent not-for-profit regional transmission organization ("RTO") which operates the transmission system and energy market in parts of 15 states and the Canadian province of Manitoba, see **Figure 3-8** for a map of MISO's footprint. As an RTO, MISO is responsible for planning and operating the transmission system within its footprint in a reliable manner. MISO also provides operational oversight and control, market operations, and oversees planning of the transmission systems of its member

Transmission Owners ("TOs"). MISO has 57-member TOs, including Great River Energy and Minnesota Power, with more than 68,000 miles of transmission lines under its functional control.[34] MISO members also include 135 non-TOs, such as independent power producers and exempt wholesale generators, municipals, cooperatives, transmission dependent electric utilities, and power marketers and brokers.

Figure 3-8. MISO Reliability Footprint

MISO has a responsibility, established by the Federal Energy Regulatory Commission ("FERC"), to study the transmission system within its footprint to identify necessary transmission projects to address reliability issues. This study includes the development of the MTEP in collaboration with TOs and other stakeholders. The MTEP is developed each year in an 18-month overlapping cycle of model building, stakeholder input, reliability analysis, economic analysis, resource assessments, and drafting of the MTEP report. MISO adheres to the planning principles outlined in FERC Order Nos. 890[35] and 1000[36] in developing the MTEP. These FERC Orders require an open and transparent regional transmission planning process and include the requirement to plan for public policy

[34] MISO Fact Sheet (Mar. 2023), *available at* https://www.misoenergy.org/about/media-center/corporate-fact-sheet/.
[35] FERC Order No. 890, Preventing Undue Discrimination and Preference in Transmission Service, 18 C.F.R. Parts 35 and 37 (Feb. 16, 2007), *available at* https://ferc.gov/sites/default/files/2020-06/OrderNo.890.pdf.
[36] FERC Order No. 1000, Transmission Planning and Cost Allocation by Transmission Owning and Operating Public Utilities, 18 C.F.R. Part 35 (July 21, 2011), *available at* https://www.ferc.gov/sites/default/files/2020-04/OrderNo.1000.pdf.

objectives and for coordinated inter-regional planning and cost allocation. Each cycle, MISO undergoes a rigorous, open, and transparent stakeholder process that offers numerous opportunities for advice and input from a diverse stakeholder community, which includes utilities, state regulators, and public interest organizations including environmental and consumer groups.

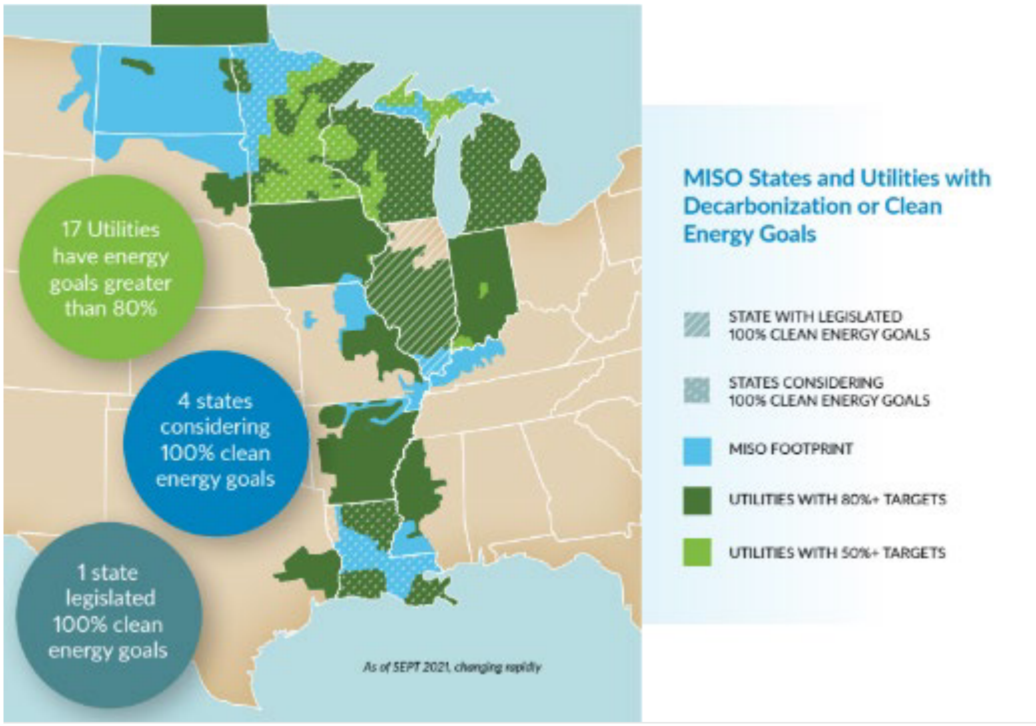
3.4.2 MISO Energy Landscape Transformation

Like Minnesota, the MISO footprint (**Figure 3-8**) is collectively amid a fundamental change in the energy industry landscape – such as shifts in generation resources, consumer demand for low-carbon resources, and decentralization of generation. MISO predicts as much industry change in the next five years as has happened in the past 35 years. In 2001, generation across MISO was largely provided by coal generation and some natural gas, and customer demand was the largest source of day-to-day operating variation[37]. In 2022, coal generation shrunk to approximately one-third of MISO's annual energy production, and annual energy from wind and solar generation rose to 17 percent. Since 2001, over 40 GW of renewable resources have been installed across MISO.

Driven by a combination of state and federal policy (including Minnesota's carbon free by 2040 legislation),[38] customer preferences, economics, and utility goals, the retirement of legacy fossil fuel generators and replacement with geographically dispersed wind and solar units. As shown in **Figure 3-9** nearly all states and/or utilities in MISO have carbon free and decarbonization targets. **Figure 3-9** displays the carbon free and decarbonization goals for the MISO footprint as of September 2021.

[37] MISO, Corporate Fact Sheet (Mar. 2023), https://www.misoenergy.org/about/media-center/corporate-fact-sheet/.
[38] Minn. H.F. 7, sec. 8 (2023); *amending* Minn. Stat. § 216B.1691, subd. 8(g).

Figure 3-9. Decarbonization or Clean Energy Goals Across the MISO Footprint as of September 2021

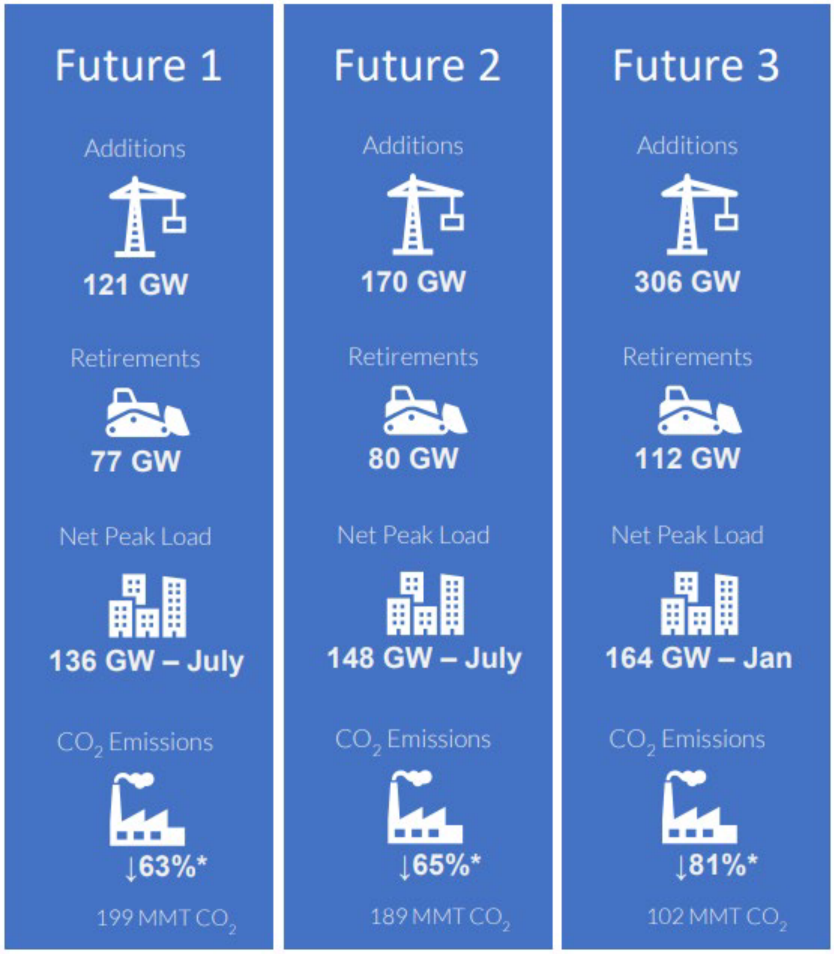


3.4.2.1 Forecast of the Changing Energy Landscape

As transmission grid expansions are long-term decisions, forecasts of the future generation mix and energy usage are necessary to plan the grid. As part of each MTEP cycle, MISO and its stakeholders develop a range of forward-looking scenarios, or Futures, which forecast multiple paths and timelines for states and utilities to meet their energy goals. The Futures are designed to "bookend" the potential range of future economic and policy outcomes, ensuring that the actual future is within the range of the Futures. These Futures, which envision system conditions 20 years ahead, are then used to assess and identify transmission needed to deliver the necessary energy reliably and efficiently from generation resources to customers. Futures are developed through an iterative and robust stakeholder process which includes representatives from MISO utilities, state regulatory authorities, public consumer advocates, environmental representatives, and independent power producers.

In the MTEP21, three Planning Futures were used in MISO's grid planning initiatives, including LRTP – the study in which MISO identified need for the Project (**Section 3.3.1**). MISO developed a series of future scenarios in 2021 ("MTEP21 Futures") over the course of 18 months and incorporated numerous rounds of stakeholder feedback, policy assessments and industry trends. MISO's three planning Futures incorporate varying assumptions about utility and state goals, retirements, Distributed Energy Resources ("DER") adoption and electrification, among other factors. All MTEP21 Futures assume changes announced through September 2020 in utility IRPs (resource plans for upwards of 10-15 years into the future) are realized. A summary of the key assumptions for each MTEP21 Future is shown in **Figure 3-10** and **Figure 3-11**.

Figure 3-10. MISO Futures Generation Assumptions[39]



[39] MISO, Futures Report (Apr. 2021 *updated* Dec. 2021) *available at* https://cdn.misoenergy.org/MISO%20Futures%20Report538224.pdf.

Figure 3-11. MTEP21 Futures Additional Assumptions[40]

Future I	Future 2	Future 3
• The footprint develops in line with 100% of utility IRPs and 85% of utility announcements, state mandates, goals, or preferences • Emissions decline as an outcome of utility plans • Load growth consistent with current loads	• Companies/states meet their goals, mandates and announcements • Changing federal and state policies support footprint-wide carbon emissions reduction of 60% by 2040 • Energy increases 30% footprint-wide by 2040 driven by electrification	• Changing federal and state policies support footprint-wide carbon emissions reduction of 80% by 2040 • Increased electrification drives a footprint-wide 50% increase in energy by 2040

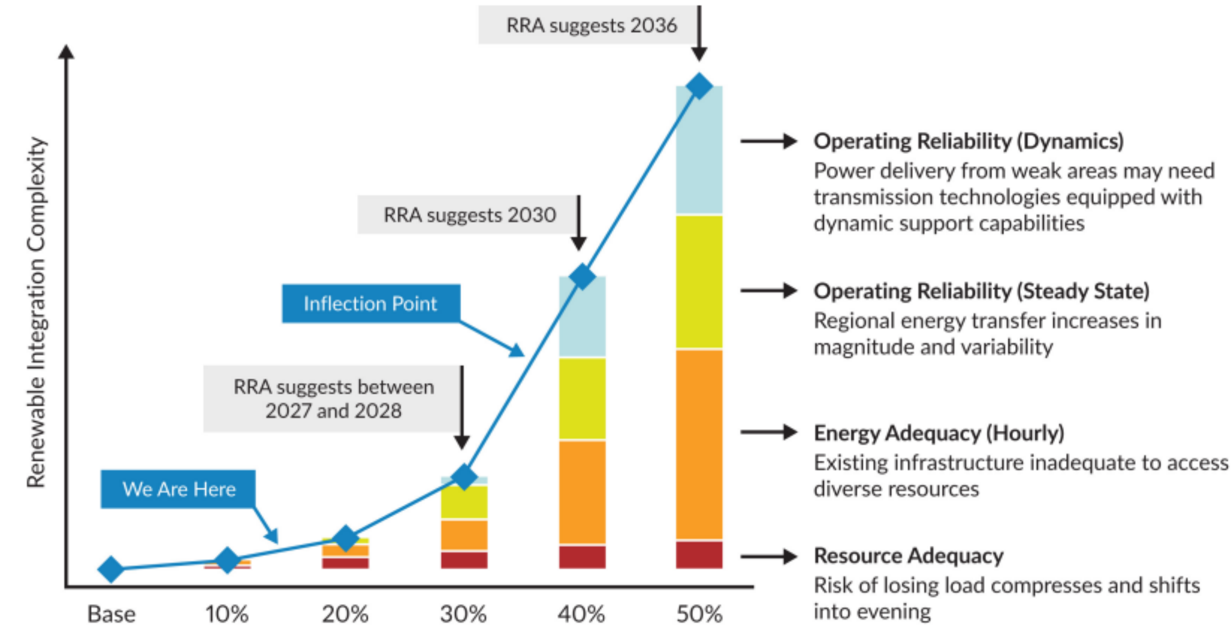
3.4.2.2 Implications of the Changing Energy Landscape

The magnitude of change considered in MTEP21 Futures is transformational. Future 1 alone, the "least transformational" of the MTEP21 Futures as it assumes only 85 percent of state decarbonization goals as of 2020 are met, anticipates 121 GW of resource additions[41] – roughly a 30 percent MISO-wide renewable penetration.

To understand the implications of the increased renewable penetrations, in 2021 MISO released a study called the Renewable Integration Impact Assessment ("RIIA").[42] The RIIA found that up to 30 percent renewable penetration is manageable with incremental transmission; however, managing the system beyond 30 percent of system-wide renewable penetrations will require transformational change in planning, markets and operations, as shown in **Figure 3-12**.

[40] **Appendix I:** MTEP21 LRTP Tranche 1 Portfolio Executive Summary & Report at 6.
[41] For reference, MISO's total system market capacity as of March 2023 is 190 GW.
[42] The full RIIA report can be found at: https://www.misoenergy.org/planning/policy-studies/Renewable-integration-impact-assessment/.

Figure 3-12. Reliability Implications of Increasing Renewable Penetrations [43]



In 2022, the MISO system achieved a 19 percent renewable (wind, solar, and hydro) penetration MISO-wide, and many areas of MISO are experiencing periods of more than 40 percent of its energy from renewables.[44] While incremental transmission expansion has and continues to be developed, the increased stress to efficiently maintain reliability is evident in the increased congestion levels[45] and more frequent use of MISO emergency operating procedures.[46]

Recognizing that transformational changes in the generation fleet require significant changes to the transmission grid to maintain reliability, in 2019 MISO launched the LRTP. The LRTP is a multi-year multi-phase study to identify a regional "backbone" to cost-effectively maintain reliability and serve future needs. The objective of the MISO LRTP was to provide an orderly and timely transmission expansion plan that supports these primary goals:

- **Reliable System** – maintain robust and reliable performance in future conditions with greater uncertainty and variability in supply
- **Cost Efficient** – enable access to lower-cost energy production

[43] MISO, 2022 Regional Resource Assessment ("RRA"), *available at* https://www.misoenergy.org/planning/policy-studies/RRA/#t=10&p=0&s=FileName&sd=desc.
[44] MISO, Fact Sheet (Mar. 2023), https://www.misoenergy.org/about/media-center/corporate-fact-sheet/.
[45] Congestion trends are available via MISO's "Yearly Historical Real-Time Constraints" market reports available at https://www.misoenergy.org/markets-and-operations/real-time--market-data/market-reports/.
[46] From 2014 to 2016, MISO did not make a single emergency declaration. Since 2016, 41 emergency declarations have been required.

- **Accessible Resources** – provide cost-effective solutions allowing the future resource fleet to serve load across the footprint

- **Flexible Resources** – allow more flexibility in the fuel mix for customer choice

MISO evaluated the LRTP in accordance with MISO's federally approved tariff. For any project to be deemed needed under MISO's tariff, it must meet defined criteria. In MISO's LRTP, MISO and stakeholders worked to identify a transmission plan that simultaneously addresses multiple regional needs – which under the MISO tariff is defined as an MVP. For a project to be deemed needed by MISO as an MVP it must:

- **Reliability** - address transmission issues associated with a projected violation of a reliability standards,

- **Economic** - Provide multiple types of economic value across multiple pricing zones with a benefit-to-cost ratio of 1.0 or higher, or

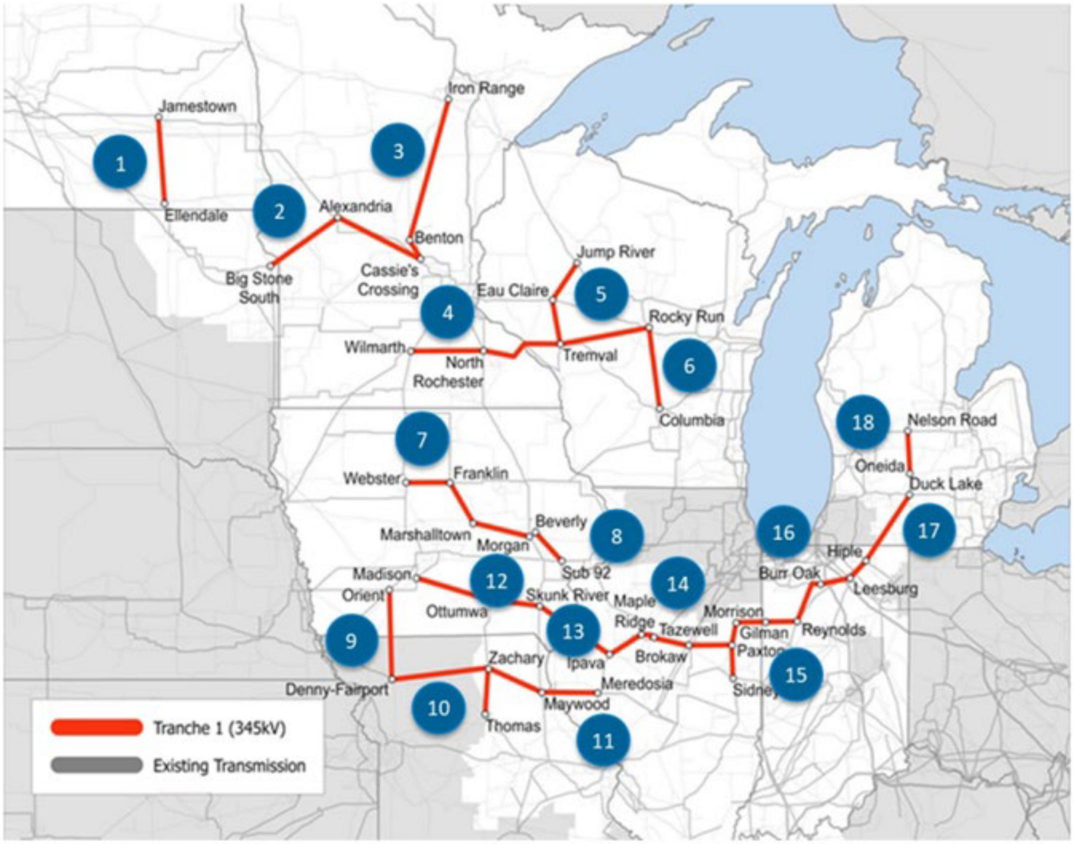
- **Policy** - Support the reliable and economic delivery of energy in support of documented energy policy mandates or laws.

3.4.3 MISO LRTP Tranche 1 Portfolio

The Project is one part of a broader regional solution to maintain reliability in the most cost-effective manner. As previously indicated, in July 2022, MISO approved the first phase or "tranche" of the LRTP. The MISO LRTP Tranche 1 Portfolio consists of 18 transmission projects, including the Project, identified in **Figure 3-13** as project number three. The MISO LRTP Tranche 1 Portfolio includes approximately 2,000 miles of new and upgraded high-voltage transmission lines equaling approximately $10 billion[47] in investment, to enhance connectivity and maintain adequate reliability for the Midwest by 2030 and beyond.

[47] As of July 2022

Figure 3-13. MISO LRTP Tranche 1 Portfolio



Overall, the LRTP Tranche 1 Portfolio is needed to:

- Address reliability violations as defined by NERC at over 300 different sites across the Midwest. In addition, increase transfer capability across the MISO Midwest subregion to allow reliability to be maintained for all hours under varying dispatch patterns driven by differences in weather conditions.
- Provide $23.2 billion in net economic savings over the first 20 years of the LRTP Tranche 1 Portfolio's service, which results in a benefit to cost ratio of at least 2.6. This amount increases to $52.2 billion in net economic savings over 40 years, resulting in a benefit to cost ratio of 3.8.[48]
- Support the reliable interconnection of approximately 43,431 MW in new, primarily renewable, generation capacity across the MISO Midwest subregion – 8,339 MW of which is in Minnesota and the surrounding region.

[48] Values as of July 2022. While market forces, have driven project costs to increase since 2022, the same forces will also cause benefits to increase.

During development of the LRTP Tranche 1 Portfolio, MISO considered multiple alternatives both to each of the eighteen individual projects and to the aggregate portfolio.

The LRTP Tranche 1 Portfolio was developed through a robust, open, and transparent stakeholder process. The LRTP Tranche 1 Portfolio is the culmination of over 200 meetings between 2020 and 2022. The average attendance at each MISO external/stakeholder meeting was 200-300.[49]

A copy of MISO's full LRTP Tranche 1 Portfolio report can be found in **Appendix I**.

3.4.3.1 Tranche 1 Portfolio Reliability Need

MISO identified that the LRTP Tranche 1 Portfolio is needed to prevent numerous thermal and voltage reliability issues – summarized in **Table 3-4**. The MISO LRTP Tranche 1 Portfolio is needed to ensure the MISO transmission grid can continue to reliably deliver energy from future generation resources to future load under a range of projected system conditions associated with the Future 1 scenario in the 10-year and 20-year time horizons.

Table 3-4. LRTP Tranche 1 Portfolio Reliability Need Summary

LRTP Project ID(s)[50]	Summary of Reliability Need
LRTP 1 & 2	Relieves 40 elements with excessive thermal loading for N-1 contingencies and 70 elements with excessive loading for N-1-1 contingencies
LRTP 3 ***Northland Reliability Project***	Relieves 15 elements with excessive thermal loading for N-1 contingencies and 25 elements with excessive loading for N-1-1 contingencies
LRTP 4, 5, & 6	Relieves 39 elements with N-1 heavy loading and severe overloads in MN and WI and 96 elements for N-1-1 contingencies
LRTP 7 & 8	Relieves 21 elements with N-1 heavy thermal loading and severe overloads in Iowa and 34 elements for N-1-1 contingencies
LRTP 9, 10, & 11	Mitigates heavy loading and severe overloads on 19 elements for N-1 and N-1-1 contingencies
LRTP 12 through 18	Addresses 600 thermal reliability violations at 77 different sites.

3.4.3.2 LRTP Tranche 1 Portfolio Generation Support

MISO's analysis shows the LRTP Tranche 1 Portfolio supports the reliable interconnection of approximately 43,431 MW of new generation needed to replace energy

[49] MISO, July 25, 2022 report to the System Planning Committee of the MISO Board of Directors.
[50] LRTP Tranche 1 Project IDs reference **Figure 3-13**.

currently provided by retiring fossil-fuel generation with newer lower carbon emitting generation resources – primarily renewable. Of the capacity supported by the LRTP Tranche 1 Portfolio, 8,339 MW is in Minnesota and the surrounding region (MISO "Local Resource Zone 1"). The generation supported by the LRTP Tranche 1 Portfolio is expected to reduce carbon-dioxide ("CO_2" or "carbon") emissions by upwards of 20 million metric tons annually across the MISO footprint or 399 million metric tons over the first 20 years of the LRTP Tranche 1 Portfolio's service and 647 million metric tons over the first 40 years of service. Using the Commission's valuation of carbon-dioxide emission reduction of $5 to $25/ton,[51] the LRTP Tranche 1 Portfolio is expected result in approximately $2 to $10 billion in carbon reduction benefits over the first 20 years across the MISO footprint.

3.4.3.3 LRTP Tranche 1 Portfolio Other Qualitative Benefits

The LRTP Tranche 1 Portfolio also provides multiple other qualitative benefits. MISO expects the addition of the LRTP Tranche 1 Portfolio to increase the operational flexibility to better allow timely outage scheduling to maintain the reliability of the system and to reduce the economic impacts due to congestion caused by outages. The operational flexibility also helps reduce the economic impacts of natural gas fuel price changes by providing access to a broader pool of generation resources.

The LRTP Tranche 1 Portfolio also gives more flexibility to better support diverse policy needs. The proactive long-range approach to planning of regional transmission provides regulators greater confidence in achieving their policy goals by reducing uncertainty around the future resource expansion plans. Elimination of much of the high transmission cost barriers allows resource planners to assume less risk in making resource investment decision.

3.4.4 Need for the Project in MISO LRTP Tranche 1

The MISO LRTP Tranche 1 was developed as a portfolio of projects designed to work together; however, each of the eighteen projects in the MISO LRTP Tranche 1 portfolio was also individually justified by MISO based on regional and local needs. MISO identified that the Project is both a critical component of the LRTP Tranche 1 Portfolio but also the most cost-effective option to maintain reliability in central and northern Minnesota following the retirement of legacy fossil fuel units. MISO's justification for the Project is summarized as follows:

> *Minnesota has and is projected to continue to undergo fleet change. This generation shift has resulted in central and northern Minnesota to have a drastic decrease in generation resources creating a large geographical area to be served by only 115 kV and 230 kV transmission. Central to northern Minnesota has moderate load, with heavy load being further north relating to iron mining operations. During the winter,*

[51] *In re Establishing an Updated 2020 Estimate of the Costs of Future Carbon Dioxide Regulation on Elec. Generation under Minn. Stat. § 216H.06*, Docket No. E999/DI-19-406, ORDER ESTABLISHING 2020 AND 2021 ESTIMATE OF FUTURE CARBON DIOXIDE REGULATION (Sept. 30, 2020).

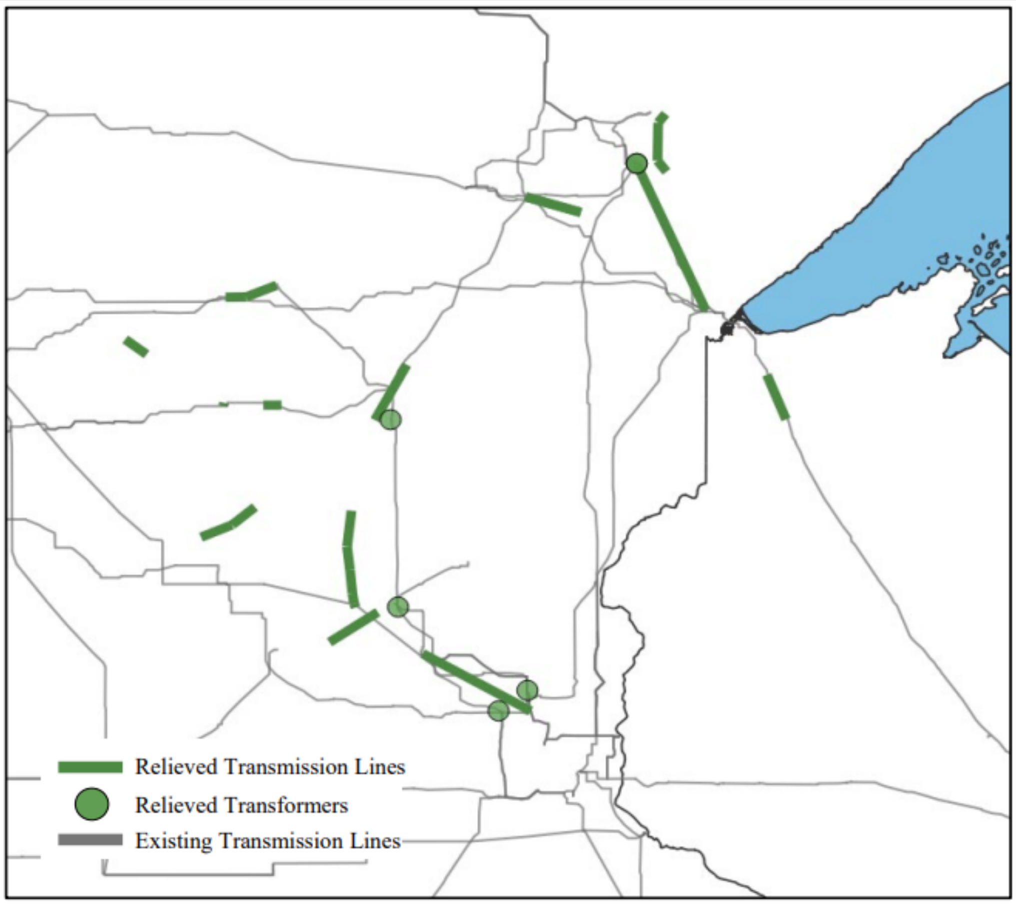
Minnesota load increases significantly. This causes strain on the widespread 115 kV and 230 kV system as power is needing to get from the twin cities to the north to serve load. This large geographical disparity in generation and weak transmission causes voltage stability concerns for a majority of the Minnesota system north of the Twin Cities. The Iron Range – Benton – [Big Oaks] 345 kV line provides a second low impedance path for power flow from southern Minnesota to the north. This unloads and relieves the 115 kV and 230 kV issues seen and relieves voltage stability concerns.[52]

MISO's analysis identified that the Project addresses many thermal and voltage issues on the lower voltage system in central and northern Minnesota, shown in **Figure 3-14**, especially for situations where the single 500 kV line heading north from the Twin Cities (Chisago to Forbes) is lost. Specifically, MISO's analysis shows that the Project relieves 15 elements with excessive thermal loading for N-1 contingencies and 25 elements with excessive loading for N-1-1 contingencies

MISO's analysis showed that under heavy winter loading situations, central and northern Minnesota suffer from voltage collapse issues (i.e., risk of blackouts) during transfer scenarios. Without the Project, MISO identified that voltage collapses for transfers less than 500 MW – an amount below what is needed to reliably serve central and northern Minnesota especially during winter months. MISO identified that with the Project, transfers through Minnesota can be greater than 2,000 MW without voltage collapse.

[52] **Appendix I:** MTEP21 LRTP Tranche 1 Portfolio Executive Summary & Report at 44.

Figure 3-14. Map of Reliability Issues Addressed by the Project[53]



In its analysis of the Project, MISO considered multiple alternatives, including:

- Iron Range – Alexandria 500 kV
- Iron Range – Arrowhead 500 kV
- Iron Range – Bison 500 kV
- Iron Range – Benton 500 kV

MISO evaluated each alternative, including the Project, through a consistent evaluation framework. At a minimum, each alternative was required by MISO to meet the following performance requirements:

- Ensure the ability to reliably serve peak load in central and northern Minnesota, and

[53] **Appendix I:** MTEP21 LRTP Tranche 1 Portfolio Executive Summary & Report at 45.

- Maintain the ability serve the existing 1,400 MW Manitoba Import Limit (i.e., meet contractual obligations).

Only the Project and Alternative 4 – a 500 kV version of the Project – met MISO performance requirements. MISO ultimately selected the Project – the double-circuit 345 kV version – as the best option because it has higher capacity (2,390 MVA vs. 1,732 MVA for Alternative 4), lower cost, and more proactively plans for potential future expansion. This MISO analysis confirmed the results of the various studies undertaken by the Applicants and discussed in **Section 3.3**.

3.5 Other Project Needs and Benefits

Beyond meeting transmission system reliability needs, the Project provides additional benefits to Minnesota Power's customers and Great River Energy's members. This section will provide an overview of the Applicants' analysis of the Project's beneficial impacts on regional transfer capability, expected economic benefits in the power market, resiliency and transmission source reliability, and future flexibility and electrification.

3.5.1 Regional Transfer Capability

The Project optimizes regional transfer capability to support increased renewable penetration. One of the continued findings of renewable integration and policy-driven studies looking at the clean energy transition is that the transmission system needs to be expanded to facilitate larger and less predictable transfers of bulk energy across the region to facilitate greater penetration levels of intermittent renewable resources. Northern Minnesota has long been a nexus for large regional transfers from energy-rich areas in North Dakota and Manitoba to loads in the Twin Cities, southeastern Wisconsin, and beyond. These transfers have typically been predictable, moving power from west to east and from north to south. However, as the regional energy portfolio continues to evolve, expanded regional transfer capability will be necessary to reliably navigate changing system conditions and dispatch scenarios.

For northern Minnesota, the lack of local dispatchable generation will lead to the need for transferring power into the region from remote low-carbon generation located in external areas. Renewable energy resource potential in northern Minnesota is comparatively limited for solar and wind. For example, a typical peak or near-peak hour in northern Minnesota occurs during severely cold winter nights where solar and wind resources may not be locally available. This drives the need for significant power transfers into northern Minnesota to supplement remaining dispatchable generation in the area. The same set of conditions generally drive peak loading in Manitoba as well, requiring Manitoba to potentially import power from MISO to supplement its own resources. These conditions result in the North Flow through Minnesota to serve winter peaking loads. An extended period of severe cold or drought conditions may further aggravate the situation by limiting the availability of hydroelectric and other dispatchable resources in northern Minnesota and Manitoba, creating near-total dependence on the transmission system to reliably serve peak load during these critical hours. As discussed in previous sections, the Project establishes reliable North Flow transfer capability to meet the needs of the region under these conditions.

The Project will further optimize regional transfer capability and benefit northern Minnesota by tying complementary renewable energy resources together. The Project establishes an additional low-impedance, high-capacity transfer path between northern Minnesota and the Twin Cities metro area. From the metro area, existing high-capacity transmission connections tie into abundant wind energy resources located in eastern South Dakota, southern Minnesota, and northern Iowa. With vast renewable hydroelectric generation resources in Manitoba to the north and high-capacity wind energy resources to the south, the Project is expected to facilitate greater access to the operational and market benefits of wind and hydro synergy. The relationship between Manitoba hydroelectric resources and MISO wind resources was first assessed by MISO in the 2013 Manitoba Hydro Wind Synergy Study.[54] As stated in the Wind Synergy Study Report, "Wind synergy benefits from the expanded use of hydro generators in Manitoba Hydro are demonstrated in three ways: by wind curtailment reduction in MISO; by an inverse correlation between imports from Manitoba Hydro and MISO wind generation; and by a better utilization of both wind and hydro resources."[55]

The synergy between MISO wind and Manitoba Hydro functionally operates like a very large energy storage solution, perhaps the largest in the world, and it is an innovative, elegant, and necessary solution to support meeting renewable energy and decarbonization goals in MISO while continuing to operate a reliable and efficient regional transmission system. In effect, when wind energy resource output is high, hydroelectric resources can be pooled and then later when wind energy resources output is low or non-existent, hydroelectric generation can be ramped up. The Project enhances the capacity for north-south and south-north transfers in Minnesota, optimizing and unlocking transfer capability for bi-directional power flows between vast dispatchable hydroelectric resources in Manitoba and vast intermittent wind and solar resources in MISO, creating better market conditions for the load in Minnesota and the surrounding area and largely using carbon-free resources to meet the local needs.

Previous discussion in **Section 3.3** and **Section 3.4** illustrates the effectiveness of the Project for enhancing transfer capability, particularly in the south to north direction, by resolving regional voltage and transient stability constraints as well as overloaded transmission lines that limit transfers when local dispatchable generators are offline. The Applicants have also evaluated the effectiveness of the Project for increasing transfer capability in the north to south direction, using the Manitoba Hydro Export interface ("MHEX_S") as a proxy. As shown in **Table 3-5**, the Project results in significant increases to transfer capability in both directions.

[54] MISO, Manitoba Hydro Wind Synergy Study Final Report (2013), *available at* https://mn.gov/eera/web/project-file?legacyPath=/opt/documents/33608/GNTL%20Appendix%20I.pdf.
[55] *Id.* at 3.

Table 3-5. Beyond Baseload Study Voltage Stability Results

Regional Transfers	Pre-Project	Post-Project	Change
Northward Transfer NOMN Interface	1,963-2,112 MW	3,017-3,141 MW	+905-1,178 MW
Southward Transfer MHEX_S	3,058 MW	~3,635 MW	+577 MW

The Project increases and optimizes regional transfer capability, enhancing reliable support for northern Minnesota and the region by adding capacity and redundancy to the regional transmission backbone.

3.5.2 Resiliency, Flexibility, and Transmission Source Reliability

The Project establishes a redundant pathway for power transfers between northern Minnesota and the Twin Cities area while enhancing the robustness of transmission sources to both areas.

In the current system configuration, bulk power transfers between northern Minnesota and the Twin Cities area are facilitated by 500 kV and 230 kV tie lines. Two 500 kV lines connect hydroelectric generation resources from Manitoba into northern Minnesota, and a single 500 kV line connects northern Minnesota to the Twin Cities area 345 kV transmission system. The Twin Cities area 345 kV transmission system is configured with high-capacity connections to western Minnesota and the Dakotas, southern Minnesota and Wisconsin. Underlying 230 kV lines also facilitate transfers in smaller amounts. The Project will create a parallel path to the existing 500 kV line that runs between northern Minnesota and the Twin Cities area, with similar capability as the 500 kV line, when considering the combined 345 kV lines, but because it is two lines, provides better resiliency by maintaining one extra high-voltage transmission line connection when considering multiple contingency events per the NERC TPL-001-5 Standard.

The configuration of the Project on robust steel monopole double-circuit 345 kV structures will establish two new high-capacity transmission lines in a geographically diverse corridor, enhancing the resiliency of regional transfer paths and bulk power delivery sources in Minnesota. Regional transfer paths will be enhanced with both redundancy and additional transfer capability, as discussed in **Section 3.5.1**. This redundant pathway also opens up additional capability to move power from regional generation resources tied into the Twin Cities area 345 kV system to support northern Minnesota as the operation of local resources like the BEC units continues to evolve. Similarly, the same pathway opens up additional capability to move power from generation resources in northern Minnesota and Manitoba to the Twin Cities area. Strengthening ties between geographically diverse generation sources enhances reliability for serving existing load centers going either direction. Expanding transmission line connections to the main sources of bulk power delivery in northern Minnesota and the St. Cloud area also provides additional resiliency as the local areas rely more heavily on these sources following local generator fleet transition. The robust physical design of the Project in combination with the flexibility to reliably transfer increased levels of power into and out of northern and central Minnesota helps to better withstand the effects of extreme weather.

The Project also provides another source of power delivery to the local distribution system that provides flexibility to meet potential electrical demand increases from adoption of commercial and personal electric vehicles, conversion to electrical heating and cooling, and the switch of industrial process from fossil fuels to electricity (e.g. electrifying iron ore mining trucks) – commonly referred to as "electrification" when considered in aggregate. MISO forecasts that electrification could increase energy consumption in Minnesota and the surrounding region (MISO Local Resource Zone 1) by approximately 2,600 gigawatt-hours ("GWh") to 40,000 GWh by 2039.[56] By providing additional transfer capability into northern and central Minnesota throughout the year, the Project supports the ability to serve increased electricity demand due to electrification and/or other drivers.

3.5.3 Economic Benefits

The Project, in concert with the broader MISO LRTP Tranche 1 Portfolio, is expected to provide economic savings more than two times the cost of the portfolio – see **Section 3.4**. By itself, the Project is projected to provide approximately $127 million to $2.1 billion in economic savings over the first twenty years of the Project's service by reducing system congestion and providing access to lower cost generation. These economic savings will help offset the capital cost of the Project.

The Applicants calculated the economic benefits of the Project in a manner consistent with MISO's calculation of the full LRTP Tranche 1 Portfolio's congestion and fuel savings benefit.[57] Both the Applicants and MISO's analysis is likely conservative in valuation (i.e., underestimates the true economic savings) as both rely on MTEP21 Future 1 which assumes only 85 percent of state carbon reduction mandates as of 2020 are achieved – see **Section 3.4**. Also, because the Project was designed and optimized to function as a portfolio, isolating the benefits of a single project results in an underestimation as it ignores the "synergic" performance impacts.

The Applicants calculated the economic benefits of the Project using production cost software ("PROMOD") by comparing the annual system performance between two cases:

- Full LRTP Tranche 1 Portfolio, and
- Full LRTP Tranche 1 Portfolio less the Project.

In each case, the annual Adjusted Production Cost ("APC") was determined for forecast years 2030 and 2040. The difference between cases was the APC savings or "economic savings" provided by the Project. APC is a measure of the overall cost to serve electrical demand – it represents an "out the door" impact to consumers considering generation

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[56] MISO, Futures Report at Figures 33, 35, and 37 *available at* https://cdn.misoenergy.org/MISO Futures Report538224.pdf/.

[57] **Appendix I:** MISO LRTP Tranche 1 Portfolio Report Section 7.

fuel costs, maintenance, purchases and sales, system congestion, etc. APC is the industry standard and the MISO federal tariff approved measure of economic benefits for a transmission project.

The APC benefits provided the Project can be broadly grouped into two categories:

- “Direct” - Congestion reduction from the Project (“transmission benefits”) and
- “Indirect” - Benefits from assumed future generation that would otherwise not be able to reliably connect and efficiently participate in the market without the Project.

As shown in **Table 3-6**, the Project is projected to provide upwards of $20 million dollars annually in economic benefits to the MISO footprint from congestion relief – or approximately $127 million over the first twenty years of service. These values do not include any anticipated indirect benefits.

Table 3-6. Annual Direct Economic Transmission Benefits Provided by the Project to the MISO Footprint

APC Benefit 2030 Future 1 (in year 2030 million dollars)	APC Benefit 2040 Future 1 (in year 2040 million dollars)
$0.1	$19.9

In addition to reducing system congestion and providing access to lower cost generating resources, the Project and broader MISO LRTP Tranche 1 Portfolio supports the interconnection of generating resources that otherwise would not be able to interconnect to the grid. MISO estimates that MISO LRTP Tranche 1 Portfolio supports approximately 43,431 MW of new generation.[58] As additional generation adds optionality to use lower cost generation to serve load, there are also APC savings associated with the enabled generation. As generation is enabled by the combination of the MISO LRTP Tranche 1 Portfolio it is infeasible to identify which generators in MISO’s estimated 43,431 MW are supported solely by the Project. To provide a reasonable upper bookend, to compare against the lower bookend which assumes the project is not responsible for enabling any new generation in **Table 3-7**, the Applicants calculated the economic benefits of the Project assuming it helps support the interconnection of the generation in Minnesota and the surrounding area (MISO Local Resource Zone 1) – approximately 8,339 MW of MISO’s total 43,431 MW.

[58] See **Section 3.4**.

Table 3-7. Annual Direct and Indirect Economic Transmission Benefits Provided by the Project to the MISO Footprint

APC Benefit 2030 Future 1 (2030$) (millions)	APC Benefit 2040 Future 1 (2040$) (millions)
$151	$304

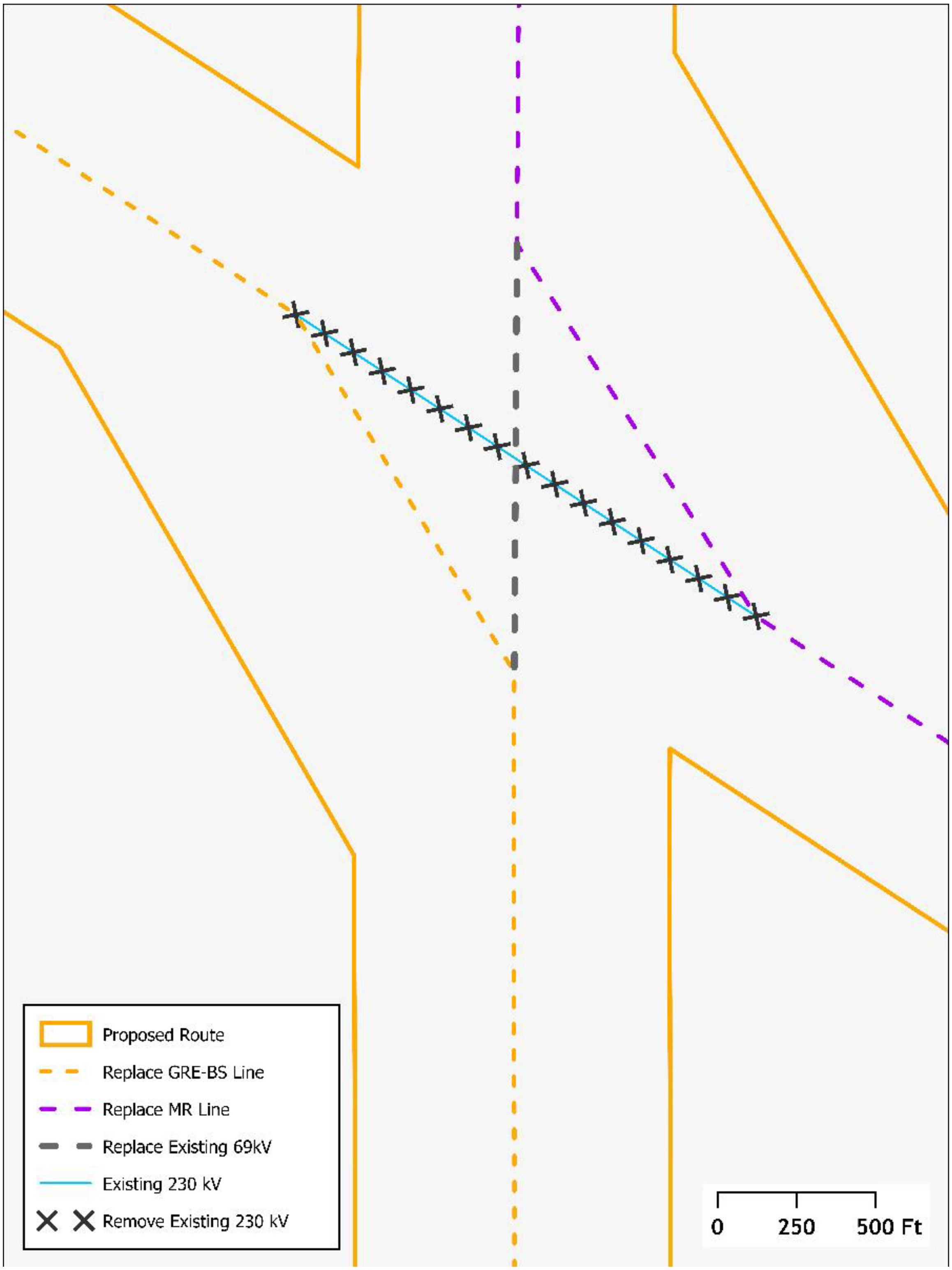
As shown in **Table 3-7**, when considering supported generation, the Project is projected to provide $151 million to $304 million in annual economic benefits - or approximately $2.1 billion over the first twenty years of service.

3.5.4 Segment 2 Line Uncrossing

The Project also improves resiliency and safety for maintenance work by allowing for "uncrossing" two existing high-voltage transmission lines. Currently, the two existing high-voltage transmission lines in Segment 2, which are being replaced as part of the Project, cross over one another – *i.e.*, the existing 345 kV GRE-BS Line traverses over the top of the existing 230 kV MR Line. Crossing of high-voltage transmission lines increases resiliency risk as should one of the lines fall it risks not only a fault (i.e., unexpected de-energization) but also taking down the other transmission line. In addition, performing maintenance at the crossing creates a safety risk, as under normal operating conditions one line must remain energized while work is occurring on the other line. Therefore, where practical, new lines are designed to minimize the number of crossings.

The Project will rebuild the existing Segment 2 transmission lines and reconfigure them such that the new lines will not cross. This uncrossing is shown in **Map 3-1**.

Map 3-1. Segment 2 Uncrossing Area



The Project will create approximately 350 feet of separation between these two transmission lines, allowing increased approach distances for maintenance without de-energizing one of the lines and eliminating the resiliency risk that could result from the unexpected failure of one line impacting the other.

In addition to uncrossing the existing lines in Segment 2, the Project avoids establishing new 345 kV over 230 kV line crossings in Segment 1 by relocating existing transmission lines to a new alignment to make room for the Project. Additional details regarding these relocation, rerouting, and reconfigurations areas are provided in **Section 2.1.5.4**.

3.6 Project Area Load Data

The Project is needed to support regional transmission system reliability as the MISO region undergoes baseload generator fleet transition and increasing renewable energy resource penetration levels. As the regional energy landscape continues to evolve, transmission reinforcements like the Project are necessary to serve current demand as well as projected future demand in northern and central Minnesota and the broader MISO region.

Great River Energy's most recent peak demand and annual forecast may be found in Great River Energy's 2023 Annual Electric Utility Forecast Report filed on July 7, 2023[59] which is provided in **Appendix P**.

Minnesota Power's most recent peak demand and annual forecast may be found in Minnesota Power's 2023 Annual Electric Utility Forecast Report filed on June 30, 2023[60] which is provided in **Appendix P**.

In addition to supporting reliability in the Applicants' service territories, the Project is needed to support the broader MISO region. MISO's base demand forecast is developed by aggregating each MISO member's forecasts. To consider a broader range of potential outcomes to "bookend" uncertainty, MISO creates multiple demand and energy forecasts from the base forecast in the Futures (see **Section 3.4** for details on the MISO's Futures). The load forecasts used in MISO's Futures consider different adaptation rates for demand response, energy efficiency, and distributed generation (e.g., behind-the-meter solar) and differing impacts of electrification. MISO's demand and energy forecasts are developed for each of MISO's ten Local Resource Zones to consider regional differences. MISO's ten Local Resource Zone forecasts are then aggregated to a MISO-wide forecast.

The MTEP21 Futures' gross peak demand and annual energy forecast for the MISO Market Footprint are provided in **Figure 3-15** and **Figure 3-16**, respectively. The associated peak demand and annual energy compound annual growth rates ("CAGR") are provided in **Table 3-8**. It should be noted that MISO's demand forecast used in planning modeling is a gross forecast, which does not include the net reductions from

[59] MPUC Docket No. E999/PR-23-11.
[60] MPUC Docket No. E999/PR-23-11.

demand response or distributed generation as is done in the Applicants' forecasts provided in their Annual Forecast Reports. MISO's planning process explicitly models demand response and distributed generation as a supply-side resource. Additional details on MISO's MTEP21 Futures and load forecast can be found the MISO 2021 Futures Report.[61]

Figure 3-15. MISO Market Footprint MTEP21 Futures Coincident Peak Load Forecast (GW)[62]

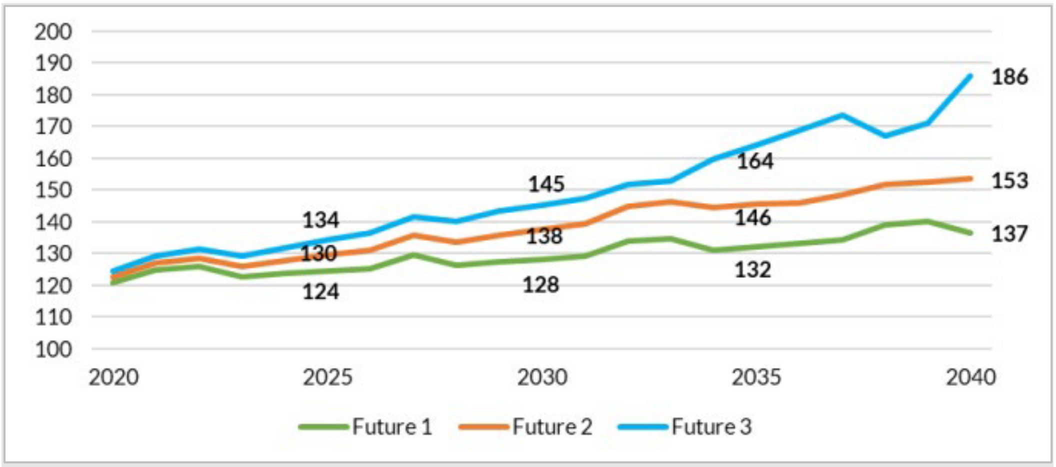
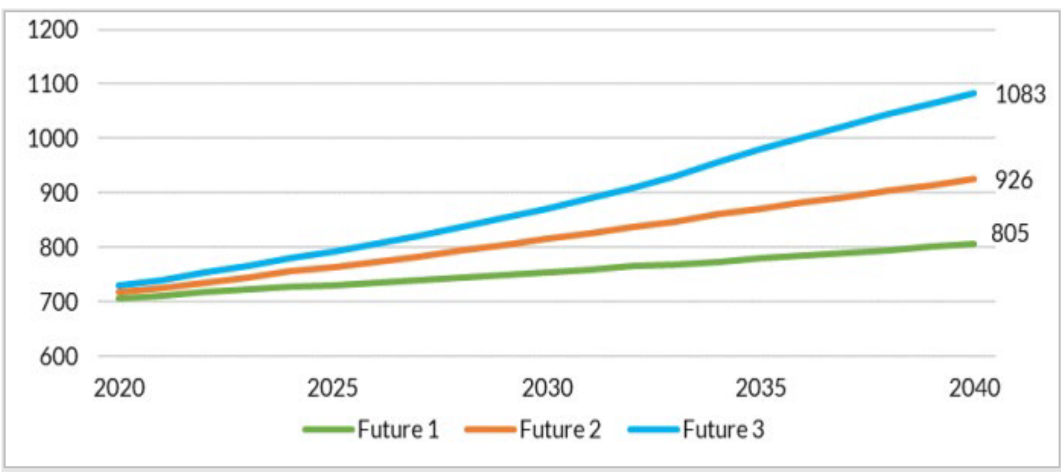


Figure 3-16. MISO Market Footprint MTEP21 Futures Annual Energy Forecast (TWh)[63]



[61] **Appendix I:** MISO LRTP Tranche 1 Portfolio, MISO Futures Report.
[62] MISO Futures Report (Apr. 2021, updated Dec. 2021), *available at* https://cdn.misoenergy.org/MISO%20Futures%20Report538224.pdf.
[63] *Id.*

Table 3-8. MTEP21 Futures 20-Year CAGR

MTEP21 Future	Annual Demand 20-Year CAGR	Annual Energy 20-Year CAGR
Future 1	0.60%	0.48%
Future 2	0.97%	1.09%
Future 3	1.41%	1.71%

3.7 Estimated System Losses

Losses are a measure of the energy flow across the system that is converted into heat due to impedance within the elements of the transmission system. It is necessary for utilities to provide enough generation to serve their respective system demands (plus reserves), taking into account the loss of the energy before it can be usefully consumed. When system losses are reduced or minimized, electrical energy is delivered to end users more efficiently, helping to defer the need to add more generation resources to a utility's portfolio. Therefore, system loss reduction results in monetary savings in the form of less fuel required to meet the system demand plus potentially delayed capital investment in generation plant construction.

Each new transmission line that is added to the electric system affects the losses of the system. In determining the losses associated with a particular transmission project, it is not reasonable to consider only the project's transmission facilities and calculate losses directly from operation of those new transmission facilities. Rather, it is necessary to look at the total losses of the system that result with and without the proposed project. The losses were therefore studied using the larger MISO North system for loss evaluation. In its Exemption Order, the Commission authorized the Applicants to provide line loss data for the system as a whole, rather than line loss data specific to an individual transmission line.[64]

The Applicants used power flow software PSS/E to calculate the losses at peak demand based on a Summer Shoulder case. The results are shown below in **Table 3-9**. The Existing Transmission System includes all projects with in-service dates prior to 2028.

Table 3-9. Calculated Project Peak Demand Loss Savings

Scenario	System Losses (MW)
Existing Transmission System	2,248.6
System with Project	2,206.6
Difference	-42.0

[64] *In the Application of Minnesota Power for a Certificate of Need for the Duluth Loop Reliability Project in St. Louis County*, Docket No. E015/CN-21-140, ORDER APPROVING NOTICE PLAN AND GRANTING VARIANCES AND EXEMPTIONS (May 17, 2021).

The table shows that the Project's proposed transmission infrastructure reduces the losses on the electrical system. Under summer peak demand conditions, the losses incurred on the Minnesota transmission system are 42 MW less when the Project is energized as compared to the existing system configuration.

Because demand for electric power is not constant and losses are related to the square of the current flowing through the transmission lines in the electric system, the losses will change over time, increasing as demand increases and decreasing as demand decreases. Because losses change over time, there is no precise method to calculate average annual loss reductions. One common method is to use the loss savings at peak demand to estimate the average annual loss savings based on the following formula:[65]

$$Loss\ Factor = (0.3 \times Load\ Factor) + \ (0.7 \times Load\ Factor^2)$$

$$Annual\ Loss\ Savings\ (MWh) = (Loss\ Factor\ \times Peak\ Loss\ Savings) \times 8760\ hours/year$$

Assuming a load factor of 55 percent and using the calculated loss savings at peak demand, the Project will reduce average transmission losses by an estimated 138,614 megawatt-hours ("MWh") annually.

3.8 Impact of Delay

If the Project is delayed, there will be both regional and local reliability consequences. The MISO LRTP Tranche 1 Portfolio assumes the Project will be in service in 2030. Delay of the Project would impact the performance of the broader portfolio, which was optimized to work together to deliver benefits across the Midwest. The loss in performance would increase the risk of reliability events, decrease and/or eliminate the approximately $410 million to $780 million in projected net annual benefits to Minnesota and the surrounding area for the length of the delay[66], and could jeopardize Minnesota and other MISO states in meeting clean energy policy objectives.

In addition to the regional impacts, a delay in the Project will also have local impacts. The Project is needed to maintain reliability in northern and central Minnesota as fossil-fuel plants transition to non-baseload operation or retirement. The transition of these fossil fuel plants in the 2020s and early 2030s is a key component of Minnesota utilities' IRPs, which have been reviewed and approved the Commission. In Minnesota Power's latest IRP, the Commission approved BEC Unit 3 to cease coal-fired operation by December 31, 2029 and BEC Unit 4 to cease coal-fired operation no later than 2035.[67]

[65] Gönen, Turan. *Electric Power Distribution System Engineering* at 55, 58-59, McGraw Hill (1986).
[66] Estimated net annual benefits associated with the MISO LRTP Tranche 1 Portfolio for Cost Allocation Zone 1 – see **Appendix I:** MISO LRTP Tranche 1 Portfolio Report for additional details.
[67] *In the Matter of the Integrated Resource Plan of Minnesota Power*, Docket No. E015/RP-21-33, ORDER APPROVING PLAN AND SETTING ADDITIONAL REQUIREMENTS at Order Point 2 (Jan. 9, 2023).

A delay in the Project could result in a delay in the cessation of coal-fired generation at Minnesota facilities due to reliability constraints as cited in **Section 3.3.2.1**. For example, if these units are submitted to MISO for retirement, MISO will not allow a unit to retire until necessary reliability upgrades are in-service. The transition away from fossil-fuel generation and the replacement with new renewable generation supported by the Project and MISO Tranche 1 Portfolio are a critical component for utilities to meet Minnesota's carbon-free by 2040 standard and its interim targets. The Project supports state carbon goals and creates the path to deliver clean energy resources to northern Minnesota while considering the cost to consumers. The Applicants and MISO have determined that this Project is needed to safely and reliably transition to a clean energy future.

3.9 Effect of Promotional Practices

The Applicants have not conducted any promotional activities or events that have triggered the need for the Project. Rather, the Project is driven by regional reliability issues related to the clean energy transition and meeting public policy objectives.

3.10 Effect of Inducing Future Development

The Project is not intended to induce future development, but it may support future economic development that otherwise would not be possible if the Project and the MISO LRTP Tranche 1 Portfolio were not constructed. These efforts are discussed in **Section 3.4** and **Section 3.5**.

3.11 Socially Beneficial Uses of Facility Output

The purpose of the Project is to maintain critical transmission reliability for the Applicants' customers and the broader MISO region as the region undergoes a transition from fossil-fuel generation resources to cleaner energy resources. The Project supports public policy goals such as Minnesota's carbon-free by 2040 standard and its interim targets.

To better understand some of the specific societal benefits of the Project, like reduced carbon emissions, the Applicants evaluated the impact of the Project on regional generation dispatch using PROMOD.

The addition of the broader MISO LRTP Tranche 1 Portfolio (including the Project) is projected to result a reduction in CO_2 emissions by supporting the reliable retirement and/or conversion of legacy fossil fuel generation and replacement with primary renewable resources. MISO estimates that the broader MISO LRTP Tranche 1 Portfolio will reduce CO_2 emissions by 399 million metric tons over the first twenty years of the portfolio's service.[68]

The Applicants also calculated specific carbon emission reductions for the Project in a manner consistent with MISO's. CO_2 emissions are forecasted using the same models

[68] **Appendix I**: - MISO LRTP Tranche 1 Portfolio Report at Section 7.

and comparison method as used to capture the economic benefits of the Project – see **Section 3.5.3**.

As shown in **Table 3-10**, the Project is expected to reduce annual CO_2 emissions by at least 1,156 to 3,093 thousand tons. As the addition of the Project directly positions the regional transmission system to continue to operate reliably after BEC Units 3 and 4 cease coal operation, as discussed in **Section 3.3**, the CO_2 reductions in **Table 3-10** and **Table 3-11**, include the estimated CO_2 from BEC Units 3 and 4 ceasing coal-fired operations. Additionally, as described in **Section 3.5**, the Project supports the reliable interconnection of new lower CO_2 emission generation in Minnesota and the surrounding region. When the additional potential generation is added to the analysis, the Project is expected to reduce annual CO_2 emission by upwards of 5,178 to 8,634 thousand tons, as shown in **Table 3-11**.

Table 3-10. Direct CO_2 Reductions Enabled by the Project

CO_2 Reduction 2030 Future 1 (thousands of tons)	CO_2 Reduction 2040 Future 1 (thousands of tons)
1,156	3,093

Table 3-11. CO_2 Reductions Enabled by the Project and Additional Lower CO_2 Generation Additions

CO_2 Reduction 2030 Future 1 (thousands of tons)	CO_2 Reduction 2040 Future 1 (thousands of tons)
5,178	8,634

4.1 Analysis of Alternatives

In any Certificate of Need proceeding for a proposed transmission line project, an applicant is required to consider various alternatives to the Project. Minn. Stat. § 216B.243, subd. 2(6) provide that in assessing need, the Commission shall evaluate "possible alternatives for satisfying the energy demand or transmission needs including but not limited to potential for increased efficiency and upgrading of existing energy generation and transmission facilities, load-management programs, and distributed generation." The Commission has also provided in its rules that an applicant for a Certificate of Need must discuss in an application a number of alternatives. Minn. R. 7849.0260 states:

> Each application for a proposed large high-voltage transmission line ("LHVTL") must include:
>
> B. a discussion of the availability of alternatives to the facility, including but not limited to:
>
> (1) new generation of various technologies, sizes, and fuel types;
>
> (2) upgrading of existing transmission lines or existing generating facilities;
>
> (3) transmission lines with different design voltages or with different numbers, sizes, and types of conductors;
>
> (4) transmission lines with different terminals or substations;
>
> (5) double-circuiting of existing transmission lines;
>
> (6) if the proposed facility is for DC (AC) transmission, an AC (DC) transmission line;
>
> (7) if the proposed facility is for overhead (underground) transmission, an underground (overhead) transmission line; and
>
> (8) any reasonable combinations of the alternatives listed in subitems (1) to (7).

Minn. R. 7849.0340 also requires an applicant to consider the option of not building the proposed facility.

This chapter discusses the various alternatives to the Northland Reliability Project that the Applicants considered, including: 1) generation, demand-side management and non-wires alternatives; 2) various transmission alternatives including upgrading the existing system, alternative transmission configurations, endpoints, and voltages, and 3) a no-build alternative. As discussed below, none of these alternatives is a more reasonable and prudent alternative to the Project.

4.2 Generation and Non-Wires Alternatives

The Applicants evaluated various generation and non-wires solutions, including new peaking generation, distributed generation, renewable generation, battery energy storage, demand-side management, and reactive resources as alternatives to the Project. To be a viable alternative to the Project, a generation or non-wires alternative (or combination of alternatives) must, at a minimum, address the primary needs for the Project by resolving regional reliability constraints resulting from baseload generator fleet transition, specifically voltage stability and other related concerns discussed in **Section 3.3**. Comprehensive alternatives to the Project should also support increased renewable penetration and provide benefits similar to the MISO LRTP Tranche 1 Portfolio benefits discussed in **Section 3.4**. Since those need drivers are more complex to assess, most alternatives were screened first according to their effectiveness addressing the underlying voltage stability issues described in **Section 3.3.2**. After a brief overview of the nature of operational characteristics required from generation and non-wires solutions to adequately address the voltage stability concerns resolved by the Project, the rest of this section will provide discussion of each of the generation and non-wires solutions considered by the Applicants.

To address the severe voltage stability issues resolved by the Project, the operational characteristics of any generation or non-wires alternative must enable it to reduce transfer on the NOMN interface enough to prevent voltage collapse due to loss of the Forbes – Chisago 500 kV Line. The NOMN Interface transfer level may be reduced by either reducing load or increasing generation in Northern Minnesota. A 10 percent stability margin must be maintained from the point of voltage collapse according to typical voltage stability planning standards.[69] In the Applicants' most recent analysis, the NOMN Interface, including the required stability margin, is 1,788 MW. With the BEC units offline, the NOMN Interface transfer level during the most limiting system conditions (winter peak, North Flow) was calculated to be 2,562 MW using a 2031 Winter Peak model. To reduce NOMN to within its voltage stability limit, total transfer on the interface would need to be reduced by 774 MW. Based on the distribution factors calculated from the power flow models, this is equivalent to about 980 MW of generation addition or load reduction in northern Minnesota.[70]

4.2.1 Peaking Generation

The Applicants considered peaking generation as an alternative to the Project. Peaking generation, in this context, means dispatchable generation that is interconnected to the transmission system and is able to run continuously when called upon, most likely using natural gas as the fuel source. The Applicants considered three general configurations

[69] MISO, Transmission Planning Business Practices Manual (BPM-020-r29), Appendix K, Table K-1 at 218 of 253. May 1 2023.
[70] Existing System Upgrades Study Report Executive Summary. Minnesota Power. May 2023.

for peaking generation. One peaking generation option would be to install several banks of small reciprocating internal combustion engine ("RICE") generators throughout northern Minnesota. To achieve the 980 MW minimum generation requirement for resolving the voltage stability issues, this solution would require 100 or more individual RICE units (estimated to cost $2,195 million).[71] Another potential peaking generation solution would be to install larger natural gas combustion turbine ("CT") generators at a handful of locations in northern Minnesota. To achieve the 980 MW minimum generation requirement, this solution would require three to five new CTs (estimated to cost approximately $850 to 1,300 million).[72] A third configuration for peaking generation would be to install a single large natural gas combined cycle ("CC") generation plant at BEC or a similar location in northern Minnesota (estimated to cost a minimum of approximately $1,152 million).[73]

All of these peaking generation solutions may be designed to mitigate the voltage stability issues as they have been identified and would potentially bring additional benefits to the energy supply portfolio. However, they do not meet CO_2 emissions reduction, renewable integration, or regional transfer capability needs addressed by the Project, and they cannot directly provide the comprehensive regional benefits identified by MISO in the LRTP Tranche 1 Portfolio analysis. Additionally, any alternative involving the siting of new natural gas generation comes with environmental permitting risks, and none of these solutions is expected to be more cost effective than the Project. Therefore, the addition of new fossil-fueled peaking generation is not a more reasonable and prudent alternative to the Project.

4.2.2 Distributed Generation

The Applicants considered distributed generation as an alternative to the Project. Distributed generation, in this context, means dispatchable generation that is connected to the local distribution system and is able to run continuously when called upon, most likely on natural gas or other fossil fuels. Renewable distributed generation and battery energy storage are also discussed in subsequent sections. Fossil-fueled distributed generation has the same fundamental limitations as transmission-connected peaking generation, as discussed in **Section 4.2.1** – and likely at a greater cost if consisting of a number of smaller generators in diverse locations. Therefore, the addition of new fossil-fueled distributed generators is not a more reasonable and prudent alternative to the Project.

4.2.3 Renewable Generation

The Applicants considered renewable generation as an alternative to the Project. Renewable generation, in this context, means either solar or wind generation. The renewable generation may be interconnected at a single location on the transmission system or at multiple locations on the transmission or distribution system. To adequately

[71] US Energy Information Administration, Annual Energy Outlook 2023 at Table 3 *available at* https://www.eia.gov/outlooks/aeo/index.php.
[72] *Id.* Each CT is assumed to be 300 to 330 MW in size.
[73] *Id.*

address voltage stability concerns in northern Minnesota, a renewable generation solution would need to be able to deliver 980 MW to reduce NOMN Interface loading to within its voltage stability limit. Therefore, to achieve 980 MW of instantaneous production, more than 980 MW nameplate of each of these generation sources would need to be added.

This power also needs to be available when called upon in the amount required to mitigate the risk of a voltage collapse. Because renewable generation is dependent on natural events, such as sunlight or wind speed, and cannot be dispatched if those conditions are not met, neither wind nor solar generation alone is a viable alternative to the Project. Energy from these resources is not necessarily available at the times when it would be most necessary to support reliability in northern Minnesota. As the major issue arises during winter peak conditions coincident with high northward transfers, 980 MW of generation delivered would be needed in the evening/nighttime hours, which negates solar energy output support. Wind energy output is unpredictable, sometimes decreasing during the evening hours of the day. Regardless of the magnitude installed, neither solar nor wind energy by itself can be relied upon to be available when needed to prevent the voltage stability issues addressed by the Project. Therefore, the addition of new renewable generation, by itself, is not a more reasonable and prudent alternative to the Project. The combination of renewable generation with energy storage is discussed below in **Section 4.2.4**.

4.2.4 Energy Storage

The Applicants considered energy storage, both by itself and combined with new renewable generation, as an alternative to the Project. Energy storage, in this context, means a battery or some other energy storage technology capable of being charged and discharged when called upon to do so as long as there is sufficient energy available. In order to address voltage stability concerns and related thermal overloads for a single contingency, a significant amount of storage and reactive support is necessary. For shorter duration outages, eight-hour battery storage would be adequate. For longer duration outages (days), storage could be paired with solar to allow recharging of battery storage during daylight hours.

Based on the calculation described at the beginning of **Section 4.2**, an energy storage solution would need to provide a nominal power injection of 980 MW to resolve voltage stability concerns. To provide 980 MW of eight-hour energy storage, a 7,840 MWh battery would be required. To investigate a more direct analytical methodology and refine the energy storage alternative, Great River Energy utilized a tool developed by the Electric Power Research Institute ("EPRI") called CPLANET. The EPRI CPLANET tool is designed to find optimal battery placement to address thermal overloads under varying conditions. The tool was used to address thermal issues as a proxy for voltage stability issues, since the two are closely tied in this case. The results indicated that 800 MW of 8-hour energy storage (6,400 MWh) would be required, split across five substations in northern Minnesota, eastern North Dakota, and Manitoba, to mitigate thermal issues to an acceptable standard. To alleviate the remaining voltage violations, 500 megavolt-amperes ("MVAR") of static synchronous compensators ("STATCOM") were staged at five different substations throughout northern Minnesota and eastern North Dakota to maintain voltage stability.

The Applicants also considered pairing the energy storage solution with new solar generation. If solar could produce the needed generation during daylight hours, energy storage could supply the needed generation outside of daylight hours. Because the primary concerns arise during winter nighttime hours with north flow transfer conditions, solar energy would have minimal benefit for addressing reliability issues in an eight-hour timeframe. Assessing this alternative for longer durations of energy storage, such as 24 hours and seven to 10 days, which solar could benefit, was not performed due to the significant size and cost for the eight-hour solution. Any longer-duration storage solutions will be significantly more costly to implement.

The Applicants utilized the Department of Energy's 2022 Grid Energy Storage Technology Cost and Performance Assessment[74] cost assumptions to estimate the cost of the 6,400 MWh energy storage solution. The estimated cost of a lithium-ion LFP energy storage solution with a rated instantaneous charge/discharge of 800 MW and an energy rating of 6,400 MWh is $2.1 to $2.5 billion. The additional STATCOMs required to maintain voltage stability would result in an additional cost of $100 million[75], for a total energy storage solution cost of $2.2 to $2.6 billion – two times the cost of the Project.

In conclusion, this non-wires alternative solution does not mitigate issues to the same level as the Project would. Most notably, this alternative only mitigates thermal and voltage concerns for a duration of eight hours. Due to the primary concerns arising during winter nighttime hours with north-flow conditions, pairing storage with non-dispatchable generation, such as wind or solar, would have little to no added benefit for this time duration. As shown from the numbers discussed above, any combination of energy storage and STATCOM meeting the minimum requirements for resolving the voltage stability concerns addressed by the Project would be very substantial in both size and cost. In addition to the economics of such a solution, siting, operational complexity, and the long-term effectiveness for the solution would all be significant concerns. Therefore, the addition of new energy storage in northern Minnesota is not a more reasonable and prudent alternative to the Project.

4.2.5 Demand Side Management and Conservation

The Applicants considered demand-side management and conservation as alternatives to the Project. In this context, demand side management and conservation are assumed to encompass all forms of peak shaving programs, such as interruptible loads and dual fuel programs, as well as more general energy conservation programs, such as energy-

[74] Department of Energy's 2022 Grid Energy Storage Technology Cost and Performance Assessment *available at* https://www.energy.gov/eere/analysis/2022-grid-energy-storage-technology-cost-and-performance-assessment. Values for 2021 escalated by five percent to convert to 2022 real dollars.
[75] Cost estimated using MISO Transmission Cost Estimation Guide for MISO's 2023 Tramission Expansion Plan ("MTEP23") *available at* https://cdn.misoenergy.org/MISO%20Transmission%20Cost%20Estimation%20Guide%20for%20MTEP23337433.pdf. Values de-escalated by five percent to convert to 2022 real dollars.

efficiency rebates. Based on the calculation described at the beginning of **Section 4.2**, northern Minnesota load would need to be reduced by 980 MW during winter peak times to avoid voltage collapse due to a fault on the Forbes – Chisago 500 kV line. Although conservation programs will continue to be implemented in the Project area to encourage efficient use of electricity, these programs are insufficient to reach these significant levels of load reduction. For these reasons, solutions involving demand-side management and conservation are not a more reasonable and prudent alternative to the Project.

4.2.6 Reactive Power Additions

As a final non-wires alternative, the Applicants considered implementing additional reactive power additions to support the area and prevent voltage collapse. Reactive power additions, in this context, mean transmission technology capable of providing reactive power and voltage support to the system through the use of traditional electromechanical devices such as switched capacitor banks and reactors, flexible AC transmission system ("FACTS") devices such as static VAR compensators ("SVCs") or STATCOMs, or synchronous condensers. Unlike generation or energy storage solutions, reactive power additions do not produce any active power (e.g. MWs) for consumption by end-use customers, meaning this alternative is not capable of directly reducing NOMN Interface transfer levels, as discussed for previous generation and non-wires alternatives. Instead, reactive power solutions enable increased interface transfer capability by providing voltage support where needed to prevent voltage collapse.

While a reactive power addition may contribute to resolving or reducing the severity of the northern Minnesota voltage stability issues, reactive power additions alone cannot satisfy any of the needs of the Project. This is because transmission lines on the NOMN Interface and the underlying system become overloaded at higher NOMN interface transfer levels achievable with reactive power additions. Reactive power additions alone cannot mitigate these thermal overloads on the transmission lines in northern Minnesota and eastern North Dakota, meaning that the additional existing system upgrades described in **Section 4.3** would also be required. For these reasons, solutions involving only reactive power additions are not a more reasonable and prudent alternative to the Project. Existing system upgrades, including reactive power additions and transmission line upgrades, are discussed in **Section 4.3**.

4.3 Upgrade of Existing Facilities

The Applicants considered upgrading existing transmission facilities as an alternative to the Project. To be a viable alternative to the Project, an alternative based on upgrade of existing facilities must, at a minimum, address the primary needs for the Project by resolving regional reliability constraints resulting from baseload generator fleet transition, specifically voltage stability and other related concerns discussed in **Section 3.3**. Comprehensive alternatives to the Project should also support increased renewable penetration and provide benefits similar to the MISO LRTP Tranche 1 benefits discussed in **Section 3.4**. Since those need drivers are more complex to assess, the existing system upgrades alternative was first developed to address the underlying voltage stability issues described in **Section 3.3.2**, along with related transmission line overloads. For the purpose of this analysis, existing system upgrades consisted of additional dynamic reactive power additions (assumed to be STATCOMs), additional capacitor banks, and rebuilding overloaded transmission lines to a higher capacity.

The existing system upgrades alternative was developed in an iterative fashion to resolve voltage stability and transmission line overload constraints following loss of the Forbes – Chisago 500 kV Line in the most limiting (Winter North Flow) case.

Where the voltage stability limit was reached and a voltage collapse occurred, a STATCOM was placed at the bus where the voltage collapse was the most severe to prevent the voltage collapse. Where system intact low voltages were identified, a capacitor bank was placed at the bus to boost the voltage. Where transmission line overloads were identified, existing transmission lines were reconductored with a higher-capacity, lower-impedance conductor to mitigate the overload. Analysis continued iteratively until the NOMN interface voltage stability limit achieved by the accumulated existing system upgrades was equivalent to the NOMN interface limit achieved by the Project, with no voltage violations and no transmission line overloads. The resulting existing system upgrades alternative included 2350 MVAR of new STATCOM additions across five separate sites, an additional 436 MVAR of new capacitor banks, and 435 miles of transmission line rebuilds on existing lines ranging from 69 kV to 230 kV. Upgrades would also be required at 35 different substations and on 18 individual transmission lines. Based on MISO’s Transmission Cost Estimate Guide for MTEP23, the Applicants estimate the cost for these upgrades alone to be at least $1,215 million.[76]

In addition to a higher cost than the Project, the vast amounts of reactive resource additions added to control voltage in the existing system upgrades alternative would create a significant amount of additional complexity in the operation of the transmission system. Heavy reliance on reactive resource additions also makes it challenging to anticipate voltage stability issues in real-time operations, as they maintain the system voltage at a set value all the way to the point of instability, meaning there is no early indication to system operators that something is wrong. On top of operational complexities, constructability is another substantial concern for the existing system upgrades alternative, as it would require extended outages on 18 individual transmission lines as well as shorter bus outages at the 35 individual substations to integrate reactive resource additions.

Lastly, the existing system upgrades alternative described in this section does not allow for any future growth or expansion beyond the studied amount. Future load growth or additional changes on the system would continue to drive additional incremental upgrade needs for the foreseeable future as the clean energy transition continues. For all these reasons, upgrading of existing facilities, including reactive resource additions and transmission line upgrades, is not a more reasonable or prudent alternative to the Project.

[76] *Id.* Cost comparable to Project mid-cost estimate.

4.4 Alternative Voltages

4.4.1 Lower Voltage Alternatives

The Applicants considered lower voltage solutions involving additions to the local 115 kV and 230 kV transmission system as an alternative to the Project.

The voltage stability concerns mitigated by the Project are caused by outage of the Forbes – Chisago 500 kV Line. The Project mitigates these concerns by establishing an electrically parallel path that will stay in service when the Forbes – Chisago 500 kV Line is lost. For any solution, including the Project, to be effective in mitigating these voltage stability concerns the Applicant's studies have found that the solution must have a similar electrical impedance to the Forbes – Chisago 500 kV Line. To achieve the required impedance and be able to accommodate the necessary power transfer levels, the Applicants' analysis indicates multiple 230 kV or 115 kV corridors would need to be developed. **Table 4-1** shows a comparison of the Forbes – Chisago 500 kV Line impedance with the Project (double-circuit 345 kV) and the number of 230 kV or 115 kV lines necessary to provide the necessary impedance.

Table 4-1. Impedance Comparison of the Project and Lower Voltage Solutions

Nominal Voltage of Solution	Single-Circuit Impedance (per unit, 100 MVA base)	Required Number of Circuits
500 kV Forbes-Chisago	0.013556 pu	1
345 kV Project	0.027933 pu	2
230 kV Alternative	0.075040 pu	5.5
115 kV Alternative	0.304080 pu	22.4

Table 4-1 accounts for the existing series compensation on the Forbes – Chisago 500 kV Line as well as the proposed series compensation included with the Project. The 230 kV and 115 kV alternatives are also assumed to be series compensated to a similar level as the Project. To determine the number of circuits required for each alternative voltage, the single-circuit impedance is divided by the targeted impedance. As shown in the table, the proposed double-circuit configuration of the Project provides nearly identical impedance to the Forbes – Chisago 500 kV Line. A 230 kV alternative would require more than five individual circuits while a 115 kV alternative would require more than 22 individual circuits. This simple calculation demonstrates why 230 kV and 115 kV are not generally proposed as solutions for the distance and power transfer levels associated with the Project. The increases in the total number of new transmission rights-of-way for the 230 kV and 115 kV alternatives would have considerable human and environmental impacts, in addition to higher costs. Based on this analysis, lower voltages such as 230 kV and 115 kV are not a more reasonable or prudent alternative to the Project.

4.4.2 Higher Voltage Alternatives

The Applicants considered higher voltage solutions involving new 500 kV and 765 kV transmission as an alternative to the Project.

The Applicants considered a 765 kV alternative. Because there is currently no 765 kV transmission in the MISO region north and west of Illinois, expensive transformation would be required to interconnect with existing 500 kV and 345 kV systems at the Iron Range Substation and the Benton County Substation. Combined with the increased construction costs and right-of-way requirements for a higher voltage line, the overall increase of cost, impacts, and operational complexity would not be worth the additional capacity gained by a 765 kV build compared to the Project. The Applicants have assessed the current and future needs of the region and concluded that double-circuit 345 kV provides the greatest degree of capacity, expandability, and long-term flexibility.

The Applicants considered a 500 kV alternative in the Northern Minnesota Beyond Baseload Study (see **Section 3.3.2.3**) and MISO also considered a 500 kV alternative (see **Section 3.4**). As described in **Section 4.4.1**, the Project needs to match the impedance of the existing Forbes – Chisago 500 kV Line, so a single circuit 500 kV line similar to the Forbes – Chisago 500 kV Line is a reasonable alternative to consider. In developing the Project, the Applicants developed a comparison of the pros and cons of 500 kV and double-circuit 345 kV. This comparison is shown in **Table 4-2**.

Table 4-2. Comparison of the Project and the 500 kV Alternative

Characteristic	Alternative 500 kV Single-Circuit	The Project 345 kV Double-Circuit
Historical Cost/Mile (2022$)	$3.0 M *Based on Dorsey – Iron Range 500 kV*	$2.8 M *Based on Cedar Mtn – Helena 345 kV Double-Circuit*
Losses	Slightly Higher Reduction	-
Voltage Stability Margin	Similar	Similar
Incremental N->S Transfer	Slightly Higher	-
Redundancy	Single Circuit	Two Circuits
Series Compensation	Single Circuit	Two Smaller Circuits
Expandability: Iron Range	Limited space for new 500 kV	No existing 345 kV Space for new substation with expandability
Expandability: Benton Co	No existing 500 kV	Existing space to expand. Native voltage for Twin Cities Area
Expandability: Mid-Line	Only at series comp station; less flexible to accommodate future regional transmission lines and/or connect to underlying system	Only at series comp station; more flexible to accommodate future regional transmission lines and/or connect to underlying system

The information in **Table 4-2** demonstrates that the proposed double-circuit 345 kV configuration for the Project has more benefits overall than a single-circuit 500 kV alternative. The 500 kV alternative has slightly lower losses and slightly higher incremental transfer capability, but it comes at a slightly higher cost with less redundancy and flexibility. In selecting double-circuit 345 kV for the Project, the Applicants considered the redundancy benefits of the double-circuit configuration compared to a single-circuit alternative, as well as the increased flexibility for future expansion and interconnection as the needs of the local and regional grid continue to evolve. One of the major benefits of 345 kV is that future connections to the Project substation and series compensation facilities come at a lower cost, impact, and complexity compared to 500 kV. Given similar performance and near-term cost, the Applicants concluded that the added long-term flexibility of 345 kV was the best solution for the Project.

Based on this analysis, higher voltages such as 765 kV and 500 kV are not a more reasonable or prudent alternative than the Project.

4.5 Alternative Endpoints

The Applicants considered alternative endpoints for the Project. The Applicants' initial analysis of alternative endpoints was combined with analysis of the 500 kV alternative voltage discussed in **Section 4.4.2** as part of the Northern Minnesota Beyond Baseload Study (see **Section 3.3.2.3**). As stated previously, to be effective in mitigating voltage stability concerns any alternative transmission solution must provide a new electrical connection parallel to the Forbes – Chisago 500 kV Line. This means that alternative endpoints must be situated similarly to the Forbes – Chisago 500 kV Line, with one end in northern Minnesota and the other end interconnecting to the existing 345 kV transmission backbone connected to the Twin Cities area. This configuration is necessary to provide a low-impedance path for facilitating bulk regional transfers between northern Minnesota and central Minnesota. In this section, evaluation of alternative endpoints will be broken down into three parts: 1) alternative northern endpoints, 2) alternative southern endpoints, and 3) alternative series compensation station configurations and locations.

4.5.1 Northern Endpoints

The Applicants considered several alternatives for the northern endpoint of the Project. Based on the assessment in **Section 4.4.1** ruling out lower voltage alternatives, all northern alternative endpoints must start at an existing 500 kV or 345 kV substation. This narrows the list of alternatives to three: 1) Forbes 500 kV, 2) Arrowhead 345 kV, and 3) Iron Range 500 kV. Northern Minnesota does not have any other substations that offer existing 345 kV or above infrastructure.

4.5.1.1 Forbes 500 kV Substation

The Forbes 500 kV Substation located near Eveleth, Minnesota, is the northern endpoint for the existing Forbes – Chisago 500 kV Line. The Project is needed to mitigate regional voltage stability issues associated with the loss of the Forbes-Chisago 500 kV Line, should it occur. The Applicants ruled out the Forbes 500 kV Substation as an alternative endpoint for the Project based on concerns about geographic diversity and single points of failure. If a catastrophic event were to occur at the Forbes Substation, it would result in the loss of both the Forbes – Chisago 500 kV Line and the project alternative connected at Forbes. Compared to the Project, this would result in a less robust solution which would fail to meet the basic reliability and resiliency needs the Project is designed to address. Given other viable northern alternative endpoints, the Applicants determined that the Forbes 500 kV Substation was not a more reasonable or prudent alternative endpoint for the Project.

4.5.1.2 Arrowhead 345 kV Substation

The Arrowhead 345 kV Substation located near Duluth, Minnesota, facilitates bulk power transfers between northern Minnesota and northern Wisconsin. While there is a considerable amount of load in the Duluth area, most of the Applicants' load in northern Minnesota is located further north on the Iron Range. The BEC is also located on the Iron Range, along with several other small coal plants previously retired or converted to peaking operation. The two existing 500 kV tie lines to Manitoba are also interconnected on the Iron Range. Since the generator fleet transition, northern Minnesota load-serving, and bulk regional transfer needs addressed by the Project all align more toward the Iron Range than the Duluth area, additional ties would need to be constructed between the Arrowhead 345 kV Substation and the transmission system on the Iron Range to comprehensively address the Project needs. Effectively, the new 345 kV line would need to be extended from the Arrowhead 345 kV Substation to either the Forbes 500 kV Substation or the Iron Range 500 kV Substation. Because an additional connection would be required to one of the other alternative northern endpoints, the Applicants concluded that a connection to the Arrowhead 345 kV Substation was not a more reasonable or prudent alternative endpoint for the Project.

4.5.1.3 Iron Range 500 kV Substation

The Iron Range 500 kV Substation located near Grand Rapids, Minnesota, was established in 2020 at the completion of the Great Northern Transmission Line Project to interconnect the new Dorsey – Iron Range 500 kV Line. The Dorsey – Iron Range 500 kV Line is one of two 500 kV interconnections facilitating bulk regional transfers between Minnesota and Manitoba. The other 500 kV interconnection to Manitoba, the Riel – Forbes 500 kV Line, interconnects to the Forbes Substation. There are currently no additional extra-high-voltage interconnections at the Iron Range Substation besides the 500 kV line from Dorsey, so all power transferred on this line is injected to the local 230 kV transmission system in northern Minnesota. As regional power transfer needs increase, interconnection of the Project at the Iron Range 500 kV Substation provides a complete high-capacity low-impedance electrical path parallel to the Riel – Forbes – Chisago 500 kV path, connecting Manitoba, northern Minnesota, and the Twin Cities area 345 kV backbone system. This provides optimal transfers in both directions (south to north and north to south) while avoiding the geographic diversity concerns associated with the Forbes 500 kV Substation. An additional regional transmission interconnection at the Iron Range 500 kV Substation also improves the redundancy of transmission sources for bulk power delivery into the local northern Minnesota 230 kV system via the existing Iron

Range 500 kV/230 kV transformer, which is becoming an increasingly critical source as local baseload generator fleet change continues in the area. Based on this assessment, the Applicants concluded that the Iron Range Substation was the only reasonable northern endpoint to meet the needs of the Project.

4.5.2 Southern Endpoints

The Applicants considered several alternatives for the southern endpoint of the Project. Based on the previous assessment ruling out lower voltage alternatives, all southern alternative endpoints must start at an existing 500 kV or 345 kV substation. Unlike the northern alternative endpoints, there is potentially a broader geographic area to consider for southern alternative endpoints, as they simply need to connect into the existing 345 kV transmission system going toward the Twin Cities. **Figure 4-1** illustrates potential southern alternative endpoints considered by the Applicants, including the Chisago 500 kV/345 kV Substation, Bison (Fargo) 345 kV Substation, Alexandria 345 kV Substation, Arrowhead 345 kV Substation, Monticello 345 kV Substation, Sherco 345 kV Substation, new Big Oaks 345 kV Substation, and Benton County 345 kV Substation.

Figure 4-1. Alternative Southern Endpoints

4.5.2.1 Chisago County 500 kV/345 kV Substation

The Chisago County 500 kV/345 kV Substation located near Chisago City, Minnesota, is the southern endpoint for the existing Forbes – Chisago 500 kV Line. The Project is needed to mitigate regional voltage stability issues associated with the loss of the Forbes-Chisago 500 kV Line, should it occur. Similar to the Forbes 500 kV Substation discussed in **Section 4.5.1.1**, the Applicants ruled out the Chisago County 500 kV/345 kV Substation as an alternative endpoint for the Project based on concerns about geographic diversity and single points of failure. If a catastrophic event were to occur at the Chisago County Substation, it would result in the loss of both the Forbes – Chisago 500 kV Line and the project alternative connected at Chisago. This would result in a less robust solution compared to the Project, which would fail to meet the basic reliability and resiliency needs the Project is designed to address. Given other viable southern alternative endpoints, the Applicants determined that the Chisago County 500 kV/345 kV Substation was not a more reasonable or prudent alternative endpoint for the Project.

4.5.2.2 Bison (Fargo), Alexandria, and Arrowhead 345 kV Substations

The Bison 345 kV Substation located near Fargo, North Dakota, is the western endpoint of the CapX 2020 Fargo – Monticello 345 kV Project. The Alexandria 345 kV Substation located near Alexandria, Minnesota, is a mid-line interconnection on the Fargo – Monticello 345 kV Project. Both of these substations are connected to the Twin Cities area 345 kV backbone network via the existing CapX 2020 345 kV line, which was constructed on double-circuit capable structures. The Arrowhead 345 kV Substation, described previously in **Section 4.5.1.2** as an alternative northern endpoint, was also considered as an alternative southern endpoint due to its high-capacity connection into the Wisconsin 345 kV system. All three of these alternative southern endpoints were evaluated by the Applicants in the Northern Minnesota Beyond Baseload Study and failed to resolve the basic voltage stability needs addressed by the Project. **Table 4-3** provides voltage stability results for the Project compared to the Bison (Fargo), Alexandria, and Arrowhead alternative endpoints.

Table 4-3. Voltage Stability Screening of Alternative Southern Endpoints

Study Case	Stability Margin
Base Case (No Solutions)	-23.1%
Iron Range – Benton 345 kV Double-Circuit	8.2%
Bison (Fargo) Alternative Endpoint	-5.9%
Alexandria Alternative Endpoint	-4.1%
Arrowhead Alternative Endpoint	-5.6%

As demonstrated in **Table 4-3**, the Bison (Fargo), Alexandria, and Arrowhead alternative endpoints all have negative stability margins. This means that these alternatives cannot address the voltage stability issue without additional modification or improvements. In contrast, the Project resolves the voltage stability concerns with a little over 8 percent margin between the modeled NOMN interface operating point and the stability limit. The Applicants' analysis demonstrates that the Bison (Fargo), Alexandria, and Arrowhead alternative endpoints do not meet the basic needs of the Project.

4.5.2.3 Monticello, Sherco and Big Oaks 345 kV Substations

Xcel Energy's Monticello 345 kV Substation, located northwest of Monticello, Minnesota, is the eastern endpoint of the CapX 2020 Fargo – Monticello 345 kV Project and the point of interconnection for the Xcel Energy Monticello Nuclear Plant. The Monticello 345 kV Substation was considered as a southern alternative endpoint as either a direct connection from the Iron Range Substation or an extension from the Benton County Substation (see **Section 4.5.2.4** for discussion of the Benton County Substation). Direct connection from the Iron Range Substation to the Monticello Substation would require a new transmission line on new right-of-way from the Benton County Substation to the Monticello Substation, unlike the Project which replaces existing transmission line rights-of-way through the area south of the Benton County Substation. It would also require establishing a new Mississippi River crossing because the Monticello Substation is on the south side of the river. To interconnect at the Monticello Substation, two new 345 kV line terminals would have to be developed inside the already space-constrained substation as well as space for the large oil-filled shunt reactors that must be connected to the end of each line. Finally, the interconnection of the existing nuclear energy facility at the Monticello Substation creates additional regulatory complexities and hurdles for project development. In view of all of these practical considerations, the Applicants determined that the Monticello Substation was not a more reasonable or prudent alternative endpoint for the Project.

The Sherco 345 kV Substation, located south of Becker, Minnesota, is a major 345 kV hub in the northwest part of the Twin Cities area 345 kV system and the point of interconnection for several Xcel Energy coal-fired generators, all of which are scheduled to be replaced with renewable energy resources in the next decade. The Sherco Substation was considered as a southern alternative endpoint for the Project as either a direct connection from Iron Range or an extension from the Benton County Substation (see **Section 4.5.2.4** for discussion of the Benton County Substation). Direct connection from the Iron Range Substation to the Sherco Substation would require a new transmission line on new right-of-way from the Benton County Substation to the Sherco Substation, unlike the Project which replaces existing transmission line rights-of-way through the area south of the Benton County Substation. Otherwise, the Sherco Substation alternative endpoint performed similar to the Benton County Substation alternative endpoint in the Applicants' studies. The Applicants ultimately determined that interconnecting at the Benton County Substation brought more practical benefits for project development and execution and more overall benefits to the power system than interconnection at the Sherco Substation. Benefits of interconnecting to the Benton County Substation are discussed in greater detail in **Section 4.5.2.4**. Based on the holistic comparison of the Benton County Substation and Sherco Substation alternative endpoints, the Applicants determined that the Sherco Substation was not a more reasonable or prudent alternative endpoint for the Project.

The Big Oaks 345 kV Substation is a new 345 kV substation proposed as part of MISO LRTP Project #2 (Big Stone – Alexandria – Big Oaks 345 kV). The Sherco Substation and Monticello Substation have multiple 345 kV transmission line corridors along the north side of the Mississippi River. In its development of LRTP Tranche 1, MISO determined that a new 345 kV substation along these corridors was desired due to a variety of factors, including consideration of generation plant operational needs, restrictions and complexities on interconnections at the Monticello Nuclear Plant, potential surplus generator interconnection and other future interconnection space requirements at the Sherco Substation, and geographic restrictions like the Mississippi River. The new Big Oaks Substation, conceptually known as "Cassie's Crossing" during development of LRTP Tranche 1, will interconnect to four existing double-circuited 345 kV transmission lines originating at the Sherco Substation. In addition to these eight transmission line entrances, the new Big Oaks Substation will also have space for two lines: one from the Benton County Substation to interconnect the Project and one line from Alexandria to interconnect LRTP Project #2, for a total of eleven initial 345 kV transmission line connections. The Applicants considered the Big Oaks Substation as a southern alternative endpoint for the Project as either a direct connection from the Iron Range Substation or an extension from the Benton County Substation. Similar to the Sherco Substation alternative endpoint, the benefits of interconnecting at the Benton County Substation drove the Applicants to select the Benton County Substation as the termination point for the line from the Iron Range Substation. However, the Project requires additional outlet capability south of the Benton County Substation to realize its full capability, and the construction of a new double-circuit 345 kV line on existing transmission line right-of-way from the Benton County Substation to the Big Oaks Substation was determined by the Applicants and by MISO to be the most optimal solution for strengthening the connection between the Project and the Twin Cities area 345 kV backbone network. Therefore, the Applicants concluded that the Big Oaks Substation was the most reasonable southern alternative endpoint for the Project after first interconnecting at the Benton County Substation.

4.5.2.4 Benton County 345 kV Substation

The Benton County 345 kV Substation, located east of St. Cloud, Minnesota, is a major source for St. Cloud and the surrounding area and the northern most 345 kV interconnection possibility in the greater Twin Cities area. The Benton County Substation is presently served by a single 345 kV line from the Sherco Substation, which is stepped down at the substation to interconnect with the local 230 kV system. Several 230 kV lines connect to the substation, including a line to the north toward the Minnesota Power Mud Lake Substation and Riverton Substation and a line to the south toward the Xcel Energy Monticello Substation. In their evaluation of southern alternative endpoints, the Applicants evaluated the need for and benefits of interconnecting at the Benton County Substation. The Applicants identified four major areas in which the Benton County Substation interconnection provides technical and practical benefits: shunt reactor considerations, series compensated line considerations, practical routing and environmental considerations, and future flexibility.

The Benton County Substation interconnection shortens the length of the new 345 kV lines from the Iron Range Substation by approximately 20 miles compared to interconnecting directly at the Sherco Substation or Big Oaks Substation, providing technical benefits for engineering and design of the Project. The shorter transmission line segment between the Iron Range Substation and Benton County Substation will have less capacitive charging, reducing overall reactive power needs impacting the Project’s shunt reactors and series capacitors. Because shunt reactor sizes are generally driven by capacitive charging during energization for longer transmission lines like the Project, the shunt reactor sizes on both ends of the line are directly impacted by line length. A longer connection from the Iron Range Substation to the Sherco Substation or Big Oaks Substation that bypasses the Benton County Substation would have greater voltage rise during energization due to higher capacitive charging and therefore would require larger shunt reactors to control line voltage. Furthermore, due to the proximity of the Project’s proposed transmission line route to the Benton County Substation it is likely that a future interconnection would eventually be developed at the Benton County Substation to strengthen local load-serving capacity. However, if the Benton County Substation interconnection is not established initially, any future interconnection at the Benton County Substation would change the line length and shift the need for shunt reactors from the Sherco Substation or Big Oaks Substation to the Benton County Substation, rendering the original shunt reactors at the Sherco Substation or Big Oaks Substation obsolete and requiring new shunt reactors at the Benton County Substation. In consideration of shunt reactor impacts, the Applicants determined that the most prudent approach would be to develop the Project with an initial interconnection at the Benton County Substation.

Similarly, the size of the Project's series capacitors is driven by line length. A longer line will have a higher series impedance, requiring larger series capacitors to offset the series impedance and achieve the same performance as the Project. Larger series capacitors would contribute to increased voltage rise during periods of heavy loading on the line, potentially impacting engineering design of the Project's transmission line and substations by increasing maximum continuous operating voltage, switching overvoltage, and transient recovery voltage. Increasing these quantities can potentially lead to the need for taller transmission line structures due to greater insulation requirements, transmission line surge arresters, increased circuit breaker ratings, and targeted protection system design considerations to manage the complexities of the series capacitors. The location of the series capacitors is also critical. The most optimal location for series capacitors is at the electrical midpoint of the transmission line. Locating the series capacitors off the midpoint will impact the transmission line voltage profile, driving line voltage up significantly on the sending end side of the series capacitors during periods of heavy loading as more current flows through the capacitors.

With the Project endpoints at the Iron Range Substation and Benton County Substation, the electrical midpoint happens to be approximately near the location of Minnesota Power's existing Riverton 230 kV/115 kV Substation. This is an ideal location for the Project's series capacitors as it would provide optimal electrical performance in addition to being located near an existing utility site and enabling a future interconnection to the underlying 230 kV system to support the local area. Series compensated lines generally cannot be tapped without modifying or replacing the series capacitors, because the amount of compensation is based on the line length between endpoints. Any future segmentation of the line at the Riverton Substation or Benton County Substation, if not included or planned from the beginning, would require replacement of the series capacitors to avoid over-compensating the shortened line segment. In consideration of series capacitor impacts, the Applicants determined that the most prudent approach would be to develop the Project with an initial interconnection at the Benton County Substation to ensure that the series capacitor size and location is optimized for the long-term use of the Project. The proposed Cuyuna Series Compensation Station will be designed to facilitate future interconnection at the only possible location that would not require replacement of the series capacitors – between series capacitor segments.

The Benton County Substation interconnection enables the Applicants to utilize existing transmission line rights-of-way in the most densely populated area of the Project. In the

Applicants' evaluation of the Project, it was determined that the existing Benton County – Monticello 230 kV transmission line could be replaced if a new Benton County – Big Oaks 345 kV double-circuit transmission line was constructed. An upgrade of the existing Benton County – Sherco 345 kV transmission line was later added to the Project by MISO as part of its Tranche 1 evaluation. For the Project, the Applicants have proposed to replace both of these existing transmission lines, largely within their existing rights-of-way. This avoids the need to establish an additional transmission line right-of-way between the Benton County Substation and Big Oaks Substation, which would be necessary if the initial interconnection at Benton County was not established as part of the Project. Thus, in addition to reducing engineering and technical complexities, the Benton County Substation interconnection also contributes to reduced human and environmental impacts. Therefore, in consideration of human and environmental impacts, the Applicants concluded that the most reasonable and prudent approach would be to include the Benton County Substation interconnection in the initial design of the Project.

Finally, including the Benton County Substation interconnection in the initial design of the Project provides the greatest degree future flexibility in addition to near-term benefits. The potential future needs are especially important given the unique technical design of the Project, which increases the complexity of future changes. Due to the technical impacts of series capacitors and shunt reactors discussed in the preceding paragraphs, it is prudent to site the new infrastructure such that it is flexible to accommodate future needs. In a series compensated line, future expansion is limited to termination points, in this case the Iron Range Substation, Cuyuna Series Compensation Station, and Benton County Substation. Thus, the design of the line compensation and necessary reactors should consider all future aspects such that the reconfiguration of the line will not impact the operating performance or future use of the line. The desire is to install the facilities that are expected such that any investment will meet long-term needs not only for future load and transfer capabilities, but also for limiting the risk of obsolescence during the life of the Project. The MISO LRTP Tranche 1 projects are intended to meet the long-term needs of the region, including continued fleet change and increasing electrification. With higher levels of electrification, it is foreseeable that added 345 kV support for the area served by the Benton County Substation will be necessary to provided added redundancy, improve resiliency, and increase local load-serving capacity to the St. Cloud area. Proactively designing the Project to account for these needs in the Benton County Substation area is more cost-effective, practical, and results in less human and environmental impacts.

In summary, including the Benton County Substation interconnection with the Project provides benefits today and in the future. The Benton County interconnection results in more optimal Project technical design, particularly for impacts on shunt reactors and series capacitors which will both be smaller as a result of the Benton County Substation interconnection. Including Benton County Substation with the Project also provides local load-serving benefits to the St. Cloud area, strengthening redundancy and resiliency of sources while increasing long-term load-serving capacity. In addition to the technical benefits, the Benton County Substation interconnection also reduces overall human and environmental impacts by enabling the Project to take advantage of existing transmission line rights-of-way south of Benton County. Based on this assessment, the Applicants concluded that the interconnection to the Benton County Substation as part of the design of the southern endpoint was the most reasonable and prudent option for the Project.

4.5.3 Series Compensation Station Location

The Applicants considered alternative series compensation station locations and configurations. There are two general options for siting a series compensation station: it can either be located at the endpoints of the transmission line or at a separate mid-line substation. The determination of the best series compensation location option for a particular project is dependent on the length of the transmission line, technical requirements, and future use considerations. It is generally accepted that the most optimal location for a series compensation station is near the electrical midpoint of the transmission line. For shorter transmission lines, it may be more practical and have less technical impact on project design to locate series capacitors at the endpoint substations. As line length increases, technical considerations begin to strongly support the midpoint location. An example technical consideration is the voltage rise along the transmission line. Full load current flowing through the series capacitors will generally lead to significant voltage rise on the line coming into the sending-end side of the capacitors, with a large voltage drop across the capacitors followed by a more moderate voltage profile going out from the series capacitors toward the receiving end of the line. By moving the series capacitors to the endpoint substations, the line length between the sending end and the series capacitors doubles and the voltage rise coming into the series capacitors increases dramatically. This also increases reactive power flow on the line, which increases losses. Therefore, in view of line length and technical considerations for the Project, the Applicants determined that locating series compensation at the endpoint substations was not a reasonable alternative for the Project, and that a midpoint series compensation station location would be necessary.

Future use considerations also impact series compensation station location. The total series compensation of a transmission line is determined based on the total series impedance between the two endpoints of the transmission line. For the Project, the Applicants anticipate series compensation being equal to approximately 60 percent of the series impedance of the new 345 kV transmission lines between the Iron Range Substation and Benton County Substation. Any future interconnections to the line would impact the total series impedance between endpoint substations and, as a result, would potentially require modification or replacement of the series compensation to avoid overcompensating the shortened line. Overcompensation can lead to protection issues, electrical resonances, and other concerns, which is why series compensation is typically limited to less than 70 percent of the total series impedance of a transmission line. As the Applicants were developing the Project, it became evident that the electrical midpoint of the Iron Range – Benton County 345 kV transmission lines would be near the existing Minnesota Power Riverton 230 kV/115 kV Substation. Because the Riverton Substation is a hub for the local 230 kV and 115 kV transmission system that supports the Baxter/Brainerd area, the Applicants determined that it would be prudent to take the opportunity to locate and design the series compensation station to address future load serving needs in the area by facilitating a connection to the underlying 230 kV system at the Riverton Substation. Special considerations are necessary in the design of the series compensation station to preserve this option, and the Riverton Substation then becomes the only location between the Iron Range Substation and Benton County Substation that can practically facilitate any type of interconnection on the Project's new transmission line without requiring replacement of the series capacitors. Without the inclusion of these design considerations for the series compensation station, there would be no practical location along the entire length of the Project from the Iron Range Substation to Benton County Substation in which to establish any future interconnection to support the underlying system. Therefore, in view of future use considerations, the Applicants determined that locating the series compensation station as close as practical to the site of the existing Riverton Substation was the most reasonable and prudent option for the Project.

4.6 Double-Circuiting and Other Engineering Considerations

Double-circuiting is the construction of two separate transmission circuits (three phases per circuit) on the same structure. Placing two transmission circuits on common structures generally reduces right-of-way requirements, which potentially reduces human and environmental impacts. The Project is already proposed as a double-circuit 345 kV line for the majority of its length and is proposed to be constructed on double-circuit-capable structures where it will not initially be operated as double-circuit.

As most of the Project is proposed to route adjacent to existing transmission lines, the Applicants also considered triple-circuit structures to further reduce right-of-way requirements. Triple-circuiting is the construction of three transmission circuits on a common structure. Triple-circuiting is typically used in only limited applications due to reliability, resiliency, cost, and safety implications. Reliability standards established by NERC require that the transmission system is planned to be able to withstand potential contingencies – including the loss of a common structure. For a triple-circuit to be a viable alternative, the system must be able to remain reliable if all three circuits were simultaneously lost. In addition, when considering triple-circuits with the existing system there are economic implications as development not only requires larger and more expensive structures compared to a double- or single-circuit, but there are also increased costs and market impacts due to the removal of an existing transmission line.

Triple-circuit structures were evaluated as an alternative, including with the existing 230 kV lines to which the Project proposes to route adjacent for most of Segment 1. Triple-circuit 345 kV/345 kV/230 kV structures are not a viable option for the Project because simultaneous outages of the proposed double-circuit 345 kV line and the parallel 230 kV lines, either due to a common structure failure or due to maintenance on a common structure requiring an outage of all three circuits, creates unacceptable reliability risks for the system. One area where the Applicants found triple-circuiting to be a viable option for the Project is along approximately ten miles of 345 kV/345 kV/69 kV triple-circuit structures in Segment 2. This is a distinct circumstance compared to potentially triple-circuiting other areas of the Project, because the system configuration in this area is able to withstand the "loss of a common tower" reliability standard. This is because the existing 69 kV line is used for local load serving, an entirely different purpose than the proposed double-circuit 345 kV line. In addition, the existing 69 kV line currently shares a common structure with a 345 kV line which will be removed and replaced by the Project so there is a need to develop either new standalone 69 kV structures or share a common structure with the Project. Given area routing constraints a new (additional) 69 kV right-of-way would have high public and land-use impacts. Because the Applicants analysis found that triple-circuit in this specific circumstance would not degrade the reliability or maintainability of the transmission system, the Applicants have proposed to triple-circuit this area of the Project.

The Applicants also considered replacement of existing facilities with the proposed double-circuit 345 kV line. Nearly all of Segment 2 will replace existing facilities to minimize the need for new right-of-way. In Segment 1 the Applicants considered replacing the existing 230 kV lines between the Iron Range Substation, Riverton Substation, Mud Lake Substation, and Benton County Substation with the proposed double-circuit 345 kV line. This alternative was not viable because it would degrade the reliability of the underlying transmission system. The 230 kV system is needed to work in conjunction with the Project to move energy from the Project's endpoints to serve load along the route. If the existing 230 kV lines were replaced by the new double-circuit 345 kV line, additional substation facility expansions would be required at both the Riverton Substation and the Mud Lake Substation to either add 345 kV/230 kV transformers or replace existing 230 kV/115 kV transformers with 345 kV/115 kV transformers. The expansions would be necessary to maintain a reliable source of power delivery to the underlying 230 kV and 115 kV transmission system, which distributes power to the local area. These substation expansions would add considerably to the cost of the Project. Also, without the existing parallel 230 kV lines, additional transmission system reinforcements may be necessary to provide capacity on the underlying system to facilitate transfers during planned or unplanned outages of the proposed double-circuit 345 kV line. Extended outages of the existing substations and 230 kV transmission lines would also potentially create reliability concerns during the multi-year construction timeframe for the Project.

Finally, the Applicants considered realigning portions of existing lines to create space for the Project to minimize routing impacts and/or to avoid crossing the existing transmission line. Most of Segment 1 is routed adjacent to an existing 230 kV line. In certain places of the route, it was less impactful (see **Section 5.2** for a discussion of the route development process) to route on the west side of the existing 230 kV and in other places on the east side. To site the line both to minimize impacts and to avoid crossing the existing transmission line multiple times which creates reliability and safety risks, the Applicants propose to realign the placement of the existing transmission line. For example: in the northern portion of Segment 1 the Project is proposed to be routed on the east side of the existing 230 kV. To avoid having to cross the existing line to route on the west side for a portion due to routing constraints, the Applicants propose to move the existing 230 kV to the west and construct the Project within the route previously occupied by the 230 kV. The Project includes six realignments – see **Section 2.1.5.4** for additional details.

4.7 Alternative Number, Size, and Type of Conductor

Project conductors are subject to change based on a conductor optimization study to be completed during detailed design of the Project. The Applicants are currently considering two potential conductor configurations for the Project: T2-ACSR conductor and ACSS conductor. Both conductor configurations will consist of two bundled sub-conductors per phase, with the T2-ACSR conductor further consisting of two individual ACSR conductors per wire twisted together. The T2-ACSR conductor generally has a higher capital cost than a typical ACSR or ACSS conductor, but it is being considered specifically due to conductor galloping concerns identified on previous projects, which are caused by wind and ice loading conditions that are common in the southern two-thirds of Minnesota.

Conductors are generally bundled together to optimize corona performance and cost effectiveness, particularly at extra high-voltages of 345 kV and above. The conductor optimization study will consider single conductors, but the Applicants expect those conductor configurations will not meet performance criteria for audible noise, electric fields, and radio frequency interference, in addition to resulting in higher losses. The most likely conductor configurations for the Project are two-conductor bundles utilizing either T2-ACSR or ACSS, as described above. The conductor optimization study may consider three-conductor bundles, but the Applicants do not expect to see significant technical or economic benefits from additional sub-conductors at 345 kV, particularly in view of the added cost and structural loading requirements from a three-conductor bundle. The conductor optimization study will also consider various sizes of conductor. Utilizing larger conductor can reduce transmission losses; however, this long-term savings must exceed the initial cost increase to be considered as a viable alternative. Beyond the wire cost alone, larger wires translate to increased structural loading which results in higher structure costs. The conductor optimization study will be specifically designed to identify the optimal conductor configuration or configurations for the Project based on technical and economic analysis of selecting different conductor sizes and configurations in view of mechanical and electrical performance criteria, long-term losses, and initial capital costs.

4.8 Direct-Current Alternative

HVDC lines are typically proposed for transmitting large amounts of electricity over long distances because line losses are significantly less over long distances on a HVDC line than an alternating-current (“AC”) line. HVDC lines require conversion stations at each delivery point because the direct-current (“DC”) power must be converted to AC power before it can be used by customers. A single converter station can be upwards of $400 million, not including the required DC line construction. Such conversion stations would add significantly to the cost of the Project. HVDC lines are typically proposed for large regional transmission projects that involve hundreds of miles of new transmission line. As a rule of thumb, HVDC becomes a cost-effective alternative to AC transmission when the total line length is greater than 350-400 miles. The total length of the Project is much shorter than this threshold – 180 miles in total. In addition, the Project is designed to support the underlying AC transmission system now and in the future by being interconnected to the Benton County Substation and being designed for a future interconnection at the Cuyuna Series Compensation Station. These connections to the underlying AC system would not be feasible with an HVDC solution. For all of these reasons, there is no justification – in terms of reliability, economy, performance, or otherwise – for a HVDC line in this case.

4.9 Underground Alternative

Undergrounding is an alternative that is seldom used for high-voltage transmission lines like those being proposed for the Project. One of the primary reasons underground high-voltage transmission lines are seldom used outside congested city areas is that they are significantly more expensive than overhead lines. The cost range depends on the design voltage, the type of underground cable required, the extent of underground obstructions like rock formations, the thermal capability of the soil, the number of river crossings, and other factors, but the construction cost of locating the entire length of the Project's proposed transmission underground is estimated to be as much as 5 to 16 times greater per mile than if it were to be constructed overhead as proposed. This cost does not include the large reactors that would likely be required at each substation to counteract the large line charging currents present on underground high-voltage lines. In addition, there are increased line losses and additional maintenance expenses incurred throughout the useful life of an underground high-voltage line further increase the total additional cost of building an underground line instead of an overhead line.

Beyond initial costs, another important consideration of undergrounding lines is consistency with existing lines and standards. The Applicants do not have any buried lines at voltages of 115 kV and above. The addition of underground transmission is outside the Applicants' current standards and would require new installation and maintenance training, tooling, equipment, and new inventory to be carried for maintenance and critical spares resulting in increased costs and/or a reduction in inventory levels of other items, which then results in diminished maintenance and emergency restoration responsiveness and effectiveness.

A common argument in favor of implementing underground lines is that they will minimize the human and environmental impacts above ground. However, there are human and environmental impacts both during and after construction of an underground transmission line. During both underground and overhead transmission line construction, the right-of-way must be cleared of vegetation. For overhead transmission, excavation work is concentrated to line structure foundations; however, for underground transmission excavation work is along the entirety of the line. This results in increased impact especially in sensitive environmental areas. In addition, large areas for access roads capable of supporting heavy construction equipment, trenching activities, and cable installation are needed for underground transmission. After construction, the right-of-way needs to be maintained free of all woody vegetation to reduce soil moisture loss, since high-voltage underground conductors make use of soil moisture for conductor cooling. A permanent road must also be maintained along the right-of-way for maintenance and repair.

Underground lines can also be more challenging to operate and maintain. While overhead lines are typically subject to more frequent outages than underground cables, service can usually be quickly restored. This is accomplished by automatic reclosing of circuit breakers, which results in only a momentary outage of the line. Since circuit breakers on underground lines are typically not reclosed until it can be verified that a fault has not occurred on the underground cable, the smaller number of outages is typically offset by their increased duration. A faulted underground line takes much longer to restore because of the difficulty in locating the fault and accessing the site to make repairs. If the fault is due to a failure in the cable, the segment of failed cable must typically be replaced. This usually involves completely replacing the failed cable between two man-hole splice points, which are ordinarily located every 1,500 to 2,000 feet along the line. To replace failed cable, it must be possible to bring heavy equipment, including cable reels weighing 30,000 to 40,000 pounds, into the right-of-way during all seasons of the year. If the fault occurs in a wetland area where all-season roads are not maintained, restoration can be delayed due to the need to install wetland matting to gain access to the manholes involved in replacing the failed cable.

Due to the construction, maintenance, reliability, and cost drawbacks of high-voltage underground transmission lines, undergrounding is not a more reasonable and prudent alternative for any segment of the Project.

4.10 No-Build Alternative/Consequence of Delay

As required by Minn. R. 7849.0340, the Applicants also considered the no build alternative, i.e., no new transmission constructed to meet the identified reliability needs in northern and central Minnesota. As detailed in **Sections 4.2** and **Section 4.3**, demand side management and conservation, peaking generation additions, additional distributed generation, additional renewable generation, additional energy storage, additional reactive support resources, or existing system upgrades were not reasonable alternatives to the Project. Should the Project be delayed and/or not constructed, there would be local and regional reliability, policy, and economic consequences.

4.10.1 Reliability Consequences of Delay

Should the Project be delayed, northern and central Minnesota would be exposed to severe reliability issues up to and including potential blackouts. The Project is needed to resolve numerous stability issues and overloads as legacy fossil fuel generation continues to transition to non-baseload operation or retirement. Reliability risks would be highest in the winter months when the need for electricity is highest in northern Minnesota. As the Project was evaluated and optimized by MISO as part of a broader regional portfolio, the reliability risk implications also extend beyond Minnesota.

4.10.2 Policy Consequences of Delay

The Project and the broader MISO LRTP Tranche 1 Portfolio are needed to maintain regional reliability as utilities and Minnesota add new clean energy resources and modify the way they use existing fossil-fuel plants. These additions and modifications in the 2020s and early 2030s are a key component of Minnesota utilities' Integrated Resource Plans ("IRPs"). These IRPs include significant renewable additions and the retirement and/or conversion of legacy fossil-fuel generation – including but not limited to Minnesota Power's BEC Unit 3 and 4. In Minnesota Power's 2021 IRP, it was determined that BEC Unit 3 would cease coal-fired operation by December 31, 2029 and BEC Unit 4 would cease coal-fired operation no later than 2035. A delay in the Project could result in a delay in the transition of Minnesota fossil-fuel plants like the BEC units due to reliability constraints. For example, if these units ultimately end up being targeted for retirement, MISO will not allow a unit to retire until necessary reliability upgrades are in-service. As noted in **Section 3.3.2.1**, without the Project there will be serious reliability issues associated with retirement of the BEC generation units, and thus MISO will require the units to remain online. The transition away from fossil-fuel plants, including the cessation of coal-fired operation of BEC, and their replacement with new generation enabled by the Project and MISO LRTP Tranche 1 Portfolio are a critical component for utilities to comply with Minnesota's carbon-free by 2040 standard. In addition to the risk of not meeting Minnesota policy objectives, as the Project is part of a broader portfolio, a delay increases the risk of other states meeting their policy objectives.

5.1 Summary of Route Selection Process and Guiding Factors

5.1.1 Route Development Process Summary

The Applicants used a multi-stage, interactive routing process to identify the Proposed Route[77] that focused on the use of existing high-voltage transmission line or other rights-of-way. This process was intended to identify a Proposed Route that met the objectives of the Project along with minimizing impacts to the environment in conformance with Minnesota's routing considerations. The iterative process started with development of an initial area for evaluation for the Project. This area was then refined two additional times into a Route Corridor and Preliminary Route before the Applicants finalized the Proposed Route. The presence of existing high-voltage transmission lines running the entire length of the Project provided an initial routing opportunity that was reviewed and analyzed prior to considering routes that deviated from the existing transmission line corridors. In areas where a route following the existing transmission lines encountered significant constraints, possible alternatives were developed and considered and compared to identify an alternative that complied with the Minnesota routing requirements and the Project need.

Throughout this process, and to refine each stage of route development, the Applicants sought feedback from stakeholders and the public through 20 in-person public open houses, a virtual self-guided open house, landowner mailings, in-person landowner property site visits, stakeholder specific meetings, print and social media engagement, and a Project website.

5.1.2 Routing Factors

The factors to be considered by the Commission in designating a route for a high-voltage transmission line are set forth in Minn. Stat. § 216E.03, subd. 7[78] and Minn. R. 7850.4100. These factors directed the Applicants' route development process.

Minn. Stat. § 216E.03, subd. 7(a) provides that the Commission's route permit determinations "must be guided by the state's goals to conserve resources, minimize environmental impacts, minimize human settlement and other land use conflicts, and ensure the state's electric energy security through efficient, cost-effective power supply and electric transmission infrastructure." Subdivision 7(e) of the same section requires the Commission to "make specific findings that it has considered locating a route for a high-voltage transmission line on an existing high-voltage transmission route and the use

[77] "Proposed Route" is defined in **Section 1.3**.
[78] Although Applicants have applied for a Route Permit under the alternative review provisions of Minn. Stat. § 216E.04, Minn. Stat. § 216E.04, subd. 8 provides that the considerations of Minn. Stat. § 216E.03, subd. 7 shall apply.

of parallel existing highway right-of-way and, to the extent those are not used for the route, the Commission must state the reasons."

In addition to the statutory factors noted above, Minn. Stat. § 216E.03, subd. 7(b) and Minn. R. 7850.4100 provide factors that the Commission will consider in determining whether to issue a route permit for a high-voltage transmission line. These routing factors from Minn. R. 7850.4100 are:

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; and

N. irreversible and irretrievable commitments of resources.

In 2023, the Minnesota Legislature amended Minn. Stat. § 216E.03, subd. 7(b) to also include the following considerations when designating routes:

- Evaluation of the benefits of the proposed facility with respect to (i) the protection and enhancement of environmental quality, and (ii) the reliability of state and regional energy supplies;

- Evaluation of the proposed facility's impact on socioeconomic factors; and

- Evaluation of the proposed facility's employment and economic impacts in the vicinity of the facility site and throughout Minnesota, including the quantity and quality of construction and permanent jobs and their compensation levels. The commission must consider a facility's local employment and economic impacts and may reject or place conditions on a site or route permit based on the local employment and economic impacts.

Applicants used these statutory and rule routing criteria, routing experience, engineering considerations, and stakeholder feedback to develop the Proposed Route for the Project. Applicants started with the identification of existing linear infrastructure, which offered existing rights-of-way along which a new transmission line might be co-located to minimize impacts to the natural and human environment. Applicants then identified routing opportunities and constraints in these rights-of-way through a series of public engagement activities discussed in detail in **Chapter 8**.

Routing opportunities include existing linear infrastructure or other features (e.g., roads, transmission lines, and public land survey divisions of land) along which siting a high-voltage transmission line would be most compatible. Routing opportunities also facilitate Project development by minimizing impacts to identified resources. Minn. R. 7850.4100 requires the Commission to consider the use or paralleling of existing rights-of-way (e.g., transportation corridors, pipelines, and electrical transmission lines), survey lines, natural division lines, and agricultural field boundaries, where practicable in its route permit decision.

Routing constraints may be resources or conditions that are less compatible for siting a high-voltage transmission line. Examples of constraints include natural resources such as lakes; existing land uses such as residences, and schools; federal, state, and locally designated environmental protection areas; critical habitats or sensitive natural resource areas; cultural resources such as national landmarks and archaeological sites; and public infrastructure such as airports and aeronautical and commercial telecom structures. The routing process aims to avoid and/or minimize constraints where practicable. For the Project, the Applicants identified existing transmission line corridors and evaluated those corridors based on constraints.

Technical and reliability considerations also affect the routing process. These include specific engineering requirements, standards, and objectives associated with the design and construction of the Project. For example, there are circumstances where technical and maintenance objectives make certain line co-locations unworkable. Other engineering objectives may include spacing for line entrances into substations, minimizing the overall line length, ensuring adequate access for construction and inspections, minimizing the number of angles, minimizing the number of "special" structures, and considering the use of longer than average spans between structures.

Applicants developed a list of potential routing opportunities, constraints, and technical guidelines for the Project (**Table 5-1**, **Table 5-2**, **Table 5-3**). It is important to note that not all of the items in **Table 5-1** to **Table 5-3** are applicable to the Proposed Route but are provided here to illustrate the wide range of issues considered by the Applicants in developing the Proposed Route.

The items listed in **Table 5-1** to **Table 5-3** were identified through:

1. State statute and rule routing factors;
2. Technical expertise of engineers and planning staff responsible for the reliable and economic construction, operation, and maintenance of the Project, and other electric system facilities;
3. NERC reliability standards; and
4. Industry best practices.

Table 5-1. Routing Opportunities

Opportunities
Existing Transmission Lines
Roadways/Trails
Railroads
Public Land Survey System (e.g., section lines, half section lines, etc.)
Property Lines (legal divisions of land)
Natural Division Lines; Field Boundaries
Pipelines

Table 5-2. Routing Constraints

Constraints
Federal/State/County Resources
National Wildlife (and Fisheries) Refuges
State Natural Resource Areas
State or National Parks (Minn. R. 7850.4300)
State and National Historic Sites and Landmarks
National Historic Districts
State or National Wilderness Areas (Minn. R. 7850.4300)
National Monuments
Federal/State/County Resources
State Scientific and Natural Areas (Minn. R. 7850.4300)

Constraints
State Wild, Scenic, and Recreational Rivers
County or City Parks
Nature Preserves
Prairie Restoration Areas
National and State Forests
Wild and Scenic Rivers
State Wildlife Refuges/Birding Areas/Management Areas
Military Lands and Operations
Resource Easement Lands
Non-Government Organization (NGO) Lands
Conservation Areas (The Nature Conservancy, Sierra Club)
Important Bird Areas (The Audubon Society)
NGO Resource Easement Lands
Special Status Species/Habitat
Designated Critical Habitat
Bald Eagle Wintering/Breeding Habitat
Threatened, Endangered & Protected Species
Cultural Resources
Historic and Cultural Resources
National Register of Historic Places (Listed or Eligible Sites)
Historic Landscapes/Trails/Markers
National Natural Landmarks
Burial Areas (Prehistoric, Historic)
Cemeteries
Special Jurisdictions
Tribal Nation Reservations
Tribal Nation Owned Lands
Visual Resources
Scenic Highways or Corridors
Scenic Overlooks
Geological Markers
Public Infrastructure
Airports
Very High Frequency Omni-Directional Range (Aeronautic Navigation Equipment-Clear Zone)
Doppler Radar Systems
Residences (consider Environmental Justice)

Constraints
Land Use
Planned Development (City/County Plans)
Daycares/Schools/Hospitals
Religious Facilities
Safety Regulations (gas stations, electrically sensitive areas, etc.)
Orchards
Forest
Aggregate Mine/Quarries
Trails (local, snowmobile, bike, horse)
Recreation Areas (Parks, Golf Courses, Off Highway Vehicle Trails)
Contaminated Areas (Superfund, Brownfields, etc.)
Natural Resources/Geomorphology
Flood Control Areas (Floodplain)
Lakes/Ponds/Reservoirs
Rivers/Streams (Impaired/Public Waters Inventory)
Trout Streams
Wetlands/Peatlands/Calcareous Fens
Native Prairie
Wooded Areas/Lands
Significant Geomorphology or Geologically Unstable Areas

Table 5-3. Technical Guidelines

Technical Guidelines
Terrain/Soil Conditions
Project Length
Number of Angle Structures
Size and Type of Foundation
Construction and Maintenance Access
Existing Transmission and Rights-of-Way
Crossing of Other Linear Features (e.g., transmission lines, rivers, pipelines)
Proximity to Airports and Associated Restrictions
Tree-trimming/Vegetation Management

5.2 Route Development Process

The endpoints of the Project are currently connected by existing 115 kV and 230 kV transmission lines (opportunities). In light of the Minnesota statutory considerations and the Commission's preference for following existing transmission line rights-of-way and other linear infrastructure, initial routing was focused on following existing transmission lines, to the extent practicable. As explained below, while more than 85 percent of the

Proposed Route follows existing high-voltage transmission line rights-of-way, the Applicants identified limited areas where constraints along the existing transmission lines prompted the Applicants to review areas not located along existing transmission line rights-of-way to develop the final Proposed Route.

5.2.1 Project Study Area

The Applicants identified an initial area that would help guide the corridor and route development processes. This area was initially developed based on the defined Project endpoints which include:

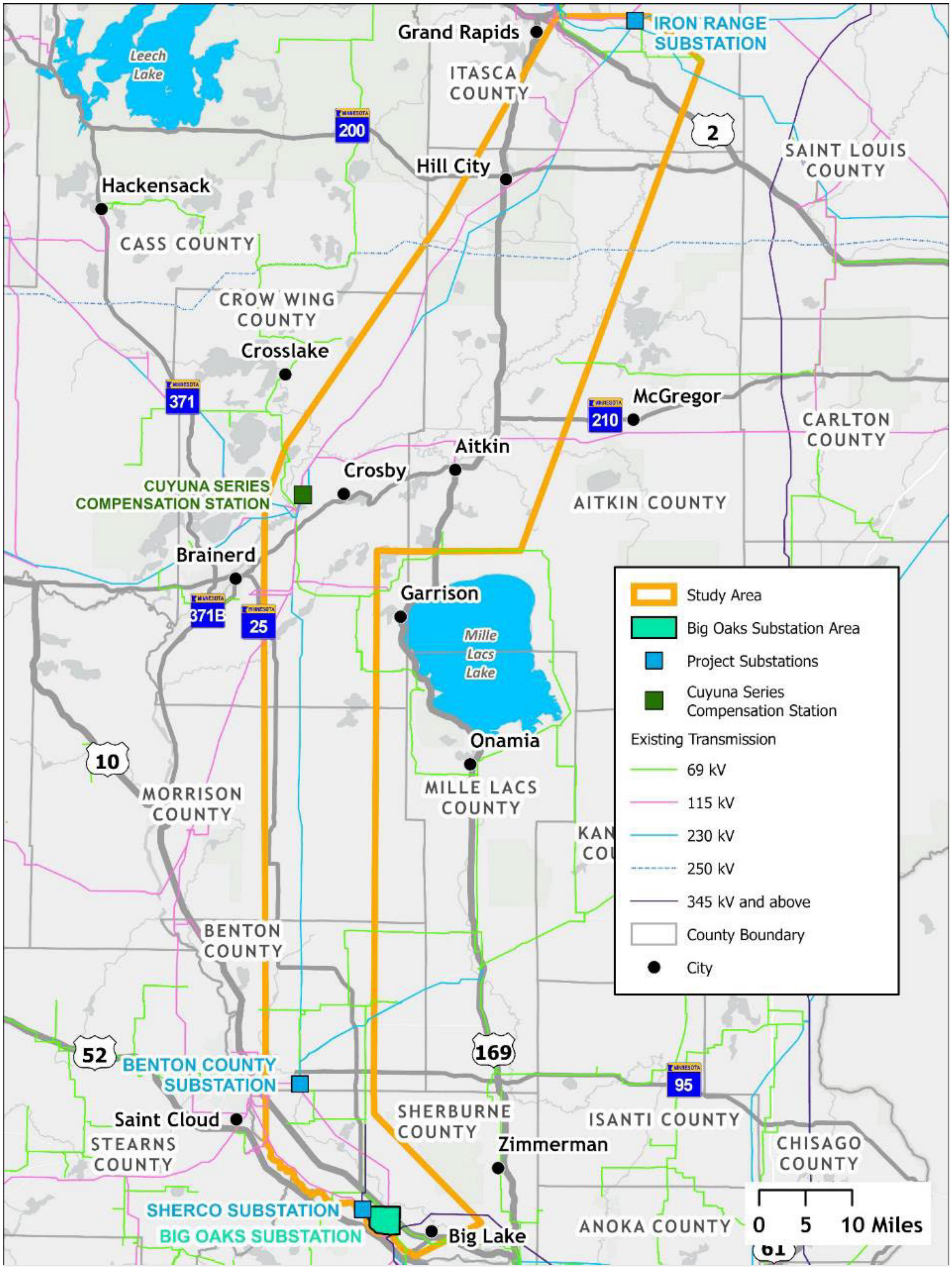
- Existing Iron Range Substation;
- New substation in the Riverton/Cuyuna area (referred to in this Application as the Cuyuna Series Compensation Station);
- Existing Benton County Substation;
- Existing Sherco Substation; and
- New Big Oaks Substation (the "Big Oaks Substation Study Area").[79]

The Study Area generally follows existing 115 kV and 230 kV transmission lines that run from the Iron Range Substation south to the area around the existing Riverton Substation, then south from the Riverton area to the Benton County Substation, and then on to the new Big Oaks Substation. From the Iron Range Substation to the proposed Cuyuna Series Compensation Station area, the Study Area ranges from 6 to 27 miles wide to encompass a variety of routing opportunities such as existing roads and other transmission line rights-of-way. Between the Cuyuna Series Compensation Station area and the Benton County Substation, the Study Area was narrowed, ranging from 6 to 10 miles wide, while providing an area wide enough to identify routing opportunities where the Project transmission line could not be located along existing rights-of-way for various reasons. Between the Benton County Substation and the new Big Oaks Substation and Sherco Substation locations, the Study Area was developed to be large enough to encompass the existing transmission lines that would be replaced by the Project.

Within the Study Area, major physiographic features, jurisdictional boundaries, sensitive land uses, public land ownership, and existing utility corridors were identified to help refine the Study Area boundaries and define the location and limits of reasonable and/or feasible transmission line corridors to be considered for the Project (discussed in the following paragraph). The Study Area is shown in **Map 5-1**.

[79] The Big Oaks Substation will be owned by Xcel Energy and is being permitting as part of a separate project. Additional information on this substation can be found in Chapter 2.

Map 5-1. Project Study Area

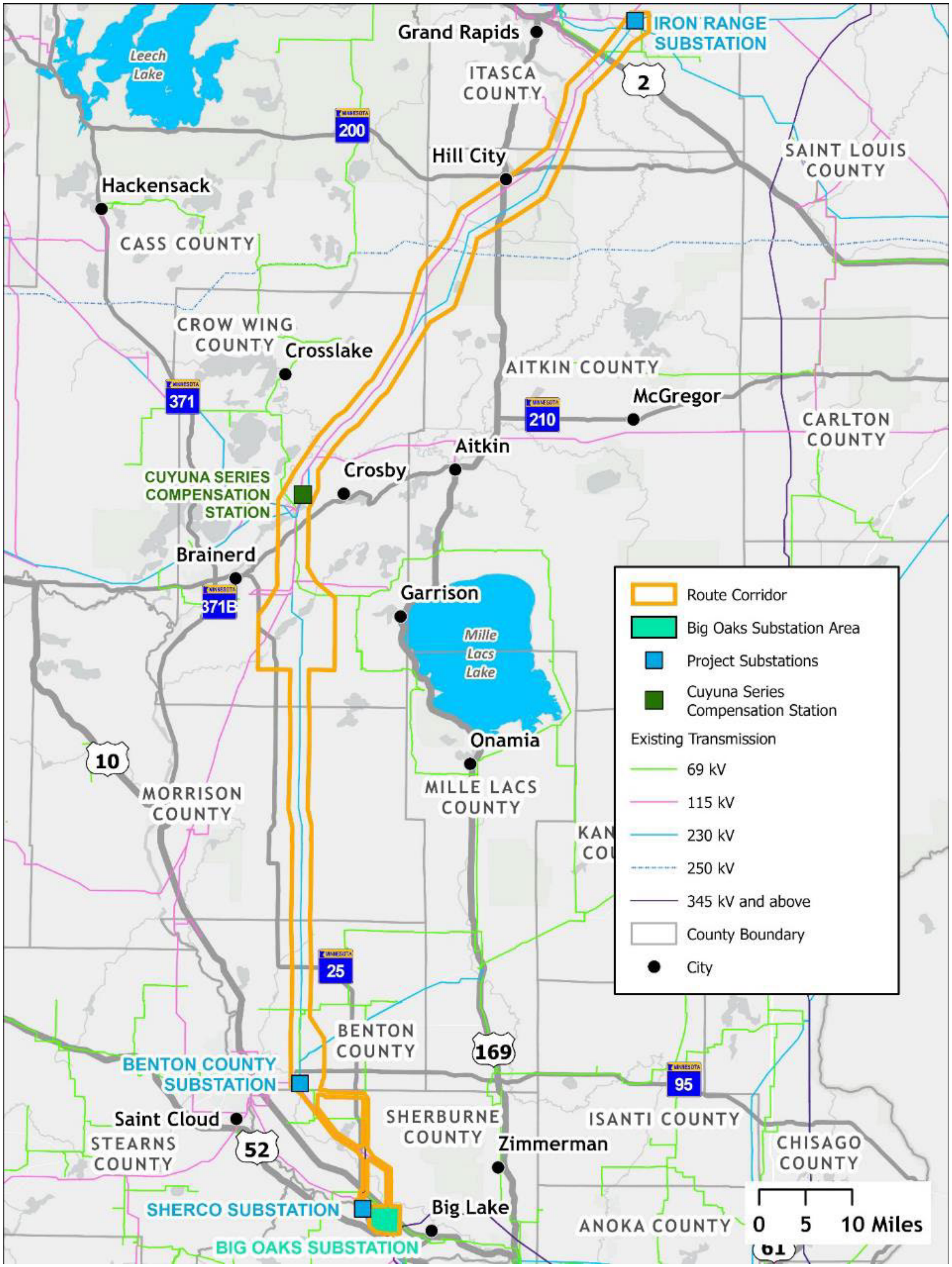


The Study Area was developed to encompass potential and feasible route alternatives that follow existing linear features, avoid constraints, and minimize impacts to known resources. In subsequent routing process steps, constraint areas were reviewed and removed from further study as route alternatives were developed. The Study Area was shared with stakeholders at stakeholder workshops in October 2022 to learn more about opportunities and constraints to transmission line development within the Study Area.

5.2.2 Study Area Refinement

This Study Area was further refined after the October 2022 workshops and more defined routing areas were presented to the public at open house meetings in January and February 2023 and to individual agencies, Tribal Nations, and local units of government during the winter of 2023. These various meetings provided additional information to the public about the Project and allowed the Applicants to solicit and gather additional public and stakeholder feedback before the Applicants established a more defined route in the winter of 2023 ("Route Corridor"). The Route Corridor is shown in **Map 5-2**.

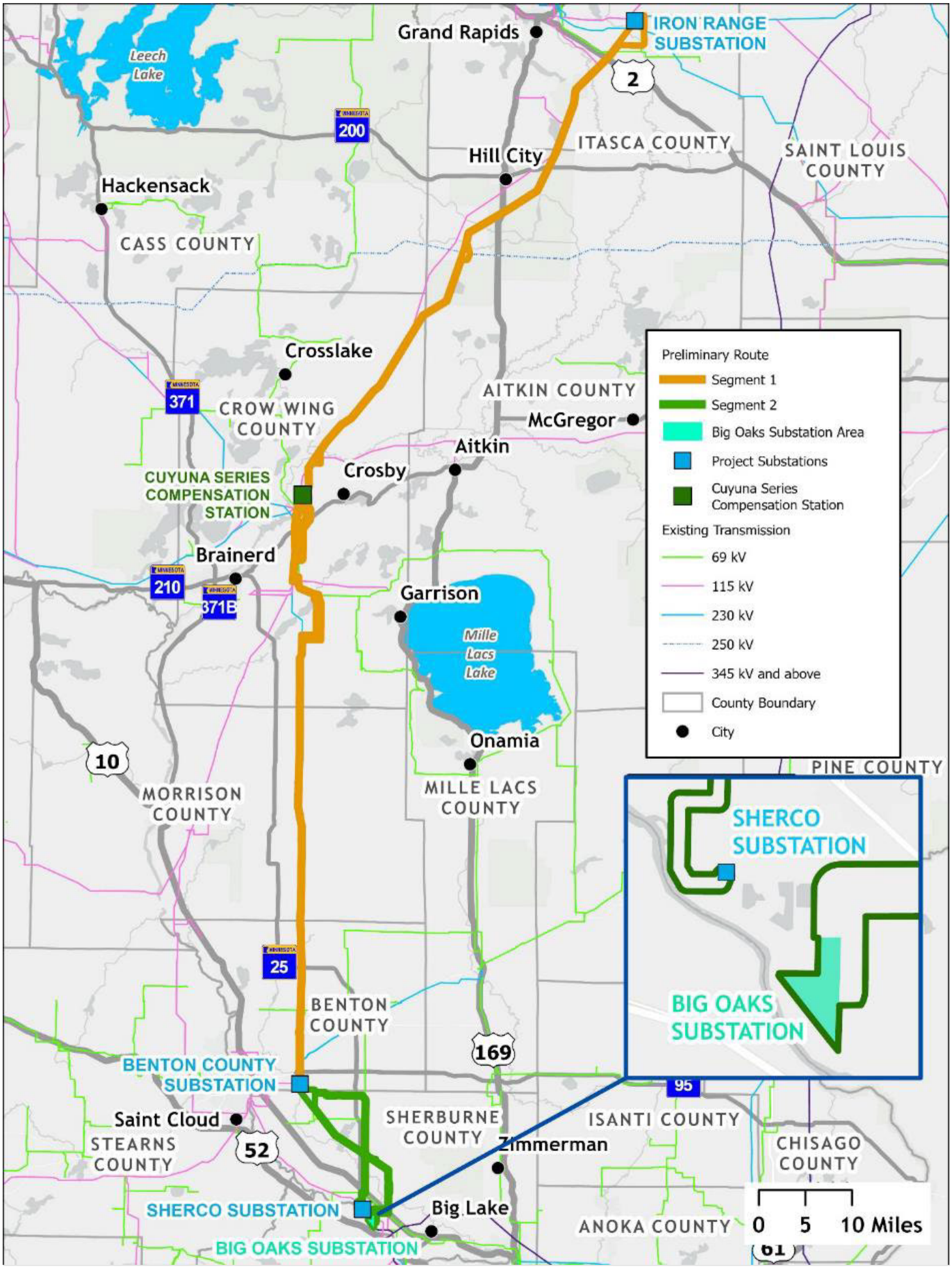
Map 5-2. Route Corridor



The Route Corridor generally followed existing high-voltage transmission lines or other rights-of-way between the identified endpoints, but included additional route width in areas where the Applicants had identified potential constraints as they worked to narrow the Study Area. Applicants gathered additional information through public open houses, meetings with agencies and Tribal Nations, and stakeholder outreach in January and February 2023. These various engagement opportunities provided more information to the Applicants about the Route Corridor, at which time the Applicants narrowed the Route Corridor into a more defined route in May 2023 (the "Preliminary Route"). Additional information on public and other stakeholder comments is provided in **Chapter 8**.

The more defined Preliminary Route was developed as two segments (Segment 1 and Segment 2). Segment 1 of the Preliminary Route extended from the existing Iron Range Substation to the proposed Cuyuna Series Compensation Station area before continuing south to the existing Benton County Substation. Segment 1 of the Preliminary Route continued to follow existing transmission line rights-of-way to the extent practicable. Segment 2 of the Preliminary Route extended from the existing Benton County Substation (1) to the Sherco Substation and (2) to the future Big Oaks Substation area. Segment 2 of the Preliminary Route primarily followed the centerline of the existing high-voltage transmission lines between these substations. The Preliminary Route is shown in **Map 5-3**.

Map 5-3. Preliminary Route



The Preliminary Route was then presented to the public and various stakeholders and agencies during public open houses and agency meetings in early May 2023. Following the May 2023 open houses, the Applicants refined the Preliminary Route into the Proposed Route. The Proposed Route is considered in this Route Permit Application. The Applicants undertook several refinements and finalized the Proposed Route for the Project. These refinements included:

- The Preliminary Route was narrowed to the Proposed Route around the Iron Range Substation to more directly follow a Proposed Centerline anticipated by the Applicants. Areas directly to the east of the existing substation were added for the expansion of the substation and for the reconfiguration of existing transmission lines entering and exiting the existing substation.

- A small area (58 acres) on the east side of the Preliminary Route in Sections 5 and 8 of Irondale Township was added to the Proposed Route at the proposed Cuyuna Series Compensation Station area to provide flexibility for locating the new series compensation station.

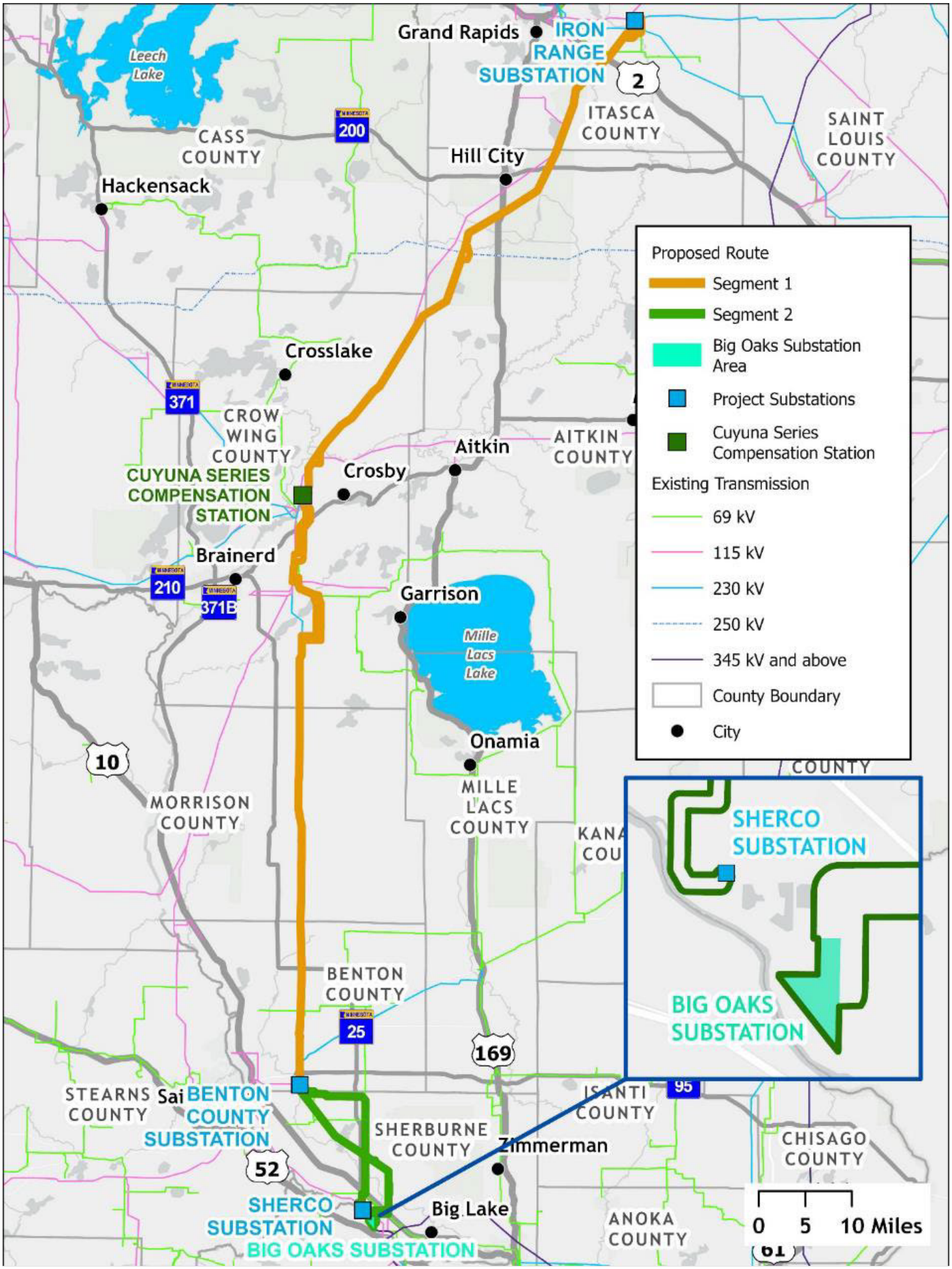
- The Preliminary Route that followed the existing Minnesota Power 92 Line and Great River Energy's MR Line south of the proposed Cuyuna Series Compensation Station was removed because of the proximity to numerous residences just north of Little Rabbit Lake, the likelihood that the Proposed Route would directly impact the Cuyuna State Recreation Area, and the need for significant reconfiguration of several existing transmission lines near the existing Riverton Substation and the Mississippi River(see **Section 5.3.5**).

- A small area (32 acres) in Section 7 of Nokay Lake Township was expanded to provide additional flexibility to minimize impacts to residences and coordinate with landowners.

- The Preliminary Route included a larger area south of the Benton County Substation in Sections 6 and 12 of Haven Township and Sections 1 and 7 of Palmer Township to provide flexibility to minimize potential impacts to the St. Cloud Airport approach zones. This area was removed from the Proposed Route and the Preliminary Route narrowed because flexibility is no longer needed to address potential impacts to the approach zones.

The Proposed Route is shown in **Map 5-4.**

Map 5-4. Proposed Route



During the refinement process from the fall of 2022 through the development of the Proposed Route, the Applicants employed several criteria around constraints and opportunities. In locations where routing constraints were present, route segments were identified and located to avoid or minimize effects to those constraints. Priority was placed on following existing linear features and property lines and maximizing distance from residences. Where route segments intersected, a node was established which creates additional route segments.

To minimize impacts to people and residences, Applicants identified residences and non-residential structures (e.g., barns, garages, sheds, businesses, etc.) within the Study Area that were located along the existing linear features, particularly the existing high-voltage transmission lines between the key Project endpoints.

Residences and non-residential structures were initially identified through GIS raster data, parcel data, aerial image interpretation, and public comments. After the identification process was completed, Applicants calculated the distance to residences and non-residential structures.

Using this information, Applicants prioritized contiguous route segments that maximized the distance from residences and non-residential structures, as well as following existing infrastructure, while seeking to minimize the length, number of turns requiring angle structures, and number of crossings of existing transmission lines. The Applicants also prioritized routing the Project along property lines or field lines, which helps minimize impacts on existing land uses. See **Section 5.3** for a description of route segments considered but rejected ("Rejected Route Alternatives") by the Applicants.

5.2.3 Description of the Proposed Route

The Proposed Route is located in the following physical locations in Minnesota as shown in **Table 5-4**.

Table 5-4. Proposed Route Physical Description

Segment Number	County	Section	Township	Range
1	Itasca	6,7	53N	24W
1	Itasca	12	53N	24W
1	Itasca	13, 23, 24, 25, 26	53N	25W
1	Itasca	1, 2, 10, 11, 15, 16, 20, 21, 29, 30, 31	54N	24W
1	Itasca	19,20, 29, 30, 31, 32	55N	23W
1	Itasca	25, 36	55N	24W

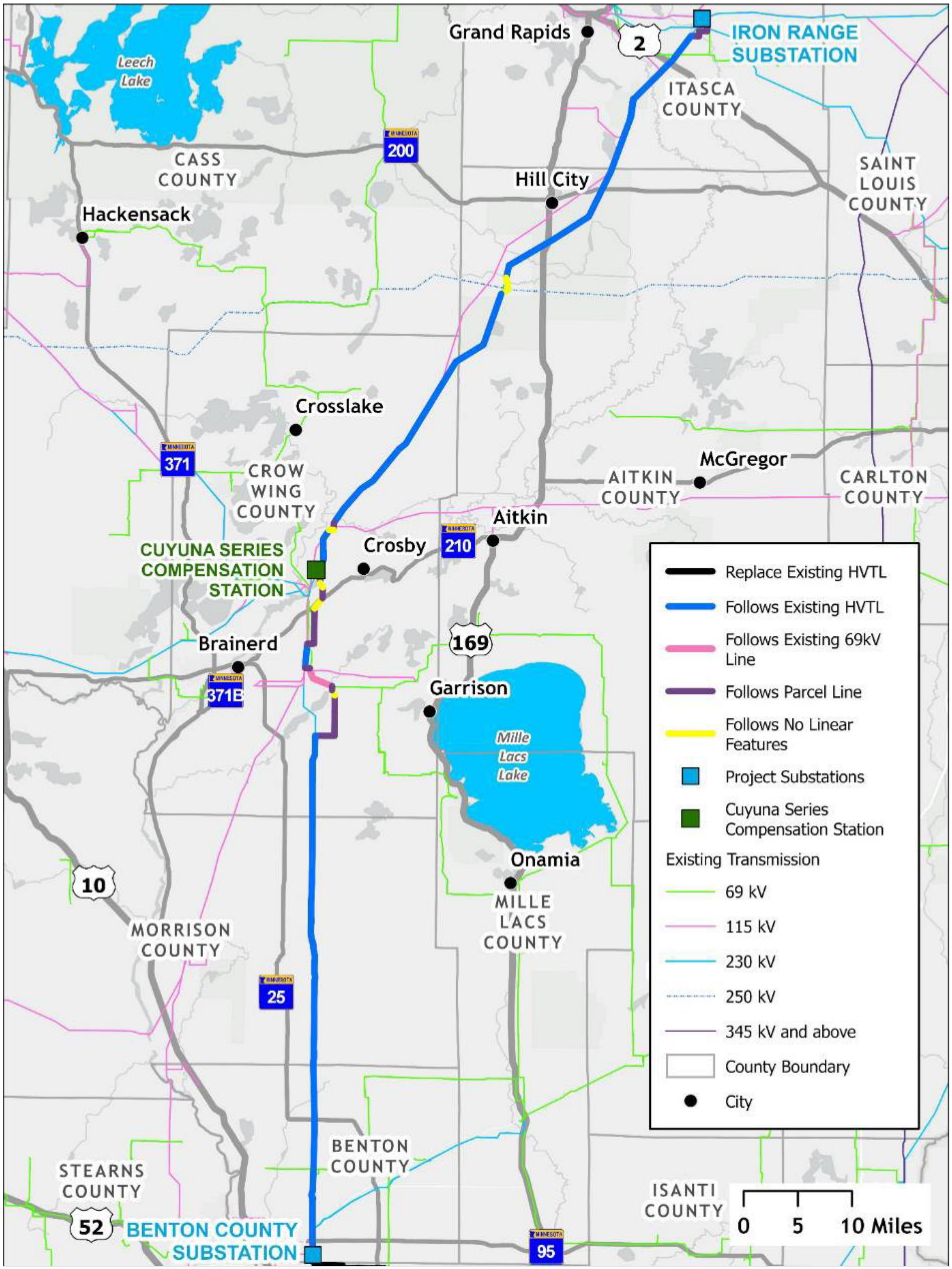
Segment Number	County	Section	Township	Range
1	Aitkin	6	50N	26W
1	Aitkin	1, 12, 13, 14, 23, 24, 26, 27, 33, 34	50N	27W
1	Aitkin	6	51N	25W
1	Aitkin	1, 2, 9, 10, 11, 16, 17, 18, 19, 20, 30 31, 32	51N	26W
1	Aitkin	36	51N	27W
1	Aitkin	2, 3, 10, 15, 16, 21, 22, 28, 29, 31, 32	52N	25W
1	Aitkin	36	52N	26W
1	Crow Wing	2, 3, 9, 10, 11, 15, 16, 17, 19, 20, 21, 29, 30, 31	136N	26W
1	Crow Wing	3, 4, 9, 10, 16, 17, 20, 29, 30, 31	137N	25W
1	Crow Wing	36	137N	26W
1	Crow Wing	13, 23, 24, 26, 34, 35	138N	25W
1	Crow Wing	6, 7, 18, 19, 30, 31	43N	29W
1	Crow Wing	4, 5, 9, 16, 21, 28, 29, 30, 31	44N	29W
1	Crow Wing	6, 7, 18, 19, 30, 31, 32, 33	45N	29W
1	Crow Wing	12, 13, 24, 25	45N	30W
1	Crow Wing	5, 6, 7, 8, 17, 18, 19, 20, 28, 30, 31	46N	29W
1	Crow Wing	16, 17, 20, 21, 29, 32	47N	29W
1	Morrison	2, 11, 14, 23, 26, 35	39N	30W
1	Morrison	11, 14, 23, 26, 35	40N	30W
1	Morrison	6, 7, 18, 19, 30, 31	41N	29W
1	Morrison	6, 7, 18, 19, 30, 31	42N	29W

Segment Number	County	Section	Township	Range
1	Benton	2, 11, 14, 23, 26, 35,36	36N	30W
1	Benton	2, 11, 14, 23, 26, 35	37N	30W
1	Benton	2, 11, 14, 23, 26, 35	38N	30W
2	Sherburne	1, 2, 12	35N	30W
2	Sherburne	1, 2, 3, 4, 5, 6, 7, 12, 13, 18, 19, 20, 24, 25, 28, 29, 33, 34, 35, 36	35M	29W
2	Sherburne	1, 2, 12, 13, 24, 25, 36	34N	29W
2	Sherburne	7, 8, 16, 17, 20, 21, 28, 29, 32, 33	34N	28W
2	Sherburne	1, 2	33N	29W
2	Sherburne	4, 5, 6, 7, 8, 9, 18	33N	28W

5.2.3.1 Segment 1

Segment 1 of the Proposed Route generally follows existing 230 kV transmission lines (Minnesota Power's 92 Line and Great River Energy's MR Line) from the Iron Range Substation to the Benton County Substation. There are several areas where the Proposed Route deviates from the existing line rights-of-way and/or is wider to allow for flexibility in developing a route centerline. Where the Proposed Route follows existing high-voltage transmission lines, the Applicants proposed a route width of 1,000 to 1,120 feet to allow for routing of the Project on either side of the existing transmission lines. Where the Proposed Route is not following existing transmission lines (greenfield route), the Applicants propose a route width of 3,000 feet to allow for flexibility to minimize impacts to resources and coordinate with landowners. There are several exceptions to these widths and deviations from the existing high-voltage transmission line rights-of-way that are explained below. Segment 1 is shown in **Map 5-5**.

Map 5-5. Segment 1 Proposed Route



5.2.3.1.1 Iron Range Substation to Cuyuna Series Compensation Station

Exiting the Iron Range Substation in Sections 19 and 20 of Little Sand Lake Township, the Proposed Route follows section and property lines running in a south and west orientation located east of Minnesota Power's existing 92 Line. Directly south of the substation the Proposed Route is one mile wide to allow for flexibility in entering and exiting the substation and reconfigure the existing transmission lines south of the substation. It then narrows to 3,000 feet wide, which allows for flexibility in siting a right-of-way that minimizes impacts to residences and non-residential structures, specifically along the 92 Line near County Roads 10 and 434 and the Swan River. The Proposed Route joins the 92 Line approximately three miles southwest of the Iron Range Substation (**Appendix J, Detailed Mapbook, Pages 1-2**).

The Proposed Route then follows Minnesota Power's 92 Line and 115 kV 11 Line southwest for approximately 28 miles to south of Swatara, Minnesota in Section 30 of Macville Township in Aitkin County. The Proposed Route is 1,000 feet wide when following only the 92 Line. When following both the existing 92 Line and 11 Line, the Proposed Route is up to 1,120 feet wide to encompass both sides of the existing lines. (**Appendix J, Detailed Mapbook, Pages 2-12**).

Where the Proposed Route crosses Minnesota Power's existing ±250 kV HVDC line in Section 31 of Macville Township in Aitkin County, the Proposed Route expands 4,100 feet to the east, resulting in an overall route width of up to 4,400 feet. An Enbridge pumping station and associated 230 kV tap line owned by Great River Energy are located east of the 92 Line and the Proposed Route would need to cross over both the HVDC line and the 230 kV tap line. The Applicants are requesting a wider route width in this area to provide flexibility to cross the HVDC line at mid-span and possibly avoid the 230 kV tap line and pump station, thus minimizing structure height and to avoid the existing infrastructure in the area. (**Appendix J, Detailed Mapbook, Pages 12-13**).

South of the HVDC line, the Applicants are requesting a 1,000-foot route width centered on the existing 92 Line and extending southwest for approximately 10 miles. The 115 kV 11 Line then rejoins the 92 Line in a shared corridor, and the Proposed Route continues to follow both transmission lines for approximately 16.4 miles (Sections 26, 34-35 of Little Pine Township; Sections 3, 9-10, 16-17, 20, 29-31 of Ross Lake Township; Section 36 of Fairfield Township; and Sections 2, 9-11, 15-17, 19, 29-31 of Perry Lake Township); along this portion, Applicants request a route width of 1,120 feet. (**Appendix J, Detailed Mapbook, Pages 13-22**).

South of the Mississippi River near River Road and Cole Lake Way northwest of Crosby in Wolford Township, Minnesota Power's 13 Line joins the 11 Line and 92 Line in Section 21 of Wolford Township in Crow Wing County from the east in a shared corridor. In this area, Applicants are requesting a route width of one mile on the east side of the existing 92 Line and 11 Lines to provide flexibility to avoid impacts to existing residences and minimize engineering challenges as the 13 Line joins the other two lines. (**Appendix J, Detailed Mapbook, Pages 22-23**).

The Proposed Route rejoins the existing Minnesota Power 11 Line, 13 Line, and 92 Line and continues south for approximately 3.5 miles to Section 7 of Irondale Township in Crow Wing County where the proposed Cuyuna Series Compensation Station will be located. To allow for the siting of the new Cuyuna Series Compensation Station and flexibility in routing into and out of the new station, the Applicants request a route width of 1.25 miles in this area. (**Appendix J, Detailed Mapbook, Pages 24-25**).

5.2.3.1.2 Cuyuna Series Compensation Station to Benton County Substation

The Proposed Route then extends south from the Cuyuna Series Compensation Station and continues southeast for 0.25 miles deviating from Minnesota Power's existing 92 Line. The Proposed Route then turns south along a section line in Sections 7 and 8 of Irondale Township for one mile before turning southeast again in Sections 17 and 18 of Irondale Township for 0.45 miles, then south in Section 17 of Irondale Township along a quarter-section line for one mile before turning southwest in Section 20 of Irondale Township for 1.25 miles, and then south in Section 30 of Irondale Township along a half-section line for 3.25 miles before turning west for 0.7 miles. The Proposed Route then turns and continues south following the existing Great River Energy 230 kV MR Line in Section 30 in Nokay Lake Township. The Applicants request a route width of approximately 3,000 feet for this portion of the Proposed Route. (**Appendix J, Detailed Mapbook, Pages 25-27**).

The Proposed Route then turns south following Great River Energy's MR Line for 2.25 miles to Section 25 of Oak Lawn Township in Crow Wing County where it turns east for approximately 0.5 miles before turning south to follow Great River Energy's 69 kV RW Line. The Proposed Route follows the RW Line generally southeast for approximately three miles before turning south following property and half-section lines for 4.65 miles. At Section 28 in Maple Grove Township, the Proposed Route turns back west for 1.8 miles to rejoin the right-of-way of Great River Energy's MR Line. Along this greenfield portion of the Proposed Route, Applicants are requesting a route width of 3,000 feet. (**Appendix J, Detailed Mapbook, Pages 27-31**).

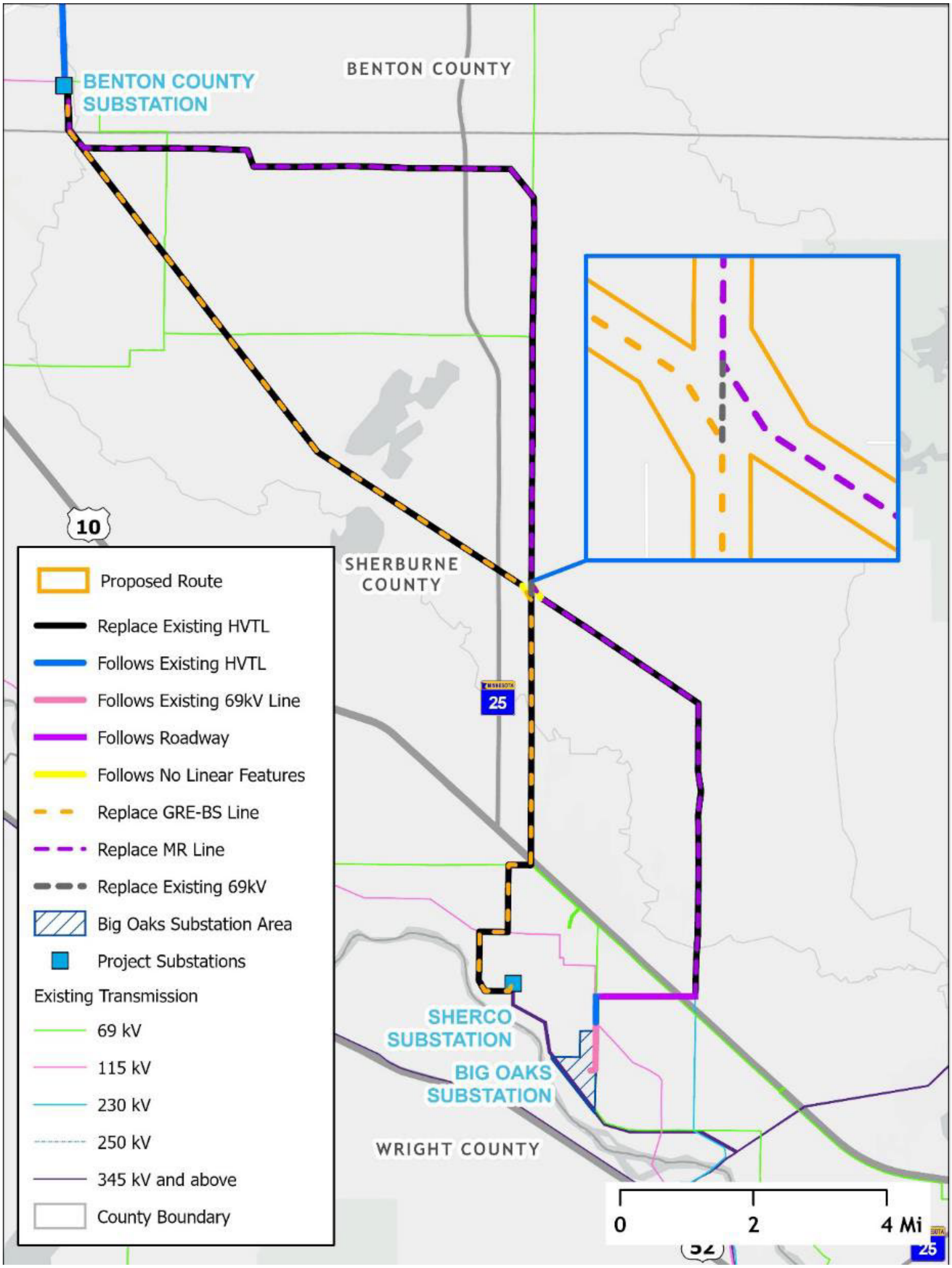
The Proposed Route then turns south and follows the MR Line for approximately 42 miles to Golden Spike Road in Section 2 of Minden Township in Benton County. Here, Applicants request that the typical route width of 1,000 feet be expanded to the east by 400 feet (total of 1,400 feet) to allow for routing a right-of-way that minimizes impacts to residences located along existing lines (Great River Energy's MR Line and BP Line), Elk River, and a crossing of Golden Spike Road. (**Appendix J, Detailed Mapbook, Pages 31-48**).

The Proposed Route continues to the south along the existing MR Line and BP Line for approximately five miles to the Benton County Substation in Section 35 of Minden Township; along this portion of the Proposed Route and prior to reaching the Benton County Substation, Applicants request a 1,000-foot route width. At the Benton County Substation, Applicants request a route width ranging from 3,500 feet to 5,670 feet to allow for flexibility in entering and exiting the substation. (**Appendix J, Detailed Mapbook, Pages 49-50**).

5.2.3.2 Segment 2

The Proposed Route continues south and east from the Benton County Substation to the existing Sherco Substation and the new Big Oaks Substation and will replace Great River Energy's GRE-BS Line and MR Line with new double-circuit capable 345 kV structures. For the majority of this segment the line will utilize the existing rights-of-way except as explained below. Segment 2 is shown in **Map 5-6**.

Map 5-6. Segment 2 Proposed Route



5.2.3.2.1 Benton County Substation to Big Oaks Substation

The Proposed Route will follow Great River Energy's existing GRE-BS Line from the Benton County Substation south for 1 mile, east for 6.65 miles, south for 5.7 miles, then follow Great River Energy's MR Line southeast for 3.1 miles, south for 4 miles (see **Map 5-6**). Where the MR Line intersects 137th Street SE, in Big Lake Township, the Proposed Route leaves the existing MR Line right-of-way and turns west for 1.5 miles, then turns south following 140th Avenue SE and Xcel Energy's 115 kV and 69 kV transmission lines for approximately one mile to Xcel Energy's new Big Oaks Substation.[80] The Proposed Route is 1,000 feet wide and it is expected that the new line will use the existing right-of-way for the entire length except for 2.5 miles near the Big Oaks Substation. (**Appendix J, Detailed Mapbook, Pages 51-59**).

5.2.3.2.2 Benton County Substation to Sherco Substation

The Proposed Route will follow Great River Energy's existing MR Line from the Benton County Substation south for one mile, southeast for 9.5 miles, before following Great River Energy's GRE-BS Line generally south for 7.15 miles to Xcel Energy's Sherco Substation in Becker, Minnesota (see **Map 5-6**). The Proposed Route is 1,000 feet wide and it is expected that the new line will primarily use the existing right-of-way for the entire length.[81] (**Appendix J, Detailed Mapbook, Pages 51 and 60-64**).

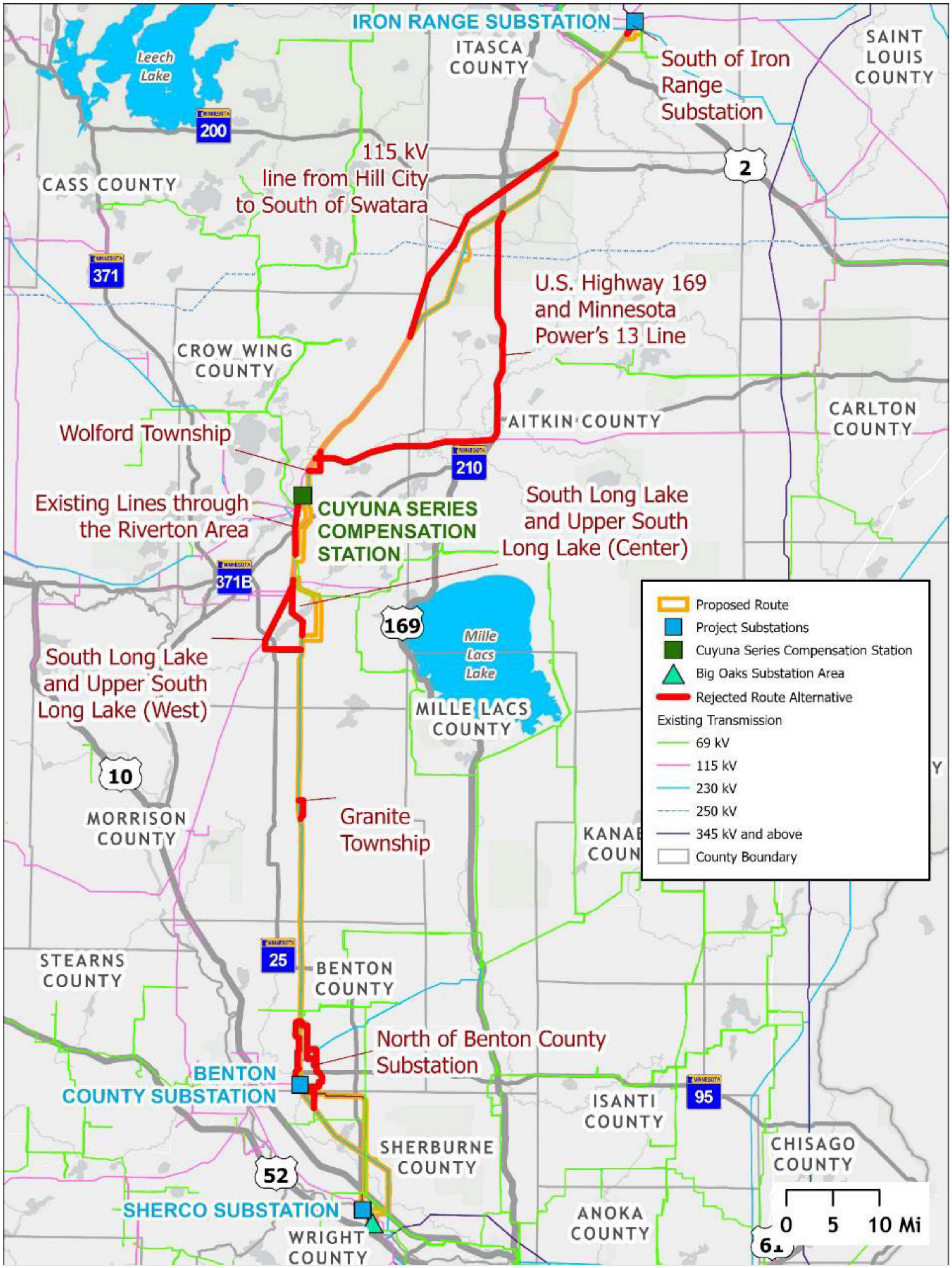
5.3 Alternatives Considered but Rejected

Under Minn. R. 7850.3100, the Applicants must identify rejected route alternatives in the Application with an explanation of the reasons for rejecting them. Over the course of initial routing analysis, public workshops and open houses, agency meetings, and stakeholder outreach from October 2022 through May 2023, various route alternatives were suggested and considered before the Proposed Route was finalized. Rejected Route Alternatives are discussed below and shown in **Map 5-7**.

[80] Once additional detail is known regarding the proposed Big Oaks Substation and the specific route for the Alexandria to Big Oaks Project, Great River Energy will develop plans for the remainder of the existing MR Line, which is not proposed for replacement in this Application.

[81] Some reconfigurations near the Sherco Substation may be necessary to accommodate transmission line needs.

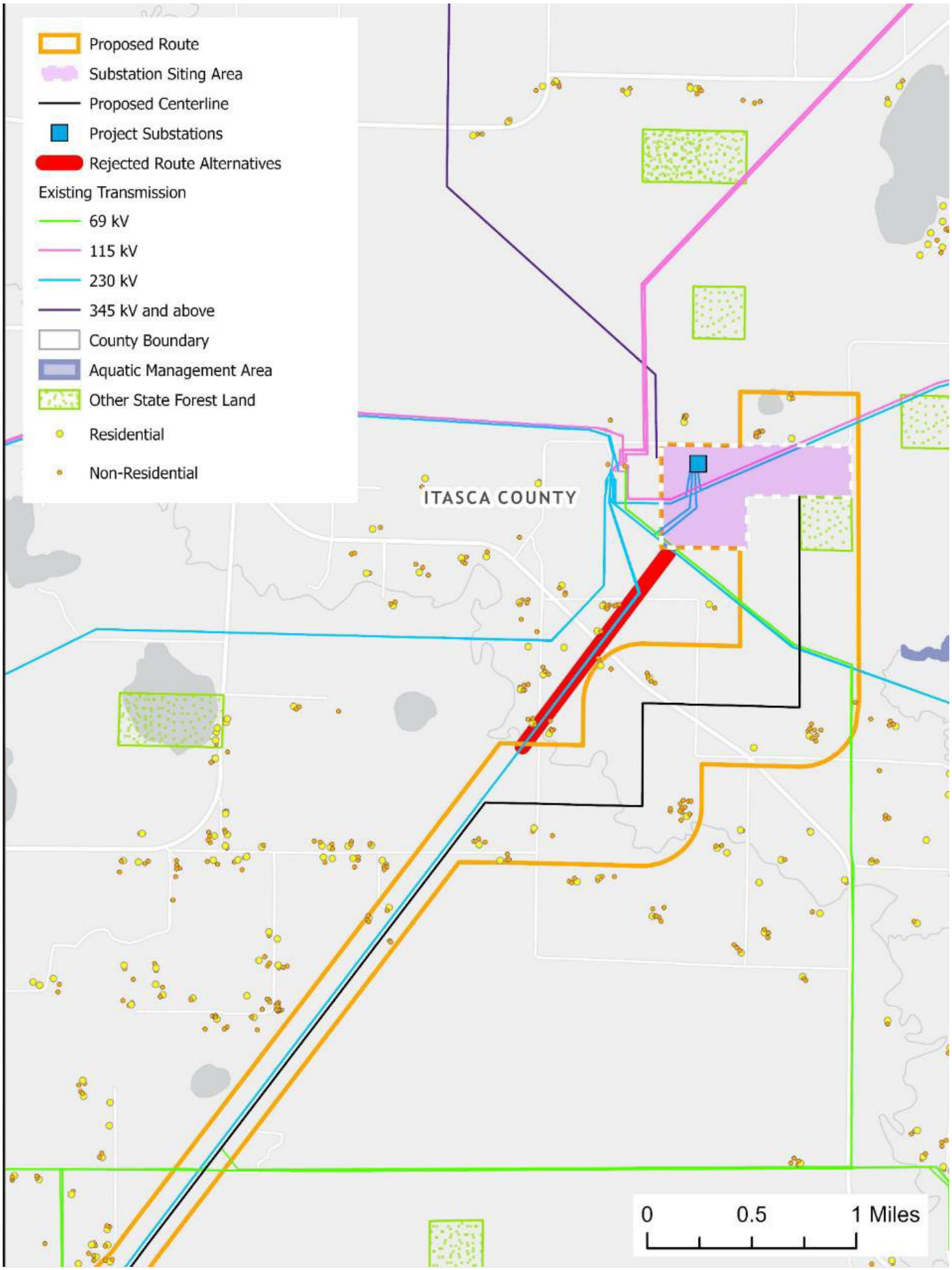
Map 5-7. Proposed Route – Rejected Route Alternatives



5.3.1 South of Iron Range Substation

From the Iron Range Substation, a route was considered that followed Minnesota Power's existing 92 Line southwest for approximately two miles (Section 30 of Little Sand Township and Section 36 of Trout Lake Township in Itasca County). This Route Alternative was rejected because two residences and non-residential structures are located directly adjacent to the existing 92 Line right-of-way at County Road 6 and two residences and non-residential structures are located directly adjacent to the existing 92 Line right-of-way at the Swan River. Also, additional wetland and stream impacts were possible along the Swan River because of an oxbow along the river at the existing 92 Line crossing. The Proposed Route better accommodates the line configuration into the substation expansion and avoids impacts to residences and structures. This Rejected Route Alternative is located in Section 30 of Little Sand Township and Section 36 of Trout Lake Township and shown in **Map 5-8**.

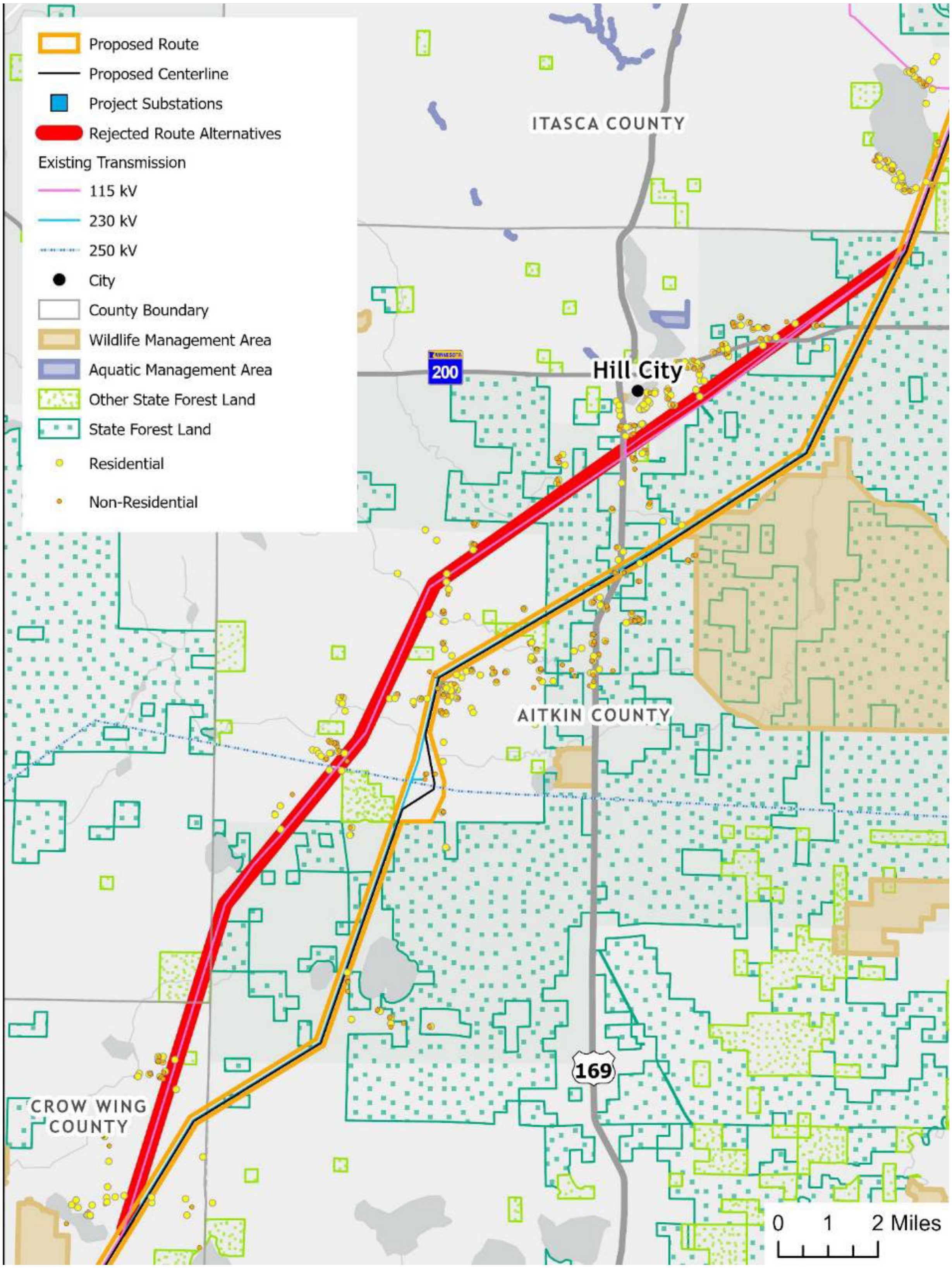
Map 5-8. Rejected Route Alternative – South of Iron Range Substation



5.3.2 115 kV line from Hill City to South of Swatara

The Applicants considered a Rejected Route Alternative that follows Minnesota Power's existing 11 Line from where it deviates from the 92 Line in Section 2 of Northwest Aitkin Township, 0.4 miles south of the Itasca/Aitkin County Line, for approximately 26 miles before it rejoins the 92 Line corridor, in Section 26 of Little Pine Township. The 11 Line generally parallels the 92 Line but is located one to two miles to the north. This Rejected Route Alternative was rejected because it is located 0.3 miles north of the Hill City-Quadna Mountain Airport, close enough in proximity to adversely impact airport operations. In addition, there are more residences within 1,000 feet of the 11 Line than the 92 Line and it is adjacent to a rural subdivision centered around McKinney Lake. This Rejected Route Alternative is shown in **Map** 5-9.

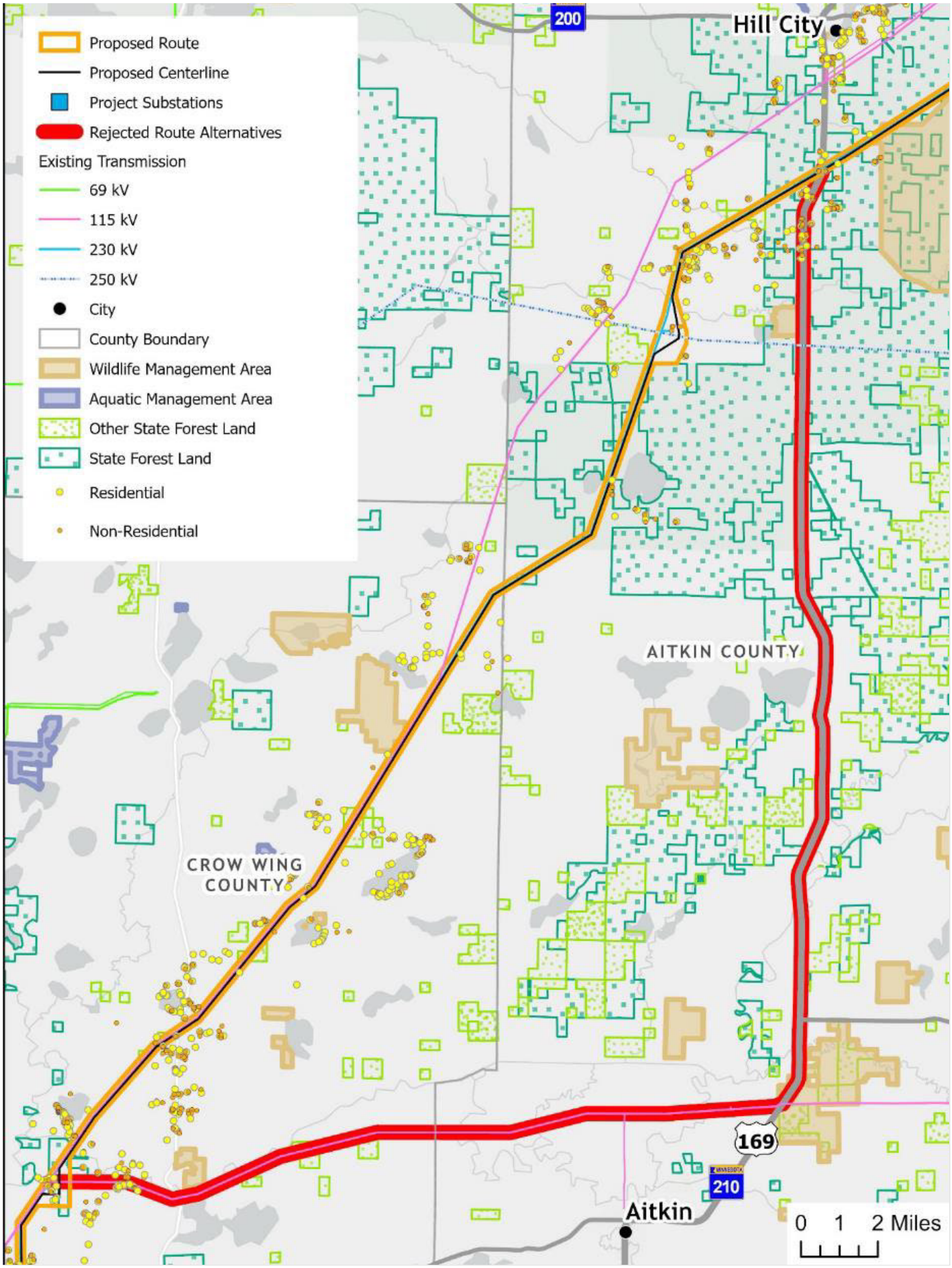
Map 5-9. Rejected Route Alternative – Hill City to South of Swatara



5.3.3 U.S. Highway 169 and Minnesota Power's 13 Line

The Applicants considered a Rejected Route Alternative that follows U.S. Highway 169 and Minnesota Power's 13 Line. The Rejected Route Alternative deviates from the Proposed Route where it crosses U.S. Highway 169 south of Hill City in Section 11 of Macville Township in Aitkin County and the Rejected Route Alternative turns south along U.S. Highway 169 for 26 miles. Where the 13 Line crosses US Highway 169 in Section 3 of Spencer Township, 3.5 miles north of Aitkin, the Rejected Route Alternative turns east and follows the 13 Line until it intersects with the 92 Line and the Proposed Route. This Rejected Route Alternative was rejected because it would be 11 miles longer, impact numerous residences and commercial buildings along US Highway 169, and is located less than one mile from the Aitkin Municipal Airport. This Rejected Route Alternative would also result in more impacts to State Forest land, Wildlife Management Areas ("WMAs"), and wetlands. In addition, the Rejected Route Alternative crosses the Mississippi River twice and parallels the Mississippi River for 5.5 miles. This Rejected Route Alternative is shown in **Map 5-10**.

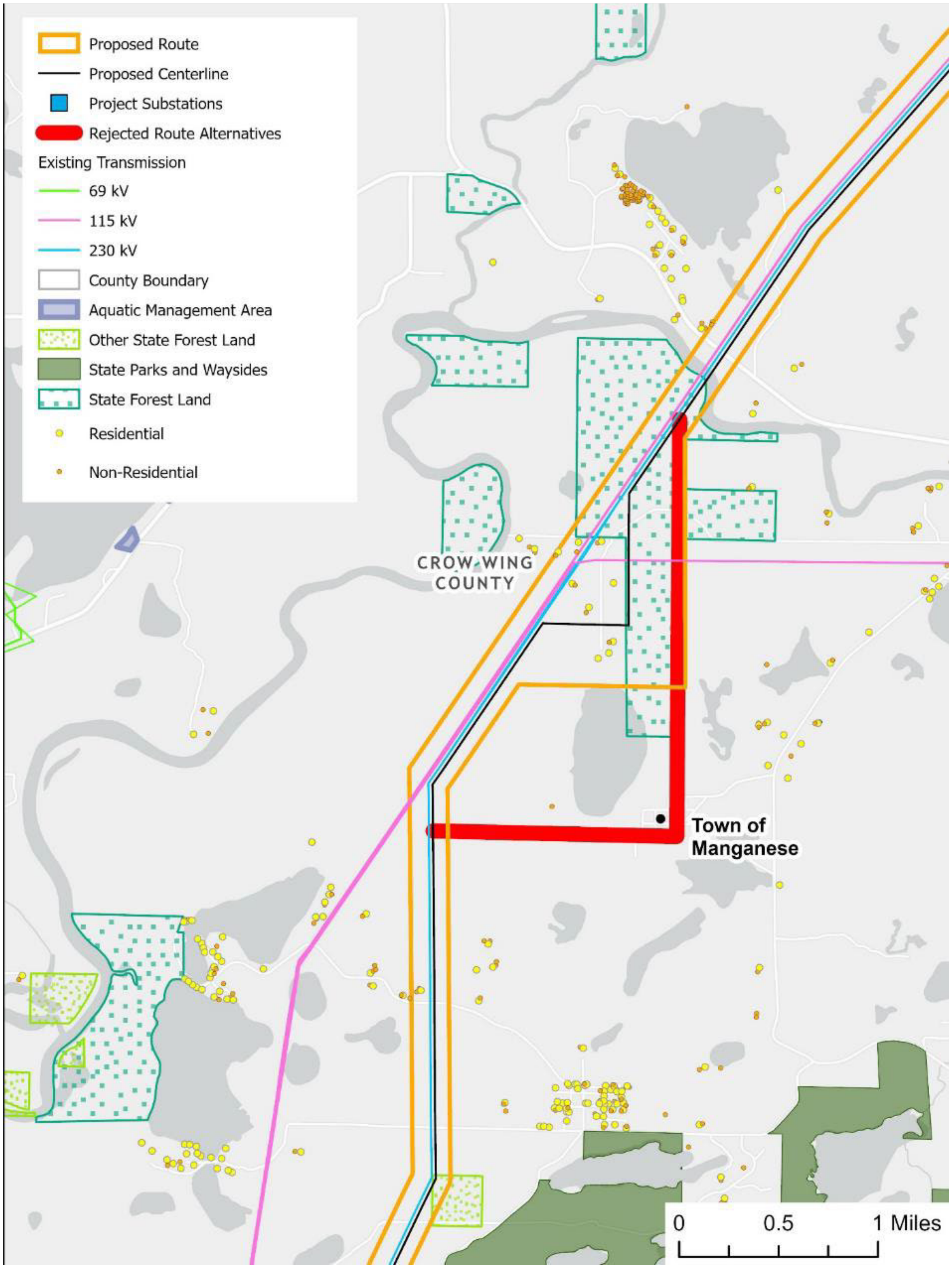
Map 5-10. Rejected Route Alternative – U.S. Highway 169 and Minnesota Power's 13 Line



5.3.4 Wolford Township

The Applicants considered a Rejected Route Alternative located south of the Mississippi River near River Road and Cole Lake Way northwest of Crosby in Crow Wing County that would place a Proposed Centerline of the Project approximately 0.25 miles east of the Proposed Route and would continue south for 0.75 miles before turning west back to the Proposed Route. This Rejected Route Alternative was rejected because it would increase the length of necessary new right-of-way and cross through the historic mining ghost town site of Manganese. This Rejected Route Alternative is located in Sections 28 and 29 of Wolford Township. This Rejected Route Alternative is shown in **Map 5-11**.

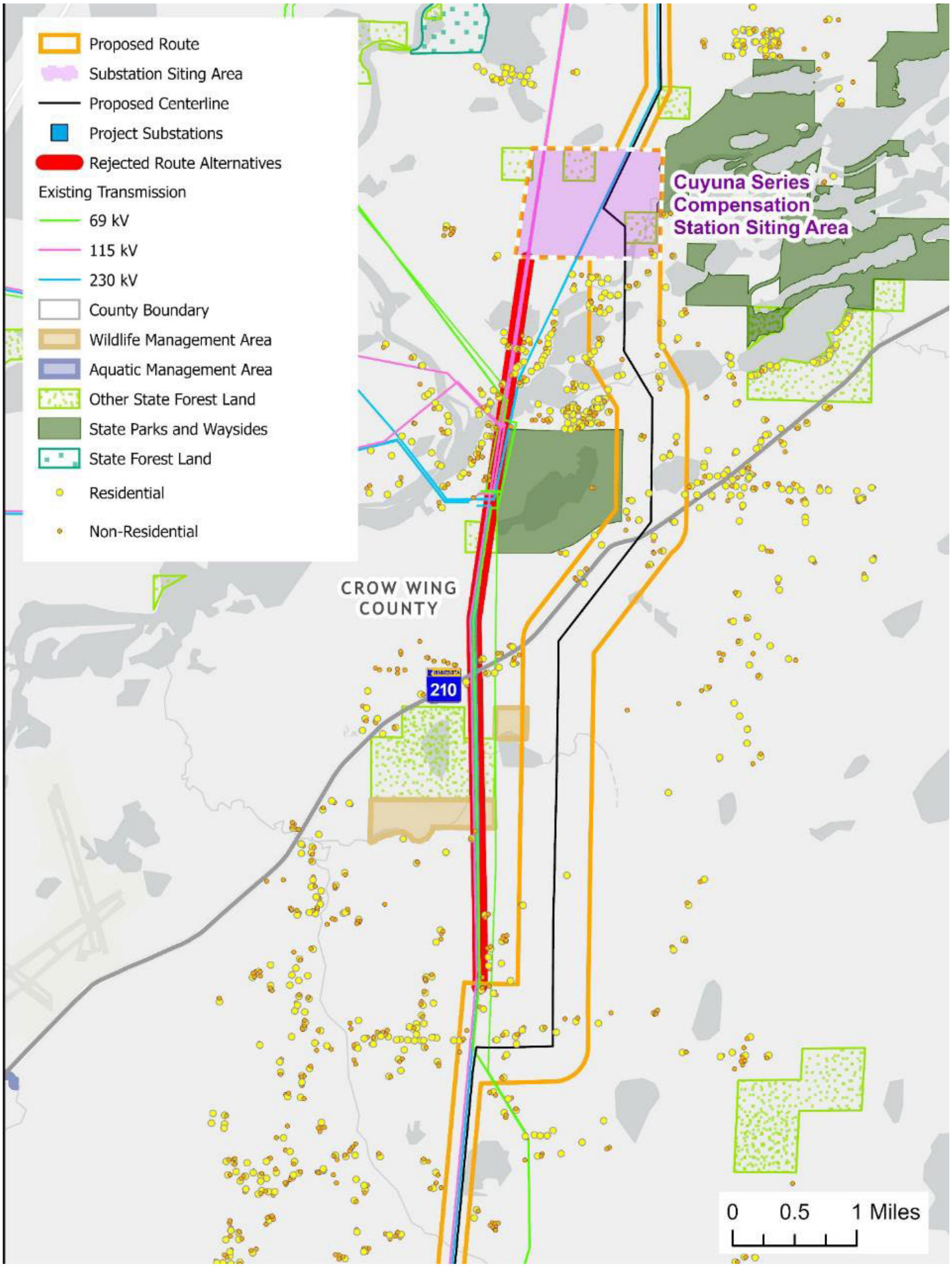
Map 5-11. Rejected Route Alternative – Wolford Township



5.3.5 Existing Lines through the Riverton Area

The Applicants considered a Rejected Route Alternative that follows the existing Minnesota Power 92 Line and 11 Line from the Cuyuna Series Compensation Station, starting at Section 7 of Irondale Township in Crow Wing County heading southeast past the existing Riverton Substation, and then turns south at Section 25 of Oak Lawn Township in Crow Wing County, following Great River Energy's MR Line for a total of 6.5 miles. While this Rejected Route Alternative is slightly shorter (1.3 miles) than the Proposed Route, this Rejected Route Alternative was rejected for several reasons. This Rejected Route Alternative would require an added span over Little Rabbit Lake (which is considered part of the Mississippi River) and approximately ten residential lots would be crossed north of Little Rabbit Lake. South of Little Rabbit Lake, the Cuyuna Country State Recreation Area is directly adjacent to the Rejected Route Alternative where additional right-of-way on this state park would be necessary if the Rejected Route Alternative were used. At Highway 210, there is a cluster of homes built near to the existing transmission line right-of-way, which creates limitations for additional new right-of-way. South of Highway 210, the Rejected Route Alternative crosses through the Loerch WMA and near residences along North Nelson Road. Further, this Rejected Route Alternative would require significant reconfiguration of four existing transmission lines in the Riverton area (possibly including new Mississippi River and Cuyuna Country State Recreation Area crossings) that would increase Project costs, likely increase aesthetic impacts near the Mississippi River, a State Forest, a WMA, and would also have potential implications for the state recreation area. This Rejected Route Alternative is shown in **Map 5-12**.

Map 5-12. Rejected Route Alternative – Riverton Area



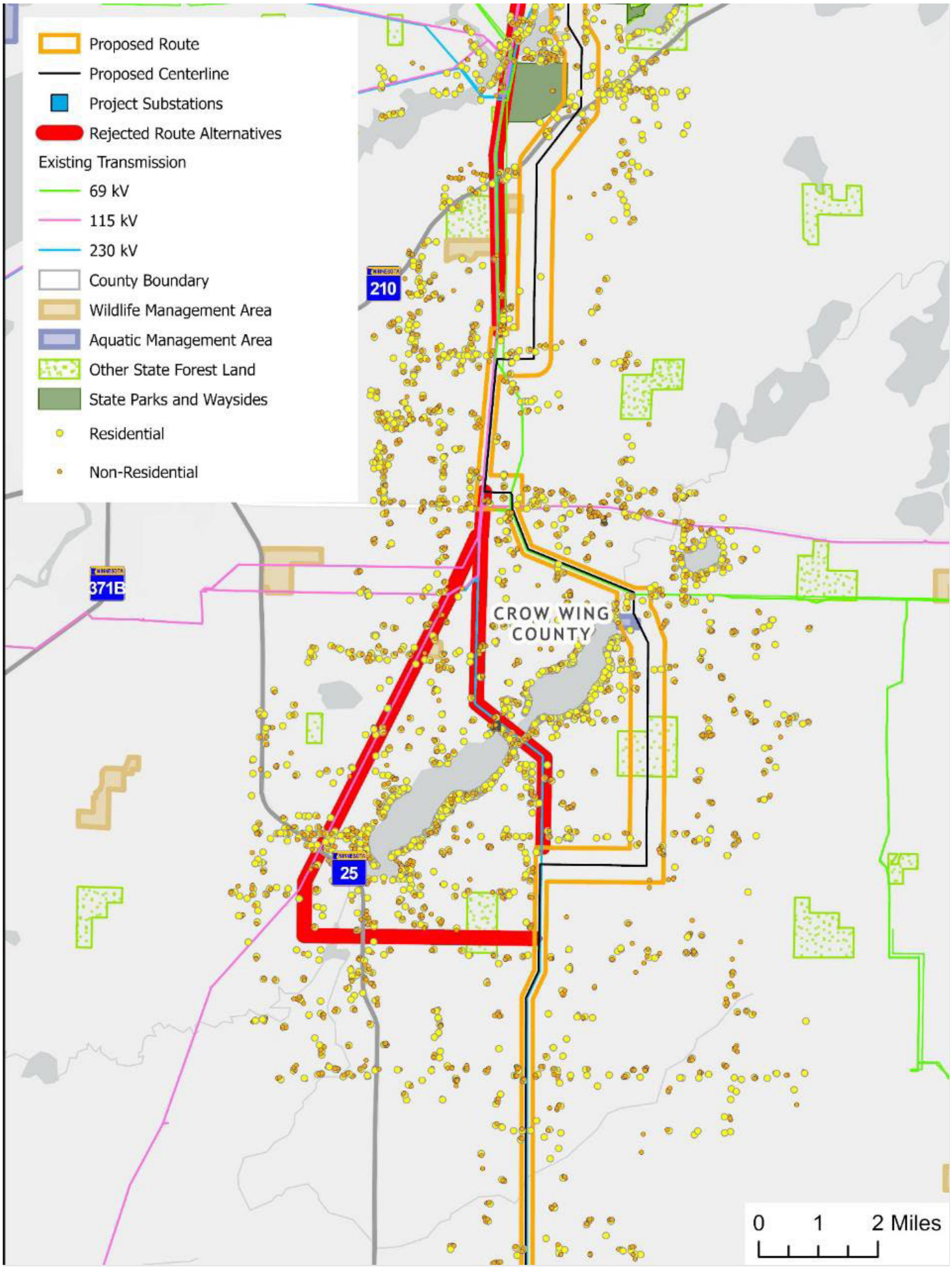
5.3.6 South Long Lake and Upper South Long Lake

The Applicants reviewed two Rejected Route Alternatives in the South Long Lake and Upper South Long Lake area – a Rejected Route Alternative located west of the lakes and a center Rejected Route Alternative that follows Great River Energy's MR Line between the lakes.

The west Rejected Route Alternative deviates from the Proposed Route beginning in Section 25 of Oak Lawn Township in Crow Wing County, following Minnesota Power's 12 Line and 46 Line to the southwest around the west side of the South Long Lake for approximately 6.5 miles before turning south along Church Road at Section 28 of Long Lake Township in Crow Wing County for one mile then turning east following Ox Cart Trail and Ox Lane at Section 33 of Long Lake Township for 4 miles before it rejoins Great River Energy's MR Line at Section 31 of Maple Grove Township in Crow Wing County. This Rejected Route Alternative was rejected because of the number of residences along this Rejected Route Alternative, notably at the southwest side of the lakes. Further, the State Historic Preservation Office ("SHPO") records identify the presence of archeological sites on the south side of South Long Lake that should be avoided. In addition, in meeting with several Tribal Nations, they expressed concern over the south side of the lake due to the number of known archaeological sites.

The center Rejected Route Alternative follows the MR Line between South Long Lake and Upper South Long Lake. This Rejected Route Alternative deviates from the Proposed Route at Section 25 of Oak Lawn Township, turns southeast at Section 12 of Long Lake Township, turns south at Section 18 of Maple Grove Township in Crow Wing County and would meet with the Proposed Route within Section 30 of Maple Grove Township. The center Rejected Route Alternative traverses through a very narrow, heavily populated, and well-traveled area. This Rejected Route Alternative was rejected due to the possibility of displacement of two to three residences, and the close proximity to a resort, and a Minnesota Department of Natural Resources ("MnDNR") boat launch as it runs between the two lakes. Construction of a transmission line within this area could create several safety concerns and could potentially limit access for resort and business owners. Further, there are 20 residences within 1,000 feet of this Rejected Route Alternative along with an active recreational vehicle resort and other small businesses. These Rejected Route Alternatives are shown in **Map 5-13**.

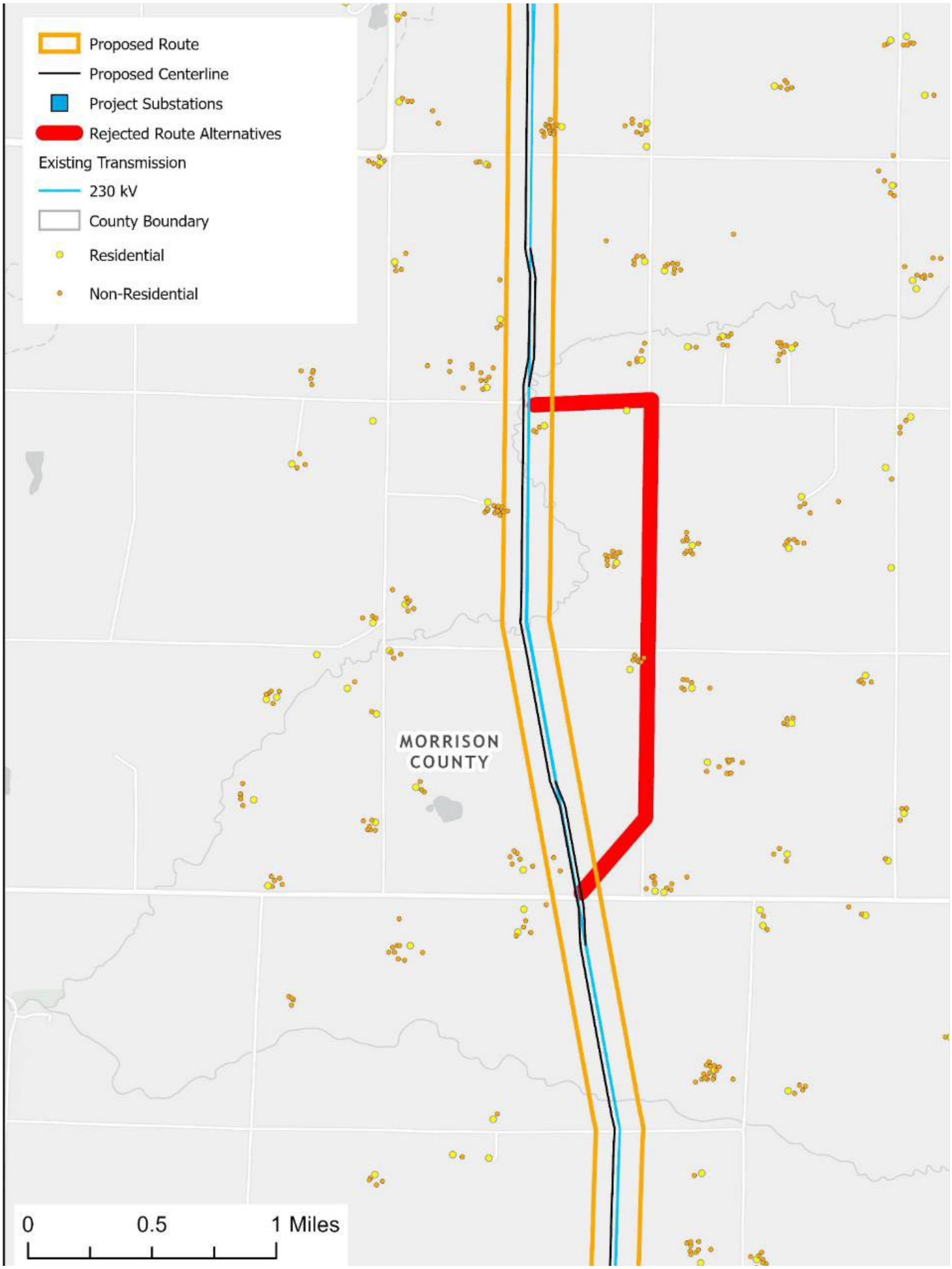
Map 5-13. Rejected Route Alternatives – South Long Lakes



5.3.7 Granite Township

The Applicants considered a Rejected Route Alternative that would use Great River Energy's existing 34.5 kV PL Line right-of-way in Granite Township. This Rejected Route Alternative follows the 34.5 kV PL Line, which is located 0.5 miles east of the existing MR Line. The Applicants rejected this Rejected Route Alternative because it would increase overall length of the Project (at least one mile) and would not mitigate impacts to a similar number of residences and farms when compared to the Proposed Route. This Rejected Route Alternative is located in Sections 20, 29, and 32 of Granite Township. This Rejected Route Alternative is shown in **Map 5-14**.

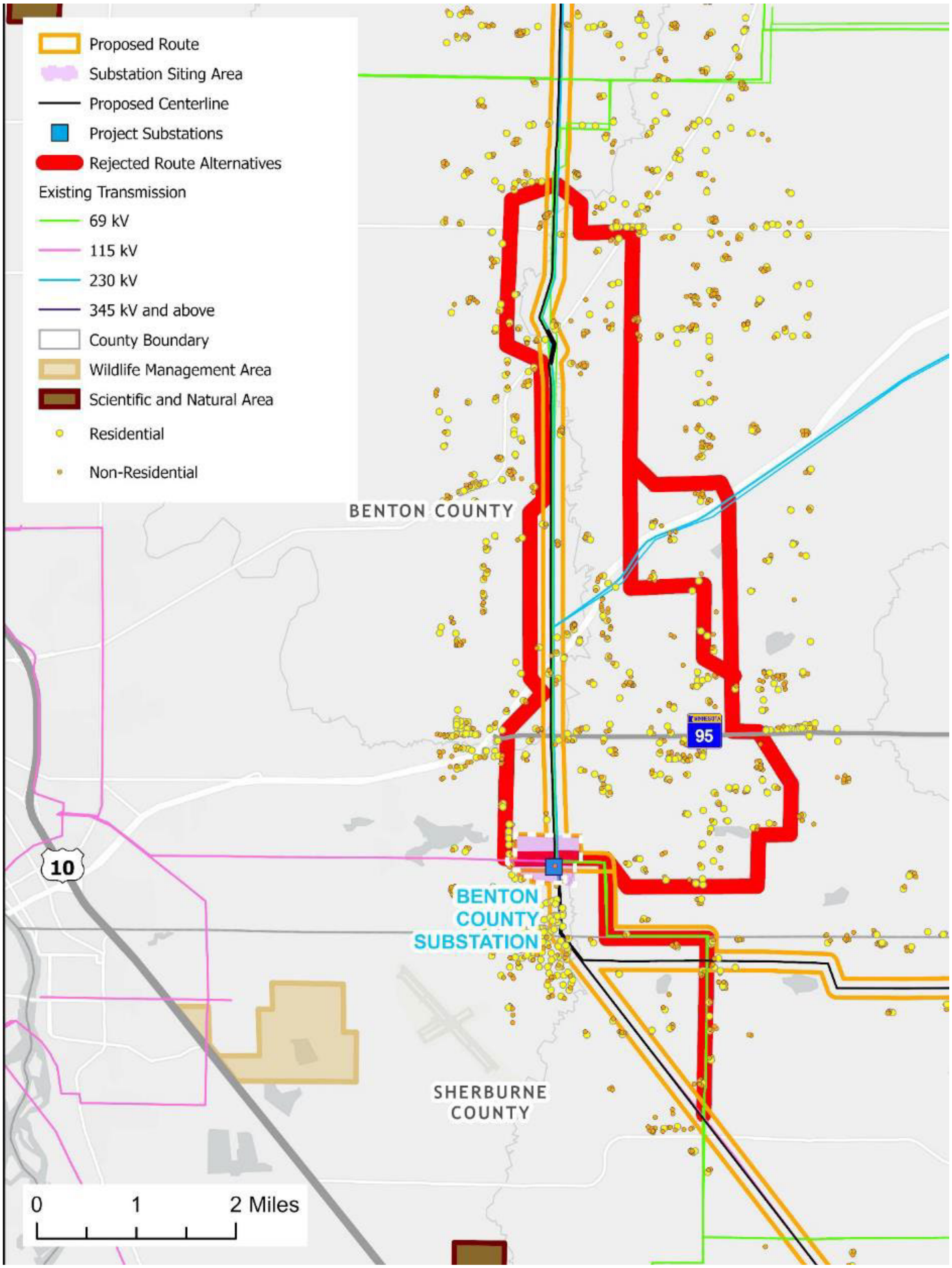
Map 5-14. Rejected Route Alternative – Granite Township



5.3.8 North of Benton County Substation

The Applicants considered several Rejected Route Alternatives north of the Benton County Substation. These Rejected Route Alternatives deviate from the existing MR Line to either the west or the east, depending on the Rejected Route Alternative. These Rejected Route Alternatives were rejected because each Rejected Route Alternative increased the overall Project length without minimization of potential impacts to residences and non-residential structures along with impacts to agricultural lands when compared to the Proposed Route. These Rejected Route Alternatives are located between Section 26 in Mayhew Township and Sections 2, 11, 14, 23, 26 in Minden Township in Benton County. These Rejected Route Alternatives are shown in **Map 5-15**.

Map 5-15. Rejected Route Alternatives – North of Benton County Substation



6 RIGHT-OF-WAY ACQUISITION, CONSTRUCTION, RESTORATION, AND OPERATION AND MAINTENANCE

6.1 Right-of-Way Requirements and Acquisition

6.1.1 Transmission Line Right-of-Way Width and Acquisition

For new 345 kV transmission lines, the Applicants typically obtain right-of-way that is 150 feet wide (75 feet on each side of the transmission line centerline) ("Proposed Right-of-Way"). Along the segment of the Project from the Iron Range Substation to the Benton County Substation, the Applicants will, where practicable, overlap the new 345 kV double-circuit transmission line right-of-way with existing high-voltage transmission line rights-of-way up to 30 to 40 feet. Along the segments of the Project from the Benton County Substation to the Big Oaks Substation and the Benton County Substation to Sherco Substation, the Applicants do not anticipate it will be necessary to expand the existing right-of-way width. Instead, the right-of-way width is expected to adequately accommodate the Project's width requirements except near the Sherco Substation and Big Oaks Substation where new or modified right-of-way is needed and in limited circumstances where new easements may need to be acquired and/or existing easements amended to account for the Project (the overall easement width to measure 150 feet).

The final right-of-way width will vary depending on factors such as proximity to or overlap with public road rights-of-way, transmission line structure types, transmission line structure locations relative to existing or future improvements, etc. Modifications to the right-of-way width acquired and/or utilized will be made on a case-by-case basis.

Table 6-1 provides the right-of-way requirements for the various areas of the Project.

Table 6-1. Proposed Right-of-Way Requirements

Transmission Voltage	Proposed Right-of-Way Width (feet)[82]
Existing 230 kV (Iron Range –Benton)	130 – 150 feet
New 345 kV (Iron Range – Benton)	150 feet*
Existing 230 kV (Benton – Big Oaks)	150 feet
New 345 kV (Benton – Big Oaks)	150 feet**

[82] This is the Proposed Right-of-Way located within the Route Width that the Applicants are requesting be approved by the Commission in the Project's Route Permit. Some areas of the Project may require wider rights-of-way based on actual design conditions.

Transmission Voltage	Proposed Right-of-Way Width (feet)[82]
Existing 345 kV (Benton – Sherco)	150 feet
New 345 kV (Benton – Sherco)	150 feet**
Existing 69 kV Underbuild (West Becker to West End)	100 feet****
New 69 kV Underbuild (West Becker to West End)***	100 feet****

* The Applicants propose to overlap 30-40 feet of this new right-of-way with existing transmission line right-of-way, where practicable.

** The Applicants do not anticipate requiring additional right-of-way width from the Benton County Substation to Big Oaks Substation and from Benton County Substation to Sherco Substation; instead placing the new transmission line within existing transmission line right-of-way except near the Sherco Substation and Big Oaks Substation.

*** The Applicants anticipate that this Proposed Right-of-Way would also apply to any of the single-circuit segments in the area of the Project where certain lines are being rerouted to avoid unnecessary crossings.

*****GRE's EW Line (West Becker to West End) easement width varies from 70- to 100-feet-wide.*

Because the Proposed Route for the Project largely follows existing high-voltage transmission line or other rights-of-way, the Applicants have existing easement rights for the existing lines (**Map 5-5** and **Map 5-6**). To accommodate the new construction and proposed rebuilds and reconfigurations, when additional or different land rights are required, the Applicants intend to work with landowners to either secure those new or amended easement rights. As discussed above, for the segment of the Project from the Benton County Substation to the Big Oaks Substation, the Applicants intend to remove the existing 230 kV H-frame transmission line structures and replace them with the new 345 kV double-circuit steel structures along the existing centerline and utilize existing easement rights. Likewise, for the Benton County Substation to Sherco Substation segment, the existing structures will be replaced with 345 kV double-circuit capable structures along the existing high-voltage transmission line centerline and Applicants intend to utilize existing easement rights.

It is anticipated that preliminary right-of-way discussions with landowners will begin as early as 2024. In locations where new easements or amendments to existing easements are needed or otherwise beneficial, the Applicants will work with landowners to negotiate the terms of a mutually acceptable agreement. In locations where new rights are not necessary, the Applicants will work with existing landowners to address the Applicants' survey, construction and access plans and potential impacts on the land, as well as restoration. The land evaluation and acquisition process will include a title search, contact with the landowner, survey, real estate document preparation, discussion and negotiation, and completion of agreements, including options, permanent easements, temporary easements, and/or other agreements necessary to support the initial survey needs of the project and construction, operation and maintenance of the Project.

As part of the land rights acquisition process, the Applicants' right-of-way agents will discuss the construction schedule and construction requirements with the owner of each parcel. Special considerations may be discussed, such as temporary or permanent gates, fencing, and access accommodations. The Applicants' experience with easement discussions is that, in most cases, they are able to work with landowners to address their concerns to reach an agreement for the purchase of the easement.

In all cases, the Applicants will use fair market value data to try in good faith to reach agreements with landowners on a voluntary basis. In some cases, agreements cannot be reached. In those cases, the Applicants may be required to obtain the necessary rights for the Project by exercising their right of eminent domain under Minnesota law. The process of exercising the right of eminent domain is called condemnation. Minnesota law establishes a common process – through Minnesota Statutes Ch. 117 – for condemnation actions and has a well-developed body of law for determining valuation issues to ensure that landowners receive just compensation.

Before commencing a condemnation proceeding, typically a condemning authority obtains an appraisal and provides it to the property owner, along with the condemning authority's offer of compensation. To start the formal condemnation process, a utility (or other condemning authority) files a petition in the district court where the property is located and serves that petition on all owners of interests in each of the properties identified in the petition.

If the court grants the petition, the court then appoints a three-person condemnation commission that will determine the just compensation for the easement. The three people must be knowledgeable of applicable real estate issues. The commissioners schedule a viewing of the property and then schedule a valuation hearing where the utility and landowners can testify as to the fair market value of the easement or fee. As part of the valuation process, the landowner typically also obtains an appraisal and has certain rights of reimbursement in connection with the costs of obtaining an appraisal. At the commissioners' hearing on valuation, the parties offer their evidence, such as testimony by appraisers or the landowners, about the fair market value impacts the acquisition has on the property's value. The condemnation commission then makes an award in an amount representing just compensation and that award is filed with the court. Each party has the right to appeal the award to the district court for a trial. In the event of an appeal, the jury or judge considers the parties' evidence and renders a verdict. At any point in this process, the case can be dismissed if the parties reach a settlement.

There may be instances where a landowner elects to require the Applicants to purchase the landowner's fee interest in all or some portion of the landowner's contiguous, commercially viable property in which the Applicants seek only an easement. Owners of certain types of property are granted this right under Minn. Stat. § 216E.12, subd. 4, which is sometimes referred to as the "Buy-the-Farm Statute." The Buy-the-Farm Statute applies only to transmission facilities that are 200 kV or more. Thus, the Buy-the-Farm

Statute may apply to parcels crossed by the proposed 345 kV and 230 kV transmission lines where new easements are being acquired by the Applicants.

6.1.2 Substations

The existing Iron Range Substation, located near Grand Rapids, and the existing Benton County Substation, located near St. Cloud, will both be expanded as part of the Project. Additionally, a new series compensation station will be constructed near the existing Riverton Substation. The Applicants have acquired the property necessary at each of the locations for the expansion or construction of these facilities. The new Big Oaks Substation is being proposed and constructed as part of a separate project.

6.1.3 Communication Infrastructure Modifications

Modifications to communications infrastructure in the Project area will be completed as part of the Northland Reliability Project to improve overall communication capabilities of the transmission system. While these modifications to communication infrastructure do not independently require a Certificate of Need or Route Permit from the Commission, Applicants elected to identify that certain communication infrastructure modifications may be necessary for the Project and elected to do so in this Application to ensure transparency in the overall work being completed in the Project area.

6.2 Construction Procedures

6.2.1 Transmission Lines

Construction will begin after all federal, state and local approvals are obtained, property and rights-of-way are acquired and final design is completed. The precise timing of construction will consider various requirements that may be in place due to permit conditions, system loading issues and available workforce. The first phase of construction will involve tree clearing in Segment 1 and removal of the existing transmission lines in Segment 2. Below is a detailed description of the first phase of construction in each segment.

6.2.1.1 Segment 1

After land rights are secured, landowners will be notified prior to the start of the construction phase of the Project, including an update on the Project schedule and other related construction activities.

The first phase of construction activities for the new structures will involve survey staking of the transmission line centerline, easement boundaries, and/or pole locations, then removal of all trees and other vegetation from the full width of the right-of-way. In areas where the Project follows existing rights-of-way and there is an opportunity to overlap rights-of-way it may not be necessary to clear within the overlap area minimizing impacts to vegetation.

As a general practice, low-growing brush will be allowed to reestablish at the outer limits of the easement area after all vegetation has initially been cleared. Tree species that endanger safe and reliable operation of the transmission facility will be removed.

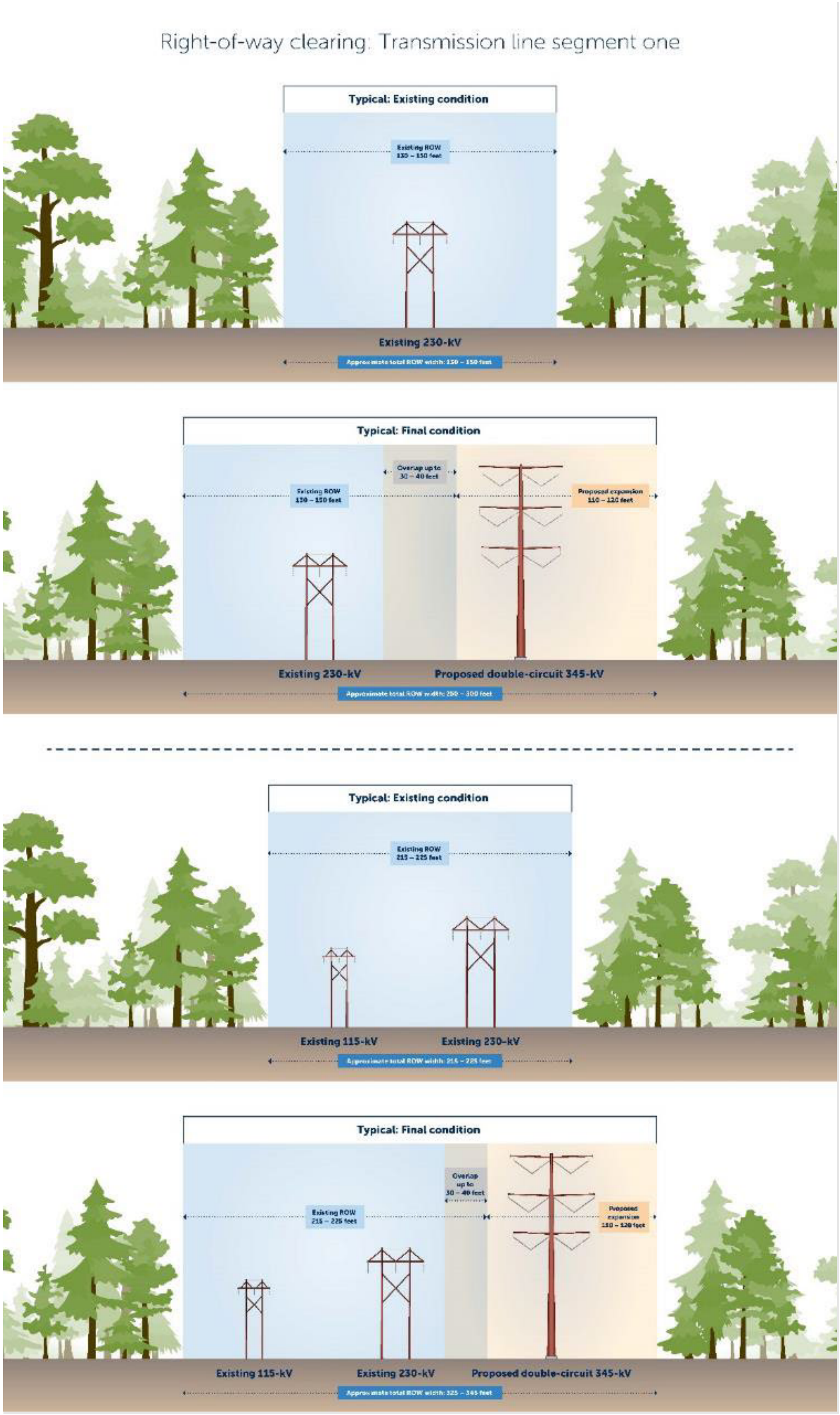
The National Electrical Safety Code ("NESC") states that "vegetation that may damage ungrounded supply conductors should be pruned or removed." Trees beyond the easement area that are in danger of falling into the energized transmission line ("danger trees") will be removed or trimmed to eliminate the hazard, as allowed by the terms in the given acquired easement. Danger trees generally are those that are dead, weak or leaning towards the energized conductors. While right-of-way clearing typically occurs close in time to the installation of structures, there are instances where right-of-way clearing must occur before the overall line design and pole placements are finalized. This is often the result of calendar restrictions to avoid vulnerable timeframes in the life cycle of particular flora or fauna species. In those situations, as the right-of-way width will be defined while final line design is in process, the Applicants would proceed with right-of-way clearing in parallel with final design efforts.

All material resulting from the clearing operations will be either chipped on site and spread on the right-of-way, stacked in the right-of-way for use by the property owner, or removed and disposed of otherwise as agreed to with the property owner during easement negotiations.

The final survey staking of pole locations will occur after the vegetation has been removed and just prior to the structure installation. **Figure 6-1** shows the typical and final conditions for Segment 1 of the Project.[83]

[83] The width at which vegetation will be maintained to ground level may increase at structure locations, around guy wires and anchors, and other improvements.

Figure 6-1. Standard Vegetation Management Practices – Segment 1



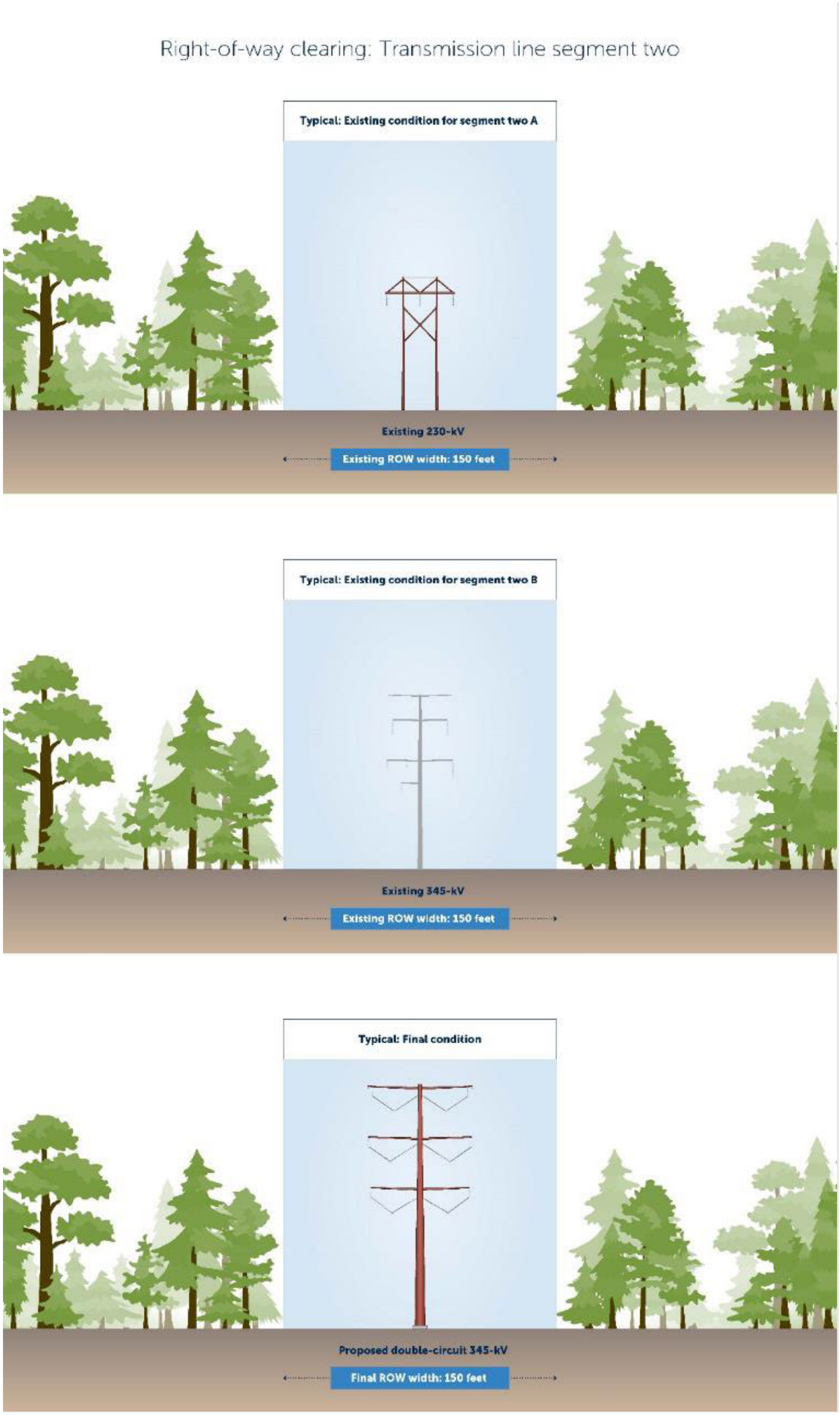
6.2.1.2 Segment 2

In Segment 2 the existing right-of-way is primarily cleared and Great River Energy routinely maintains the right-of-way for regrowth and other vegetation concerns. However, prior to construction activities for the new Project beginning, the existing high-voltage transmission lines will need to be removed. It is anticipated that each existing line will be removed and replaced before the second line is removed and replaced. For the existing structures on Great River Energy's GRE-BS Line that are constructed on concrete foundations, the existing foundations will need to be removed before a new foundation is installed. Applicants will remove the existing concrete four feet below grade and backfill with topsoil.

The final survey staking of pole locations will occur after the vegetation has been removed and just prior to the structure installation. **Figure 6-2** shows the typical and final conditions for Segment 2 of the Project.[84]

[84] The width at which vegetation will be maintained to ground level may increase at structure locations, around guy wires and anchors, and other improvements.

Figure 6-2. Standard Vegetation Management Practices – Segment 2



6.2.1.3 All Segments

The second phase of construction will involve structure installation and stringing of conductor wire. During this phase, underground utilities are identified through the required Gopher State One Call process to minimize conflicts with the existing utilities along the routes.

If temporary removal or relocation of fences is necessary, installation of temporary or permanent gates will be coordinated with the landowner. The right-of-way agent may work with the property owner for early harvest of crops, where practicable and as necessary, with compensation to be paid for any actual crop losses. During the construction process, it may be necessary for the property owner to remove or relocate equipment and livestock from the right-of-way.

Transmission line structures are typically designed for installation at existing grades. Therefore, structure sites will not be graded or leveled unless it is necessary to provide a reasonably level area for construction access and activities. For instance, if vehicle installation equipment cannot safely access or perform construction operations properly near the structure, minor grading of the immediate terrain may be necessary.

The Applicants will employ standard construction practices that were developed from experiences with past projects in addition to industry-specific Best Management Practices ("BMPs"). BMPs address right-of-way clearance, erecting transmission line structures, and stringing transmission lines. BMPs for the Project will be based on the specific construction design, prohibitions, maintenance guidelines, inspection procedures, and other activities involved in constructing the line. In some instances, these activities, such as schedules, are modified to incorporate a BMP for construction that will assist with minimizing impacts on sensitive environments. For example, in areas where construction occurs within a wetland, BMPs such as matting or winter construction may be used to minimize impacts.

The existing transmission lines that will be removed as part of this Project are identified in **Appendix J, Detailed Mapbook, Pages 4, 5, 38-41, 43, 44, 48, 49, and 51-64**.

New steel pole structures will generally be installed on concrete foundations. To install a foundation, a hole is drilled that measures approximately eight feet in diameter for a 345 kV double-circuit transmission structure foundation and 25 feet, or more, deep. An angle or dead-end structure may require a foundation of 12 feet or larger in diameter. The actual diameter and depth of the hole (and foundation) depend on soil conditions that are established during the initial survey and soil testing phases. Concrete is brought to the site by concrete trucks from a local concrete batch plant and filled around a steel rebar support cage. Once the foundation is set, installation of the actual pole on top of the foundation can begin. Poles will be moved from staging areas and delivered to the foundation. Insulators and other hardware are attached while the pole is still on the ground at the installation location. Using a crane, the pole is lifted, placed, and secured to the cured concrete foundation.

Some soil conditions will require that construction mats be placed along the right-of-way or at a pole location to minimize soil disturbances. These mats can also be used to provide access across sensitive areas to minimize impacts including soil compaction, rutting, or damage to plant species. Once the pole has been set, any remaining holes are back-filled with the excavated material or crushed rock. The Applicants prefer to spread any remaining excavated material in the area from which they were removed if landowner permission is obtained. If spreading of the excavated material is not permitted by the landowner, the material will be offered to the landowner or completely removed from the site.

After a number of structures have been erected, the Applicants will begin to install the conductor wire by establishing stringing setup areas. These stringing setup areas are usually located every four miles along a project route, or as needed, and occupy approximately 150-foot by 600-foot area. Conductor stringing operations require brief access to each structure to secure the conductor wire to the insulators and to install shield wire clamps once final sag is established. Temporary guard or clearance structures are installed, as needed, over existing distribution or communication lines, streets, roads, highways, railways or other obstructions after any necessary notifications are made or permits obtained. This ensures that conductors will not obstruct traffic or contact existing energized conductors or other cables. This also protects the conductors from damage.

Crossing of rivers, streams and wetlands will require particular attention during construction. **Section 7.6.4** and **Section 7.6.7** describes potential public water inventory and wetland crossings anticipated for the Project. In areas where construction occurs close to waterways, BMPs help prevent soil erosion and ensure that equipment fueling and lubricating occur at a distance from waterways.

6.2.2 Substations

Details regarding the expansion necessary at the existing Iron Range and Benton County Substations and the construction of a new Series Compensation Station are provided in **Section 2.1.5.2**.

Substation construction will be performed in compliance with the applicable NESC, Occupational Safety and Health Act, and state and local requirements. Designs will be completed by Minnesota licensed professional engineers, as required by Minnesota Statutes and Rules. Contractors will be committed to safe working practices. The final design of the substations will take into account the local conditions of the substation sites and comply with all applicable safety codes and the Applicants' standards.

The substation modifications will be designed to allow future maintenance to be done with minimum impact on substation operation and provide the necessary clearance from energized equipment to ensure safety.

Standard construction and mitigation practices developed from experience with past projects in addition to industry-specific BMPs will be employed. BMPs for the Project will be based on the specific construction design, prohibitions, maintenance guidelines, inspection procedures, and other activities involved in constructing the substations. As with the transmission lines, in some cases these activities will be modified to incorporate a BMP for construction that will assist with minimizing impacts on sensitive environments.

When construction activities are completed, the Applicants will restore the remainder of the construction sites in accordance with the restoration procedures described in **Section 6.4**.

6.2.3 Workforce Required

The workforce required for construction of the Project's facilities is estimated to be about 75-150 construction workers, depending on the construction sequencing and time of the year. This includes vegetation maintenance crews, transmission line and substation construction workers, safety supervisors, environmental support, and other on- and off-site support staff. Applicants will work with local contractors, to the extent practicable, in the Project area to identify potential opportunities to complete this work using contractors local to the Project area. Additionally, Applicants have strong relationships with the Building Trades and are committed to working with organized labor on the Project, including paying prevailing wages for applicable positions for the construction of the Project, as discussed in **Section 2.2.1.**

The construction activities will provide a seasonal influx of additional dollars into the communities during the construction phase, with construction materials purchased from local vendors where feasible.

6.3 Restoration Procedures

6.3.1 Transmission Lines

During construction, limited ground disturbances at the structure sites may occur. Staging areas for temporary storage of materials and equipment are established under agreements with the property owner or agency. Preferably, a previously-disturbed or developed area is used, and includes sufficient space to lay down material and pre-assemble certain structural components or hardware and store construction equipment. Parts of the right-of-way or property immediately adjacent to the right-of-way may be used for structure laydown and framing prior to structure installation. Additionally, stringing setup areas are used to store conductors and equipment necessary for stringing operations. Disturbed areas will be restored to their original condition to the maximum extent practicable, or as negotiated with the landowner.

Post-construction reclamation activities will include removing and disposing of debris, removing all temporary facilities, including staging and laydown areas, employing appropriate erosion control measures, reseeding areas disturbed by construction activities with a seed mixture certified as free of noxious or invasive weeds and restoring the areas to their original condition to the extent practicable. In instances where soil compaction has occurred, the construction crew or restoration contractor will use various methods to alleviate the compaction, or as negotiated with landowners.

The right-of-way agent will contact the landowners once construction is completed to determine if the clean-up measures have been to their satisfaction and if any other damage may have occurred. If damage has occurred to crops, fences or other property, Applicants will compensate the landowner. In some cases, an outside contractor may be hired to restore the damaged property as near as practicable to its original condition.

6.3.2 Substations

Upon completion of the substation construction activities, the Applicant responsible for any work at that particular substation will restore the remainder of the site. Post-construction restoration activities will include the removing and disposing of debris, dismantling all temporary facilities, employing appropriate erosion control measures and reseeding areas disturbed by construction activities with vegetation similar to that which was removed as appropriate.

6.4 Operation and Maintenance

6.4.1 Transmission Lines

Transmission lines will be designed and maintained in accordance with the NESC and the Applicants' standards. In general, transmission lines are highly reliable and unplanned outages have been limited. The average annual availability of transmission infrastructure is very high, in excess of 99 percent. Transmission facilities have decades-long estimated service lives but, practically speaking, high-voltage transmission lines are seldom retired. Regular maintenance and asset renewal of transmission line components is necessary for longer term reliable operation.

Access to the right-of-way of a completed transmission line is required periodically to conduct inspections, perform maintenance, and repair damage. Regular maintenance and inspections will be performed during the life of the transmission line to ensure its continued integrity. Generally, the Applicants will inspect the Project once by air and once on the ground annually. These inspections will be limited to the right-of-way and to areas where obstructions or terrain may require off-right-of-way access. If problems are identified during inspection, repairs will be performed and damage restoration will occur or the landowner will be provided reasonable compensation for any damage to the property.

The right-of-way will be managed to control any encroachments that may interfere with the operation of the transmission line including removal of vegetation that interferes with the operation and maintenance of the transmission line. Native shrubs that will not interfere with the safe operation and maintenance of the transmission line will be allowed to reestablish in the outer edge the right-of-way. Right-of-way clearing practices include a combination of mechanical and hand clearing, with herbicide application where allowed, to remove or control vegetation growth. Noxious weed control with herbicides will be conducted as needed around structures and anchors.

6.4.2 Substations

Substations also require a degree of maintenance to keep them functioning in accordance with accepted operating parameters and NESC requirements. Transformers, circuit breakers, batteries, protective relays and other equipment need to be serviced periodically in accordance with the manufacturer's recommendation. The site itself must also be kept free of vegetation, and drainage maintained.

The operating and maintenance costs associated with the transmission lines and substations are provided in **Section 2.2.2**. Actual transmission line and substation maintenance costs will depend on the setting, the amount of vegetation management necessary, storm damage occurrences, structure types, age of the line, and other variables.

6.4.3 Workforce Required

The workforce necessary to perform the transmission line and substation operation and maintenance will consist of two to four workers. Regular maintenance and inspections will be performed over the life of the facility to ensure a reliable system. Annual inspections will be performed on foot or by motorized vehicle, in addition to annual aerial inspections.

6.5 Electric and Magnetic Fields

Electric and magnetic fields ("EMF") are invisible lines of force that are present anywhere electricity is produced or used, including around electric appliances and any wire that is conducting electricity. The term "EMF" is typically used to refer to electric and magnetic fields that are coupled together. However, for lower frequencies associated with power lines, electric and magnetic fields are relatively decoupled and should be described separately. Electric fields are the result of electric charge, or voltage, on a conductor. The intensity of an electric field is related to the magnitude of the voltage on the conductor and is typically described in terms of kV per meter ("kV/m"). Magnetic fields are the result of the flow of electricity, or current, traveling through a conductor. The intensity of a magnetic field is related to the magnitude of the current flow through the conductor and is typically described in units of magnetic flux density expressed as Gauss ("G") or milliGauss ("mG"). Electric and magnetic fields are found anywhere there are energized, current-carrying conductors, such as near transmission lines, local distribution lines, substation transformers, household electrical wiring, and common household appliances.

6.5.1 Electric Fields

Voltage on any wire produces an electric field in the area surrounding the wire. The voltage on the conductors of a transmission line produces an electric field extending from the energized conductors to other nearby objects, such as the ground, structures, vegetation, buildings, and vehicles. The intensity of transmission line electric fields is proportional to the voltage of the line, and rapidly decreases with distance from the transmission line conductors. The presence of trees, buildings, or other solid structures nearby can also significantly reduce the magnitude of the electric field. Because the magnitude of the voltage on a transmission line is near-constant, the magnitude of the electric field will be near-constant for each of the proposed configurations, regardless of the power flowing on the line.

When an electric field reaches a nearby conductive object, such as a vehicle or a metal fence, it induces a voltage on the object. The magnitude of the induced voltage is dependent on many factors, including the object's capacitance, shape, size, orientation, location, resistance with respect to ground, and the weather conditions. If the object is insulated or semi-insulated from the ground and a person touches it, 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 can occur when a person walks across a carpet and touches a grounded object, like a doorknob, or another person.

The main concern with induced voltage is not the magnitude of the voltage induced, but the current that would flow through a person to the ground should the person touch the object. To ensure that any such spark discharge associated with transmission line induced voltage does not reach unsafe levels, the NESC requires that any discharge be less than 5 milliAmperes ("mA"). The Project will be designed consistent with this NESC requirement.

There is no federal standard for transmission line electric fields. The Commission, however, has historically imposed a maximum electric field limit of 8 kV/m measured at one meter above ground for new transmission projects.[85] As demonstrated below, the electric field associated with the Project will be well within the Commission's 8 kV/m limit.

The predicted intensity of electric fields associated with the various structure configurations of the Project are given in **Table 6-2** for the edge of right-of-way and at the location where the maximum electric field will be experienced. Where the Project parallels existing transmission lines, the presence of another energized line nearby will impact the electric field profile around the parallel lines. Therefore, the predicted intensity of electric fields associated with the various corridor scenarios where the Project's new transmission line parallels existing transmission lines are also given in **Table 6-2**. Because electric fields are particularly dependent on the voltage of the transmission line, the values in **Table 6-2** were calculated at the line's maximum continuous operating voltage. Maximum continuous operating voltage is generally defined for the Project and adjacent transmission lines as the nominal voltage plus 10 percent, in this case 379.5 kV (for nominally 345 kV lines), 253 kV (for nominally 230 kV lines), 126.5 kV (for nominally 115 kV lines), or 75.9 kV (for nominally 69 kV lines). At some locations, such as near a substation where more restrictive voltage criteria are used, the maximum continuous operating voltage will be limited to the nominal voltage plus 5 percent, as noted in **Table 6-2**. Values were calculated assuming minimum conductor-to-ground clearance (that is, at mid-span) and a height of one meter above ground. The maximum calculated electric

[85] *In the Matter of the Route Permit Application for a 345 kV Transmission Line from Brookings County, S.D. to Hampton*, Docket No. ET2/TL-08-1474, ORDER GRANTING ROUTE PERMIT (Sept. 14, 2010) (adopting the Administrative Law Judge's Findings of Fact, Conclusions, and Recommendation at Finding 194).

field among all possible configurations is 7.91 kV/m, which is within the Commission's 8 kV/m limit. Plots of the lateral profile of electric field for each corridor configuration in **Table 6-2** are provided in **Appendix H**.

Table 6-2. Calculated Electric Fields (kV/M) for the Project

Corridor Configuration	Line Voltage	Edge of right-of-way	Maximum Overall		
		Intensity (kV/m)	Intensity (kV/m)	Distance from right-of-way Centerline (feet)	Combined right-of-way Width (feet)
Project: Double-Circuit 345 kV	379.5 kV	0.54	7.89	19	150
Existing: 230 kV H-Frame Project: Double-Circuit 345 kV	253 kV 379.5 kV	0.68	7.80	36	250
Existing: 115 kV H-Frame Existing: 230 kV H-Frame Project: Double-Circuit 345 kV	126.5 kV 253 kV 379.5 kV	0.43	7.88	110	340
Existing: 115 kV H-Frame Existing: 115 kV H-Frame Existing: 230 kV H-Frame Project: Double-Circuit 345 kV	126.5 kV 126.5 kV 253 kV 379.5 kV	0.54	7.79	120	430
Existing: 115 kV H-Frame Existing: 230 kV H-Frame Project: Double-Circuit 345 kV	126.5 kV 253 kV 379.5 kV	0.44	7.80	71	340
Project: Double-Circuit 345 kV Existing: 69 kV Monopole	379.5 kV 75.9 kV	0.54	7.91	16	220
Project: Double-Circuit 345 kV Existing: 230 kV H-Frame	379.5 kV 253 kV	0.61	7.65	74	250
Project: Double-Circuit 345 kV Existing: 69 kV Monopole Existing: 230 kV H-Frame	379.5 kV 75.9 kV 253 kV	0.51	7.90	56	300
Project: Double-Circuit 345 kV Existing: 69 kV Monopole Existing: Double-Circuit 230 kV	379.5 kV 72.5 kV 241.5 kV	0.54	7.68	51	270
Project: Triple Circuit 345 kV with 69 kV	379.5 kV 72.5 kV	0.58	1.61	32	150
Project: 345 kV Monopole Project: Double-Circuit 345 kV	362.3 kV 362.3 kV	0.12	5.99	57	240

6.5.2 Magnetic Fields

Current passing through any conductive material, including a wire, produces a magnetic field in the area around the material. The current flowing through the conductors of a transmission line produces a magnetic field that extends from the energized conductors to other nearby objects. The intensity of the magnetic field associated with a transmission line is proportional to the amount of current flowing through the line's conductors, and rapidly decreases with the distance from the conductors. Unlike electric fields, magnetic fields are not significantly impacted by the presence of trees, buildings, or other solid structures nearby. Because the actual power flow on a transmission line could potentially vary widely throughout the day depending on electrical system conditions, the actual magnetic field level in the vicinity of the transmission line could also vary widely from hour to hour.

There are currently no Minnesota regulations pertaining to magnetic field exposure. The Commission has acknowledged that Florida, Massachusetts, and New York have established standards for magnetic field exposure.[86] To provide context for the calculated magnetic field levels associated with the Project, magnetic field levels associated with some common household electric appliances are provided in **Table 6-3**.

Table 6-3. Table of Magnetic Fields of Common Electric Appliances

Appliance	6 Inches from Source	1 Foot from Source	2 Feet from Source
Hair Dryer	300 mG	1 mG	-
Electric Shaver	100 mG	20 mG	-
Can Opener	600 mG	150 mG	20 mG
Electric Stove	30 mG	8 mG	2 mG
Television	N/A	7 mG	2 mG
Portable Heater	100 mG	20 mG	4 mG
Vacuum Cleaner	300 mG	60 mG	10 mG
Copy Machine	90 mG	20 mG	7 mG
Computer	14 mG	5 mG	2 mG

The predicted intensity of magnetic fields associated with the various structure configurations of the Project are provided in **Table 6-4** for the edge of right-of-way and at the location where the maximum magnetic field will be experienced. Where the Project parallels existing transmission lines, the presence of another energized line nearby will impact the magnetic field profile around the parallel lines. Therefore, the predicted intensity of magnetic fields associated with the various corridor scenarios where the Project's new 345 kV or 230 kV line parallels existing transmission lines are provided in **Table 6-4**. Because magnetic fields are particularly dependent on the current flowing on the transmission line, magnetic field information is provided for the projected typical loading under high transfer conditions for the Project when placed into service and adjacent facilities, in **Table 6-4**. Typical loading for the Project and adjacent facilities was derived from power system modeling of the Project under system normal conditions during winter peak power flow. Values were calculated assuming minimum conductor-to-ground clearance (that is, at mid-span) and a height of one meter above ground. Plots of the lateral profile of magnetic field for each corridor configuration in **Table 6-4** are provided in **Appendix H**.

[86] *In the Matter of the Route Permit Application for the North Rochester to Chester 161 kV Transmission Line Project*, Docket No. E-002/TL-11-800, ORDER at 20 (Sept. 12, 2012).

Out of all the possible transmission line configurations, the maximum possible magnetic field under typical operating conditions during typical loading is 173.2 mG with the maximum possible magnetic field at the edge of the right-of-way calculated at 28.5 mG. These projected levels are below the magnetic field levels associated with most of the household electric appliances shown in **Table 6-3**.

Table 6-4. Calculated Magnetic Fields for Project Corridors (Projected Typical Loading – Winter Peak)

Corridor Configuration	Line Current (Amps)	Edge of Right-of-Way	Maximum Overall		
		Intensity (mG)	Intensity (mG)	Distance from Right-of-Way Centerline (feet)	Combined Right-of-Way Width (feet)
Project: Double-Circuit 345 kV	1549.0	22.63	171.49	0	150
Existing: 230 kV H-Frame Project: Double-Circuit 345 kV	39.9 1549.0	25.70	167.02	55	250
Existing: 115 kV H-Frame Existing: 230 kV H-Frame Project: Double-Circuit 345 kV	29.6 39.9 1549.0	19.98	170.73	90	340
Existing: 115 kV H-Frame Existing: 115 kV H-Frame Existing: 230 kV H-Frame Project: Double-Circuit 345 kV	29.6 88.4 39.9 1549.0	22.39	166.07	140	430
Existing: 115 kV H-Frame Existing: 230 kV H-Frame Project: Double-Circuit 345 kV	43.7 376.8 1549.0	17.38	173.16	87	340
Project: Double-Circuit 345 kV Existing: 69 kV Monopole	1549.0 104.6	26.35	165.82	36	220
Project: Double-Circuit 345 kV Existing: 230 kV H-Frame	1549.0 376.8	28.51	160.36	59	250
Project: Double-Circuit 345 kV Existing: 69 kV Monopole Existing: 230 kV H-Frame	1549.0 67.8 376.8	14.88	167.64	77	340
Project: Double-Circuit 345 kV Existing: 69 kV Monopole Existing: Double-Circuit 230 kV	1549.0 67.8 472.9	22.77	165.23	68	290
Project: Triple Circuit 345 kV with 69 kV	986.3 119.7	21.75	40.56	22	150
Project: 345 kV Monopole Project: Double-Circuit 345 kV	986.3 119.7	19.15	68.16	47	240

6.5.3 EMF and Health Effects

Significant research has been performed since the 1970s to determine whether exposure to power frequency magnetic fields causes biological responses and health effects. Reviews of this research by public health agencies such as the U.S. National Cancer Institute, the U.S. National Institute of Environmental Health Sciences, and the World Health Organization do not show that exposure to electric power EMF causes or contributes to adverse health effects. For instance, the U.S. National Cancer Institute concluded that:

> Numerous epidemiologic studies and comprehensive reviews of the scientific literature have evaluated possible associations between exposure to non-ionizing EMFs and risk of cancer in children (13-15). (Magnetic fields are the component of non-ionizing EMFs that are usually studied in relation to their possible health effects.) Most of the research has focused on leukemia and brain tumors, the two most common cancers in children. Studies have examined associations of these cancers with living near power lines, with magnetic fields in the home, and with exposure of parents to high levels of magnetic fields in the workplace. No consistent evidence for an association between any source of non-ionizing EMF and cancer has been found.[87]

Minnesota, Wisconsin, and California have also all performed literature reviews or research to examine this issue. In 2002, Minnesota formed an Interagency Working Group to evaluate EMF research and develop policy recommendations to protect the public health from any potential problems arising from EMF effects associated with HVTLs. The Working Group included staff from a number of state agencies and published its findings in *A White Paper on Electric and Magnetic Field (EMF) Policy and Mitigation Options*. The Working Group summarized its findings as follows:

> Research on the health effects of EMF has been carried out since the 1970s. Epidemiological studies have mixed results – some have shown no statistically significant association between exposure to EMF and health effects, some have shown a weak association. More recently, laboratory studies have failed to show such an association, or to establish a biological mechanism for how magnetic fields may cause cancer. A number of scientific panels convened by national and international health agencies and the United States Congress have reviewed the research carried out to date. Most concluded that there is insufficient evidence to prove an association between EMF and health effects; however, many of them also concluded that there is insufficient evidence to prove that EMF exposure is safe (MnDoH, 2002).

[87] NATIONAL CANCER INSTITUTE, *Electromagnetic Fields and Cancer* (reviewed May 30, 2022), available at https://www.cancer.gov/about-cancer/causes-prevention/risk/radiation/electromagnetic-fields-fact-sheet.

The Commission, based on the findings of the Working Group and U.S. National Cancer Institute, has repeatedly found that "there is insufficient evidence to demonstrate a causal relationship between EMF exposure and any adverse human health effects."[88]

The potential impacts of electric fields include interference with the operation of pacemakers and Implantable Cardioverter/Defibrillators ("ICDs"). Interference with implanted cardiac devices is rare, but can occur if the electric field intensity is high enough to induce sufficient body currents to cause interaction. Generally, the response depends on the make and model of the device in addition to the individual's height, build, and physical orientation with respect to the electric field. Pacemaker manufacturers such as Medtronic and Guidant have indicated that modern cardiac devices are considerably less susceptible to interactions with electric fields than older "unipolar" designs. A 2005 study (Scholten et al. 2005) concluded that the risk of interference inhibition of unipolar cardiac pacemakers from high-voltage power lines in everyday life is small. In 2007, Minnesota Power and Xcel Energy conducted studies with Medtronic to evaluate the impact of the electric fields associated with existing 115 kV, 230 kV, 345 kV, and 500 kV transmission on implantable medical devices. The analysis was based on real life public exposure levels under actual transmission lines in Minnesota; no adverse interaction with pacemakers or ICDs occurred (University of Minnesota Power Systems Conference Proceedings 2007). The analysis concluded that, although interaction may be possible in unique situations, device interaction due to typical public exposure would be rare.

In the unlikely event a pacemaker is impacted, the effect is typically a temporary asynchronous pacing. The pacemaker would return to its normal operation when the person moves away from the source of the interference.

6.6 Stray Voltage and Induced Voltage

Stray voltage is often caused by a lower voltage service system serving a customer, usually a farm, but it can also be caused by customer equipment. Questions concerning stray voltage are usually best addressed by the electric distribution utility that serves the farm directly. Transmission lines can, however, induce voltage on objects parallel to and immediately under the transmission line. Appropriate measures will be taken to prevent induced voltage problems when the Project parallels or crosses objects.

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[88] *In the Matter of the Application for a HVTL Route Permit for the Tower Transmission Line Project*, Docket No. ET2,E015/TL-06-1624, FINDINGS OF FACT, CONCLUSIONS OF LAW AND ORDER ISSUING A ROUTE PERMIT TO MINNESOTA POWER AND GREAT RIVER ENERGY FOR THE TOWER TRANSMISSION LINE PROJECT AND ASSOCIATED FACILITIES (August 1, 2007); *see also In the Matter of the Route Permit Application by Great River Energy and Xcel Energy for a 345 kV Transmission Line from Brookings County, South Dakota to Hampton, Minnesota*, Docket No. ET2/TL-08-1474, ALJ FINDINGS OF FACT, CONCLUSIONS AND RECOMMENDATION at Finding 216 (April 22, 2010 and amended April 30, 2010) ("there is no demonstrated impact on human health and safety that is not adequately addressed by the existing State standards for exposure") (adopted by the Commission on July 15, 2010); *In the Matter of the Application of Xcel Energy for a Route Permit for the Lake Yankton to Marshall Transmission Line Project in Lyon County*, Docket No. E002/TL-07-1407, FINDINGS OF FACT, CONCLUSIONS OF LAW AND ORDER ISSUING A ROUTE PERMIT TO XCEL ENERGY FOR THE LAKE YANKTON TO MARSHALL TRANSMISSION PROJECT at 7-8 (Aug. 29, 2008).

6.7 Corona-Induced Ozone and Nitrogen Oxide Emissions

Corona, in the context of transmission lines, refers to the breakdown or ionization of air within a few centimeters of conductors. Corona occurs when the electric field intensity, or surface gradient, on the conductor exceeds the breakdown strength of air. Usually, a water droplet or some imperfection such as a sharp edge or scratch on the conductor is necessary to cause corona. Chemical reactions can occur when corona forms, which can produce ozone and oxides of nitrogen in the air surrounding the conductor. In general, monitored concentrations of ozone due to corona discharge from transmission lines show no significant incremental ozone concentrations at ground level, and minimal (0 to 8 parts per billion ("ppb")) concentrations at an elevation nearer to the transmission line (Jeffers, 1999). Typically, these concentrations are detected only during heavy corona discharge in foul weather conditions. Additional testing has shown that production of nitrogen oxide due to corona discharges is approximately one-fourth of the production of ozone due to corona discharges (Jeffers, 1999).

Ozone also forms in the lower atmosphere from lightning discharges, and from reactions between solar ultraviolet radiation and air pollutants. The natural production rate of ozone is directly proportional to temperature and sunlight, and inversely proportional to humidity. Thus, humidity or moisture, the same factor that increases corona discharges from transmission lines, inhibits the natural production of ozone. Ozone is a very reactive form of oxygen molecules and combines readily with other elements and compounds in the atmosphere. Because of its reactivity it is relatively short-lived.

Both the State and federal governments currently have regulations regarding permissible concentrations of ozone and oxides of nitrogen. The National Ambient Air Quality Standards ("NAAQS") for ozone is 0.070 ppm on an eight-hour averaging period. The State standard for ozone is also 0.070 ppm on an eight-hour averaging period.

The national and state standard for nitrogen dioxide ("NO_2"), one of several oxides of nitrogen, is 100 ppb and the annual standard is 53 ppb. The State of Minnesota is currently in compliance with the national standards for NO_2. The operation of the proposed transmission lines would not create any potential for the concentration of these pollutants to exceed the nearby (ambient) air standards.

6.8 Radio and Television Interference

Generally, transmission lines do not cause interference with radio, television, or other communication signals and reception. While it is rare in everyday operations, four potential sources for interference do exist, including gap discharges, corona discharges, and shadowing and reflection effects.

Gap discharge interference is the most commonly noticed form of power line interference with radio and television signals, and also typically the most easily fixed. Gap discharges are usually caused by hardware defects or abnormalities on a transmission or distribution line causing small gaps to develop between mechanically connected metal parts. As sparks discharge across a gap, they create the potential for electrical noise, which can cause interference with radio and television signals in addition to audible noise. The degree of interference depends on the quality and strength of the transmitted communication signal, the quality of the receiving antenna system, and the distance between the receiver and the power line. Gap discharges are usually a maintenance issue, since they tend to occur in areas where gaps have formed due to broken or ill-fitted hardware (clamps, insulators, brackets). Because gap discharges are a hardware issue, they can be repaired relatively quickly once the issue has been identified.

Corona from transmission line conductors can also generate electromagnetic noise at the same frequencies that radio and television signals are transmitted. The air ionization caused by corona generates audible noise, radio noise, light, heat, and small amounts of ozone as noted in **Section 6.7**. The potential for radio and television signal interference due to corona discharge relates to the magnitude of the transmission line-induced radio frequency noise compared to the strength of the broadcast signals. Because radio frequency noise, like electric and magnetic fields, becomes significantly weaker with distance from the transmission line conductors, very few practical interference problems related to corona-induced radio noise occur with transmission lines. In most cases, the strength of the radio or television broadcast signal within a broadcaster's primary coverage area is great enough to prevent interference.

If interference from transmission line corona associated with the Project does occur for an AM radio station within a station's primary coverage area where good reception existed before the Project was built, satisfactory reception can be obtained by appropriate modification of (or addition to) the receiving antenna system. The situation is unlikely, however, because AM radio frequency interference typically occurs immediately under a transmission line and dissipates rapidly with increasing distance from the line.

FM radio receivers usually do not pick up interference from transmission lines because:

- Corona-generated radio frequency noise currents decrease in magnitude with increasing frequency and are quite small in the FM broadcast band (88-108 Megahertz), and

- The interference rejection properties inherent in FM radio systems make them virtually immune to amplitude type disturbances.

The potential for television interference due to radio frequency noise caused by transmission lines is now substantially reduced because the United States has completed the transition from analog to digital broadcasting. Digital reception is in most cases considerably more tolerant of noise than analog broadcasts. Due to the higher frequencies of television broadcast signals (54 megahertz ("MHz") and above) a transmission line seldom causes reception problems within a station's primary coverage area. In the rare situation where the Project may cause interference within a station's primary coverage area, the problem can usually be corrected with the addition of an outside antenna.

Shadowing and reflection effects are typically associated with large structures, such as high buildings, that may cause reception problems by disturbing broadcast signals and leading to poor radio and television reception. Although the occurrence is rare, a transmission structure or the conductor can create a “shadow” on adjoining properties that obstructs or reduces the transmitted signal. Structures may also cause a “reflection” or scattering of the signal. Reflected signals from a structure result in the original signal “breaking” into two or more signals. Multipath reflection or “scattering” interference can be caused by the combination of a signal that travels directly to the receiver and a signal reflected by the structure that travels a slightly longer distance and is received slightly later by the receiver. If one signal arrives with significant delay relative to the other, the picture quality of digital television broadcast signals may be impacted. With digital broadcasts, the picture can become pixelated or freeze and become unstable. The most significant factors affecting the potential for signal shadow and multipath reflection are structure height above the surrounding landscape and the presence of large flat metallic facades. Television interference due to shadowing and reflection effects is rare but may occur when a large transmission structure is aligned between the receiver and a weak distant signal, creating a shadow effect. In the rare situation where the Project may cause interference within a station’s primary coverage area, the problem can usually be corrected with the addition of an outside antenna.

If television or radio interference is caused by or from the operation of the proposed facilities in those areas where good reception was available prior to construction of the Project, Applicants will evaluate the circumstances contributing to the impacts and determine the necessary actions to restore reception to the present level, including the appropriate modification of receiving antenna systems if necessary.

6.9 Audible Noise

Transmission lines can cause audible noise due to corona discharge from the conductors. This noise, which resembles a crackling sound, is typically only within the threshold of human hearing during rainy or foggy conditions, and even then, is generally imperceptible due to background noise. The impacts and mitigation of audible noise due to the Project are discussed further in **Section 7.2.3**.

7.1 Environmental Setting

The Proposed Route traverses Itasca, Aitkin, Crow Wing, Morrison, Benton and Sherburne counties, Minnesota. It is sited within the St. Louis Moraines, Tamarack Lowlands, Pine Moraines and Outwash Plains, and Mille Lacs Uplands subsections of the Laurentian Mixed Forest Province and the Anoka Sand Plain Subsection of the Eastern Broadleaf Forest Province as defined by the Minnesota Department of Natural Resource Ecological Classification System (MnDNR 2000).

The Laurentian Mixed Forest Province is characterized by broad areas of conifer forest, mixed hardwood and conifer forests, and conifer bogs and swamps. The landscape ranges from rugged lake-dotted terrain with thin glacial deposits over bedrock, to hummocky or undulating plains with deep glacial drift, to large, flat, poorly drained peatlands.

The Eastern Broadleaf Forest Province serves as a transition zone between semi-arid portions of the state that were historically prairie and semi-humid mixed conifer-deciduous forests to the northeast. The southern portion of the Proposed Route is located within the Anoka Sand Plain Subsection within this province and consists of a flat, sandy lake plain and terraces along the Mississippi River.

The environmental setting of the Proposed Route consists of open space, deciduous forest, and hydrologic features such as lakes, streams, rivers, and wetlands. The physiographic features (topography, soils, geology, and vegetation) vary from flat to rolling hills with steep ravines along streams and rivers. Major physiographic features, jurisdictional boundaries, and environmental resources, found in or adjacent to the Proposed Route, are described in this chapter.

Typical land use within and adjacent to the Proposed Route consists of low density and rural residential property, open and public lands, agricultural land, forest land, and commercial property. The closest cities to and within the Proposed Route are Hill City, Riverton, Harding, Pierz, St. Cloud, and Becker. The most important land uses are forestry, agriculture, and tourism. Tourism is common where there are concentrations of recreational trails, parks, and lakes.

Existing rights-of-way associated with transmission lines, distribution lines, and roads are prevalent within and adjacent to the Proposed Route (**Map 1-1**).

Chapter 7 includes environmental analysis of the Proposed Route and, where applicable, the Proposed Right-of-Way and Proposed Centerline. Potential impact calculations and direct (permanent and temporary) impacts presented in **Chapter 7** are based upon the Proposed Right-of-Way and Proposed Centerline using typical and assumed design and construction practices. More information on how anticipated impacts were calculated is provided in each chapter subsection below. Several terms are used throughout this Chapter and applicable definitions are provided below:

- Study Area – The Study Area ranges from 6 to 27 miles wide (east to west) and extends (north to south) from the existing Iron Range Substation to the existing Sherco Substation and new Big Oaks Substation. More information on the Study Area can be found in **Section 5.2.1**.

- Route Corridor – The Route Corridor extends (north to south) from the existing Iron Range Substation to the existing Sherco Substation and new Big Oaks Substation. The Route Corridor is narrower in width (east to west) than the Study Area. More information on the Route Corridor can be found in **Section 5.2.2**.

- Proposed Route – The Proposed Route ranges from 1,000 feet to 6,600 feet wide (east to west) and extends (north to south) from the existing Iron Range Substation to the existing Sherco Substation and new Big Oaks Substation. The Proposed Route is narrower in width than the Route Corridor. More information on the Proposed Route can be found in **Section 5.2.3**.

- Proposed Centerline – The Proposed Centerline for the Project is where the Applicants, based on information available at the time of filing this Application, intend to place the centerline of the Project. The Proposed Centerline for the Project can be found on the maps contained in **Appendix J, Detailed Mapbook, Pages 1-64**.

- Proposed Right-of-Way – The Proposed Right-of-Way for the Project is located within the Proposed Route. The Proposed Right-of-Way extends approximately 75 feet on either side of the Proposed Centerline. In Segment 1, the Proposed Centerline will overlap with existing transmission line rights-of-way up to 30 to 40 feet, where practicable. In Segment 2, Applicants do not anticipate it will be necessary to expand the existing transmission line right-of-way widths, except near the existing Sherco Substation and new Big Oaks Substation where new or modified rights-of-way (not to exceed 75 feet on either side of a transmission line centerline) may be needed to accommodate transmission line configurations around these substations. More information on the Proposed Right-of-Way can be found in **Section 6.1** and on the maps contained in **Appendix J, Detailed Mapbook, Pages 1-64**.

- Substation Siting Area – The Substation Siting Area is the area within which the proposed Cuyuna Series Compensation Station or the Iron Range Substation and Benton County Substation expansions will be located. The Substation Siting Area is larger than the area that will be needed for the fenced area of the proposed series compensation station or the expansions at the existing substations. The Substation Siting Area is intended to allow flexibility as design develops. However, the potential impact calculations and direct (permanent and temporary) impacts presented in **Chapter 7** are based on the size of area needed to construct the proposed Cuyuna Series Compensation Substation (25 acres), Iron Range

Substation expansion (15 acres), and Benton County Substation expansion (8.9 acres) as described in **Section 2.5.1**. The Substation Siting Area for the proposed Cuyuna Series Compensation Station, Iron Range Substation expansion, and Benton County Substation expansion can be found on maps contained in **Appendix J, Detailed Mapbook, Pages 24-25, 1, and 51,** respectively**.**

7.2 Human Settlement

7.2.1 Proximity to Residences

Residences and businesses are located along roads within the Project. Residences are typically low density and rural residential with a house and non-residential structure. Avoidance of residences was a priority when identifying the Proposed Route.

7.2.1.1 Impacts and Mitigation

Potential impacts to residences were identified by measuring distance to residences from the Proposed Centerline as shown in **Table 7-1**. Within Segment 1 (Iron Range to Benton County) no residences and seven non-residential structures are located within the Proposed Right-of-Way. The non-residential structures are outbuildings. Within Segment 2 ((a) Benton County Substation to Big Oaks Substation and (b) Benton County Substation to Sherco Substation), five residences and 17 non-residential structures are located within the current right-of-way for the replaced transmission line. (**Table 7-1** and **Appendix J, Detailed Mapbook, Page 3, 4, 37, 39, 46, 50, 51, 54, 57, 58, 60, 61, 63, and 65**).

In Segment 2, the five residences (one on the MR Line and four on the GRE-BS Line) that have residential improvements partially within 75 feet of the centerlines of the existing transmission lines were constructed after the existing transmission lines were built. These improvements have been reviewed in connection with the existing transmission lines to ensure that there are no safety, integrity, or compliance concerns that require action to continue to safely operate the existing lines. With respect to the Project, the Applicants anticipate that the Project likewise will not require that Applicants take action to relocate any or all of these residences, or any portion thereof, and Applicants will work with the residence owners to document these situations and/or agreements, as necessary.

Table 7-1. Proximity of Residences and Non-Residential Structures to the Proposed Centerline

Feature	Segment 1		Segment 2	
	Residences	Non-Residential Structures	Residences	Non-Residential Structures
Number within 0 to 75 feet from Proposed Centerline	0	7	5	17
Number within 76 to 150 feet from Proposed Centerline	8	8	52	43
Number within 151 to 300 feet from Proposed Centerline	27	63	61	64
Number within 301 - 500 feet from Proposed Centerline	44	139	88	93
Number within 501 to 1,000 feet from Proposed Centerline	136	391	235	182
Number within the Proposed Route	160	368	212	233

With respect to the transmission line, the Applicants may work with landowners to address alignment adjustments and structure placement to the extent practicable. The requested route widths afford the Applicants the flexibility to work with landowners around existing residences, other structures, and businesses, as appropriate. Property or easement acquisition will be conducted in accordance with applicable regulations.

7.2.2 Public Health and Safety

Public health and safety will be a priority during the construction, operation and maintenance of the Project. Safety concerns related to construction may include slow movement of construction equipment on public roads, construction equipment crossing public roads and trails, conductor stringing across public roads and near public areas, and land clearing operations. Public health and safety concerns related to operation include outages, fires, and electrocution.

Refer to **Section 6.5** for a discussion of electric and magnetic fields.

7.2.2.1 Impacts and Mitigation

No effects to public health and safety are anticipated as a result of the Project. Proper safeguards would be implemented for construction, operation, and maintenance of the proposed 345 kV transmission lines. The Project will be designed in compliance with state, NESC, Great River Energy, and Minnesota Power standards regarding clearance to ground, clearance to crossing utilities, clearance to buildings, strength of materials, and right-of-way widths. Construction crews and/or contract crews will comply with state and NESC standards regarding installation of facilities and standard construction practices. Applicants' established safety procedures, as well as industry safety procedures, will be followed during and after installation of the transmission lines. During active construction, safety measures will be implemented to protect residents and trail users including, but not limited to, signage where active construction is occurring, flaggers at road and railroad crossings, and barriers around active construction zones. When crossing roads or railroads during stringing operations, guard structures will be used to eliminate traffic delays and provide safeguards for the public. Spotters will be employed during active construction activities (e.g., clearing and stringing) that span or are adjacent to trails. Additionally, Applicants will meet and maintain contact with trail advocacy groups (snowmobile, all-terrain vehicle ("ATV"), bicycle, etc.) to make trail users aware of construction and safety guidelines. With implementation of these safeguards and protective measures, no additional mitigation is proposed.

The proposed high-voltage transmission line will be equipped with switching devices (circuit breakers and relays located in the substations where the transmission lines terminate). These devices are intended to make, carry, and break line currents under normal conditions and in specified abnormal conditions such as a short circuit or fault. The circuit breakers stop the specified current and can protect other equipment and the extended power system from damaging currents and more extensive outages; however, any electrical facility which becomes isolated by operation of circuit breakers should not be considered de-energized or safe. Downed power lines and other damaged electrical equipment should always be assumed to be energized and dangerous.

As discussed in **Chapter 6**, no effects to public health and safety from electric and magnetic fields are anticipated as a result of the Project.

7.2.3 Audible Noise

Noise is defined as unwanted sound. It may be comprised of a variety of sounds of different intensities across the entire frequency spectrum. Noise is measured in units of decibels (dB) on a logarithmic scale. Because human hearing is not equally sensitive to all frequencies of sound, the most noticeable frequencies of sound are given more "weight" in most measurement schemes. The A-weighted decibel ("dBA") scale corresponds to the sensitivity range for human hearing by applying more "weight" to frequencies a person hears clearly and less "weight" to frequencies a person doesn't hear as well. A noise level change of 3 dBA is barely perceptible to a person with healthy hearing organs in an ideal listening environment (i.e., an audiology booth). A 5-dBA change in noise level is clearly noticeable for that same person in the same listening environment. For reference, **Table 7-2** shows noise levels associated with common, everyday sources, providing context for the transmission line and substation noise levels discussed later in this section.

Table 7-2. Common Noise Sources and Levels

Sounds Pressure Levels (dBA)	Common indoor and outdoor noises
110	Rock band at 5 meters
100	Jet flyover at 300 meters
90	Chainsaw at 1 meter
85	Typical construction activities
80	Food blender at 1 meter
70	Vacuum cleaner at 3 meters
60	Normal speech at 1 meter
50	Dishwasher in the next room
40	Library
30	Bedroom
20	Quiet rural nighttime

Source: MPCA 2015

Table 7-3 provides the Minnesota Pollution Control Agency ("MPCA") daytime and nighttime noise standards organized by Noise Area Classifications. MPCA noise standards are expressed using the L_{50} and L_{10} statistical descriptors. The L_{50} noise level represents the level exceeded 50 percent of the time, or for 30 minutes in an hour. The L_{10} noise level represents the level exceeded 10 percent of the time, or for six minutes in an hour. Noise Area Classifications ("NAC") are categorized by the type of land use activities at a location and the sensitivity of those activities to noise. Residential-type land use activities including residences, churches, camping and picnicking areas, and hotels are included in NAC-1. Commercial-type land use activities such as transit terminals, retail and business services are included in NAC-2. Industrial-type land use activities are included in NAC-3. Most of the Project area would be categorized as NAC-1 or NAC-2, since much of it is rural in nature. Practically, this means that during the one-hour period of monitoring, daytime noise levels in a residential-type (NAC-1) land use area of the Project cannot exceed 65 dBA for more than 10 percent of the time or 60 dBA more than 50 percent of the time.

Table 7-3. MPCA Noise Limits by Noise Area Classification

Noise Area Classification	Description	Daytime (dBA)		Nighttime (dBA)	
		L_{10}	L_{50}	L_{10}	L_{50}
1	Residential-type Land Use Activities	65	60	55	50
2	Retail-type Land Use Activities	70	65	70	65
3	Manufacturing-type Land Use Activities	80	75	80	75

Source: MPCA 2015

Audible noise will occur as part of the construction and operation phases of the Project. Noise-sensitive land uses within the vicinity of the Proposed Route primarily includes residences and neighborhoods, cross-country ski and walking trails, trout streams, natural areas, cemeteries, churches, office buildings, restaurants, retail/shopping stores, and parks.

7.2.3.1 Noise Related to Construction

Construction is anticipated to occur primarily during daytime hours. The main source of noise will derive from heavy construction equipment operation, tree clearing equipment, and increased vehicle traffic due to construction personnel transporting materials to and from the site.

7.2.3.2 Noise Related to Substations

Transformers, inverters, and switchgears are among the primary noise sources of a substation. Noise emissions from this equipment have a tonal character that sometimes sounds like a hum or a buzz, that corresponds to the frequency of the alternating current. Transformers are among the largest noise sources, and the core of a transformer will expand and contract as it is magnetized and demagnetized at a rate that is based on the frequency of the alternating current. This type of noise does not have much low frequency content, and therefore blends into background noise levels with increasing distance away from the source without being too intrusive off-site. The Applicants will secure substation components that operate within the state noise standard.

7.2.3.3 Noise Related to Transmission Lines

Transmission line conductors emit a noise that is called corona. Corona noise has a crackling sound and is due to corona discharges—the small amount of electricity ionizing the moist air near the conductors. During heavy rain the background noise level of the rain is usually greater than the corona noise from the transmission line. As a result, people do not normally hear noise from a transmission line during heavy rain. During light rain, dense fog, and sometimes snow and other high humidity conditions, corona noise is more perceivable because it is not being masked by the sounds of rain.

During dry weather, corona noise from transmission lines is much less perceptible than during periods of high humidity. Several other factors, including conductor voltage, shape and diameter, and surface irregularities such as scratches, nicks, dust, or water drops can affect a conductor's electrical surface gradient and therefore its corona noise emission levels. The way conductors are arranged on the support poles also affects corona noise production.

7.2.3.4 Impacts and Mitigation

Construction noise will be temporary and primarily limited to daytime hours. Instances such as outages, operational limitations, customer schedules, or other factors may cause construction to occur outside of daytime hours or on weekends. Heavy equipment will also be equipped with sound attenuation devices such as mufflers to minimize the daytime noise levels. Transformers, inverters, and switchgears will create audible noise in the direct vicinity of substations, but residences will be far enough away to meet MPCA noise standards.

Corona noise levels were calculated using the audible noise module of CFI8X, a corona noise model created by Bonneville Power Administration. CFI8X calculates audible noise levels due to corona at different distances from the transmission line centerline, expressed as L50 noise levels in A-weighted decibels. Calculated audible noise levels associated with the various transmission line structure configurations of the Project are provided in **Table 7-4** for the edge of right-of-way.

Where the Project parallels existing transmission lines, the presence of another energized line nearby will affect the audible noise profile around the parallel lines. Therefore, the predicted audible noise associated with the various corridor scenarios where the Project's new transmission line parallels existing transmission lines are also given in **Table 7-4**. Because audible noise is primarily related to the electric field, and electric fields are particularly dependent on the voltage of the transmission line, the values in **Table 7-4** were calculated at the lines' maximum continuous operating voltage. Maximum continuous operating voltage is generally defined for the Project and adjacent transmission lines as the nominal voltage plus 10 percent, in this case 379.5 kV (for nominally 345 kV lines), 253 kV (for nominally 230 kV lines), 126.5 kV (for nominally 115 kV lines), or 75.9 kV (for nominally 69 kV lines). At some locations, such as near a substation where more restrictive voltage criteria are used, the maximum continuous operating voltage will be limited to the nominal voltage plus 5 percent, as noted in **Table 7-4**. Values were calculated assuming minimum conductor-to-ground clearance (that is, at mid-span) and a height of one meter above ground. Plots of the lateral profile of audible for each corridor configuration in **Table 7-4** are provided in **Appendix H**.

As indicated in **Table 7-3**, the most stringent MPCA noise standard is the nighttime L_{50} limit for the land use category that includes residential areas (NAC-1). The NAC-1 nighttime limit is 50 dBA. Modeling results in **Table 7-4** indicate that Project-related audible noise is expected to be within the most stringent MPCA noise standards for all corridor configurations.

Table 7-4. Calculated L_{50} Audible Noise for the Project

Project Configuration with Existing Transmission Lines	Configuration	Line Voltage	L_{50} Noise Level at Edge of Right-of-Way (dBA)
Project alone	Project: Double-Circuit 345 kV	379.5 kV	43.9
Project parallel 92 Line	Existing: 230 kV H-frame Project: Double-Circuit 345 kV	253 kV 379.5 kV	49.8
Project parallel 92 Line & 11 Line	Existing: 115 kV H-Frame Existing: 230 kV H-frame Project: Double-Circuit 345 kV	126.5 kV 253 kV 379.5 kV	49.0
Project parallel 92 Line & 11 Line & 13 Line	Existing: 115 kV H-Frame Existing: 115 kV H-Frame Existing: 230 kV H-frame Project: Double-Circuit 345 kV	126.5 kV 126.5 kV 253 kV 379.5 kV	48.9
Project parallel MR Line & 12 Line	Existing: 115 kV H-Frame Existing: 230 kV H-Frame Project: Double-Circuit 345 kV	126.5 kV 253 kV 379.5 kV	48.9
Project parallel RW Line	Project: Double-Circuit 345 kV Existing: 69 kV Monopole	379.5 kV 75.9 kV	47.8
Project parallel MR Line	Project: Double-Circuit 345 kV Existing: 230 kV H-Frame	379.5 kV 253 kV	49.9
Project parallel MR Line & BP Line	Project: Double-Circuit 345 kV Existing: 69 kV Monopole Existing: 230 kV H-Frame	379.5 kV 75.9 kV 253 kV	49.3
Project parallel MRX Line double-circuit & BP Line	Project: Double-Circuit 345 kV Existing: 69 kV Monopole Existing: Double-Circuit 230 kV	379.5 kV 72.5 kV 241.5 kV	49.6
Project Rebuild: triple circuit EW Line	Project: Triple-Circuit 345 kV with 69 kV	379.5 kV 75.9 kV	46.5
Project Reconfiguration GRE-BS Line and MR Line	Project: 345 kV Monopole Project: Double-Circuit 345 kV	362.3 kV 362.3 kV	48.9

Source: Minnesota Power (2023)

7.2.4 Aesthetics

This section describes the current visual landscape in and adjacent to the Proposed Route and the potential impacts and associated mitigation that could occur.

Current land use along the Proposed Route consists of low density and rural residential land, open and public land (dense forest, prairie, and wetland areas), agricultural land, and scattered industrial areas.

Existing transmission lines are currently visible throughout much of the Proposed Route. More than 85 percent (155.1 of 181.4 miles) of the Proposed Route will follow existing 115 kV and/or 230 kV high-voltage transmission line rights-of-way, which will reduce impacts to new areas. Another 2.9 percent of the Proposed Route will follow existing 69 kV lines and roads. The existing transmission structure heights in Segment 1, range in height between 45 feet to 105 feet. South of the Benton County Substation to the future Big Oaks and existing Sherco substations, the existing high-voltage transmission lines will be replaced. Structures associated with those existing lines in Segment 2, range between 75 and 105 feet tall. In comparison, proposed Project structures are anticipated to range between 120 and 180 feet tall.

7.2.4.1 Impacts and Mitigation

7.2.4.1.1 Segment 1

(a) Substations and Series Compensation Station

The Iron Range and Benton County substation expansions will occur at existing substations and on property owned by the Applicants. There is already considerable utility infrastructure in both of the substation areas as existing transmission and distribution lines are prevalent around the substations.

New utility infrastructure will be developed in the proposed Cuyuna Series Compensation Station location, and tree removal and grading will be needed to support construction. The proposed Cuyuna Series Compensation Station Siting Area is shown on **Appendix J, Detailed Mapbook, Pages 24-25**.

Substation expansions would occur where the visual character of the area is already dominated by electric infrastructure. Although the expansion would establish additional permanent visual features, impacts are expected to be minimal based on the existing substation. The new Cuyuna Series Compensation Station will be constructed on currently vacant forested land and will introduce a new permanent visual feature into the environment. However, the current site is removed from public roads or residences and would be screened by adjacent forested areas. Although a permanent impact, it would only be visible to individuals potentially recreating (i.e., hunting) in the area.

(b) Transmission

Existing transmission lines are currently visible throughout much of the Proposed Route. More than 83 percent (116 of 139.5 miles) of the Proposed Route in Segment 1 will be follow existing 115 kV and/or 230 kV high-voltage transmission line rights-of-way, which will reduce impacts to new areas. Another 22.0 percent of the Proposed Route in Segment 1 will follow existing 69 kV lines and roads. The existing transmission structure heights in Segment 1, range in height between 45 feet to 105 feet.

Approximately 1,109 acres of forested land (deciduous, evergreen, mixed forest, and woody wetlands) will be cleared for new right-of-way in Segment 1 (see **Section 7.8.3**). Right-of-way tree clearing and other construction activities will be temporarily visible throughout the Proposed Route during the construction period. In addition, tree clearing outside of the rights-of-ways necessary for conductor pulling and tensioning sites would also occur during construction. The proposed transmission lines will be permanently visible to observers in the general area surrounding the Project. To avoid and minimize potential aesthetic impacts, the Applicants have proposed a route that generally follows existing rights-of-way, where practicable. More than 85 percent of the Proposed Route follows existing 115 kV and 230 kV high-voltage transmission line rights-of-way. Some visual impacts may still result from placement of new, taller transmission structures, but overall, permanent impacts will be reduced because the Project is generally proposed where transmission structures are already part of the visual character of the area.

There are areas of high scenic integrity and significance at points along the Proposed Route, as identified by the public and agency officials during public outreach. Some portions of new right-of-way within the Proposed Route could create new visual impacts in these areas (see **Section 7.2.8**).

The Proposed Route crosses the Mississippi River in two locations, southeast of Grand Rapids in Itasca County and just north of the proposed Cuyuna Series Compensation Station in Crow Wing County. Both crossings will expand the existing transmission corridor and will result in the removal of some native tree cover. However, in both locations the Proposed Right-of-Way follows existing transmission lines across the river.

The Project will also cross the Great River Road scenic byway at two locations near the Mississippi River, one crossing at County Road 3 in Itasca County (**Appendix J, Mapbook JA, Page 2**) and the second crossing at County Road 11 in Crow Wing County (**Appendix J, Mapbook JA, Page 9**). As the proposed transmission structures will have a greater height compared to existing structures, construction may result in some new visual impacts. In addition, forest areas will likely be removed adjacent to the existing county road right-of-way as part of the construction process. However, as the Proposed Route will be located adjacent to existing rights-of-way, impacts are expected to be reduced. No structures will be proposed to be located within the county road right-of-way.

The Proposed Route also crosses the Cuyuna Country State Recreation Area. Currently, there are five transmission lines (two 230 kV, two 115 kV and one 69 kV) that cross the recreation area at the western end. The Project will create new, permanent visual impacts. However, because multiple transmission lines presently exist throughout the recreation area and the area is a historic industrial district, those impacts will be limited. In discussion with the SHPO, the Project would likely result in no significant change in visual characteristics to the historic industrial district. Trail users throughout the Proposed Right-of-Way may notice limited impact in the aesthetic quality of affected areas, but impacts should dissipate with increased distance.

To limit impacts to residents in Segment 1, the Proposed Right-of-Way is located near multiple existing transmission lines. This paralleling of existing transmission lines will result in visual impacts to residences not substantially changing from existing conditions. Impacts should dissipate with increased distance from the right-of-way.

In addition, in areas along the Proposed Route, the Route width and Proposed Centerline have been modified away from the existing transmission right-of-way to allow for flexibility near areas where there are residences (see **Section 5.2.3**). Visual impacts from the Project will occur in these modified areas, but are anticipated to be reduced. Locations where the Proposed Route or Proposed Centerline realignments have been shifted to reduce impacts on residences are as follows:

Proposed Route not located along existing high-voltage transmission line rights-of-way:

- The Proposed Route south of the Iron Range Substation was located away from the existing 92 Line near County Roads 10 and 434 and the Swan River (**Appendix J, Detailed Mapbook, Pages 1 and 2**).

- The Proposed Route south of the Mississippi River near River Road and Cole Lake Way northwest of Crosby in Section 21 of Wolford Township in Crow Wing County, Minnesota Power's 13 Line joins the 11 Line and 92 Line from the east. The Proposed Centerline was placed on the east side of the existing lines to reduce impacts to existing residences (**Appendix J, Detailed Mapbook, Page 23**).

- The Proposed Route south of the Cuyuna Series Compensation Station was located away from the existing transmission lines because of an added span over Little Rabbit Lake (which is considered part of the Mississippi River) and approximately ten residential lots would be crossed north of Little Rabbit Lake (**Appendix J, Detailed Mapbook, Pages 24 and 25**).

- The Proposed Route was located east of South Long Lake and Upper South Long Lake due to the close proximity of many residences to the existing transmission line between the two lakes and may residences on the southwest side of South Long Lake (**Appendix J, Detailed Mapbook, Pages 28, 29, 30, and 31**).

Proposed Centerline realignments are discussed in **Section 2.1.5.4.2**:

- In Section 31 of Blackberry Township and Section 6 of Splithand Township, Itasca County, the Proposed Route is located on the east side of Minnesota Power's existing 92 Line. At this point, the existing 115 kV 11 Line crosses the 230 kV 92 Line, then crosses back. To avoid additional line crossings, the 115 kV 11 Line will be routed in a new 100-foot right-of-way on the west side of the 230 kV 92 Line for approximately 1.5 miles and the Proposed Centerline will continue on the east side of the 92 Line (**Appendix J, Detailed Mapbook, Pages 4 and 5**).

- In Granite Township, Morrison County, the Proposed Centerline is located on the west side of the MR Line. In Section 19, to reduce residential impacts and provide screening for a home on the west side of the MR Line, the Proposed Centerline will be shifted to the current MR Line right-of-way and the MR Line will be shifted east to a new 150- foot right-of-way (**Appendix J, Detailed Mapbook, Pages 38 and 39**).

- In Section 31 of Granite Township and Section 11 of Pierz Township, Morrison County, the Proposed Centerline and the MR Line will be shifted to the east because of existing poultry barns just west of the current MR Line right-of-way. The Proposed Centerline will be shifted to the current MR Line right-of-way and the MR Line will be shifted east to a new 150-foot right-of-way (**Appendix J, Detailed Mapbook, Page 39**).

- In Section 23 and 26 of Pierz Township, Morrison County, the Proposed Centerline and the MR Line will be shifted to the east because of existing agricultural buildings and a farmstead just west of the current MR Line right-of-way. The Proposed Centerline will be shifted to the current MR Line right-of-way and the MR Line will be shifted east to a new 150-foot right-of-way (**Appendix J, Detailed Mapbook, Pages 40 and 41**).

- In Section 26 and 35 of Buckman Township, Morrison County, the Proposed Centerline and the MR Line will be shifted to the east because of existing agricultural buildings and two farmsteads west of the current MR Line right-of-way. The Proposed Centerline will be shifted to the current MR Line right-of-way and the MR Line will be shifted east to a new 150-foot right-of-way (**Appendix J, Detailed Mapbook, Pages 43 and 44**).

- In Section 2 of Minden Township, Benton County, the Proposed Centerline is west of the existing MR Line and Great River Energy's BP Line. At the crossing of Golden Spike Road, the existing MR Line and BP Line will be shifted to the east to allow the Proposed Centerline to avoid impacting a residence just west of the existing lines and to minimize impacts to the Elk River. The existing lines will be shifted to new right-of-way east of the Proposed Centerline (**Appendix J, Detailed Mapbook, Pages 48 and 49**).

7.2.4.1.2 Segment 2

Between the Benton County Substation and Sherco Substation and the Big Oaks Substation, the Project would use existing rights-of-ways and replace the existing H-frame and steel monopole structures with new double-circuit 345 kV steel monopole structures for all but 2.25 miles, or 5.4 percent of the length. As described above, transmission lines that already exist in the vicinity of the Proposed Route will limit the extent to which the new infrastructure is viewed as a disruption to the area's scenic integrity, but increased structure height will impart some visual differences. Since the proposed replacement route rebuilds existing high-voltage transmission line segments, visual impacts will be minimized to residents and other land uses.

The Proposed Route will cross the proposed Big Elk Lake Park, within existing right-of-way. As existing transmission line H-frame structures have been in place prior to the park being proposed, the Project should result in only minimal permanent visual impacts, primarily from the change in structure type and height. The Applicants will work with park development on structure placement to reduce impacts on aesthetics.

7.2.5 Environmental Justice

Two methodologies were used to assess environmental justice areas within the Environmental Justice Study Area (within one-quarter mile of the edge of the Proposed Route). The first methodology uses guidance from the U.S. Environmental Protection Agency ("USEPA") to assess minority, low-income, and Limited English Population ("LEP") areas. According to USEPA guidance, a minority or low-income area is present if the percentage of minorities (Hispanic, Black or African American, Native American or Alaska Native, Asian, or Native Hawaiian or Pacific Islander) or if the percentage of people with an income below the poverty level is meaningfully greater than the general population in the larger surrounding area (EPA, 1998). Based on recent EAs completed for transmission lines in Minnesota, meaningfully greater is defined as 10 percentage points higher than the total population of the area (Mn DoC 2021a). An LEP population is identified when five percent of the population, or 1,000 people who speak one language other than English, speak English less than very well. The latest Census data was used to identify minority or low-income populations within the Environmental Justice Study Area. Data from the 2020 Decennial Census was used to identify minority populations and data from the 2021 American Community Survey was used to identify low-income populations. Data for cities within the Environmental Justice Study Area were compared to the counties in which they are located. Because much of the Environmental Justice Study Area is rural, data from Census block groups was also compared to the counties in which they are located.

Minority and low-income populations were identified in St. Cloud using the USEPA methodology. Minority or low-income populations were not identified at the Census block level, as summarized in **Table 7-5**. The presence of an LEP potentially requiring written translations of documents, in accordance with USEPA guidance, was not identified in the Environmental Justice Study Area. Within the Environmental Justice Study Area, 103 people who speak Spanish speak English less than very well (0.3 percent of the Environmental Justice Study Area population). LEP for other languages is 200 or less, representing less than one percent of the Environmental Justice Study Area population (US Census, 2021). Data for the 19 Census tracts and 34 Census block groups is included in **Appendix T**.

Table 7-5. Minority and Low-Income Populations in the Environmental Justice Study Area – USEPA Methodology

Location	Percent Minority	EJ Area	Percent Low-Income	EJ Area
Minnesota	19.2%	No	9.2%	No
Aitkin County, Minnesota	4.4%	No	11.6%	No
Benton County, Minnesota	9.3%	No	9.5%	No
Crow Wing County, Minnesota	3.4%	No	10.2%	No
Itasca County, Minnesota	5.4%	No	11.1%	No
Morrison County, Minnesota	3.0%	No	10.0%	No
Sherburne County, Minnesota	8.4%	No	5.0%	No
Wright County, Minnesota	6.8%	No	4.9%	No
City of Becker (Sherburne County)	4.4%	No	5.2%	No
City of Harding (Morrison County)	2.4%	No	14.0%	No
City of Lastrup (Morrison County)	0.0%	No	9.0%	No
City of Riverton (Crow Wing County)	5.1%	No	17.8%	No
City of St. Cloud (Sherburne County)	27.3%	Yes	22.0%	Yes
City of Trommald (Crow Wing County)	2.0%	No	14.8%	No

Source: United States Census Bureau (2021)

The second methodology uses a definition from Minn. Stat. § 216B.1691, subd. 1(e), which was recently updated to include the following definition of "environmental justice area." Although this statute is not directly applicable to the Project, the definition provides a different methodology for assessing environmental justice areas along the Proposed Route. The statute defines an environmental justice area as area that meets one or more of the following criteria:

1. 40 percent or more of the area's total population is nonwhite;

2. 35 percent or more of households in the area have an income that is at or below 200 percent of the federal poverty level;

3. 40 percent or more of the area's residents over the age of five have limited English proficiency; or

4. the area is located within Indian country, as defined in United State Code, title 18, section 1151.

This area is based on one or more Census tracts. The percentage of nonwhite, low-income, and limited English proficiency populations in cities and counties in the environmental justice study area is summarized in **Table 7-6**.

Table 7-6. Environmental Justice Populations in the Environmental Justice Study Area – Minnesota Methodology

Location	Nonwhite Population	Percent Low-Income (MN)	Limited English Proficiency	EJ Area
Minnesota	23.7%	22.7%	3.0%	No
Aitkin County, Minnesota	7.8%	31.8%	0.3%	No
Benton County, Minnesota	13.4%	25.1%	1.8%	No
Crow Wing County, Minnesota	7.4%	29.0%	0.4%	No
Itasca County, Minnesota	10.8%	30.2%	0.4%	No
Morrison County, Minnesota	5.8%	28.8%	0.7%	No
Sherburne County, Minnesota	12.8%	14.9%	0.8%	No
Wright County, Minnesota	10.8%	14.8%	0.9%	No
City of Becker (Sherburne County)	8.3%	12.1%	0.0%	No
City of Harding (Morrison County)	7.3%	56.6%	0.0%	Yes
City of Lastrup (Morrison County)	5.0%	45.5%	0.0%	Yes
City of Riverton (Crow Wing County)	11.0%	42.1%	0.0%	Yes
City of St. Cloud (Sherburne County)	32.3%	41.2%	5.0%	Yes
City of Trommald (Crow Wing County)	5.1%	61.1%	0.0%	Yes

Source: United States Census Bureau (2021)
Note: Bold text indicates locations where minority or low-income population were identified.

Low-income populations were identified in Harding, Lastrup, Riverton, St. Cloud, and Trommald using the Minnesota definition of an environmental justice area.

Using the Minnesota definition of an environmental justice area, no minority populations were identified in Census tracts or Census block groups. One low-income population was identified in one Census tract and in a Census block group within this Census tract in Crow Wing County that encompasses Trommald, Minnesota. Data for the 19 Census tracts and 34 Census block groups is included in **Appendix T**.

The percentage of LEP is less than the Minnesota definition of an environmental justice area for all Census tracts (US Census 2021). The Proposed Route would not pass through Indian reservation or trust land, as defined in United States Code, title 18, section 1151.

7.2.5.1 Impacts and Mitigation

Environmental justice areas were identified within the Environmental Justice Study Area. Specifically, using the EPA guidance, the City of St. Cloud was identified as a minority and low-income environmental justice area. Using the Minnesota guidance, the following were identified as environmental justice areas: City of Harding (low-income); City of Lastrup (low-income); City of Riverton (low-income); City of St. Cloud (minority and low-income); City of Trommald (low-income); and one census block group in Crow Wing County (low-income). Environmental impacts from all resources area assessed in this Application were evaluated. As described in **Section 7.2.8** and **Section 7.5.1** of this Application, the Project is not anticipated to result in adverse impacts to air quality, recreation, or climate, and the Project is anticipated to result in positive socioeconomic benefits. As a result, the Project is not anticipated to have disproportionately high and adverse impacts on environmental justice areas, and no additional mitigation is proposed.

7.2.6 Socioeconomic

The socioeconomic setting of the Proposed Route was evaluated on a regional level comparing data from the cities of Trommald, Riverton, Harding, Lastrup, Becker, St. Cloud, the counties of Itasca, Aitkin, Crow Wing, Morrison, Benton, and Sherburne, and the state of Minnesota. Data gathered from the 2010 and 2020 U.S. Censuses are summarized in **Table 7-7**.

Table 7-7. Socioeconomic Characteristics Surrounding the Proposed Route

Location	2010 Population	2020 Population	Change (%)	2020 Unemployment Rate	2020 Median Household Income	2020 Population Below Poverty Level
State of Minnesota	5,303,925	5,639,632	6.3%	2.6%	$74,593	9.0%
Itasca County	45,058	45,180	0.3%	3.3%	$32,295	12.3%
Aitkin County	16,202	15,826	-2.3%	2.5%	$31,287	12.2%
Crow Wing County	62,500	64,775	3.6%	2.4%	$33,593	10.0%
Riverton City	117	205	75.2%	0.0%	$31,250	25.9%
Trommald City	98	94	-4.1%	28.4%	N/A	10.6%
Morrison County	33,198	33,119	-0.2%	2.7%	$33,918	10.3%
Harding City	125	156	24.8%	0.0%	$26,964	11.5%
Lastrup City	104	146	40.4%	1.9%	$30,417	6.2%
Benton County	38,451	40,476	5.3%	2.4%	$38,651	8.5%
Sherburne County	88,499	96,015	8.5%	1.7%	$42,063	5.3%
Becker City	4,538	4,919	8.4%	0.9%	$44,146	4.5%
St. Cloud City	65,842	68,390	3.9%	5.2%	$26,583	21.9%

Sources: United States Census Bureau (2010) (2020)

7.2.6.1 Impacts and Mitigation

Impacts to socioeconomics at a local and regional level would be beneficial and relatively temporary (i.e., 2-3 years). Additional information on these impacts, including Applicants' commitment to pay prevailing wages for applicable positions is available in **Sections 2.2.1** and **6.2.3**. During construction, revenue increases may occur for local businesses from the purchases of goods and services made by utility personnel and contractors. It is unlikely that construction activities would negatively impact local businesses or community function in a meaningful way.

Long-term societal benefits of the Project include ensuring the continued clean, reliable electric service to local customers into the future, which in turn, supports the local economy.

Because socioeconomic impacts are anticipated to be temporary and beneficial to the local communities, no mitigation is proposed.

7.2.7 Cultural Values

Cultural values are based on core principles and beliefs that form the foundation for community unity. The Project spans multiple counties including Crow Wing, Itasca, Aitkin, Morrison, Benton, and Sherburne. Contemporary Tribes with historic stake in lands within the vicinity of the Project include the Bois Forte Band of Chippewa, Leech Lake Band of Ojibwe, Lower Sioux Indian Community, Mille Lacs Band of Ojibwe, and Upper Sioux Community. Historic demographics for areas spanning the length of the Project Study Area include European immigrants with German, Norwegian, Swedish, and Irish heritage.

The Proposed Route crosses lands ceded by the Ojibwe in 1837 and 1855 treaties and by the Dakota in an 1837 treaty. The language of the 1837 treaties with the Ojibwe and Dakota reserved hunting, fishing, and gathering rights.

Itasca County contains natural areas, scenic byways, and opportunities for recreation including the 47-mile Edge of the Wilderness Scenic Byway, Scenic State Park, Chippewa National Forest, Lost Forty virgin pine forest, and Tioga Recreation Area. Itasca County includes a portion of the Leech Lake Band of Ojibwe Reservation and the Chippewa National Forest. At the northern edge of Itasca County lays the Deer Creek Indian Reservation of the Bois Forte Band of Chippewa, just east of the City of Effie. Itasca County is also home to multiple cultural and historical enrichment opportunities that include the Judy Garland Museum, the Reif Performing Arts Center, and the Children's Discovery Museum. Major industries in Itasca County include health care, retail, and forestry.

Aitkin County contains nearly one-million acres of public forest and chances for recreation, including Rice Lake National Wildlife Refuge, Hill River State Forest, Savanna Portage State Park, Mille Lacs Lake, Aitkin Campground, the Sandy Lake Recreation Area, and Aitkin City Park. Aitkin County contains multiple land holdings by the Mille Lacs Band of Ojibwe along Mallard Lake, Swamp Lake, east of Mille Lacs Lake, east of Rice

Lake National Wildlife Refuge, and along the shores of Big Sandy Lake. Aitkin County has many popular attractions including the Aitkin County Historical Society, the Jacques Art Center, and many shopping opportunities. Major industries include tourism, health care, and education.

Crow Wing County is known for its abundance of access to natural resources, recreational areas, and historical features including Crow Wing State Park, Emily State Forest, Cuyuna Country State Recreation Area, Mississippi River, and Gull Lake. The Mille Lacs Band of Ojibwe owns off-reservation land holdings between Dean and Deer Lake in east-central Crow Wing County. The Proposed Route crosses into the City of Riverton and the Cuyuna Iron Range Historic Mining Landscape District (see **Section 7.2.7**). Popular attractions in Crow Wing County include Cuyuna Country State Recreation Area, Breezy Belle Cruises, Gull Lake Cruises, Jack Pine Brewery, Paul Bunyan Trail, Brainerd International Raceway, and Deacon's Lodge golf course. The major industries of Crow Wing County include health care, retail, and mining.

Morrison County has multiple natural areas including Belle Prairie County Park, Crane Meadows National Wildlife Refuge and Management Area, Coon Lake State WMA, Charles A. Lindbergh State Park, and Lake Alexander Woods Scientific and Natural Area. Attractions and enrichment opportunities in Morrison County include Charles Lindbergh House and Museum, Pine Grove Zoo, Minnesota Military Museum, Minnesota Fishing Museum, Charles A. Weyerhaeuser Memorial Museum, and Linden Hill Historic Estate. Major industries in the area include health care, manufacturing, and retail.

Benton County contains natural areas including Englund Ecotone Scientific and Natural Area and Benlacs, Bibles, Sartell, and Wisneski State WMAs. Popular attractions in Benton County include Summerland Family Fun Park, St. Joseph's Church, St. Cloud Symphony Orchestra, and Paramount Theatre and Arts District. The largest industries in Benton County are health care, manufacturing, and retail.

Sherburne County has abundant recreation opportunities and natural areas including Woodland Trails Regional Park, Orono Park, Grams Regional Park, Oak Savanna Park, Sand Dunes State Forest, Sherburne National Wildlife Refuge, and William H. Houlton Conservation Area. Popular attractions within Sherburne County include Sherburne History Center, Munsinger Gardens, and Clemens Gardens. Major industries of Sherburne County are professional and business services, trades, and government.

7.2.7.1 Impacts and Mitigation

Construction of the Project is not expected to affect contemporary cultural values. Although there may be localized disruptions during construction, any disruptions should be of short duration and localized to the Project area. Accordingly, no mitigation is proposed.

7.2.8 Recreation

Public trails, parks, rivers and lakes, and state forests are located within one mile of the Proposed Route (**Appendix J, Mapbook JA, Pages 1-20**). The Proposed Route spans multiple waterbodies and rivers, three state forests, one state recreation area, multiple trails, three WMAs, one Aquatic Management Area ("AMA"), one scenic byway (at two locations), two county parks, and a golf club. Common recreational activities within the Proposed Route include hunting, trapping, biking, hiking, snowmobiling, ATV riding, cross-country skiing, fishing, boating, and camping.

Rivers, streams, and lakes are located near and within the Proposed Route (see **Section 7.6**). It spans the Mississippi River twice, southeast of Grand Rapids in Itasca County and just north of the Cuyuna Series Compensation Station in Crow Wing County. Briggs Creek, in Sherburne County, is a designated trout stream and is crossed twice by the Proposed Route. Rivers, streams, and lakes are important considerations for recreation as they provide habitat for game species and offer opportunities for fishing and boating.

7.2.8.1 Segment 1

There are three state forests and one state recreation area situated within one mile of Segment 1 including Golden Anniversary State Forest, Hill River State Forest, Crow Wing State Forest, and Cuyuna County State Recreation Area.

- Golden Anniversary State Forest is located in southern Itasca County and is crossed by the Proposed Route, Proposed Right-of-Way, and Proposed Centerline. The portion crossed by the Proposed Route contains the River Road Unit Ski Trail and the Cowhorn Lake Ski Touring and Hiking Trail, with Cowhorn Lake Trail within 0.1 miles of the Proposed Route. (Minnesota DNR 2019).
- Hill River State Forest is in Aitkin County, 20 miles south of Grand Rapids, and is crossed by the Proposed Route, Proposed Right-of-Way, and Proposed Centerline. There are ATV trails in the Hill River State Forest including the UPM Blandin Trail, Rabey Line ATV Trail, the Soo Line North ATV Trail, the Hill City ATV Trail, and the Blind Lake ATV Trail. Multiple off-highway motorcycle and snowmobile trails are located within the Forest. The Proposed Route runs along the Blind Lake ATV Trail and a snowmobile trail. In addition, it is located approximately 1.1 miles away from a boat ramp at White Elk Lake and 1.4 miles away from a hiking trail (Minnesota DNR 2020a).
- Crow Wing State Forest is about 20 miles north of Brainerd in Crow Wing County and is crossed by the Proposed Route, Proposed Right-of-Way, and Proposed Centerline. This area has multiple recreation opportunities including Pelican Beach Day-Use Area, Greer Lake Campground, Pine River State Water Trail, Mississippi River State Water Trail, and multiple snowmobile and ATV trails. The Project Route directly crosses multiple off-highway motorcycle and Class 1 and 2 ATV and snowmobile trails on Crow Wing State Forest Land (Minnesota DNR 2020b).
- The Cuyuna Country State Recreation Area is within the Proposed Route; however, the Proposed Right-of-Way and Proposed Centerline are not expected

to cross the recreation area. The area is situated between Ironton and Riverton and includes camping, hunting, mountain biking, and birding opportunities. The Cuyuna Lakes State Trail and mountain bike trails are spanned by the Proposed Route. The area is surrounded by lakes that provide opportunities for fishing and boating. Additionally, the Cuyuna Country State Recreation Area features the 20-acre Ironton Sintering Plant Complex, the greater Cuyuna Iron Range Historic Mining Landscape District, and multiple associated attractions throughout, which provide ample opportunities for enrichment. (Minnesota DNR 2023b). A planned trail expansion is under design moving west to Brainerd via the Sagamore Unit and Mississippi Northlands properties in the Study Area (Public Comment, January 23, 2023).

WMAs present within one mile of Segment 1 include Birchdale, Moose Willow, and Loerch. All WMAs support production of game species and provide hunting, trapping, and wildlife observation opportunities.

- Birchdale WMA is southeast of the junction between County Roads 1 and 106 in Crow Wing County and is crossed by the Proposed Route. The very southeastern-most corner of the WMA is crossed by the Proposed Right-of-Way and Proposed Centerline. This WMA features 1,425 acres of migration and production habitat for waterfowl, large and small game, and upland birds (Minnesota DNR 2023c).
- Moose Willow WMA (16,945 acres) is located southeast of Hill City in Aitkin County and is crossed by the Proposed Route. The western-most portion of the WMA is crossed by the Proposed Right-of-Way and Proposed Centerline. This WMA provides habitat for small game, large game, upland birds and waterfowl. A primitive campground is also present in the area. (Minnesota DNR 2023d).
- Loerch WMA is situated northeast of Brainerd and southeast of State Highway 210 in Crow Wing County within the Proposed Route, but is not crossed by the Proposed Right-of-Way or Proposed Centerline. The WMA is 206 acres and provides habitat for hardwood forest species, wetland species, and waterfowl. The two-mile Hay Lake Hunter Walking Trail extends through the WMA starting at a parking area south of Highway 120 and looping south of Hay Lake (Minnesota DNR 2023e).

There are two AMAs situated within one mile of Segment 1 including Sand Creek AMA and Wolvert AMA. AMAs provide aquatic habitat and opportunities for public fishing, wildlife observation, and research.

- Sand Creek is located northeast of the Proposed Route within four miles of the Iron Range Substation in Itasca County. The Sand Creek AMA is 59.5 acres and does not cross the Proposed Right-of-Way or Proposed Route. (Minnesota DNR 2023f).
- Wolvert AMA is located at the northeast corner of Upper South Long Lake and is crossed by the Proposed Route, Proposed Right-of-Way, and approximately 275 feet of the Proposed Centerline.

Paul Bunyan Land, an amusement park with multiple rides and a campground, is located in Brainerd about 1.25 miles east of the Proposed Route along Segment 1. (Paul Bunyan Land 2023). No other known resorts or private recreation facilities border the Proposed Route.

Scenic Byways are crossed along Segment 1 of the Proposed Route. The Great River Road provides an opportunity to view the Minnesota landscape and visit local communities along the highway and the Mississippi River. The Proposed Route crosses County Road 3 in Itasca County northeast of Golden Anniversary State Forest and County Road 11 in Crow Wing County.

7.2.8.2 Segment 2

There are four recreation sites located within one mile of Segment 2 along the Proposed Route including the Territory Golf Club, Rice Lake Savanna Scientific and Natural Area ("SNA"), Big Elk Lake Park, and Oak Savanna Park in Sherburne County.

- The Territory Golf Club is located within the Proposed Route on the east side of St. Cloud. (Territory Golf Club 2023). The club is a 58-acre public golf course that features natural wetlands, undulating topography, and a portion of the Elk River. The golf course is crossed by the Proposed Right-of-Way and Proposed Centerline. Great River Energy's existing high-voltage transmission line over the golf course will be rebuilt from the Benton County Substation to Sherco Substation as a part of this project. No new right-of-way is currently planned in this area.
- The Rice Lake Savanna SNA is 0.5 miles south of the Proposed Route, five miles southeast of the Benton County Substation. This SNA features abundant bur-oak savanna, oak woodland, and pockets of shallow wetlands that represent a globally rare ecosystem type (Minnesota DNR 2023a). This SNA provides habitat for native birds and vegetation and offers recreation opportunities including wildlife watching, hiking, photography, snowshoeing, and cross-country skiing.
- Sherburne County is planning a new, approximately 430-acre park in Palmer Township called the Big Elk Lake Park that is within the Proposed Route, Proposed Right-of-Way, and Proposed Centerline (Trust for Public Land 2023). Great River Energy's existing MR Line crosses this area and is planned to be replaced from the Benton County Substation to the Sherco Substation.
- Oak Savanna Park in Clear Lake Township is crossed by the existing MR line and the Proposed Route. No new right-of-way is currently planned in this area.

7.2.8.3 Impacts and Mitigation

Impacts to recreation will be minimal along Segment 1, as new Project structures will parallel existing transmission facilities and share existing rights-of-way within recreational areas. Impacts along Segment 2 will be minimal as this portion of the Project will consist primarily of rebuilt transmission lines. Construction activities such as tree clearing, lighting, and noise from heavy construction equipment may temporarily disturb recreators, as well as nearby wildlife and habitat, which could also temporarily impact recreation.

Specifically, temporary disturbance to recreation (hunting, trail use, and wildlife observation) during construction could occur due to potential short-term trail closures and the influence of increased construction activity on wildlife. The Project has been designed to avoid and minimize these impacts by using or paralleling existing infrastructure where feasible. Overall, disturbance should not affect recreation beyond the duration of the Project construction. Please refer to **Section 7.7** for further information on impacts and mitigation to local flora and fauna.

The Project is not anticipated to permanently disrupt nearby recreational activities. New visual impacts would result from new transmission line rights-of-way within State Forests, WMAs, and recreation areas. Existing transmission line rights-of-way and access will be used when feasible. Since transmission lines currently exist throughout the proposed area, it is expected that any permanent impacts to recreation will be minimal.

Construction activities could impact the safety of trail users. See **Section 7.2.2** for a discussion of safety measures that will be implemented in recreation areas.

The Applicants will coordinate with the MnDNR and local governments to ensure construction of the Proposed Route will not cause any significant impacts to recreation.

7.2.9 Public Services and Transportation

The Proposed Route is located in areas with public services, such as waste and recycling services, city sewer and water systems, fire protection, police, electricity, and natural gas. In addition, the Proposed Route traverses areas with a road-based transportation system and is adjacent to several local airports. A discussion of existing public services in terms of utilities (i.e., electricity and natural gas), transportation, and airports and any potential impacts and mitigation is provided below.

7.2.9.1 Utilities

Existing electric transmission lines, natural gas and liquid pipelines rights-of-way are located within the Proposed Route (**Appendix J, Detailed Mapbook, Pages 2, 3, 26, 27, 41, 42, 46, and 48** pipelines are listed below in **Table 7-8**. In addition, the Project spans the Mayhew Solar Site,[89] near Sauk Rapids, Minnesota (**Appendix J, Detailed Mapbook, Page 49**).

Table 7-8. Utility Gas and Liquid Pipelines Located within the Proposed Route

Utility	Ownership	Location
Liquid	Lakehead Pipeline Company	0.1 miles south of US Highway 2
Liquid	Lakehead Pipeline Company	0.1 miles south of US Highway 2
Liquid	Lakehead Pipeline Company	0.1 miles south of US Highway 2
Gas	Great Lakes Gas Transmission	0.4 miles south of US Highway 2

[89] For more information on this site, please see https://www.us-solar.com/solar-garden/uss-mayhew-solar-llc.

Utility	Ownership	Location
Gas	NA	Bordering and overlapping N Nelson Road near Loerch, MN
Gas	Viking Gas Transmission	0.5 miles north of 93rd St near Buckman, MN
Liquid	Minnesota Pipeline Company	2 miles south of State Highway 25
Gas	Northern Natural Gas Company	Crossing Golden Spike Rd near Sauk Rapids, MN

7.2.9.1.1 Impacts and Mitigation

Transmission lines typically span the right-of-way of a pipeline and thus do not directly impact the pipeline. Where the Project will cross existing pipelines, the Applicants will work with the existing pipeline owners to avoid impacts to their operation along with acquiring the necessary permits/agreements. The Applicants will work with the Mayhew Solar operator and other potential future solar developers on crossing agreements.

The design and operating process of transmission lines require specific standards and mitigation outlined in NERC, FERC, and NESC requirements and guidance, which aid in the compatibility of new construction with existing utilities. Existing transmission lines and substations may be temporarily taken out of service during construction of the Project. This construction work will be coordinated to avoid electric service outages and associated impacts. All existing utilities will be identified and marked prior to construction with help from the Gopher State One Call utility locate service.

7.2.9.2 Transportation

Existing federal, state, county, and city owned roadway and railroad rights-of-way are located within the Proposed Route. Railroads that are spanned by the Project include the Club Lake – Staples, State Line – Cass Lake, and University – East Dilworth BNSF Railroads (**Appendix J, Detailed Mapbook, Pages 2-3, 26-27, 59 and 64**). Roadways include but are not limited to US Highways 2, 169, and 10; State Highways 6, 210, and 18; County Highways 29, 18, and 27-; County Roads 10, 11, and 2; and Danson Road, Golden Spike Road, and Osprey Ave.

7.2.9.2.1 Impacts and Mitigation

The Applicants will coordinate with the Minnesota Department of Transportation ("MnDOT") to confirm that construction of the Project will not interfere with routine roadway maintenance. The Project does not intend to locate any structures within the existing MnDOT road rights-of-way. Temporary localized traffic delays may occur when heavy equipment enters and exits roadway rights-of-way along the transmission corridor and for stringing operations at roadway crossings. When wire stringing across a road, the Applicants will install appropriate traffic control and safety devices, such as H braces, signs, or flaggers. The Applicants will work with townships and counties on the appropriate safety measures during stringing and haul routes.

7.2.9.3 Airports

The Proposed Route is located within two miles of three airports, of which two airports are public and one is a private landing strip. The Hill City/Quadna Mountain Airport (07Y) is located approximately 1.7 miles northwest (**Appendix J, Mapbook JA, Page 4)**, Barrett Airport is located approximately 1.8 miles west (**Appendix J, Mapbook JA, Page 12**), and St. Cloud Regional Airport is located approximately 1.9 miles west from the Proposed Route (**Appendix J, Mapbook JA, Page 18**). The Proposed Route is not within approach zones A or B of the Hill City/Quadna Mountain Airport (07Y) but is located within the horizontal Airspace Obstruction Zone (zone C). (MNDOT Aeronautics 2018). The Proposed Route is located within the horizontal Airspace Obstruction Zone (zone C) of the St. Cloud Regional Airport (STC) per the St. Cloud Municipal Airport Zoning Ordinance Sections IV and V (St. Cloud Municipal Airport, 1976). The Barrett Airport is privately-owned and does not have public airport zoning ordinances.

The Brainerd Lakes Regional Airport (BRD) is located approximately 3.6 miles west of the Proposed Route. The Proposed Route is not located within the Airspace Obstruction Zone of the Brainerd Lakes Regional Airport (BRD) per the Brainerd-Crow Wing County Amended Airport Zoning Ordinance No. 861 (Brainerd Lakes Regional Airport Joint Airport Zoning Board 2007).

7.2.9.3.1 Impacts and Mitigation

The Proposed Route is anticipated to parallel existing transmission lines when feasible, and transmission line structure height may be reduced in accordance with the Federal Aviation Administration ("FAA") Standards. The Applicants will continue to coordinate with the FAA to avoid impacts to the airport and air traffic and therefore impacts are not anticipated.

7.3 Land-Based Economics

7.3.1 Agriculture

Data gathered from the U.S. Department of Agriculture ("USDA") 2017 Census of Agriculture including counties spanned by the Proposed Route is summarized in **Table 7-9**.

Table 7-9. Summary of Agricultural Activities by County (2017 Census)

	Itasca County	Aitkin County	Crow Wing County	Morrison County	Benton County	Sherburne County
Number of farm operations in the county	337	462	494	1,760	816	501
Total acreage of farm operations in the county	71,710	105,730	89,196	382,376	194,832	102,544
Average size of farm operations (acres)	110	128	93	120	90	57

	Itasca County	Aitkin County	Crow Wing County	Morrison County	Benton County	Sherburne County
Total crop and livestock sales (USD)	>$8 million	>$12 million	>$19 million	>$394 million	>$207 million	>$89 million

Source: USDA Census (2017)

Approximately 5,370 acres of cropland and 3,931 acres of hay/pastureland are within the Proposed Route. Approximately 702.9 acres of cropland and 581.9 acres of hay/pastureland are within the Proposed Right-of-Way (see **Section 7.8.3**). In addition, approximately 0.44 acres of land used for Christmas tree production are crossed by the Proposed Right-of-Way. According to the Minnesota Department of Agriculture ("MDA") Organic Farm Directory (Minnesota Department of Agriculture 2023a) no registered organic producers are within the Proposed Route. Also, a search of the Minnesota Apiary Registry (Minnesota Department of Agriculture, 2023b) identified no apiaries within one mile of the Proposed Route.

7.3.1.1 Impacts and Mitigation

Construction activities will temporarily use cropland and pasture, which could displace livestock during the construction activity, and/or result in a delay or loss of crop production. The Applicants will work with landowners once a final route and alignment are permitted, to the extent practicable, to coordinate the need for any early harvest of crops that may be necessary. Applicants will compensate the landowner for any crop losses.

The Project will permanently impact prime farmland as discussed in **Section 7.10.3**. With the exception of land that will be used for permanent structures, other areas in the Proposed Right-of-Way will continue to be used for pasture and crops, so long as the agricultural practice does not interfere with the operation of the transmission line. The Applicants are proposing to primarily use steel monopoles for the Project. These types of structures have smaller footprints when compared to steel lattice towers, requiring an area of only 50 square feet to about 80 square feet of permanent disturbance per structure (i.e., each monopole would be 8 feet to 10 feet in diameter, while an angle or dead-end structure would have a diameter up to 12 feet). The span between each monopole for the Project is expected to be, on average, 900 feet. In addition, when following along existing transmission line rights-of-way, the distance between the two transmission line centerlines would be approximately 110 feet. This separation is intended to allow for the area to continue to be used for agriculture.

Agricultural activities, including the operation of farming equipment, could occur as close to the structures. Center-pivot irrigation systems are common along the Project area in Morrison, Benton, and Sherburne counties. A review of publicly available GIS and satellite imagery reveals center-pivot irrigated lands are crossed by the Proposed Right-of-Way in Morrison and Benton counties in Segment 1 and Benton and Sherburne counties in Segment 2. All center-pivot crossings will occur in existing right-of-way, where transmission lines will be replaced. The Applicants will work with landowners to minimize impacts to existing center-pivot irrigation systems and impacts from the irrigation system to the transmission facility.

The Applicants will work with landowners for safe access to agricultural lands during construction including access to cropland and pastures within the Proposed Right-of-Way. Additionally, the Applicants will undertake the following measures to avoid, minimize, and/or mitigate for potential impacts:

- Crops may be damaged during construction and lost where structures are placed. The Applicants will work with and compensate landowners for crop damage or loss, if damage or loss occurs.
- Prior to construction, Applicants will work with landowners to identify drain tile locations. If a drain tile is impacted (e.g., severed or crushed during construction), Applicants will work with landowners to repair damages.
- The Applicants will work with landowners to review structure placement and address pole placement issues to minimize impacts on agricultural operations where practicable.
- Soils will be disced and de-compacted so impacts to crop yields are minimized. Soil rutting will be minimized and repaired during restoration.
- Once construction is completed the Applicant will work with landowners to determine if the clean-up measures have been to their satisfaction and if any other damage may have occurred. If additional damage has occurred to crops, fences or other property, Applicants will compensate the landowner or repair the identified damage.
- The Applicants will work with landowners to ensure livestock are not present in construction areas during active construction. Fences and gates will be maintained in accordance with landowner specifications.

Operation of the transmission line and substations are unlikely to impact agriculture beyond the initial placement of permanent structures. The Applicants will conduct annual inspections of the line, both from the ground and air. Inspectors will contact landowners prior to conducting ground inspections, ensure that identified gates are closed, and limit impacts to crops. In the unlikely event crop damage occurs during operations, the Applicants would work with the landowners on that damage and compensate the landowners as needed.

The Applicants will work with Christmas tree operators to clear the right-of-way prior to construction. Christmas trees will be allowed to re-grow at restricted locations and heights upon completion of construction activities. The Applicants will work with Christmas tree operators on structure placement and construction timing to minimize impacts to Christmas tree production in the Proposed Right-of-Way.

7.3.2 Forestry

The Proposed Route crosses three MnDNR state forests including Golden Anniversary State Forest (**Appendix J, Detailed Mapbook, Page 4**), Hill River State Forest (**Appendix J, Detailed Mapbook, Pages 7-11 and 13-16**), and Crow Wing State Forest

(**Appendix J, Detailed Mapbook, Pages 22-23**). However, the Proposed Right-of-Way is not anticipated to cross the Golden Anniversary State Forest. Other State Forested Lands, are those state forests open for limited public recreation, but are not associated with a specific-named state forest (such as Hill River State Forest. The Other State Forest Lands are managed solely for timber production and are a primary source of commercial timber products throughout the Proposed Route. State forests provide many opportunities for recreation (see **Section 7.2.8**). Forested areas within the Proposed Route are summarized in **Table 7-10** below and are shown on **Appendix J, Detailed Mapbook and Mapbook JD**.

Forested areas within the Proposed Right-of-Way are harvested for timber products, which are used as fuel for heating homes, sawmills, construction materials, pulp to make paper products, furniture, and various commercial items. The MnDNR manages about 260 acres of forested land within the Proposed Right-of-Way. Approximately 19 acres of private commercial timberland (Blandin Paper Company) are present within the Proposed Right-of-Way in Itasca County, located about 1 mile south of Iron Range Substation and between and south of Split Hand Lake and Little Split Hand Lake (**Appendix J, Detailed Mapbook, Page 1 and 6-7)**. The substation areas do not include state forests, state forest lands, or private commercial forest lands. Forestry resources land that within the Proposed Route and Proposed Right-of-Way is summarized below in **Table 7-10**.

Table 7-10. Lands Managed for Forestry Resources within the Proposed Route and Proposed Right-of-Way[90]

Forestry Resources	Proposed Route (Acres)	Proposed Right-of-Way (Acres)
Private Commercial Forest Lands	217.51	19.20
Other State Forest Lands	782.13	65.66
Crow Wing State Forest	295.19	24.68
Golden Anniversary State Forest	3.13	0.00
Hill River State Forest	1144.77	169.77
Total	**2,442.73**	**279.31**

7.3.2.1 Impacts and Mitigation

The Project will result in permanent impacts to commercial forest products, as forested land is cleared within the Proposed Right-of-Way, and will regrow as herbaceous vegetation. The Project will result in clearing trees along Segment 1 and applying herbicide within the rights-of-way, which could negatively impact adjacent forestry activities. The Applicants will work with the MnDNR and counties to mitigate and minimize impacts to adjacent forest resources on state and county lands. Commercial forestry and private landowners will be compensated for loss of timber resulting from clearing the Project right-of-way. Construction staging areas will be located in areas with minimal tree

[90] While Golden Anniversary State Forest is located within the Proposed Route, it is not located within a Proposed Right-of-Way for the Project.

cover to the maximum extent practicable. Impacts to forested areas cleared for construction outside of the Proposed Right-of-Way and permanent access roads will be temporary, as those areas would be allowed to revegetate naturally.

7.3.3 Tourism

Tourist attractions crossed by the Proposed Route consist of snowmobile, off-road vehicle, and mountain bike trails as well as public parks, hiking trails and recreational areas (see **Section 7.2.8** for a discussion on public parks, trails and recreational areas). The economic impact from tourism-based revenue broken down by county is shown in **Table 7-11**.

Table 7-11. Summary of Tourism Activities by County

County	Gross Sales	Sales Tax	Private Sector Employment
Itasca County	$94,196,313	$5,998,496	1,437
Aitkin County	$30,472,194	$2,116,498	603
Benton County	$59,915,608	$3,923,264	1,123
Crow Wing County	$303,097,741	$18,483,949	4104
Morrison County	$54,407,054	$3,701,107	1009
Sherburne County	$132,996,572	$8,716,541	2384
Total	**$949,085,455**	**$42,939,855**	**10,660**

Source: Minnesota Tourism Matters (2021)

Over 21,000 miles of snowmobile trails are maintained by local snowmobile club volunteers in Minnesota. Trails crossed by the Proposed Route include the Itasca Trail, Haypoint Trail, Emily Outing Snowbird Trail, Sno Serpents Trail, Brainerd Snodeo Trail, Garrison Trail, Morrison County Recreational Trail, Benton County Trail, and Sherburne County Snowmobile Trail.

Nine off-highway vehicle trails are crossed by the Proposed Route which include the UPM Blandin Trail, Rabey Line Trail, Hill City Trail, Soo Line north Aitkin Trail, Blind Lake Trail, Emily-Blind Lake Trail, Miller-Black Bear Trail, Crow Wing Southern Loop, and Soo Line South Morrison Trail.

The Proposed Route crosses the Cuyuna Lakes State Trail and multiple mountain bike trails including the Cuyuna Lakes Mountain Bike Trail. The Cuyuna Lakes State Trail is inside the Cuyuna Country State Recreation Area and includes an eight-mile paved trail running from Crosby to Riverton, and a 25-mile single track mountain bike trail system.

Additional tourist attractions in proximity to the Proposed Route include public recreational trails and parks, and rivers and lakes which provide opportunities for watersports, fishing, and hunting.

7.3.3.1 Impacts and Mitigation

The Proposed Route is in proximity or crosses over recreational resources listed above but will not permanently interfere with the use of the recreational areas, therefore no mitigation is proposed. Signage and temporary closures may be necessary during construction, such as when vehicles are crossing a trail or wire stringing occurs across a trail causing temporary impacts. The Applicants will attempt to avoid or limit trail closures to the maximum extent practicable. Users of the recreational areas will hear temporary construction noise and visual aesthetics may be impacted if they are using the recreation areas while construction is occurring. Refer to **Section 7.2.3** for information related to noise impacts and **Section 7.2.4** for aesthetic impacts.

7.3.4 Mining

The Proposed Route crosses and borders multiple gravel pits in Aitkin and Benton County. Gravel pits within the Proposed Route are presented below in **Table 7-12** and in **Appendix J, Detailed Mapbook, Pages 11, 12, 14, 49, 50, and 51**. MnDNR Aggregate Resource Mapping data and satellite imagery from the past 30 years were utilized in identifying and locating gravel pits within the Proposed Route. Parcel ownership boundaries provided via GIS data collated by each county were also utilized to estimate the full potential horizontal extent of identified gravel pit mining operations. The MnDNR Compilation ID utilized in their GIS dataset refers to the identification number used in the first column in the table. Where multiple MnDNR Compilation IDs are listed in a single row, those identification numbers were found to be part of the same gravel pit after the combined review with satellite imagery and parcel ownership.

Fourteen gravel pits were identified within the Proposed Route. Five of these gravel pits overlap the Proposed Right-of-Way (AM-1553, AM-1518/AM-1391, AM-1424, AM-1578, AM-1360/AM-1550, AM-1316). AM-1578 is an active operation gravel pit. One former gravel pit overlaps the proposed Benton County Substation expansion area (AM-1517). The above-mentioned gravel pits, besides AM-1578, are not currently active.

Table 7-12. Gravel Pits within the Proposed Route

MnDNR Compilation ID	County	Status	Approximate location	Within Proposed Right-of-Way
NA	Aitkin	Inactive	Northwest of Swatara, MN	No
NA	Aitkin	Inactive	South of Swatara, MN	No
NA	Aitkin	Inactive	South of Swatara, MN near Mud Lake, White Elk Lake	No
AM-1553	Benton	Inactive	East of Golden Spike Rd, north of Highway 23	Yes
AM-1518/ AM-1391	Benton	Inactive	East of Golden Spike Rd, north of Highway 23	Yes

MnDNR Compilation ID	County	Status	Approximate location	Within Proposed Right-of-Way
AM-1556/ AM-1347	Benton	Inactive	East of Golden Spike Rd, north of Highway 23	No
AM-1424	Benton	Inactive	North of Highway 23	Yes
AM-1454	Benton	Inactive	North of Highway 23	No
AM-1465	Benton	Inactive	North of Highway 23	No
AM-1578	Benton	Active	Southeast of Highway 23	Yes
AM-1360/ AM-1550	Benton	Inactive	South of Highway 23, north of Territory Golf Club	Yes
AM-1316	Benton	Inactive	South of Highway 23, north of Territory Golf Club	Yes
AM-1517	Benton	Inactive	South of Highway 23, east of Territory Golf Club	No
AM-1430	Benton	Inactive	West of 75th Ave, southeast of Territory Golf Club	No

Source: MnDNR Aggregate Resource Mapping Program 2022

7.3.4.1 Impacts and Mitigation

The Project will not inhibit ongoing mining activities. Potential impacts during construction could occur to gravel pits within the Proposed Right-of-Way. Impacts could include a temporary suspension of excavation activities to ensure safe wire stringing. The Applicants will work closely with gravel pit owners to minimize impacts.

7.4 Archaeological and Historic Resources

A Phase 1a Cultural Resources Literature Search was completed for the Project to learn about known cultural and architectural resources within the Cultural Resources Study Area (**Appendix R**). The Cultural Resources Study Area encompasses the Route Corridor developed during the winter of 2023 (see **Section 5.2.2**) including additional areas to coincide with the notice area identified in the Applicants' Notice Plan Petition (see **Appendix D**). Research using SHPO inventory files, and the Minnesota Office of the State Archeologist ("OSA") online portal was conducted to identify known Precontact and Post-Contact archaeological sites, as well as architectural history properties that have been previously identified within the Cultural Resources Study Area. The National Park Service system online National Register of Historic Places ("NRHP") information was reviewed to confirm if NRHP Listed Historic Properties or National Historic Landmarks are present within the Cultural Resources Study Area.

A summary of cultural resource types (Archaeological Sites, Historic Cemeteries, Historic Architectural Resources) in the Cultural Resources Study Area, Proposed Route, and Proposed Right-of-Way is presented in **Table 7-13**.

From August 2022 through May 2023, outreach to all of the Minnesota federally recognized Tribes, Minnesota Indian Affairs Council ("MIAC"), and state cultural regulatory agencies was conducted. Details regarding this engagement are summarized in **Section 8.1**. Information regarding known resources gathered from engagement with the Tribes and agencies is referenced in the sections below.

Table 7-13. Summary of Archaeological and Historic Resources

Cultural Resource Types	Total Within Cultural Resources Study Area	Number Within Proposed Route	Number Within Proposed Right-of-Way	Total NRHP-Eligible or Listed within Proposed Route
Within Segment 1				
Archaeological Sites	36	6	4	0
Historic Cemeteries	12	0	0	0
Historic Architectural Resources	62	11	4	2 (1 Eligible, 1 Listed)
Within Segment 2				
Archaeological Sites	15	7	4	0
Historic Cemeteries	0	0	0	0
Historic Architectural Resources	9	0	0	0

7.4.1 Previously Recorded Archaeological Sites

The Phase 1a Cultural Resources Literature Search identified 51 previously recorded archaeological sites and 12 unrecorded historic cemeteries within the Cultural Resources Study Area (**Table 7-13**, **Appendix R**). Thirteen of these archaeological sites and no unrecorded historic cemeteries were identified as located fully or partially within the Proposed Route (**Appendix R Cultural Resources Mapbook**). Eight archaeological sites (21AK0136, 21BN0013, 21BN0016, 21CWy, 21SH0081, 21SH0084, and 21SH0086, 21SHbe) and no unrecorded cemeteries are located within the Proposed Right-of-Way (**Table 7-14**; **Appendix R Cultural Resources Mapbook, pages 7, 14, 30-31, 34-36**). Of the 13 sites located wholly or partially within the Proposed Route, none have been formally evaluated for the NRHP.

A review of the OSA online portal indicated a cluster of ten Precontact archaeological sites (nine within the Cultural Resources Study Area) are located just north of Elk Lake in Sherburne County, which overlaps a portion of the existing transmission line right-of-way proposed to be rebuilt in Segment 2 (**Appendix R Cultural Resources Mapbook, page 34**). In a meeting on January 10, 2023, with Sherburne County and the Mille Lacs Band of Ojibwe, Upper Sioux Community, and Lower Sioux Indian Community, it was determined that these sites were identified during investigations for a proposed county park known as Big Elk Lake Park. Those parties are also working together regarding designation of a portion of the park area as part of a Traditional Cultural Landscape and a potential National Heritage Area. A Tribal Cultural Property survey was in progress and was planned to be completed in June of 2023. Three of the sites within this cluster overlap the Proposed Route (21SH0081, 21SH0082, and 21SH0084), two of which overlap the Proposed Right-of-Way (21SH0081 and 21SH0084).

Three substations within the Proposed Route will involve ground disturbance during their expansion or construction. These are the Iron Range Substation (slated for expansion), the Benton County Substation (slated for expansion), and the Cuyuna Series Compensation Station (to be constructed). No archaeological sites have been identified within the immediate vicinity of the Iron Range or Benton County substations (**Appendix R Cultural Resources Mapbook, page 1 and 31**). A cluster of Precontact sites focused around Little Rabbit Lake and the Mississippi River was identified approximately 0.75 miles south of the proposed Cuyuna Series Compensation Station location, but no sites have been identified within the proposed Cuyuna Series Compensation Station location (**Appendix R Cultural Resources Mapbook, page 14**).

The Proposed Route crosses lands ceded by the Ojibwe in 1837 and 1855 treaties, and by the Dakota in an 1837 treaty (**Appendix R Ceded Territories and Historic Reservations Map**). The 1837 treaties with the Ojibwe and Dakota reserved hunting, fishing, and gathering rights. The 1855 treaty established historic reservations that were later ceded in a 1964 treaty. Tribal outreach highlighted the significance of these historic reservation bounds to contemporary indigenous descendants and the potential for archaeological deposits related to reservation occupation and nearby activities. One of the Ojibwe reservations, Rabbit Lake, overlaps the Proposed Route. Two additional historic Ojibwe reservations highlighted during outreach, Pokegama Lake and Gull Lake, are located nearby, but do not overlap the Proposed Route. According to reservation boundaries as described in Bureau of Land Management records, the historic Pokegama Lake Reservation was located approximately 0.5 miles west of the Proposed Route, and the historic Gull Lake Reservation bounds were located approximately three miles west of the Proposed Route.

Following initial outreach to all Minnesota federally-recognized Tribes, the Applicants have been engaging with the Leech Lake Band of Ojibwe, Lower Sioux Indian Community, Mille Lacs Band of Ojibwe, and the Upper Sioux Community, who have indicated an interest in continued communications regarding the Project. A summary of outreach to these Tribes is provided in **Section 8.1**. Tribal outreach has highlighted several areas of Tribal cultural interest that are not formally investigated archaeological sites and otherwise not recorded with OSA or SHPO. These resources are therefore not listed in **Table 7-14**.

In a May 5, 2023 meeting, Samantha Odegard, Tribal Historic Preservation Officer ("THPO") of the Upper Sioux Community, indicated that additional portions of the Proposed Route may contain archaeological potential, including the Upper Long Lake Area and the Elk River area. Odegard is aware of a few specific Tribally-recorded resources within or near the Proposed Route, but determining their exact locations and whether they may be impacted will likely need additional review. Odegard recommended a pre-field survey visual reconnaissance to review the Proposed Route and identify areas of Tribal interest for further field investigation. The Applicants met with Odegard on June 27, 2023 to provide a Project update and discuss the details of a pre-field survey visual reconnaissance (windshield) review.

In a meeting with the Mille Lacs Band of Ojibwe on May 5, 2023, Charlie Lippert, Air Quality Specialist, shared several areas of cultural interest. Two of these are the Mississippi Chippewa historic reservation bounds of Pokegama and Rabbit Lake established in 1855 which, according to Mille Lacs Band internal records, overlap the Proposed Route. Other areas of interest include some indigenous trailways near Hill City, a historical Ojibwe battle ground near the southern end of the Proposed Route, and an area near the Big Oaks Substation. Lippert recommended outreach to their newly appointed THPO, Mike Wilson, for further information regarding potential cultural areas. An email was sent to Mike Wilson on May 14, 2023, summarizing key project information and communication with the Mille Lacs Band of Ojibwe to date. In a follow-up meeting on June 26, 2023, Mike Wilson indicated several areas of interest along the Proposed Route, including the Benton and Big Oaks Substation areas, and the Upper Long Lake area.

In a July 13, 2023 meeting, Cheyanne St. John, the Lower Sioux Indian Community THPO, indicated there are some sensitive areas along the Proposed Route, including the Big Elk Lake Park, Ironton Substation, and Pierz areas.

The Applicants are continuing to engage with the Leech Lake Band of Ojibwe, Lower Sioux Indian Community, Mille Lacs Band of Ojibwe, and the Upper Sioux Community. Review of the Proposed Route is ongoing by the four Tribes and the Applicants are coordinating with them to facilitate a pre-field survey visual (windshield) reconnaissance to inform their review.

Table 7-14. Previously Recorded Archaeological Sites within Proposed Route

Site Number	Site Name	Description	National Register Status	Within Proposed Right-of-Way
Within Segment 1				
21AK0136	L3R-KLB-01	Post-contact artifact scatter, structural ruin	Not evaluated	Yes
21AK0137	L3R-KLB-02	Precontact single artifact	Not evaluated	No
21BN0013	East Elk River/ Bronder/Charles Stark	Precontact artifact scatter	Not evaluated	Yes
21BN0016	Thielen	Precontact lithic scatter	Not evaluated	Yes

Site Number	Site Name	Description	National Register Status	Within Proposed Right-of-Way
21CWx	No Name	Precontact earthwork	Not evaluated	No
21Cwy	Rabbit River Mission	Precontact artifact scatter	Not evaluated	Yes
Within Segment 2				
21SH0036	No Name	Precontact lithic scatter	Not evaluated	No
21SH0068	Bale	Precontact single artifact	Not evaluated	No
21SH0081	No Name	Precontact artifact scatter	Not evaluated	Yes
21SH0082	No Name	Precontact lithic scatter	Not evaluated	No
21SH0084	No Name	Precontact lithic scatter	Not evaluated	Yes
21SH0086	No Name	Post-contact artifact scatter, farmstead ruins	Not eligible	Yes
21Shbe	No Name	Precontact artifact scatter	Not evaluated	Yes

7.4.2 Historic Architectural Resources

The Phase 1a Cultural Resources Literature Search identified 71 previously recorded architectural/history properties (SHPO-inventoried properties) within the Cultural Resources Study Area (**Table 7-15**, **Appendix R**). Eleven of these properties are located within the Proposed Route. Two of these architectural/history properties within the Proposed Route have been evaluated for NRHP listing (**Table 7-15**). One of these, the Frank Gran Farmstead (IC-UOG-017; **Appendix R Cultural Resources Mapbook, page 1**) is Listed on the NRHP. The other is the Cuyuna Iron Range Historic Mining Landscape District (CW-XXX-0001; **Appendix R Cultural Resources Mapbook, pages 14-15**). This industrial district is NRHP-eligible and overlaps approximately 290 acres of the Proposed Route, and 11 acres of the Proposed Right-of-Way. The remaining three, all roadways, were determined Not Eligible for the NRHP (XX-ROD-017, XX-ROD-021, XX-ROD-044; **Appendix R Cultural Resources Mapbook, pages 17, 31, and 6,** respectively**).** The Eligible Cuyuna Iron Range Historic Mining Landscape District and the three Not Eligible roadways are the only previously recorded architectural/history properties to overlap the Proposed Right-of-Way.

No architectural/history properties were identified within the immediate vicinity of any Project substations proposed for expansion or construction.

Table 7-15. Previously Recorded Architectural Sites within Proposed Route

Inventory Number	Property Name	Description	National Register Status	Within Proposed Right-of-Way
Within Segment 1				
AK-MCV-011	Boyd's Ranch	Inn	Not evaluated	No
BN-GRM-005	Bridge 05501	Bridge	Not evaluated	No
CW-IRN-001	Farmstead	Farmstead	Not evaluated	No
CW-XXX-00001	Cuyuna Iron Range Historic Mining Landscape District	Landscape	Eligible	Yes
IC-TLT-015	Log Barn	Barn	Not evaluated	No
IC-TLT-016	Log Barn	Barn	Not evaluated	No
IC-UOG-016	Log Hay Barn	Barn	Not evaluated	No
IC-UOG-017	Frank Gran Farmstead	Farmstead	Listed	No
XX-ROD-017	Trunk Highway 18	Roadway	Not Eligible	Yes
XX-ROD-021	Trunk Highway 95	Roadway	Not Eligible	Yes
XX-ROD-044	Current TH 169	Roadway	Not Eligible	Yes
Within Segment 2				
No Historic Architectural Resources are located within Segment 2 of the Proposed Route				

7.4.3 Impacts and Mitigation

The Proposed Route was developed to avoid or minimize potential effects to previously recorded archaeological and historic architectural resources. Of the eight archaeological sites within the Proposed Right-of-Way (**Table 7-14**), three have been previously disturbed to varying degrees. Site 21BN0016 falls directly within the existing transmission line right-of-way and may have been disturbed during previous transmission line installation. Site 21BN0013 has been bisected by Highway 95 and is located within the existing transmission line right-of-way. Site 21SH0086 has been fully excavated as part of an archaeological field school. All cultural materials from this site were either collected or deposited out-of-context near the remaining farmstead structural foundations. Considering the three aforementioned sites' locations within the existing transmission line right-of-way, or other previous impacts to these sites (i.e., archaeological excavation, road construction), all or portions of sites 21BN0016, 21BN0013, and 21SH0086 have likely been previously disturbed.

Two of the archaeological sites within the Proposed Right-of-Way are considered archaeological ‘alpha sites’ (21CWy, 21SHbe). Alpha sites are recorded via historical documentation or landowner reports but have not been confirmed through archaeological survey. These sites are identified by historical documentation or anecdotal accounts from landowners and, therefore, they are typically drawn as full Public Land Survey System (“PLSS”) sections or quarter sections since the exact area cannot be pinpointed from the description. In the case of 21CWy, historic documentation mentions a single stone axe was recovered here, and the full quarter section recorded as the location. The southwestern corner of the reported quarter section is crossed by the Proposed Right-of-Way. Considering this site has not been archaeologically surveyed, the density and horizontal extent of the potential deposit is unknown. It may have been a single dropped artifact, or it may have been part of a larger habitation deposit. Further investigation would be needed to determine if this site is located within the Project right-of-way. Site 21SHbe was reported by the landowner stating they had recovered lithic artifacts from the property. The site was visited by archaeologists in 1981, but no cultural materials were identified (Lass 1981). In the case of 21SHbe, it is likely all or most artifacts were already collected by the landowner, and the site has been largely disturbed. The Project right-of-way crosses along the western edge of 21SHbe, running adjacent to the portion of the site already impacted by a previous transmission line installation. Again, further investigation would be needed to determine if this site is located within the Project right-of-way.

The Applicants’ ongoing Tribal engagement indicates that sites 21SH0081, 21SH0082, and 21SH0084 may be part of a larger complex of cultural resources within the proposed Big Elk Lake Park in Sherburne County (discussed previously in **Section 7.4.1**). Project plans in this area include replacing an existing transmission line and utilizing the previously established right-of-way. Engagement with the THPO of the Upper Sioux Community indicates that pole placement in this area may avoid or minimize impacts to these resources. Tribal engagement regarding this area and the remainder of the Proposed Route is ongoing and will continue through permitting and construction, as appropriate.

The remaining archaeological sites within the Proposed Route (outside of the Proposed Right-of-Way) include two isolated Precontact finds (21AK0137 and 21SH0068), two Precontact lithic scatters (21SH0036 and 21SH0082), and a single Precontact earthwork alpha site (21CWx). The areas around both sites 21AK0137 and 21SH0068 were thoroughly surveyed via shovel testing with single lithic flakes identified as comprising both sites. Considering these sites have already been previously investigated, they are unlikely to yield additional cultural resources. The Precontact lithic scatter of 21SH0036 includes various lithic tools, flakes, and fire-cracked rock but was reported as having little research potential due to all artifacts having been located within the plow horizon of an agricultural field, and therefore no original stratigraphy remained intact.

Site 21SH0082 is within the planned Big Elk Lake Park in Sherburne County and is located approximately 40 feet northeast of the Proposed Right-of-Way. Sites 21SH0036, 21SH0068, and 21SH0082 are also all located within portions of the Proposed Route where the Project is planned to replace the existing transmission lines using the established right-of-way (Segment 2). Further analysis will be conducted regarding appropriate avoidance and mitigation if the Proposed Right-of-Way is adjusted in this area.

Precontact earthwork site 21CWx was described in notes by late 19th century earthwork-recorder Jacob Brower as a single mound. The western edge of the site area is located approximately 1,300 feet east of the Proposed Right-of-Way and should be avoided if the Proposed Right-of-Way needs to be adjusted through this area, or further archaeological investigation should be conducted prior to ground disturbing activities.

Of the historic reservation bounds highlighted during Tribal outreach, no impacts are anticipated to the Pokegama and Gull Lake Reservations because the historical bounds are located outside of the Proposed Route. The Proposed Route and Proposed Right-of-Way do cross through the historic Rabbit Lake Reservation bounds. The Cuyuna Series Compensation Station is also anticipated to be constructed within the Rabbit Lake Reservation historic bounds. Significant portions of the Rabbit Lake Reservation have been previously disturbed due to historic mining activity (this area also contains the Cuyuna Iron Range Historic Mining Landscape District).

Table 7-15 lists architectural structures within the Proposed Route and Proposed Right-of-Way. In the first instance, the Project avoids and minimizes impacts to these structures by primarily following existing rights-of-way. Further, based on the height of the proposed transmission line structures (ranging between 120 to 180 feet tall) it is anticipated that the new structures could be visible up to 0.25 miles from the Proposed Centerline. However, intervening vegetation and structures would likely reduce visibility of the transmission structures in many areas. Of the architecture/history properties located within the Proposed Right-of-Way, the roadways (XX-ROD-017, XX-ROD-021, XX-ROD-044) are unlikely to be impacted. The transmission line structures would span existing roadways, thereby avoiding direct impacts. Because all three roadways have been previously considered Not Eligible for listing in the NRHP within the past 10 years, they do not need to be resurveyed per state guidelines (MDA, 2017) Three Historic Properties are located within 0.25 miles of the Proposed Centerline. These are the NRHP-Listed Herbert Maximilian Fox House (SH-BKC-012, 0.06 miles from Proposed Centerline), the NRHP-Listed Frank Gran Farmstead (IC-UOG-017, 0.14 miles from Proposed Centerline), and the previously mentioned NRHP-Eligible Cuyuna Iron Range Historic Mining Landscape District (CW-XX-00001, overlapping Proposed Centerline). The Maximilian Fox House is currently 0.06 miles from the existing transmission line proposed for replacement as part of the Project. The Fox House has been moved twice after it was originally listed in the NRHP. The National Park Service has reevaluated the house after its most recent move and determined it to still be eligible for the NRHP. The Project will introduce a new transmission line in closer proximity to the Frank Gran Farmstead where an existing transmission line is located approximately 0.7 miles to the northwest; however, view of the new transmission line will be limited by rows of trees surrounding the farmstead. The

Project will introduce a new transmission line within the Cuyuna Iron Range Historic Mining Landscape District. However, existing transmission lines cross the district and are not out of character for this industrial historic district.

The Applicants will develop a Cultural Resource Survey Strategy that includes an assessment of known Historic Properties and the potential for unknown resources along the Proposed Route in the latter half of 2023 to inform field surveys anticipated to be conducted in fall 2023 and continuing into 2024. The Cultural Resource Survey Strategy will involve review of archaeological surveys previously completed within the Proposed Route and reviews of historic plat maps, historic topographic maps, Precontact hydrography models, land use history to identify previous disturbances, and additional research into areas of Tribal cultural interest highlighted during current and future outreach. This assessment will refine and deepen understanding of archaeological potential within the Proposed Route and inform the Cultural Resource Survey Strategy. An Unanticipated Discoveries Plan will also be prepared for construction.

7.5 Natural Environment

7.5.1 Air Quality

The Clean Air Act (42 U.S.C. 7401 et seq.) (the "Act") was passed to protect human health and the environment from air pollution. Section 109 of the Act required the USEPA to establish NAAQS. The USEPA established NAAQS for six criteria pollutants: sulfur dioxide, NO_2, carbon monoxide, ozone, lead, and particulate matter (PM_{10} and $PM_{2.5}$). The Act requires states to establish procedures to attain and maintain these standards.

The Proposed Route crosses (from north to south) Itasca, Aitkin, Crow Wing, Morrison, Benton, and Sherburne counties. All counties are currently in attainment for all criteria pollutants under the Clean Air Act. (EPA 2023).

7.5.1.1 Impacts and Mitigation

During construction, limited temporary impacts to air quality are expected to occur along the Proposed Route due to increased vehicle exhaust emissions and disturbance of topsoil from construction, replacement of existing structures, and clearing of rights-of-way. Exhaust emissions from equipment and employee vehicles will increase during the duration of Project construction, but impacts will be transient and minimal and are discussed in more detail in **Section 6.7**. The magnitude of emissions will be influenced heavily by weather conditions and the specific construction activity taking place.

Project construction will produce some inhalable dust particulate matter (PM_{10} and $PM_{2.5}$) during earth-moving construction and deconstruction activities. Under the Clean Air Act, PM_{10} particle pollution cannot exceed 150 $\mu g/m^3$ per 24 hours more than once per year over a period of three years, and $PM_{2.5}$ pollution cannot exceed 12.0 $\mu g/m^3$ more than once per year over a period of three years. Appropriate dust control measures such as wetting of unpaved roads near residences will be implemented to mitigate impacts. Cleared rights-of-way, storage areas, and access roads will be restored and revegetated once construction is complete, which will limit the potential for further dust production. Impacts to air quality are not expected to affect the attainment status of any of the counties crossed.

The discharge of ozone and oxides of nitrogen due to corona production from transmission lines or conductors within substations may occur during operation. For a discussion of these potential emissions, please refer to **Section 6.7**. Impacts of these ozone and oxides of nitrogen emissions will be minimal.

7.6 Water Resources

Hydrologic features located within the Proposed Route include groundwater and surface water, such as wetlands, lakes, rivers and floodplains. These features perform several important functions within a landscape including water supply, flood attenuation, groundwater recharge, water quality protection, and wildlife habitat production (**Appendix J, Mapbook JC**). The Proposed Route lies within the Mississippi River (Grand Rapids, Brainerd, Sartell, St. Cloud) and Pine River watersheds in north-central and central Minnesota.

7.6.1 Ground Water

MnDNR divides Minnesota into six groundwater provinces. The Project is located within Central Province, which is characterized by superficial and buried sand aquifers, with thick sandy and clayey glacial drift overlying Precambrian and Cretaceous bedrock (MnDNR 2021). A review of the Minnesota County Well Index identified multiple private wells mapped within the Proposed Route. Municipal water supply wells are also located within the Project Route as well as the Riverton Drinking Water Supply Management Area. No Minnesota Department of Health wellhead protection areas or USEPA sole source aquifers occur within the Proposed Route.

7.6.1.1 Impacts and Mitigation

The Applicants do not anticipate impacts to groundwater as a result of the Project. Structure foundations will generally range from 25 feet to 60 feet in depth. All foundation materials would be non-hazardous. Any effects on water tables would be localized and temporary and would not affect hydrologic resources. The Applicants will conduct geotechnical investigations to help identify shallow depth to groundwater resource areas, which may require special foundation designs. The Applicants will continue to work with landowners to identify springs and wells near the Project.

7.6.2 Floodplains

A floodplain is 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 floodwaters, but which do not experience strong current. Floodplains function to prevent 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 (FEMA National Flood Hazard Layer, 2021). FEMA designates floodplain areas based on the percent chance of a flood occurring in that area every year. These areas include the 100-year floodplain, which has a one percent chance of flooding each year and the 500-year floodplain, which has a 0.2 percent chance of flooding each year.

At the state level, the MnDNR oversees the administration of the state floodplain management program by promoting land use development to promote the health and safety of the public, minimize loss of life, and reduce economic losses caused by flood damages. In addition, the MnDNR oversees the national flood insurance program for the state of Minnesota. Floodplains may also be regulated at the local level by each county.

The Proposed Route crosses both FEMA-designated 100-year and 500-year floodplain areas in locations associated primarily with waterbodies such as the Mississippi River and its tributaries (Swan River, Mud Brook, Rabbit River, Ironton Creek, Nokasippi River), Willow River and its tributaries (Hill River, Unnamed Streams), Platte River and its tributaries (Skunk River), and the Elk River and its tributaries (Mayhew Creek, Unnamed Stream (M-065-017-015.5), Unnamed Stream (M-065-017-014-001), Unnamed Creek (M-065-013-001) Rice Creek, Unnamed Creek (M-065-013), and Briggs Creek (M-065-011). A review of National Flood Hazard Layer ("NFHL") data shows approximately 3,327.03 acres of 100-year floodplain and 0.81 acre of 500-year FEMA-designated floodplains occur within the Proposed Route, and 122.67 acres of 100-year floodplain and 0.58 acres of 500-year floodplains occur within the Proposed Right-of-Way.

7.6.2.1 Impacts and Mitigation

The Project may require transmission line structures to be placed within FEMA designated 100-year floodplain areas, though attempts will be made to span floodplains to the extent practicable. Temporary impacts during construction may result from access routes, structure work areas, and conductor pulling and tensioning sites. However, the temporary impacts would occur outside of periods when seasonal flooding would occur and would not affect the function of the floodplain. The placement of transmission line structures in floodplains is not anticipated to temporarily or permanently alter the flood storage capacity of the floodplain based on the minimal size of individual transmission line structures.

7.6.3 Impaired Waters

The MPCA is charged with classifying waterbodies in Minnesota. Consistent with the requirements of the Clean Water Act ("CWA"), the MPCA has established water quality standards, including the identification of beneficial uses of the state's waters, numeric standards and narrative criteria, and non-degradation protections for high-quality or unique waters. Minnesota advances the CWA's presumption that a waterbody should attain healthy aquatic life and recreation uses, and groups the waters of the state into one or more of the following seven designated use classifications per Minn. R. 7050.0140:

- Class 1 waters, domestic consumption
- Class 2 waters, aquatic life and recreation
- Class 3 waters, industrial consumption
- Class 4 waters, agriculture and wildlife
- Class 5 waters, aesthetic enjoyment and navigation
- Class 6 waters, other uses and protection of border waters
- Class 7 waters, limited resource value waters

Section 303(d) of the CWA requires that states publish a list of streams and lakes that are not meeting their designated uses because of excess pollutants (impaired waters) every two years. The list, known as the 303(d) list, is based on violations of water quality standards. In Minnesota, the MPCA has jurisdiction over determining 303(d) "impaired" waters. The Project Centerline crosses 19 impaired streams (**Table 7-18 Appendix J, Mapbook JC**) (MPCA 2022). Of the impaired streams crossed by the Project Centerline, eight are designated as "Impaired," but a total maximum daily load ("TMDL") study has been approved by USEPA," ten streams are listed with a designation of "Impaired and a TMDL study is required," and one stream with a designation of "Impaired or threatened but doesn't require a TMDL study because the impairment is due to natural conditions with only insignificant anthropogenic influence." Stream impairments for these 19 streams include mercury in fish tissue, fish bioassessments, dissolved oxygen, *Escherichia coli* (*E. coli*), turbidity, benthic macroinvertebrate bioassessments, and fecal coliform. No impaired lakes were mapped within the Proposed Route (MPCA, 2022).

7.6.3.1 Impacts and Mitigation

The construction of the Project could result in temporary erosion of soils and increased sedimentation to surface waters. Mitigation measures will be implemented to prevent or minimize surface water impacts that could affect water quality. The MPCA, through the National Pollutant Discharge Elimination System ("NPDES") and under the CWA and the State Disposal System ("SDS"), regulates construction activities that may impact stormwater runoff. The Applicants will apply for authorization to discharge stormwater associated with construction activity under the MPCA NPDES/SDS Construction Stormwater General permit (MNR100001). The Project will develop a Stormwater Pollution Prevention Plan ("SWPPP") that will identify BMPs to be implemented during construction to minimize erosion and sedimentation impacts to surface waters. Erosion and sedimentation abatement measures, for example, would be employed to mitigate impacts to water resources within the Proposed Route. No fueling or maintenance of vehicles or application of herbicides would occur within 100 feet of streams, ditches, and waterways to protect against introduction of these materials into surface or groundwater systems. Materials such as fuels, lubricants, paints, and solvents required for construction would be stored away from surface water resources according to appropriate regulatory standards. Any spills or leaks would be cleaned up immediately and leaking equipment removed from the area for proper maintenance. In the area of impaired waters, the Project will implement BMPs in accordance with Section 23.1 of MNR100001, which defines additional requirements for discharges to special (Prohibited, Restricted, Other) and impaired waters.

7.6.4 Public Waters

Public Waters are wetlands, water basins, and watercourses of significant recreational or natural resource value in Minnesota as defined by Minn. Stat. § 103G.005. The MnDNR has regulatory jurisdiction over these waters, which are identified on the MnDNR PWI maps. In addition to Public Waters, certain surface waters in Minnesota are designated by statute (Minn. R. 6264.0050) as trout streams or lakes and are considered Public Waters regulated by the MnDNR.

The Proposed Route crosses 37 MnDNR Public Waterways listed in **Table 7-18** and **Table 7-19**. One Public Waterway crossed twice by the Proposed Centerline in Segment 2, Briggs Creek, is a designated trout stream (**Appendix J, Mapbook JC, page 19** and **Table 7-16**). Twenty-five Public Water Wetlands or Basins are located within or near the Proposed Route. Twelve PWI lakes are crossed by the Proposed Route, 5 of which are wild rice lakes. Three wild rice lakes are crossed by the Proposed Right-of-Way.

7.6.4.1 Impacts and Mitigation

For a discussion of specific Public Water Lakes, Rivers and Streams, and Wetlands see **Sections 7.6.5**, **7.6.6**, and **7.6.7**, respectively. The Applicants will work with the MnDNR to obtain proper licenses and approvals for Public Water crossings by the Project. Through the license approval process, the Applicants and the MnDNR will determine the appropriate stipulations for Public Water crossings, including trout streams. Stipulations for work in or near PWIs may include in-water work exclusion dates and clearing setbacks. In locations where clearing activities may take place near a PWI a stream bank buffer may be established or hand clearing techniques may be used to minimize impacts to soils and existing vegetation. Rootstock of woody vegetation will remain in place to avoid impacts to soils and allow existing vegetation to regrow more quickly. Through the NPDES permitting process the Project will be required to comply with Section 23.1 of MNR100001, which includes designated trout streams within the definition of special waters. Best management practices such as redundant perimeter controls and the stabilization of exposed soils immediately upon completion of work within the 75-foot buffer would be implemented to minimize erosion near MnDNR designated trout streams.

7.6.5 Lakes

The Proposed Route crosses 25 unique Public Water Inventory ("PWI") lake features identified in **Table 7-16**. The Proposed Right-of-Way crosses 12 locations (**Table 7-17**). Five MnDNR wild rice lakes will be crossed by the Proposed Route: Birchdale, Clitty, Olson, Mud, and Hay. The Proposed Right-of-Way crosses three wild rice lakes: Hay, Mud, and Olson lakes. Crossings of wild rice lakes will only occur at existing transmission line rights-of-way.

Table 7-16. PWI Lake Crossings by the Proposed Route

MnDNR DOWLKNUM ID	Name	Public Water Designation	Crossed by Segment 1	Crossed by Segment 2	Impaired	Wild Rice Lake	Appendix J, Mapbook JC, Page Number
71014600	Briggs Lake	Basin	No	Yes	No	No	19
31034100	Little Split Hand Lake	Basin	Yes	No	No	No	2
18013700	Mud Lake	Basin	Yes	No	No	Yes	10
18017100	Olson Lake	Basin	Yes	No	No	Yes	7
18052200	Unnamed	Basin	Yes	No	No	No	9
3102040	Unnamed	Basin	Yes	No	No	No	2
31113400	Unnamed	Basin	Yes	No	No	No	2
18066700	Unnamed	Basin	Yes	No	No	No	9
01035600	Unnamed	Basin	Yes	No	No	No	3
18017500	Birchdale	Basin	Yes	No	No	Yes	7
18056500	Bullhead	Basin	Yes	No	No	No	8
18013900	Little Rabbit	Basin	Yes	No	No	No	9, 10
18011900	Roe Mine	Basin	Yes	No	No	No	10
18052400	Snoshoe Mine	Basin	Yes	No	No	No	10
180102000	Hay Lake	Wetland	Yes	No	No	Yes	6
18056600	Unnamed	Wetland	Yes	No	No	No	9
18057600	Unnamed	Wetland	Yes	No	No	No	7
18063400	Unnamed	Wetland	Yes	No	No	No	9
71011600	Clitty	Wetland	No	No	No	Yes	20
18011800	Little Black Hoof	Wetland	Yes	No	No	No	9, 10
71016000	Unnamed	Wetland	No	Yes	No	No	18
71019500	Unnamed	Wetland	No	Yes	No	No	19, 20
71021700	Unnamed	Wetland	No	Yes	No	No	18
71023700	Unnamed	Wetland	No	Yes	No	No	20
71036100	Unnamed	Wetland	No	Yes	No	No	18

Source: Mn DNR Public Waters Inventory Dataset (2020)

Table 7-17. PWI Lake Crossings by the Proposed Right-of-Way

MnDNR DOWLKNUM ID	Name	Public Water Designation	Crossed by Segment 1	Crossed by Segment 2	Impaired	Wild Rice Lake	Appendix J, Mapbook JC, Page Number
71014600	Briggs Lake	Basin	No	Yes	No	No	19
31034100	Little Split Hand Lake	Basin	Yes	No	No	No	2

18013700	Mud Lake	Basin	Yes	No	No	Yes	10
18017100	Olson Lake	Basin	Yes	No	No	Yes	7
18052200	Unnamed	Basin	Yes	No	No	No	9
3102040	Unnamed	Basin	Yes	No	No	No	2
31113400	Unnamed	Basin	Yes	No	No	No	2
180102000	Hay Lake	Wetland	Yes	No	No	Yes	6
18063400	Unnamed	Wetland	Yes	No	No	No	9
71019500	Unnamed	Wetland	No	Yes	No	No	19, 20
71023700	Unnamed	Wetland	No	Yes	No	No	20
71036100	Unnamed	Wetland	No	Yes	No	No	18

Source: Mn DNR Public Waters Inventory Dataset (2020)

7.6.5.1 Impacts and Mitigation

Because the Proposed Right-of-Way spans multiple lakes including MnDNR wild rice lakes and PWI Waters, impacts to lakes are anticipated. The construction of the Project could result in temporary erosion of soils and increased sedimentation to lakes. In addition, tree clearing along lakeshore areas may result in warming lake water and removing shaded lakeshore habitat. Although tall growing vegetation would be excluded from the right-of-way, shrubs and other vegetation would be allowed to regrow, which would mitigate any temporary impacts to water temperature.

Currently in Segment 2, Great River Energy has two transmission line structures within an Unnamed Public Water Wetland (DOWLKNUM ID 71019500) just east of the intersection of 137th Ave SE and 82nd St SE in Sherburne County (Sec 7, T34, R28). This open water wetland is under a 1,500-foot span and therefore after replacement transmission line structures may be located within this wetland. Great River Energy also has two transmission line structures within an Unnamed Public Water Wetland (DOWLKNUM ID 71023700) just south of 107th St SE east of the intersection of 107th St SE and 150th Ave SE in Sherburne County (Sec 28 and 29, T34, R28). This open water wetland is over a 1,700-foot span and therefore after replacement, transmission line structures may be located within this wetland. The Applicants will review these spans and try to minimize the number of structures within each wetland.

Impacts have been minimized to the maximum extent feasible by following existing rights-of-way where practicable. Mitigation procedures along lake shorelines and for crossing lakes will include utilizing the road system for access, minimizing physical impacts including tree clearing, and protecting wetland areas with common best management practices. Mitigation measures will be implemented to prevent or minimize surface water impacts that could affect water quality as described in **Section 7.6.3.1** above including obtaining a Construction Stormwater General Permit (MNR100001) and implementing an SWPPP. Erosion and sedimentation abatement measures, for example, would be employed to mitigate impacts to water resources within the Proposed Route. No fueling or maintenance of vehicles or application of herbicides would occur within 100 feet of streams, ditches, and waterways to protect against introduction of these materials into surface or groundwater systems. Materials such as fuels, lubricants, paints, and solvents required for construction would be stored away from surface water resources according to appropriate regulatory standards. Any spills or leaks would be cleaned up immediately and leaking equipment removed from the area for proper maintenance.

The Applicants will obtain necessary approvals for PWI lakes crossed by the Proposed Right-of-Way and will comply with conditions of these approvals to avoid and minimize impacts. Mitigation procedures including BMPs for major activities surrounding waterbodies are outlined in **Section 7.6.6.**

The Project crossings of wild rice lakes are at existing crossings. No new right-of-way cross wild rice lakes, so the Project should not interfere with the production or harvest of wild rice. No mitigation is proposed.

Mitigation measures will include those outlined in **Section 7.6.7**

7.6.6 Rivers and Streams

The Proposed Centerline would cross 99 unique waterway features, 41 of which are PWI Waters (**Table 7-18**). Some features will be crossed multiple times, for a total of 154 crossings.

Table 7-18. Waterway Crossings by the Proposed Centerline

MnDNR Kittle ID Number	Feature Name	Number of Segment 1 Crossings	Number of Segment 2 Crossings	Impaired	PWI Crossing	MnDNR Designated Trout Stream	Appendix J, Mapbook JC, Page Number
M-081-002-002-002	Arramba Creek	1	0	No	No	No	15
M-081-005	Big Mink Creek	1	0	Yes	Yes	No	13
M-065-011	Briggs Creek	0	2	No	Yes	Yes	19
M-081-002-002	Buckman Creek	1	0	No	No	No	15
M-078-002	Bunker Hill Creek	1	0	Yes	Yes	No	15
M-094-014-002	Coon Brook	1	0	No	No	No	12
M-094-014	Daggett Brook	3	0	No	Yes	No	12
M-109	Dean Brook	1	0	No	No	No	7
M-065	Elk River	26	4	Yes	Yes	No	19
M-065-B013	Elk River	0	2	No	Yes	No	18
M-117-011	Hill River	1	0	No	Yes	No	4

MnDNR Kittle ID Number	Feature Name	Number of Segment 1 Crossings	Number of Segment 2 Crossings	Impaired	PWI Crossing	MnDNR Designated Trout Stream	Appendix J, Mapbook JC, Page Number
M-081-002-001-003	Hillman Creek	1	0	Yes	Yes	No	14
M-103-001	Ironton Creek	1	0	Yes	Yes	No	10
M-081-003	Little Mink Creek	1	0	No	Yes	No	13
M-078	Little Rock Creek	1	0	Yes	No	No	15
MAJ-070111818_A	Unnamed	1	0	No	No	No	11
MAJ-070113492_A	Unnamed	1	0	No	No	No	11
MAJ-070113877_B	Unnamed	0	2	No	No	No	18
MAJ-070114123_B	Unnamed	1	0	No	No	No	16
MAJ-070115183	Unnamed	1	0	No	No	No	17
MAJ-070116190_A	Unnamed	1	0	No	No	No	7
MAJ-070116603_A	Unnamed	3	0	No	No	No	6
MAJ-070116803_B	Unnamed	0	1	No	No	No	20
MAJ-070116992_B	Unnamed	0	1	No	No	No	19
MAJ-070117213_A	Unnamed	1	0	No	No	No	7
MAJ-070117801_A	Unnamed	1	0	No	No	No	6
MAJ-07013276_B	Unnamed	1	0	No	No	No	14

MnDNR Kittle ID Number	Feature Name	Number of Segment 1 Crossings	Number of Segment 2 Crossings	Impaired	PWI Crossing	MnDNR Designated Trout Stream	Appendix J, Mapbook JC, Page Number
MAJ-07013688_A	Unnamed	1	0	No	No	No	4
MAJ-07013941_B	Unnamed	1	0	No	No	No	13
MAJ-07014392_B	Unnamed	1	0	No	No	No	13
MAJ-07014394_B	Unnamed	1	0	No	No	No	14
MAJ-07014555_B	Unnamed	1	0	No	No	No	15
MAJ-07014758_A	Unnamed	1	0	No	No	No	4
MAJ-07015142_B	Unnamed	1	0	No	No	No	15
MAJ-07015406_B	Unnamed	2	0	No	No	No	14
MAJ-07015538_A	Unnamed	1	0	No	No	No	5
MAJ-07015696_B	Unnamed	1	0	No	No	No	14
MAJ-07015698_B	Unnamed	1	0	No	No	No	13
MAJ-07015756_B	Unnamed	1	0	No	No	No	15
MAJ-07016006_B	Unnamed	1	0	No	No	No	14
MAJ-07016027_B	Unnamed	1	0	No	No	No	15
MAJ-07016163_B	Unnamed	3	0	No	No	No	15

MnDNR Kittle ID Number	Feature Name	Number of Segment 1 Crossings	Number of Segment 2 Crossings	Impaired	PWI Crossing	MnDNR Designated Trout Stream	Appendix J, Mapbook JC, Page Number
MAJ-07016426_B	Unnamed	1	0	No	No	No	15
MAJ-07016432_B	Unnamed	1	0	No	No	No	14
MAJ-07016439_A	Unnamed	1	0	Yes	No	No	4
MAJ-07017140_B	Unnamed	2	0	No	No	No	14
MAJ-07017492_B	Unnamed	1	0	No	No	No	13
MAJ-07017548_B	Unnamed	1	0	No	No	No	16
MAJ-07018895_A	Unnamed	1	0	No	No	No	4
MAJ-07019868_A	Unnamed	1	0	No	No	No	10
M-065-017	Mayhew Creek	1	0	Yes	Yes	No	17
M	Mississippi River	2	0	Yes	Yes	No	2
M-117-012	Moose River	1	0	Yes	Yes	No	5
M-106-001-003	Mud Brook	3	0	No	Yes	No	8
M-094	Nokasippi River	1	0	Yes	Yes	No	11
M-081	Platte River	1	0	Yes	Yes	No	12
M-103	Rabbit River	3	0	No	Yes	No	10
M-065-013	Rice Creek	0	2	Yes	Yes	No	18
M-106-001-003-001	Ross Creek	1	0	No	Yes	No	7
M-081-002-001-001	Skunk Creek	1	0	No	Yes	No	14
M-081-002-001	Skunk River	3	0	Yes	Yes	No	14

MnDNR Kittle ID Number	Feature Name	Number of Segment 1 Crossings	Number of Segment 2 Crossings	Impaired	PWI Crossing	MnDNR Designated Trout Stream	Appendix J, Mapbook JC, Page Number
M-130	Split Hand Creek	1	0	Yes	Yes	No	3
M-128	Swan River	1	0	Yes	Yes	No	1
M-130-002	Unnamed Ditch	1	0	No	No	No	2
M-065-008	Unnamed Stream	0	1	Yes	Yes	No	20
M-065-009	Unnamed Stream	0	1	No	No	No	20
M-065-010	Unnamed Stream	0	2	No	No	No	19
M-065-010-001	Unnamed Stream	0	2	No	No	No	19
M-065-010-002	Unnamed Stream	0	1	No	No	No	19
M-065-013-001	Unnamed Stream	0	2	Yes	Yes	No	18
M-065-013-002	Unnamed Stream	0	1	No	No	No	18
M-065-013-002-001	Unnamed Stream	0	2	No	No	No	18
M-065-013-004	Unnamed Stream	0	1	No	No	No	19
M-065-017-014	Unnamed Stream	1	0	No	No	No	16
M-065-017-014-001	Unnamed Stream	1	0	No	No	No	16
M-065-017-014-001-002	Unnamed Stream	1	0	No	Yes	No	16
M-065-017-015.5	Unnamed Stream	1	0	No	Yes	No	17
M-065-017-016	Unnamed Stream	1	0	No	No	No	16
M-065-019	Unnamed Stream	1	0	No	No	No	17
M-065-021	Unnamed Stream	1	0	No	No	No	17
M-065-029	Unnamed Stream	1	0	No	No	No	17
M-065-032	Unnamed Stream	1	0	No	No	No	16

MnDNR Kittle ID Number	Feature Name	Number of Segment 1 Crossings	Number of Segment 2 Crossings	Impaired	PWI Crossing	MnDNR Designated Trout Stream	Appendix J, Mapbook JC, Page Number
M-065-035	Unnamed Stream	1	0	No	No	No	16
M-065-035-001	Unnamed Stream	1	0	No	No	No	16
M-078-013	Unnamed Stream	1	0	No	Yes	No	15
M-081-002-001-002-006	Unnamed Stream	1	0	No	Yes	No	14
M-081-002-002-001-001	Unnamed Stream	1	0	No	Yes	No	15
M-101-001.1	Unnamed Stream	1	0	No	Yes	No	10
M-101-001-001	Unnamed Stream	1	0	No	Yes	No	10
M-101-002	Unnamed Stream	4	0	Yes	Yes	No	11
M-106-001-008	Unnamed Stream	1	0	No	Yes	No	6
M-109-002	Unnamed Stream	1	0	No	No	No	8
M-117-001	Unnamed Stream	1	0	Yes	Yes	No	6
M-117-011-000.2	Unnamed Stream	1	0	No	Yes	No	3
M-117-012	Unnamed Stream	1	0	No	No	No	5
M-117-012-002	Unnamed Stream	1	0	No	Yes	No	5
M-130-003	Unnamed Stream	1	0	No	Yes	No	3
M-132	Unnamed Stream	1	0	No	No	No	2
M-117	Willow River	1	0	Yes	Yes	No	4

Source: MnDNR Public Waters Inventory Dataset (2020)

7.6.6.1 Impacts and Mitigation

Because the Proposed Right-of-Way would span multiple rivers and streams, including a MnDNR Designated Trout Stream (Briggs Creek) and PWI Waters, permanent impacts to rivers and streams are not anticipated. The construction of the Project could result in temporary erosion of soils and increased sedimentation to rivers and streams. In addition, tree clearing along waterways may result in warming water and removing shaded habitat.

Although tall growing vegetation would be excluded from the right-of-way, shrubs and other vegetation would be allowed to regrow, which would mitigate any temporary impacts to water temperature.

Mitigation measures will be implemented to prevent or minimize surface water impacts that could affect water quality as described in **Section 7.6.3.1** above including obtaining a Construction Stormwater General Permit (MNR100001) and implementing a SWPPP. Erosion and sedimentation abatement measures, for example, would be employed to mitigate impacts to water resources within the Proposed Route. No fueling or maintenance of vehicles or application of herbicides would occur within 100 feet of streams, ditches, and waterways to protect against introduction of these materials into surface or groundwater systems. Materials such as fuels, lubricants, paints, and solvents required for construction would be stored away from surface water resources according to appropriate regulatory standards. Any spills or leaks would be cleaned up immediately and leaking equipment removed from the area for proper maintenance.

The Applicants will span the designated trout stream and will work with the MnDNR to avoid impacts by following in-water exclusion dates. This stream is located in Segment 2 where the existing right-of-way is cleared and no additional clearing is required. Through the NPDES permitting process the Project will be required to comply with Section 23.1 of MNR100001, which includes designated trout streams within the definition of special waters. Best management practices such as redundant perimeter controls and the stabilization of exposed soils immediately upon completion of work within the 75-foot buffer would be implemented to minimize erosion near MnDNR designated trout streams.

Invasive and noxious species in Minnesota are regulated by the MnDNR and MDA. If work occurs in a state water, such as an access bridge, the Applicants will work with the DNR to obtain required permits and/or approvals.

Mitigation measures will include those outlined in **Section 7.6.7**.

7.6.7 Wetlands

Wetlands are important resources for flood abatement, wildlife habitat, and water quality. The Minnesota Wetland Inventory ("MWI") is a publicly-available GIS database that provides information on the location and characteristics of wetlands in Minnesota (Minnesota DNR 2023G). The inventory is a 2008 update of the U.S. Fish and Wildlife Service ("USFWS") National Wetlands Inventory ("NWI") that was completed for Minnesota in the 1980s. Wetlands listed on the MWI may be inconsistent with local wetland conditions; however, the MWI is the most accurate and readily available database of wetland resources within the Project area and were therefore used to identify wetlands in the Proposed Route.

Wetland types within the MWI are classified using the Cowardin wetland habitat classification system (MnDNRc 2021). The Cowardin Classification System is hierarchical and defines wetland habitats based on vegetative and sediment class along with water regimes. About 8,382 acres of wetlands are located within the Proposed Route and approximately 996 acres of wetlands are present within the Proposed Right-of-Way. (**Table 7-19** and **Appendix J, Mapbook JC**).[91] Wetland habitat types/type combinations are mapped as occurring within the Proposed Route including palustrine emergent ("PEM"), palustrine forested ("PFO"), palustrine scrub/shrub ("PSS"), palustrine unconsolidated bottom ("PUB"), and riverine. PEM wetlands are habitats dominated by emergent herbaceous plant species. PFO wetlands are dominated by woody tree species. PSS wetlands are dominated by woody shrub species. PUB wetlands are associated with ponds, less than 20 acres in size, and have less than 30 percent vegetative cover.

Table 7-19. MWI Wetlands within the Proposed Route and Right-of-Way

Wetland Type	Wetland within Proposed Route (Acres)	Wetland within Proposed Right-of-Way (Acres)	Wetland within Segment 1 Proposed Right-of-Way (Acres)y	Wetland within Segment 2 Proposed Right-of-Way (Acres)
Freshwater Emergent Wetland	3,128.26	457.50	316.31	141.20
Freshwater Forested Wetland	1,637.92	170.24	162.57	7.67
Freshwater Forested/Emergent Wetland	78.72	10.08	9.06	1.02
Freshwater Forested/Shrub Wetland	526.24	56.92	52.05	4.87
Freshwater Pond	165.49	16.83	11.66	5.16
Freshwater Shrub Wetland	1,443.36	137.48	121.03	16.45
Freshwater Shrub/Emergent Wetland	1,081.13	115.48	108.71	6.77
Lake	135.16	7.44	3.98	3.46
Riverine	185.82	23.66	20.24	3.42
Total	**8,382.10**	**995.63**	**805.61**	**190.02**

7.6.7.1 Impacts and Mitigation

Both temporary and permanent impacts to wetlands would result from construction of the Project. Temporary fill impacts to wetlands would occur in the form of the placement of temporary construction matting along access routes, transmission line structure work areas, and conductor pulling and tensioning sites. Temporary fill would be removed upon completion of construction.

Permanent impacts would include the placement of fill material within the wetland area, such as the placement of a transmission line structure or grading work associated with the expansion and construction of the substations. It is estimated that 110 to 121 structures may need to be placed within a wetland. This estimate was developed by identifying the number and length of wetlands that are longer than 800 feet. An estimated

[91] On May 25, 2023, the US Supreme Court issued its decision in *Sackett v. EPA*, 598 U.S. ____ (2023), holding that "the CWA extends to only those 'wetlands with a continuous surface connection to bodies that are 'waters of the United States' in their own right,' so that they are 'indistinguishable' from those waters." The analysis described in this section was conducted prior to *Sackett*, and the Applicants will continue to work with applicable agencies as the impacts of *Sackett* are more fully understood.

5,500 to 6,050 square feet of permanent wetland impacts may occur from structures being placed in a wetland.

Permanent wetland conversion impacts would constitute the clearing of forested wetlands within the Segment 1 right-of-way where these resources would not be allowed to revegetate to a forested wetland due to safety requirements but would be managed as either emergent or shrub wetlands. It is estimated that approximately 224 acres of forested, forested/emergent and forested/shrub wetlands may be converted to either emergent or shrub wetlands within the Segment 1 new right-of-way and through right-of-way maintenance will not be allowed to revegetate to the original forested wetland community type. Segment 2 right-of-way is cleared and maintained, therefore no clearing is anticipated. (**Table 7-19**).

Temporary fill impacts to wetlands would occur in the form of the placement of temporary construction matting along access routes, transmission line structure work areas, and conductor pulling and tensioning sites. Temporary fill would be removed upon completion of construction.

The Project minimizes wetland clearing and change in wetland type by following existing rights-of-way for the majority of its length. Additional wetland impact avoidance measures that may be implemented during design and construction of the Project include structure spacing — placing the transmission structures at variable distances to span and avoid wetlands, where practicable. When it is not practicable to span the wetland, several measures can be used to minimize impacts during construction:

- When practicable, construction will be scheduled during frozen ground conditions.
- When construction during winter is not practicable, construction mats (e.g., wooden mats and/or a composite matting system) will be used to protect wetlands.
- All-terrain construction vehicles may be used, which are designed to minimize impact to soils in damp areas.
- Construction crews will attempt to access the wetlands with the least amount of physical impact to the wetlands.
- Construction crews will use the existing road system where practicable for access and material delivery to minimize travel through wetlands.

Initial coordination with the U.S. Army Corps of Engineers ("USACE") regarding the Project indicated that wetland impacts associated with the Project will likely meet conditions to be authorized under the USACE St. Paul Regulatory District Utility Regional General Permit. The Applicants will continue to coordinate with USACE and will obtain permit coverage once design details are available. Mitigation may be required by the USACE, typically in the form of wetland replacement credits, for permanent fill of wetland areas. A wetland permit from the appropriate Local Government Units ("LGUs") may be required in compliance with the Wetland Conservation Act ("WCA"). The Applicants will coordinate with the LGUs and apply for a permit if required once design details are available.

7.7 Flora and Fauna

The following sections describe the flora and fauna that could occur in or adjacent to the Proposed Route and any associated potential impacts and proposed mitigation measures.

7.7.1 Flora

Pre-settlement vegetation in the Project Study Area consisted of mostly aspen-birch forest, aspen oak land, hardwood/pine forests, conifer bogs and swamps, with smaller amounts of jack pine barrens, oak openings, brush prairies, and scattered lakes and streams. Vegetation communities in the area currently include developed urban areas, woody wetland, and deciduous forest (**Appendix J, Mapbook JD**). Invasive species and noxious weeds are also present in the Project Study Area. For additional discussion of land cover, see **Section 7.8.3**.

7.7.1.1 Impacts and Mitigation

Impacts to vegetation are anticipated due to construction activities. Permanent vegetation conversion impacts would include the clearing of trees and shrubs within the right-of-way where these resources would not be allowed to revegetate to their previous heights and density due to safety requirements but would be managed to a safe height and density. Temporary impacts to vegetation would occur in the form of using construction matting along access routes, transmission line structure work areas, removal of foundations on existing transmission line structures where the Project will replace existing lines, and conductor pulling and tensioning sites. The disturbance would be minimized by using the existing road system to the extent practicable, traveling within the right-of-way as appropriate, and not building new access roads unless necessary. In addition, the transmission line is primarily being constructed parallel to existing transmission lines and/or rebuilding existing transmission lines. More than 85 percent (about 155.1 of 181.4 miles) of the Project would parallel or rebuild existing high-voltage transmission rights-of-way, and vegetation has already been cleared and is being maintained within Segment 2 rights-of-way, minimizing impacts to vegetation in those areas.

Construction of the Project could lead to the introduction or spread of invasive species and noxious weeds. Construction activities that could potentially lead to the introduction of invasive species include ground disturbance that leaves soils exposed for extended periods, introduction of topsoil contaminated with weed seeds, vehicles importing weed seed from a contaminated site to an uncontaminated site, and conversion of landscape type, particularly from forested to open settings.

Potential impacts due to invasive species and noxious weeds can be mitigated by:

- Revegetating disturbed areas using weed-free seed mixes and using weed-free straw and hay for erosion control.
- Removal of invasive species/noxious weeds via herbicide and manual means.
- Cleaning and inspecting construction vehicles to remove dirt, mud, plant, and debris from vehicles prior to arriving at and leaving construction sites.

7.7.2 Fauna

Wildlife species throughout the Proposed Route include reptiles, amphibians, woodcock, raptors, ruffed grouse, wild turkeys, white-tailed deer, black bear, beaver, muskrat, river otter, grey wolf, rabbits, squirrels, red and gray fox, raccoon, migratory water birds (geese, ducks, trumpeter swans, herons, shorebirds), and various perching birds (meadowlarks, sparrows, thrushes, woodpeckers, warblers). For a discussion of additional species see **Section 7.9.1**.

7.7.2.1 Impacts and Mitigation

There is potential for the displacement of wildlife and loss of habitat from construction and construction-related disturbances including noise and activity of the Project. Wildlife that inhabit natural areas could be impacted temporarily within the immediate area of construction. The distance that animals will be displaced will depend on the species. Small species including small mammals, reptiles, and amphibians could be more affected by construction activities because of their inability to vacate a construction area. However, these animals will be typical of those found in forested and rural settings and should not incur population level effects due to construction.

Raptors, waterfowl, and other bird species may be affected by the construction and placement of the transmission lines. Avian collisions (with or without electrocution) are a possibility after construction of the Project. Waterfowl are typically more susceptible to transmission line collision, especially if the transmission line is placed between wetlands and fields that serve as feeding areas, or between wetlands and open water, which serve as resting areas. The Project minimizes potential new impacts by predominantly paralleling existing transmission rights-of way and rebuilding existing lines.

In addition, where practicable the Project will consider the Avian Powerline Interaction Committee ("APLIC") recommendations to reduce electrocution and collisions (APLIC 2006). The Applicants propose to coordinate with the MnDNR on the appropriate locations of bird flight diverters to mark the section of proposed double-circuit transmission line. If construction were to occur during the migratory bird nesting season, pre-construction nest surveys would be conducted.

7.8 Zoning and Land Use

7.8.1 Zoning

The Proposed Route crosses (from north to south) Itasca, Aitkin, Crow Wing, Morrison, Benton, and Sherburne Counties. According to public zoning GIS data provided by these counties and their respective zoning ordinances (see footnote references in **Table 7-20**), the Proposed Route primarily crosses Agricultural and Farm Residential zoning areas with scattered zoned areas of Public and Open land, Single Family Residential, and Natural Environment. The southern end of the Proposed Route crosses through the City of Becker in Agricultural and Industrial zones.

The Proposed Route also crosses county-managed shoreland overlay districts within each county along the Proposed Route.

Table 7-20. Shoreland Overlay Districts within the Proposed Route

County	District Name	Zoning Ordinance
Itasca County	Itasca County Shoreland Overlay Zoning District (including Mississippi Headwaters Corridor)	Itasca County Zoning Ordinance Article 5[1]
Aitkin County	Aitkin County Shoreland Management Zones	Aitkin County Shoreland Management Ordinance[2]
Crow Wing County	Crow Wing County Shoreland District (including Mississippi Headwaters Corridor)	Crow Wing County's Land Use Ordinance Article 11[3]
Morrison County	Morrison County Shoreland District	Morrison County Land Use Control Ordinance Section 700[4]
Benton County	Benton County Shoreland Areas	Benton County Shoreland Ordinance[5]
Sherburne County	Sherburne County's Shoreland Overlay District	Sherburne County Zoning Ordinance Section 14[6]

[1] Itasca County, 2018.
[2] Aitkin County, 2018.
[3] Crow Wing County, 2011.
[4] Board of County Commissioners of Morrison County, 2016.
[5] Benton County, 1972.
[6] Sherburne County, 2021.

7.8.2 Land Use

According to combined public land use GIS data provided by each county and current satellite imagery, land use within the Proposed Route consists of rural residential areas, open and public lands, forestlands, agricultural lands, and commercial areas. Commercial and retail spaces are primarily located within the City of Becker in Sherburne County. The Proposed Route intersects several recreational areas and trails including snowmobile, cross-country skiing, and walking trails (see **Sections 7.2.8** and **7.6**). Four Minnesota Board of Water and Soil Resources ("BWSR") conservation easements are crossed by the Proposed Route (41.23 acres) and two are crossed by the Proposed Right-of-Way (4.14 acres). Two active BWSR easements, classed as Perpetual Riparian Land, are crossed by Segment 1 and Segment 2 of the Proposed Route, but not crossed by the Proposed Right of Way. Two expired BWSR easements, classed as Limited Marginal Cropland, are crossed by the Proposed Right-of-Way in Segment 2. No Natural

Resources Conservation Service ("NRCS") easements are crossed by the Proposed Route or Proposed Right-of-Way.

7.8.3 Land Cover

The total acreage of each land cover type overlapped by the Proposed Route is provided in **Table 7-21** and shown on **Appendix J, Mapbook JD**. **Table 7-22** provides an overview of the land cover within the Proposed Right-of-Way, and **Table 7-23** provides an overview of the land cover for the proposed substation expansions.

Table 7-21. Land Cover within the Proposed Route

Land Cover Type	Acres	Percent of Total	Segment 1 (Acres)	Segment 2 (Acres)
Barren Land	37.65	0.13%	26.29	11.35
Cultivated Crops	5,370.41	18.58%	2,746.33	2,624.08
Deciduous Forest	7,687.83	26.60%	6,947.32	740.51
Developed, High Intensity	41.07	0.14%	10.26	30.82
Developed, Low Intensity	317.61	1.10%	176.15	141.46
Developed, Medium Intensity	151.97	0.53%	46.71	105.26
Developed, Open Space	518.34	1.79%	376.02	142.31
Emergent Herbaceous Wetlands	4,003.77	13.85%	3,295.11	708.66
Evergreen Forest	360.04	1.25%	286.48	73.56
Hay/Pasture	3,930.98	13.60%	2,882.21	1,048.78
Herbaceous	231.19	0.80%	173.51	57.68
Mixed Forest	862.35	2.98%	843.02	19.34
Open Water	230.27	0.80%	168.18	62.09
Shrub/Scrub	367.61	1.27%	349.36	18.25
Woody Wetlands	4,787.70	16.57%	4,366.17	421.52
Total	**28,898.79**	**100.00%**	**22,693.12**	**6,205.67**

Table 7-22. Land Cover within the Proposed Right-of-Way

Land Cover Type	Acres	Percent of Total	Segment 1 (Acres)	Segment 2 (Acres)
Barren Land	1.45	0.04%	0.64	0.81
Cultivated Crops	702.92	21.29%	419.77	283.15
Deciduous Forest	630.83	19.10%	584.63	46.20
Developed, High Intensity	3.64	0.11%	0.67	2.98
Developed, Low Intensity	39.78	1.20%	10.53	29.25
Developed, Medium Intensity	18.01	0.55%	2.52	15.49
Developed, Open Space	53.07	1.61%	30.91	22.17
Emergent Herbaceous Wetlands	588.53	17.82%	464.97	123.56

Land Cover Type	Acres	Percent of Total	Segment 1 (Acres)	Segment 2 (Acres)
Evergreen Forest	26.11	0.79%	25.01	1.10
Hay/Pasture	581.90	17.62%	404.50	177.41
Herbaceous	45.50	1.38%	27.25	18.26
Mixed Forest	67.50	2.04%	65.23	2.27
Open Water	20.63	0.62%	9.97	10.66
Shrub/Scrub	62.76	1.90%	59.10	3.66
Woody Wetlands	459.61	13.92%	434.03	25.58
Total	**3,302.24**	**100.00%**	**2,539.72**	**762.52**

Table 7-23. Land Cover within the Proposed Substation Expansion Areas

Land Cover Type	Benton County Substation Expansion (Acres)	Cuyuna Series Compensation Station (Acres)	Iron Range Substation Expansion (Acres)	Total Substations (Acres)
Barren Land	0.22	-	-	0.22
Cultivated Crops	1.56	-	-	1.56
Deciduous Forest	-	24.68	14.84	39.52
Developed, High Intensity	0.60	-	-	0.60
Emergent Herbaceous Wetlands	-	0.02	-	0.02
Hay/Pasture	5.82	-	-	5.82
Mixed Forest	-	0.34	0.09	0.43
Shrub/Scrub	-	-	0.09	0.09
Total	**8.20**	**25.05**	**15.01**	**48.26**

7.8.4 Impacts and Mitigation

The Project primarily follows existing rights-of-way (more than 85 percent), and it is largely consistent with existing land use and is not anticipated to impact zoning. The Proposed Right-of-Way would traverse both privately and publicly owned lands. The Applicants would work with landowners to secure easements for constructing and operating the Project, and with the exception of structure locations, landowners would still be able to use the right-of-way property for certain uses like agriculture and grazing. However, there would be temporary access and use impacts during construction.

Table 7-23 identifies the land cover categories overlapped by the Proposed Right-of-Way. Much of the Proposed Route is proposed to parallel or rebuild existing transmission lines, which will avoid and/or minimize impacts. Permanent impacts of Segment 1 would include the conversion of tree and shrub land cover to herbaceous vegetation. Segment 2 is already cleared, and other than ongoing vegetation maintenance, no impacts are anticipated. Temporary impacts to land cover would occur from temporary access routes, transmission line structure work areas, removal of foundations on existing transmission line structures within the rebuild segments, and conductor pulling and tensioning sites. Preconstruction vegetation would regrow in the temporarily impacted areas after construction.

The Iron Range, Cuyuna Series Compensation Station, and the Benton County substation parcels currently have approximately 40 acres in forested land cover, 0.6 acres in developed land cover and 0.1 acres in herbaceous/scrub shrub land cover (**Table 7-23**). The construction footprints of the substation construction and expansions are minor and no mitigation is proposed. Iron Range Substation expansion area is shown on **Appendix J, Detailed Mapbook, Page 1**. Cuyuna Series Compensation Station Substation construction is shown on **Appendix J, Detailed Mapbook, Pages 24-25.** Benton County Substation expansion area is shown on **Appendix J, Detailed Mapbook, Pages 50-51**.

Impacts to BWSR conservation easements could include temporary vegetation clearing, construction access, and ongoing vegetation maintenance. Impacts to BWSR conservation easements will be minimal as the right-of-way crossings are within the Segment 2 maintained right-of-way and these segments are proposed for rebuild. The Applicants will work with BWSR and landowners to confirm active status and minimize impacts to active conservation easements in the Proposed Right-of-Way.

7.9 Rare and Unique Resources

7.9.1 Threatened and Endangered Species

The Applicants reviewed available data on threatened and endangered species and requested consultation with the MnDNR and USFWS. The Applicants reviewed an unofficial listing of documented occurrences of state-listed species within the Study Area and within one mile of the Proposed Route. Although this review does not represent a comprehensive survey, it provides information on the potential presence of state-protected species and habitat within the vicinity of the Proposed Route. The USFWS Information, Planning, and Consultation ("IPaC") system was used to identify federally threatened, endangered, proposed for listing, and candidate species, and proposed and designated critical habitat that may occur near and within the Proposed Route.

7.9.1.1 State Listed Species

A review of rare MnDNR Natural Heritage Information System ("NHIS") state-listed special concern, threatened, or endangered species within the Project Study Area and within one-mile of the Proposed Route identified one amphibian, three reptiles, seven birds, one fish, three insects, two mammals, two mussels, and 22 plant species (**Table**

7-24 and **Table 7-25**).[92] Of these species, nine are listed as threatened and six are listed as endangered.

Table 7-24. State-Listed Species within the Study Area

Scientific Name	Common Name	Type	Status	Habitat
Hemidactylium scutatum	Four-toed Salamander	Amphibian	Special Concern	Sphagnum bogs, grassy areas; surrounding deciduous, mixed forests
Emydoidea blandingii	Blanding's Turtle	Reptile	Threatened	Wetlands, adjacent sandy uplands
Pituophis catenifer	Gophersnake	Reptile	Special Concern	Dry sand, bluff prairies
Buteo lineatus	Red-shouldered Hawk	Bird	Special Concern	Mature deciduous habitat with scattered wetland openings
Lanius ludovicianus	Loggerhead Shrike	Bird	Endangered	Upland grasslands, pastures, agricultural areas
Etheostoma microperca	Least Darter	Fish	Special Concern	Clear freshwater streams, lakes
Pelegrina arizonensis	A Jumping Spider	Insect	Special Concern	Grasslands
Ligumia recta	Black Sandshell	Mussel	Special Concern	Riffle and run areas of medium to large rivers
Lasmigona compressa	Creek Heelsplitter	Mussel	Special Concern	Creeks, small rivers, upstream portions of large rivers
Waldsteinia fragarioides var. *fragarioides*	Barren Strawberry	Plant	Special Concern	Mesic to dry-mesic pine, mixed pine, hardwood forests
Cardamine pratensis	Cuckoo Flower	Plant	Threatened	Sedge-dominated fens, white cedar swamps
Poa paludigena	Bog Bluegrass	Plant	Threatened	Swamps, sedge meadows, small pool margins, rivulets

[92] The review of the NHIS data is preliminary until such time as MnDNR is able to provide an official review. The Applicants will conduct a formal NHIS review and consultation with the MnDNR once an official route is chosen.

Scientific Name	Common Name	Type	Status	Habitat
Antennaria parvifolia	Small-leaved Pussytoes	Plant	Special Concern	Dry prairie, savanna
Nuttallanthus canadensis	Old Field Toadflax	Plant	Special Concern	Dry, sandy soil in prairie, savanna
Minuartia dawsonensis	Rock Sandwort	Plant	Threatened	Dry, sedimentary bedrock outcrops

Table 7-25. State-Listed Species within One Mile of the Proposed Route

Scientific Name	Common Name	Type	Status	Habitat
Heterodon nasicus	Plains Hog-nose Snake	Reptile	Special Concern	Open, sparsely vegetated habitats with well-drained soils
Coturnicops noveboracensis	Yellow Rail	Bird	Special Concern	Sedge- or grass-dominated wetlands
Cygnus buccinator	Trumpeter Swan	Bird	Special Concern	Ponds, lakes, bays, large water bodies with extensive emergent vegetation
Ammodramus nelsoni	Nelson's Sparrow	Bird	Special Concern	Sedge- or grass-dominated wetlands
Chondestes grammacus	Lark Sparrow	Bird	Special Concern	Dry grasslands with sparse grasses, bare ground, patchy forested areas
Falco peregrinus	Peregrine Falcon	Bird	Special Concern	Riparian cliff ledges or buildings
Ophiogomphus howei	Pygmy Snaketail	Insect	Special Concern	Pristine, low gradient rivers with finely graveled, sandy substrates
Cicindela patruela	Northern Barrens Tiger Beetle	Insect	Special Concern	Openings and sandy roads through pine forests
Myotis lucifugus	Little Brown Myotis	Mammal	Special Concern	Caves, cellars, human structures and forests
Eptesicus fuscus	Big Brown Bat	Mammal	Special Concern	Caves, cellars, human structures and forests
Ranunculus lapponicus	Lapland Buttercup	Plant	Special Concern	Rich forested and alder swamps
Botrychium rugulosum	St. Lawrence Grapefern	Plant	Special Concern	Low, moist habitats in grass areas, open forested areas

Scientific Name	Common Name	Type	Status	Habitat
Botrychium lanceolatum var. *angustisegmentum*	Narrow Triangle Moonwort	Plant	Threatened	Moist, shady, mature northern hardwood forests
Botrychium oneidense	Blunt-lobed Grapefern	Plant	Threatened	Mesic hardwood forests
Botrychium simplex var. *simplex; B.s.* var. *compositum; B.s.* var. *tenebrosum*	Least Moonwort	Plant	Special Concern	Open prairies, wetlands; prairie; moist hardwood forest interiors
Najas gracillima	Slender Naiad	Plant	Special Concern	Clear, soft water lakes with low disturbance
Utricularia purpurea	Purple-flowered Bladderwort	Plant	Endangered	Small- to medium-sized lakes, adjacent to boggy shoreline
Botrychium campestre var. *campestre*	Prairie Moonwort	Plant	Special Concern	Prairies
Botrychium campestre var. *lineare*	Slender Moonwort	Plant	Endangered	Prairies; tailings basin in Crow Wing County, mine "dump" in St. Louis County
Botrychium ascendens	Upswept Moonwort	Plant	Endangered	Open, grassy habitat adjacent to forest
Botrychium spathulatum	Spatulate Moonwort	Plant	Endangered	Open, grassy habitat adjacent to forest
Botrychium pallidum	Pale Moonwort	Plant	Special Concern	Open fields, dry sand and gravel ridges, wet depressions, marshy lakeshores, mixed-deciduous hardwood forests
Juglans cinerea	Butternut	Plant	Endangered	Mesic hardwood forests
Platanthera flava var. *herbiola*	Tubercled Rein Orchid	Plant	Threatened	Wet meadows, sunny swales in savannas, margins of shallow marshy lakes
Aristida tuberculosa	Seaside Three-awn	Plant	Threatened	Sand savannas, sand prairies, dunes
Hudsonia tomentosa	Beach Heather	Plant	Threatened	Active sand dunes

7.9.1.2 Federally Listed Species

A review of the USFWS IPaC system identified six federally threatened, endangered, proposed endangered, candidate, and non-essential experimental population species within the Study Area and within one mile of the Proposed Route. IPaC identified four mammals, one bird, and one insect species (**Table 7-26**). No designated critical habitat for federally listed species occurs within the Proposed Route. An official species list from the USFWS is included in **Appendix R**.

Table 7-26. Federally-Listed Species within One Mile of the Proposed Route

Scientific Name	Common Name	Type	Status	Habitat
Lynx canadensis	Canada Lynx	Mammal	Threatened	Boreal spruce-fir forests
Canis lupus	Gray Wolf	Mammal	Threatened	Habitat generalists, areas with ungulate prey.
Myotis septentrionalis	Northern Long-eared Bat	Mammal	Endangered	Live and dead trees, cavities, crevices
Perimyotis subflavus	Tricolored Bat	Mammal	Proposed Endangered	Caves, cellars, human structures and forests
Grus americana	Whooping Crane	Bird	Experimental Population, Non-Essential	Coastal marshes and estuaries, inland marshes, lakes, open ponds, shallow bays, salt marsh and sand or tidal flats, upland swales, wet meadows and rivers, pastures, and agricultural fields.
Danaus plexippus	Monarch Butterfly	Insect	Candidate	Milkweed and flowering plants

The Canada lynx is a mid-sized boreal forest cat species that is approximately 30 to 35 inches long and weighs about 15 to 30 pounds. Canada lynx habitat is associated with moist, cool, boreal spruce-fir forests with high snowshoe hare (*Lepus americanus*) densities. Critical habitat for the Canada lynx was published in the *Federal Register* Vol. 71, No. 217 on November 9, 2006. However, no designated critical habitat for Canada lynx occurs within the Proposed Route.

The gray wolf is a large canine species that is approximately 41 to 63 inches long with a mean body mass of 88 pounds. Gray wolves have high habitat adaptability and are considered integral components of their host ecosystems. The gray wolf is classified as federally threatened in the United States. Critical habitat for gray wolves was published in the *Federal Register* Vol. 43, No. 47 on March 9, 1978. However, no designated critical habitat for gray wolves occurs within the Proposed Route.

The northern long-eared bat ("NLEB") is a medium-sized bat that is 3.0 to 3.7 inches in length. The species' name is due to its relatively long ears compared to other members of the genus *Myotis*. The NLEB was recently uplisted from threatened to endangered primarily due to population declines from white-nose syndrome, a fatal fungal infection that affects hibernating bats. In winter, NLEBs hibernate in mines and caves in areas with high humidity, constant temperatures, and no air currents. In summer, the species roosts alone or in colonies in live and dead trees under bark, in cavities, or in crevices. Critical habitat has not been proposed. The MnDNR maintains a list of townships containing documented NLEB maternity roost trees and hibernacula entrances. (MnDNR 2017). A review of the MnDNR's township list indicates there are NLEB maternity roost trees present within one mile of the Proposed Route in the following unorganized territories in Aitkin County (PLSS): T52 R25W, T51 R27W, T50 R26W. There are no known hibernacula within 1 mile of the Proposed Route.

The tricolored bat is a small (2.8 to 3.1 inches), insectivorous bat that is distinguished by unique yellow-orange tricolored fur. The species ranges across the eastern and central United States and has been proposed for official listing as endangered due to severe population declines from white-nose syndrome. Suitable roosting habitat includes deciduous hardwood trees, pine trees, and occasional human structures. Critical habitat has not been proposed and a list of maternity roost trees and hibernacula is not maintained by the MnDNR. The current range of the tricolored bat, identified by MnDNR, does not include counties within the Project Study Area.

The whooping crane is a large crane with snowy white plumage, black primary feathers, a red crown, and a black half-moon shaped patch on the face. Whooping crane habitat includes marshes along the gulf coast of Texas and inland salt and freshwater marshes throughout the central United States, where whooping cranes will forage for animal and plant material. The whooping crane is federally endangered and is nearing local extinction in much of its native range. The endangered designation is attributed to the population that migrates between Canada and Texas (Aransas Wood Buffalo Population), primarily through North Dakota, South Dakota, Nebraska, Kansas, Oklahoma, and Texas. Critical habitat for this population of whooping cranes was published in the *Federal Register* Vol. 43, No. 94 on May 15, 1978. An experimental, non-essential population of cranes was introduced between 2001 and 2010, designated as the Eastern Migratory Population. This experimental population migrates from Minnesota and Wisconsin to Florida. No critical habitat for this population has been designated. Under the ESA, protections extended to an experimental, non-essential designation equates to the protection of species proposed for listing unless found in a National Park or a USFWS property, where it is treated as if designated as threatened.

Adult monarch butterflies are large with bright orange wings covered with black veins and are found throughout the inland United States. During the breeding season, monarch butterflies will lay eggs on their obligate host plant (milkweed species, *Asclepias spp.*). The monarch butterfly is a candidate species that is not yet federally listed or proposed for listing.

7.9.1.3 Impacts and Mitigation

The Applicants will continue to coordinate with the MnDNR and USFWS to avoid and minimize Project impacts to threatened and endangered species.

As described above, there are 41 state-listed species; this analysis focuses on those designated as threatened or endangered.

Slender Moonwort, Upswept Moonwort, and Spatulate Moonwort These three species of endangered moonwort occur in open grassy habitat adjacent to forests. There are only three populations of slender moonwort that have been identified in Minnesota, none of which occur in the Project Route. Impacts to these three species if present could result from right-of-way clearing and grubbing activities, as well as access road and structure construction. If present, structures, access roads, and construction activity would be sited to avoid and minimize documented presence.

Purple-flowered Bladderwort This endangered plant is found submerged in small and medium size lakes, adjacent to boggy shorelines. The Project is not expected to impact this species because this habitat would not be affected.

Tubercled Rein Orchid This threatened plant species is found in permanent and natural openings in wooded or savanna landscapes, typically in moist soils. Impacts to the species could result from right-of-way clearing and grubbing activities, as well as access road and structure construction. If present, structures, access roads, and construction activity would be sited to avoid and minimize documented presence.

Butternut, Narrow Triangle Moonwort, and Blunt-lobed Grapefern These three species occur in mesic hardwood forests. Butternut was historically a fairly common forest tree but its population was devastated by a fungal disease. However, there has been evidence of potentially fungal-resistant individuals. The clearing of forested areas for right-of-way or access road development could remove healthy butternuts. The narrow triangle moonwort and blunt-lobed grape-fern are threatened species found in moist areas or vernal pool edges in hardwood forests. They are most affected by activities that create gaps in the canopy. The removal of canopy trees from right-of-way clearing could impact these species by changing the local hydrology or soil moisture content. Impacts to the species could result from right-of-way clearing and grubbing activities, as well as access road and structure construction. If present, structures, access roads, and construction activity would be sited to avoid and minimize documented presence.

Seaside Three-awn and Beach Heather Both of these threatened plant species are found exclusively in sand dunes and sandy habitat. Given the narrow habitat requirements of these species, they would be avoided during routing and construction.

Rock Sandwort This threatened species is found in sedimentary bedrock outcrops. The Project is not expected to impact this species because its habitat would likely be avoided for structure location or other construction activities.

Bog Bluegrass This threatened species is found in forested wetland habitat maintained by springs. Adverse impacts could occur if wetland habitat is converted and/or filled as a result of Project construction. If present, structures, access roads, and construction activity would be sited to avoid and minimize documented presence.

Cuckoo Flower This threatened species is found in fens, especially white cedar swamps. Impacts to the species could result from right-of-way clearing and grubbing activities, as well as access road and structure construction. If present, structures, access roads, and construction activity would be sited to avoid and minimize documented presence.

Blanding's Turtle This threatened species of turtle is found in calm, shallow waters, including wetlands associated with rivers and streams with rich aquatic vegetation. In Minnesota, this species utilizes a wide variety of wetland types and riverine habitats in different regions of the state. This species is on the USFWS National Listing Workplan and is expected to be considered for federal listing in fiscal year 2024. Impacts could occur if wetland habitat is converted and/or filled as a result of Project construction.

Loggerhead Shrike This endangered bird is found in upland grasslands and some agricultural areas. They are only found in open areas, avoiding forested areas. They nest in Minnesota and overwinter in the southern US and Mexico. They nest low in trees and brush associated with open areas. Impacts from the Project could result from clearing of potential nesting habitat in grasslands areas. The Applicants would seek to minimize tree removal in open grasslands areas, reducing impacts to nesting habitat. Pre-construction migratory bird survey would occur during the nesting season, prior to land clearing, to avoid impacts to nesting pairs.

Canada Lynx and Gray Wolf Due to the transient nature of Canada lynx and gray wolves and existing development within the Proposed Route, it is unlikely that Canada lynx or gray wolves will commonly occur within the Proposed Route. No gray wolf designated critical habitat occurs within the Proposed Route, but suitable habitat including boreal and hardwood forests are present. However, such habitat is plentiful in the larger area and both species have large home ranges.

NLEB and Tricolored Bats There are multiple NLEB documented roost trees in PLSS locations (T52 R25W, T51 527W, T50 R26W) within one mile of the Proposed Route. Potential tricolored bat habitation is assumed to occur in deciduous hardwood trees and pine trees surrounding the Project, though its current range as described by MnDNR does not include the Project Route. Potential impacts to individual northern long-eared bats may occur if clearing or construction takes place when the species is breeding, foraging, or raising pups in its summer habitat. Bats may be injured or killed if occupied trees are cleared during this active window. Tree clearing activities conducted when the species is in hibernation and not present on the landscape will not result in direct impacts to individual bats but could result in indirect impacts due to removal of suitable foraging and roosting habitat.

In Minnesota, the species is most likely to be found in forested wetlands and riparian area; however, individual trees, fence rows, or small wooded lots (fewer than 10 acres) that are greater than 1,000 feet from forested or wooded areas are considered unsuitable for the species, as are pure stands of less than three-inch diameter-at-breast-height trees that are not mixed with larger trees and trees found in highly developed urban areas. Potentially suitable roosting and foraging habitat is present in the Proposed Route.

Based on the USFWS Determination Key ("Dkey") for the NLEB, the Project may affect the species (see **Appendix R**). With that determination, the Applicants will comply with applicable USFWS guidance in place at the time of Project construction and will continue to consult with the USFWS, as applicable, on any additional or replacement measures developed or appropriate for the Project.

Whooping Crane An experimental, non-essential population of whooping cranes is present in Crow Wing County. Because no known native populations or critical habitat for whooping cranes occur along the Proposed Route, mitigation is not proposed, with the exception of bird flight diverter installation in certain areas.

Monarch Butterfly The Project may result in impacts to monarch butterflies because its host plant is a common milkweed genus found throughout Minnesota within open and disturbed habitat. The monarch butterfly is not officially listed as threatened or endangered, so mitigation is not required. The Applicants will continue to coordinate with the MnDNR and USFWS regarding species status and potential impacts.

Once a Route Permit is issued and detailed design of the line is available, the Applicants will coordinate with the MnDNR and USFWS regarding potential impacts to rare and unique resources.

7.9.2 Natural Resource Sites

MnDNR Natural Resource Sites are mapped within the Proposed Route (**Appendix R**). Six MnDNR WMAs, three state forests, and one AMA are mapped within the Proposed Route. Two state forests include Hill River State Forest and Crow Wing State Forest are crossed by the existing transmission line right-of-way. Rice Lake Savanna, a MnDNR SNA, is mapped within 0.6 miles of the Proposed Route. See **Section 7.2.8** for a full discussion of WMAs, AMAs, SNAs, and state forests. There are 126 MnDNR Minnesota Biological Survey ("MBS") areas of Biological Significance located within the Proposed Route. The acres of MBS areas in the Proposed Route and Proposed Right-of-Way are listed below in **Table 7-27** by site ranking.

Table 7-27. MBS Area within the Proposed Route and Proposed Right-of-Way-

MBS Site Ranking	Proposed Route (Acres)	Proposed Right-of-Way (Acres)	Segment 1 Right-of-Way (Acres)	Segment 2 Right-of-Way (Acres)
Below	466.1	75.4	58.3	17.1
Moderate	5,802.4	512.2	509.9	2.3
High	3,444.5	430.3	421.1	9.2
Outstanding	41.9	9.4	0.0	9.4
Total	**9,754.8**	**1,027.3**	**989.2**	**38.0**

7.9.2.1 Impacts and Mitigation

New impacts will occur to "Moderate" and "High" ranked MBS land along Segment 1 of the Proposed Route. No new impacts are anticipated for MBS sites along Segment 2 because this portion of the Project is proposed for rebuild on existing rights-of-way. The Cuyuna Series Compensation Station is located within the "Moderate" ranked Rabbit Lake Uplands MBS group and an estimated 25 acres of substation area will be impacted. No new impacts are anticipated for "Outstanding" ranked MBS land because it is located entirely along Segment 2. The Applicants will work with the MnDNR to avoid or minimize impacts to areas of Biological Significance and will use sediment and erosion control BMPs for all biologically significant areas crossed by the Project. See **Section 7.2.8** for a discussion of impacts and mitigation for WMAs, AMAs, and State Forests within the Proposed Route.

7.10 Physiographic Features

7.10.1 Topography

The Proposed Route lies within the Interior Plains of the United States. It is primarily located in the Central Lowlands Province, with a small portion of the northern end in the Superior Upland Province. The Central Lowlands Province is the largest physiographic province. It is bounded by areas of higher relief and elevations in the region are 2,000 feet above mean sea level ("AMSL") or less. This province is characterized by flat lands with geomorphic remnants of glaciation. The Superior Upland province is a southern extension of the Laurentian Upland Province that makes up the Canadian Shield to the north. This province is comprised of igneous and metamorphic bedrock covered by a thin veneer of glacial deposits (NPS 2017).

Elevations along the Proposed Route vary from 924 feet to 1462 feet AMSL. The lowest elevations along the route occur at the southern end near the Mississippi River Valley. Elevations then steadily increase to the north, with elevations at the north end near the Iron Range Substation occurring between 1350 feet to 1400 feet AMSL. The topographic high (highest elevations) along the Proposed Route occurs in Aitkin County east of Buss Lake.

7.10.1.1 Impacts and Mitigation

Construction of the Project will have minimal to no impacts to the topography of the area; therefore, no mitigation is proposed.

7.10.2 Geology

The surficial geology of the Proposed Route consists of sediments deposited by the Des Moines Lobe (including the Brainerd and St. Louis sublobes), and Superior Lobe during the Wisconsinan Episode 10,000 to 75,000 years ago. Des Moines lobe till is gray to brown and is distinguishable by its shale content that originates from North Dakota and

Canada. The Superior Lobe deposits are distinctly red in color and contain rocks derived from the Lake Superior basin (Ludsari 1994). The majority of the surficial deposits along the Proposed Route are categorized as glacial plain deposits that include fine-grained lake sediment, washed till, sandy loam, loamy sand, sand, gravel, and cobble gravel. Additional deposit types include alluvium and terrace deposits in the vicinity of major rivers (such as the Mississippi River), channel deposits near smaller streams and rivers, drumlins, and moraine deposits.

The Proposed Route is underlain by bedrock formed during the Penokean Orogeny (mountain building) that occurred during the Precambrian Age. At the southern end, the Proposed Route traverses the East-Central Batholith, which is made up of felsic rock such as granite, tonalite, and granodioritic orthogneiss. The mid-portion of the route, in the vicinity of Brainerd and Lake Mille Lacs, metasedimentary and metavolcanic from the Little Falls Formation, Mille Lacs Group, and Cuyuna North Range Groups are present. The bedrock is made up of graywacke, mudstone, slate, phyllite, schist, quartzite, and argillite. To the north of this section, the route passes through the Cuyuna Iron Range near Riverton, where iron-formation interbedded with mafic volcanics occur in narrow, northeast-southwest trending bands. The remaining northern section of the Proposed Route passes through the Animikie Basin. Metasedimentary bedrock made up of mudstone and graywacke from the Virginia, Thompson, and Rove formations are present (Jirsa et. al. 2011).

No geologic hazards such as sinkholes, springs, or active faults were identified along the Proposed Route.

7.10.2.1 Impacts and Mitigation

Construction of the Project will not alter the geology of the region; therefore, no mitigation is proposed.

7.10.3 Soils

Based on USDA soils data, a total of 249 different soil types are located within the Proposed Route, 216 soil types are located within the Proposed Right-of-Way, and seven soil types are in the substation areas. The soils textures are fine, fine-loamy, fine-silty, loamy, coarse-loam, and sandy. The erosion hazards for these exposed soil types are classified as slight (63.4 percent), moderate (24.3 percent), and severe (10.4 percent) erosion hazard of Forest Roads and Trails - Dominant Component (and their percentage of the area within the Proposed Route). Soil types are organized by general association units. Each association unit represents a distinctive pattern of soils, relief, and drainage, and is a unique natural landscape typically, an association consists of one or more major soils and some minor soils. There are 20 soil association units that are crossed by the Proposed Route (see **Appendix J** and **Mapbook JE**).

As provided in **Table 7-28**, approximately 3,400 acres of Prime Farmland and 5,137 acres of Farmland of Statewide Importance were identified along the Proposed Route. This amounts to 11.76 percent and 17.77 percent, respectively, of the entire Proposed Route;

however, permanent impacts will be less than the acres identified in this table because only those locations of transmission structure installation and permanent access roads would permanently impact these types of soils. Approximately 70 percent of the Proposed Route is not considered Prime Farmland.

Table 7-28. Acres of Prime Farmland and Farmland of Statewide Importance within the Proposed Route

Category	Acres	Percentage
All areas are prime farmland	3,399.86	11.76%
Farmland of statewide importance	5,136.56	17.77%
Not prime farmland	19,129.41	66.19%
Prime farmland if drained	1,232.95	4.27%
Total	**28,898.79**	**100.00%**

7.10.3.1 Impacts and Mitigation

Impacts on soils are dependent, to some extent, on the conditions of the soil surface at the time of construction. Most impacts will be temporary. Construction activities that occur on wet soils tend to have longer lasting impacts, regardless of the soil type. Identifying specific staging areas and associated impacts will be completed during final design; impacts will be mitigated as required by state and federal permits. Surface soils will be disturbed by site clearing, grading, and excavation activities at structure locations, substation sites, pulling and tensioning sites, setup areas, and during the transport of crews, machinery, materials, and equipment over access routes (primarily along rights-of-way). During dry conditions, this disturbance will be temporary, minimal, and generally will be less invasive than typical agricultural practices such as plowing and tilling. Soil compaction may occur on access paths, and at other locations as a result of heavy equipment activity. Soil erosion may occur if surface vegetation is removed, especially on fine textured soils that occur on sloping topography.

Table 7-29 below lists the soils acreage with the Proposed Route and Proposed Right-of-Way.

Table 7-29. Soil Acreage by Segment

NLCD 2019 Category	Proposed Route (Acres)	Proposed Right-of-Way - Segment 1 (Acres)	Proposed Right-of-Way - Segment 2 (Acres)
All areas are prime farmland	3,399.86	256.71	69.10
Farmland of statewide importance	5,136.56	609.44	62.35
Not prime farmland	19,129.41	1,560.25	616.22
Prime farmland if drained	1,232.95	113.32	14.85
Total	**28,898.79**	**2,539.72**	**762.52**

Table 7-30 lists the percent of soils by Proposed Route and Proposed Right-of-Way.

Table 7-30. Percent of Potential Soils Impact by Segment

NLCD 2019 Category	Proposed Route	Proposed Right-of-Way - Segment 1	Proposed Right-of-Way - Segment 2
All areas are prime farmland	11.76%	7.77%	2.09%
Farmland of statewide importance	17.77%	18.46%	1.89%
Not prime farmland	66.19%	47.25%	18.66%
Prime farmland if drained	4.27%	3.43%	0.45%
Total	**100.00%**	**76.91%**	**23.09%**

Impacts to soils would be reduced through implementation of the following mitigation measures:

- Soils will be disced and de-compacted in agricultural properties.
- Revegetating disturbed areas using weed-free seed mixes and using weed-free straw and hay for erosion control.
- Low ground pressure construction equipment may be used, which are designed to minimize impact to soils in damp areas.
- Erosion control methods and BMPs will be utilized to minimize runoff during construction. Soils will be revegetated as soon as practicable to minimize erosion.
- If more than one acre of soil will be disturbed during construction, the Applicants will obtain a NPDES construction stormwater permit from the MPCA and will prepare a SWPPP.

7.11 Unavoidable Impacts

The design, construction, and operation of the Project will use the procedures and process described in this Application to specifically mitigate potential impacts. Impacts from construction activities are unavoidable and could include GHG emissions, short-term traffic delays, soil compaction and erosion, vegetative clearing, wetland conversion, wetland fill impacts, aesthetic (visual) impacts, habitat loss, conversion of forested land to cleared right-of-way, disturbance and displacement of wildlife, seasonal maintenance of tall growing vegetation, and loss of land use for other purposes.

The Project will require only minimal commitments of resources that are irreversible and irretrievable. Irreversible and irretrievable resource commitments are related to the use of nonrenewable resources and the effects that the use of these resources have on future generations. Irreversible commitments of resources are those that result from the use or destruction of a specific resource that cannot be replaced within a reasonable timeframe.

Irretrievable resource commitments are those that result from the loss in value of a resource that cannot be restored after the action.

Those commitments that do exist are primarily related to construction. Construction resources include aggregate resources, concrete, steel, and hydrocarbon fuel. During construction, vehicles necessary for these activities would be deployed on site and would need to travel to and from the construction area, consuming hydrocarbon fuels. Other resources would be used in structure construction, structure placement, and other construction activities. These activities would be temporary and would last for the two- to three-year construction duration.

7.12 Greenhouse Gas and Climate Change Considerations

7.12.1 Greenhouse Gases

Climate change is the alteration on average or "typical" weather in a location which includes variables like temperature, precipitation, and drought. Anthropogenic climate change is caused by the production of GHG, which are gases that contribute to climate change by absorbing infrared radiation in the atmosphere. The most significant contributor to GHG is CO_2, followed by methane ("CH_4"), nitrous oxide ("N_2O"), and fluorinated gases (Hydrofluorocarbons, perfluorocarbons, sulfur hexafluoride ("SF_6"), and nitrogen trifluoride). Other GHGs include nitrogen oxides, volatile organic compounds ("VOCs"), and other gases produced through human activities. In Minnesota, carbon dioxide makes up 70 percent of GHG emissions. (Minnesota Department of Commerce 2021b). CO_2 is most frequently produced through the combustion of hydrocarbon fuels to operate vehicles and equipment, which may be used throughout the Project to support vehicle transport, construction, equipment operation, maintenance, and repair activities.

The Project will produce GHG emissions during earth-moving activities, construction, and restoration activities through the use of cranes, bulldozers, bucket loaders, personal employee vehicles, and other heavy equipment associated with Project construction and maintenance. Carbon dioxide emissions for Project construction equipment are estimated to range from 3.7-6.8 pounds CO_2/hour (e.g., flat-bed truck driving at 30 miles per hour, ATV) to 237.9-350.7 pounds CO_2/hour (e.g., rubber tire loader, 40-ton crane) depending on the type of equipment and total GHG emissions (CO_2, CH_4, N_2O, nitrogen oxides, VOCs) resulting from clearing, construction, and restoration.

To estimate the potential amount of GHG emissions, the Applicants identified the types and numbers of construction equipment that could be used to construct the Project. This assessment is preliminary and based on the best information available to the Applicants as of the date of this Application. To understand the potential range of effects, this assessment was compared to the disclosed greenhouse gas emissions rates in the Great Northern Transmission Line Project Final EIS (DOE/EIS-0499) and adjusted to the specifics of the Project, including length of the Proposed Route and Proposed Right-of-Way clearing. Based on this assessment, potential GHG emissions from tree clearing (i.e., right-of-way preparation) are estimated to range from approximately 3,533 metric tons to 7,645 metric tons, whereas construction and restoration are estimated to range from 55,570 metric tons to 65,355 metric tons. All estimates are quantified as CO_2 equivalents and based on a 3.5 year construction period.

Based on this initial assessment the Total GHG emissions from construction of the Project will be negligible in terms of overall regional GHG emissions and, in turn, climate change impacts.

During operations, some negligible operational GHG emissions are anticipated as a result of the use of maintenance vehicles (cars, trucks, helicopters) or substation equipment (SF_6 production). The emission of SF_6, when it occurs, would originate from substations as releases occur due to cracks in seals in certain substation equipment. The Applicants track SF_6 and would maintain their equipment to minimize unanticipated releases.

The Project will ultimately result in a net decrease of GHG emissions during operation, as it will facilitate the replacement of legacy fossil fuel generation with renewable resources. The Project is anticipated to reduce CO_2 emissions in the broader MISO region by 399 million metric tons over the first twenty years (**Section 3.4.3.2**). The Project will also increase regional transmission reliability and allow additional carbon-free energy sources to be integrated into the power supply. See **Section 3.11** for a discussion of societal benefits of the proposed Project.

7.12.2 Climate Adaptation and Resilience

When analyzing the historical climate data from the MnDNR Minnesota Climate Trends resource, there were upward trends visible within all four of the analyzed climate variables including average and maximum temperatures, annual precipitation, and Palmer Drought Severity Index ("PDSI") trends. These trends are based on the compilation of historical data from 1895 to 2023 for the following counties: Aitkin, Benton, Crow Wing, Itasca, Morrison, and Sherburne (Minnesota DNR 2023h).

Based on the available data within these Minnesota counties, there have been increases in average temperatures, maximum temperatures, and precipitation depths, all which can be explained or supported by the idea of climate change. With increased GHG emissions from anthropogenic actions such as the burning of fossil fuels like coal and natural gas for transportation and power generation, the positive feedback loop of the greenhouse gas effect continues to be fueled. Implications of this feedback loop include rising temperatures and increased precipitation and are a very reasonable explanation for the rising trends in analyzed climate variables. The following trends were identified:

- Annual average temperatures have displayed an average increase of 0.5 °F/Decade (**Figure 7-1)**.
- Maximum temperatures have displayed an average increase of 0.1°F/Decade for the months of June through September and 0.24°F/Decade for the average of all monthly maximum temperatures **(Figure 7-2** and **Figure 7-3)**.
- Annual precipitation has shown an increasing trend of 0.28"/Decade **(Figure 7-4)**.

- Annual PDSI has demonstrated an average increase of 0.2/Decade (**Figure 7-5**).[93]

Figure 7-1. Average Annual Temperatures for the Study Area

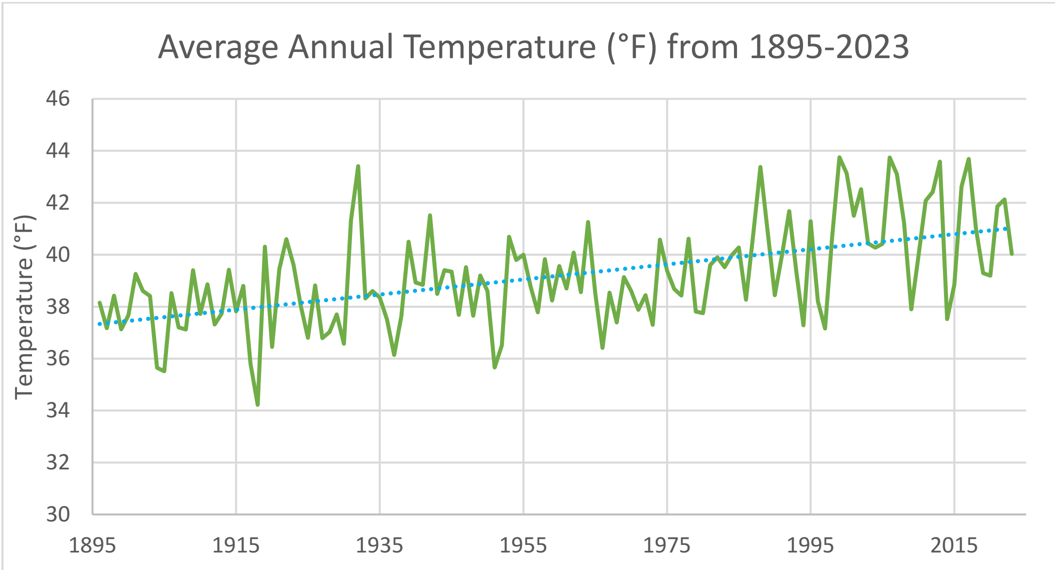
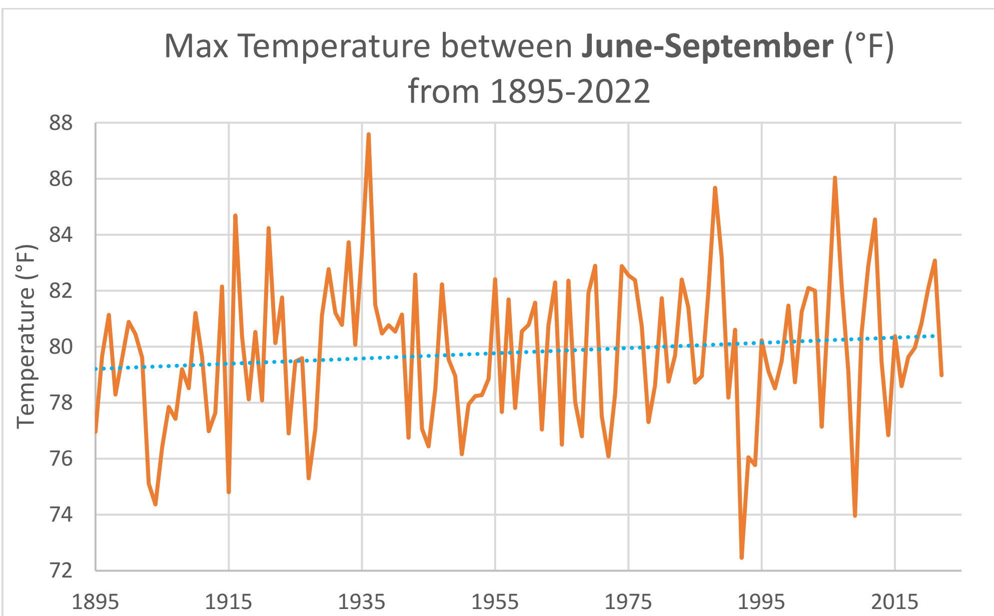


Figure 7-2. Maximum Temperature Between June and September in the Study Area



[93] It should be noted that PDSI from the Minnesota Climate Trends resource is displayed on a monthly basis to better represent the drought status of an area. By averaging the annual values for every month, it raises the question as to whether this underrepresents the drought severity of a year. This is not of great concern for these counties considering the historical data for every month had a trend value ranging from 0.14 to 0.27 so all the months are expressing decreasing dryness (i.e., increasing wetness).

Figure 7-3. Maximum Average Temperatures of All Months in the Study Area

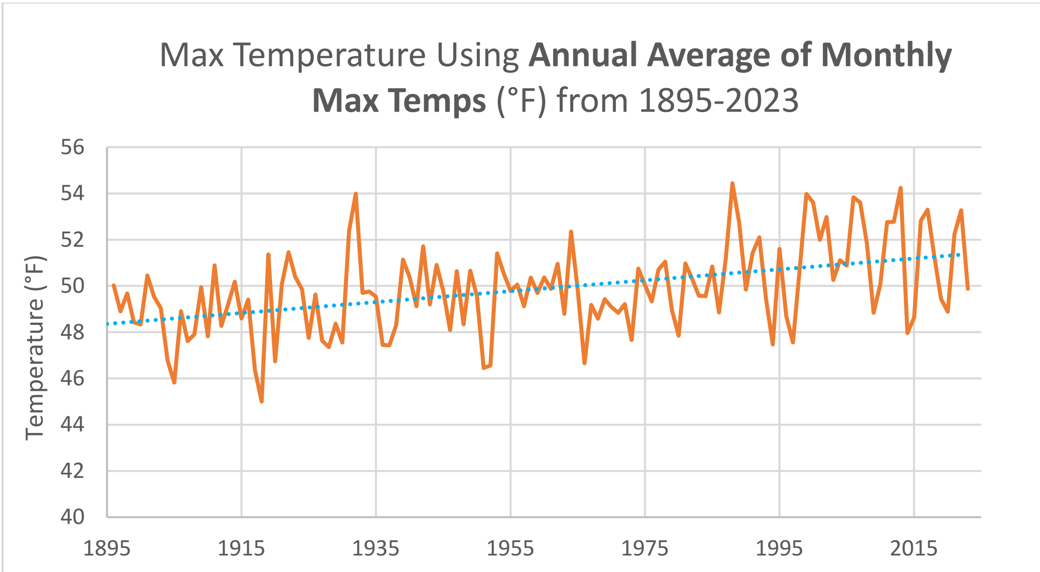


Figure 7-4. Annual Precipitation Depth as Snow Water Equivalent in the Study Area

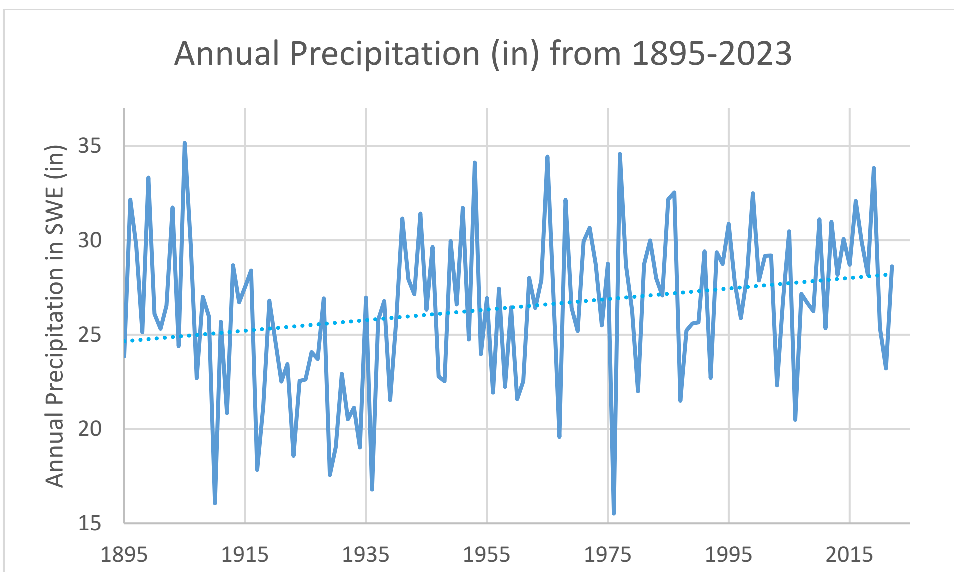
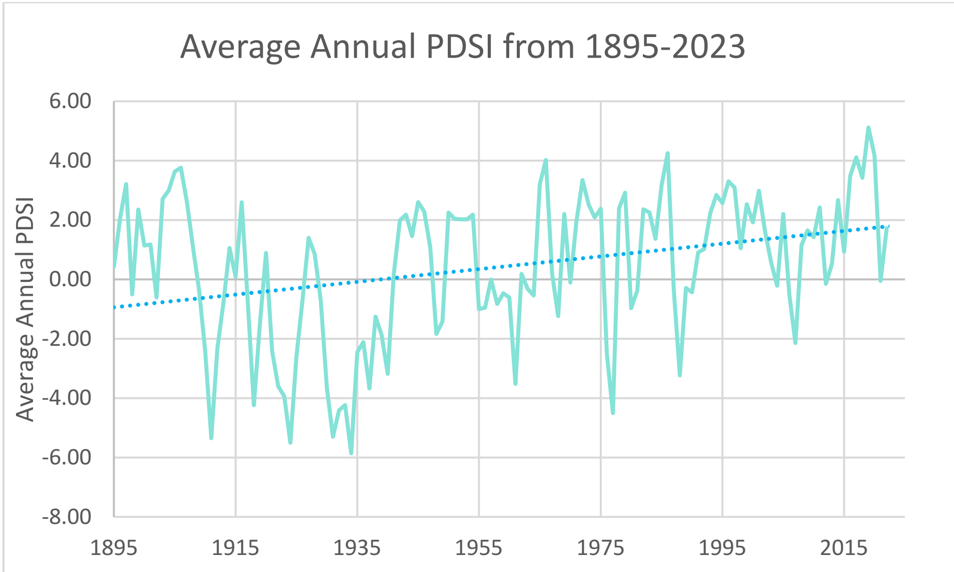


Figure 7-5. Average Annual PDSI in the Study Area



The Project will be routed and designed to be resilient under changing climatic factors such as increased temperatures and changes in intensity and timing of storm events and associated precipitation. High temperatures can affect the sagging of a transmission line and its thermal tolerance. However, the transmission lines would be built to NERC reliability standards to address thermal limitations. Changes in storm timing and intensity could increase landslide potential in steep areas and increase local flooding. Final structure placement would consider slope to avoid areas with steeper slopes that could be prone to future erosion or landslides from increased, intense precipitation events. During construction a SWPPP would be implemented to manage stormwater and reduce the potential for runoff and erosion. Upon the conclusion of construction, the work areas would be restored.

Although the trends in precipitation are increasing, there may be periods of dry weather and concerns over wildfire, which is corroborated by the increase in drought severity as indicated by the change in the PDSI (i.e., wet winters and dry springs and summers). However, the transmission lines would be maintained following or exceeding NERC reliability standards that address vegetation management, including the increase of noxious weeds that could occur from changed conditions that allow them to spread. Surface water temperatures could increase in locations where the Project requires tree clearing along shorelines increasing sun exposure. This would be exacerbated by increased temperatures. Although the climate trends in the Study Area show increases in precipitation it also shows an increased in drought severity (PDSI). In the event that irrigated agriculture becomes more prevalent, the Applicants will work with landowners to potentially influence the design and configuration of future center-pivot irrigation systems.

8.1 Agency and Tribal Outreach

Table 8-1 identifies agencies that were contacted through meetings or a notification email outside of the Public Outreach outlined in **Section 8.2** and the date that the consultation was conducted. Initial outreach letters were sent to Tribal agencies August 8, 2022 and initial outreach letters to federal, state, and local agencies were sent on September 15, 2022.

Table 8-1. Agency and Tribal Contacts

Name	Dates of Meeting(s)/Key Correspondence
U.S. Fish and Wildlife Service	9/15/22, 2/20/23, 3/2/23
U.S. Army Corps of Engineers	2/8/23
U.S. Bureau of Indian Affairs	9/15/22
U.S. Department of Agriculture -Natural Resources Conservation Service	9/15/22
U.S. Department of Defense Military Aviation and Installation Assurance Siting Clearinghouse	7/17/23
Federal Highway Administration	9/15/22
Federal Aviation Administration	9/15/22, 11/3/22, 11/7/22, 5/9/23, 5/22/23, 7/14/23, 7/17/23
St. Cloud Regional Airport Authority	4/25/23, 5/22/23, 7/13/23
Bois Forte Band of Chippewa	8/22/22
Fond du Lac Band of Lake Superior Chippewa	8/22/22
Grand Portage Band of Lake Superior Chippewa	8/22/22
Leech Lake Band of Ojibwe	8/22/22, 3/9/23, 4/17/23, 4/27/23, 5/30/23, 7/18/23
Lower Sioux Indian Community	8/22/22, 1/20/23, 5/9/23, 6/12/23, 7/13/23, 7/18/23
Mille Lacs Band of Ojibwe	8/22/22, 8/26/22, 12/12/22, 1/20/23, 1/23/23, 1/24/23, 2/8/23, 4/18/23, 5/5/23, 5/14/23, 6/12/23, 6/26/23, 6/28/23
Prairie Island Indian Community	8/22/22
Red Lake Nation	8/22/22
Shakopee Mdewakanton Sioux Community	8/22/22
Upper Sioux Community	8/22/22, 1/20/23, 3/2/23, 4/10/23, 4/13/23, 4/17/23, 5/5/23, 6/12/23, 6/27/23, 6/30/23
White Earth Nation	8/22/22
Minnesota Chippewa Tribe	8/22/22
MN Dept. of Natural Resources	9/15/22, 12/20/22, 1/30/23, 3/7/23, 4/24/23, 4/25/23, 5/16/23, 5/23/23, 6/27/23, 6/30/23, 7/25/23
MN Dept. of Commerce – Energy Environmental Review and Analysis	9/15/22

Name	Dates of Meeting(s)/Key Correspondence
MN Public Utilities Commission	9/15/22
MN State Historic Preservation Office	9/15/22, 3/27/23, 5/9/23, 6/12/23
MN Office of State Archaeologist	9/15/22, 3/27/23, 5/9/23, 6/12/23
MN Indian Affairs Council	9/15/22, 3/27/23, 5/9/23, 6/12/23
MN Board of Water and Soil Resources	9/15/22
MN Dept. of Agriculture	9/15/22, 5/25/23
MN Pollution Control Agency	9/15/22
MN Dept. of Transportation	9/15/22, 11/3/22, 11/7/22, 12/5/22, 1/31/23, 3/30/23, 4/18/23, 4/28/23, 5/1/23, 5/22/23, 6/29/23, 7/7/23, 7/14/23, 7/17/23
MN Dept. of Health	9/15/22
MN Association of Watershed Districts	9/15/22
MN Association of Soil and Water Conservation	9/15/22
MN Association of Townships	5/22/23
Arrowhead Regional Development Commission	9/15/22
Region 5 Development Commission	9/15/22
Aitkin County	9/15/22, 3/14/23, 6/13/23
Benton County	9/15/22, 2/7/23, 5/16/23
Cass County	9/15/22
Crow Wing County	9/15/22
Itasca County	9/15/22, 2/14/23
Morrison County	9/15/22, 3/7/23, 3/8/23, 3/14/23, 6/27/23
Sherburne County	9/15/22, 1/20/23, 1/23/23, 2/21/23, 2/23/23, 4/28/23, 6/6/23

8.1.1 Federal Agencies

8.1.1.1 U.S. Fish and Wildlife Service

The Applicants sent an initial project introduction letter to the USFWS in September 2022. In March 2023, the Applicants organized a conference call with USFWS to discuss the project and potential impacts to protected species. The USFWS provided an overview of potential permitting pathways. See Appendix M for more information on the meeting. In May of 2023, the Applicants submitted an IPaC for the Proposed Route and completed the Determination Key for the threatened and endangered species and the northern long eared bat. As the Project develops, the Applicant will continue to coordinate with the USFWS.

8.1.1.2 U.S. Army Corps of Engineers

The Applicants have coordinated with the USACE on a Section 214 Agreement for consultation, project review, and permitting. The USACE was invited to monthly meetings with the MnDNR. See **Section 8.1.3.4** for more information about the MnDNR meetings.

8.1.1.3 U.S. Department of Agriculture, Natural Resources Conservation

The Applicants sent an initial project introduction letter to the NRCS in September 2022. As the Project develops, the Applicants will coordinate with NRCS if any easement lands are crossed.

8.1.1.4 U.S. Department of Defense Military Aviation and Installation Assurance Siting Clearinghouse

The Applicants received a letter in July 2023 from the U.S. Department of Defense ("DOD") Military Aviation and Installation Assurance Siting Clearinghouse indicating that the Project will have a minimal impact on military operations in the area. As the Project develops, the Applicants will continue to coordinate with the DOD. See **Appendix M** for a copy of the letter.

8.1.1.5 Federal Aviation Administration

The Applicants sent an initial Project introduction letter to the FAA in September 2022. On November 3, 2022, the Applicants organized a conference call with FAA and MnDOT Aeronautics staff to discuss the project and potential impacts to several public use airports in proximity to the Route Corridor. FAA staff also attended Project open houses in May 2023 and in a subsequent email provided additional information on potential effects to public use airports near the Proposed Route. Another conference call with FAA and MnDOT Aeronautics staff was held on July 14, 2023. See **Appendix M** for more information on the meeting.

8.1.2 Tribal Nations

On August 22, 2022, initial outreach letters were sent to all federally recognized Tribes in Minnesota (see **Table 8-1**). A summary of responses and follow-up communication with Tribes who indicated an interest in continued communication regarding the Project is provided below. See **Appendix M** and **Appendix R** for copies of key Tribal correspondence. The cultural resource literature review was distributed to the Lower Sioux Indian Community, Mille Lacs Band of Ojibwe, and Upper Sioux Community on June 12, 2023, and the Leech Lake Band of Ojibwe on June 14, 2023.

8.1.2.1 Leech Lake Band of Ojibwe

Following submittal of initial outreach letters in August of 2022, the Applicants held a meeting with the Leech Lake Band of Ojibwe on March 9, 2023 with the Band's Interim Environmental Director, Sustainability Coordinator, and Environmental Deputy Director.

At this meeting, the Applicants presented an overview of the Project Study Area and Route Corridor. This was followed by a review of the GIS mapping for the Route Corridor along with a layer illustrating ceded territories and discussion of potential impacts to known cultural or natural resources. The Leech Lake Band of Ojibwe requested a copy of the GIS shapefile of the Route Corridor to review as well as a copy of the presentation for reference, which were provided the same day.

On April 17, 2023, the Applicants provided an update via email regarding the routing process including GIS data of the preliminary route. The Applicants held a follow-up meeting with the Leech Lake Band of Ojibwe on April 27, 2023 with the Band's Archaeologist/Field Director of the Heritage Sites Program and Interim Environmental Director. The Applicants reviewed the project details, including differences between the initial larger Project Study Area and the more refined Proposed Route and Proposed Right-of-Way. A summary of preliminary results from the cultural resources literature review was discussed. The Leech Lake Band of Ojibwe requested this report be sent to them when finalized. The Leech Lake Band of Ojibwe are reviewing the data to determine if there are resources or areas of interest within the Proposed Route.

On April 27 and May 30, 2023, the Applicants followed up via email to questions from Amy Burnette, the Leech Lake Band of Ojibwe THPO. Information regarding more detailed project mapping, water crossings, cultural resources review and Tribal outreach completed to date, and the potential federal permits/approvals anticipated for the project was provided. Burnette communicated via email on July 18, 2023 indicating an interest in seeing previous archaeological survey reports within the Proposed Route, as well as interest in participating in a joint tribal meeting with other THPOs, tentatively scheduled for the beginning of the planned pre-field survey visual (windshield) reconnaissance. In follow-up, on the same day, GIS shapefiles of the Proposed Route, Proposed Right-of-Way, and Proposed Centerline were provided. Engagement with the Leech Lake Band of Ojibwe will continue throughout the Project.

8.1.2.2 Lower Sioux Indian Community

Following submittal of initial outreach letters in August of 2022, the Applicants met with the Lower Sioux Indian Community on January 20, 2023 in a combined meeting with Sherburne County, Mille Lacs Band of Ojibwe, and Upper Sioux Community regarding the proposed Big Elk Lake Park. This meeting is summarized in **Section 8.1.4.6**. The Applicants also sent a Project update email to Cheyanne St. John, the Lower Sioux Indian Community THPO, on May 9, 2023 defining the refined Preliminary Route and providing GIS shapefiles of the Preliminary Route and intended right-of-way and centerline. The Applicants met with St. John on June 27, 2023 to provide a Project update and discuss the details of a pre-field survey visual reconnaissance (windshield) review. St. John indicated interest in participating in the visual reconnaissance, as well as identified some sensitive areas along the Proposed Route, including the Big Elk Lake Park, Ironton Substation, and Pierz areas. In follow-up, GIS shapefiles of the Proposed Route, Proposed Right-of-Way, and Proposed Centerline were provided. Engagement with the Lower Sioux Indian Community will continue throughout the Project.

8.1.2.3 Mille Lacs Band of Ojibwe

Following submittal of initial outreach letters in August of 2022, the Mille Lacs Band of Ojibwe sent a response letter on August 26, 2022 with a follow-up response December 12, 2022 expressing interest in the Project. The Applicants first met with the Mille Lacs Band of Ojibwe on January 20, 2023 in a combined meeting with Sherburne County, Upper Sioux Community, and Lower Sioux Indian Community regarding the proposed Big Elk Lake Park. This meeting is summarized in **Section 8.1.4.6**. On January 23, 2023, GIS data of the Route Corridor and updated figures correcting the Mille Lacs Band of Ojibwe reservation boundary and Tribal lands was provided via email.

The Applicants met separately with the Mille Lacs Band of Ojibwe's Air Quality Specialist, Director of Environmental Programs, Executive Director of Natural Resources, Wildlife Biologist, and Public Relations Coordinator on February 8, 2023. This meeting began with an overview of the Project Study Area then focused on the right-of-way needs for the Project, vegetation maintenance within the right-of-way, studies required by the permitting process, how storm or fire events will be addressed, and how mitigation for potential impacts is identified. This was followed by a GIS review of the Study Area and Route Corridor. Tribal representatives stated that the Mille Lacs Band ceded territory is included within the Route Corridor north of the Benton County Substation, and area south of the substation was historically Anishinaabe and Dakota territory. Other discussion topics included access to wild rice, specifically near Long Lake, and that a portion of the historical Rabbit Lake Reservation is within the Route Corridor. A review of the data during the meeting indicated wild rice resources around Dean Lake are located more than 2.5 miles from the Proposed Route. The Mille Lacs Band of Ojibwe requested a list of known migratory birds and flyways overlapping the Project This information, as well as GIS data of the preliminary route were provided on April 18, 2023.

The Applicants held a second meeting with the Mille Lacs Band of Ojibwe on May 5, 2023. Charlie Lippert, Air Quality Expert, shared several areas of cultural interest. Two of these are the Mississippi Chippewa historic reservation bounds of Pokegama and Rabbit Lake established in 1855 which, according to Mille Lacs Band internal records, overlap the Proposed Route. Other areas of interest include several indigenous trailways near Hill City, a historical Ojibwe battle ground near the southern end of the Proposed Route, and an area near the Big Oaks Substation. These areas of interest will be researched in greater detail and discussed within the Cultural Resource Survey Strategy to be developed. Lippert recommended outreach to their newly appointed THPO, Mike Wilson, for further information regarding potential cultural areas. An email was sent to Mike Wilson on May 14, 2023, summarizing key project information and communication with the Mille Lacs Band of Ojibwe to date. The Applicants met with Wilson and Lippert on June 26, 2023 to provide a Project update and discuss the details of a pre-field survey visual reconnaissance (windshield) review. Wilson indicated several areas of interest along the Proposed Route, including the Benton and Big Oaks Substation areas, and the Upper Long Lake area. Wilson also indicated interest in participating in the visual reconnaissance. On June 28, 2023, GIS shapefiles of the Proposed Route, Proposed Right-of-Way, and Proposed Centerline were provided. Engagement with the Mille Lacs Band of Ojibwe will continue throughout the Project.

8.1.2.4 Upper Sioux Community

Following submittal of initial outreach letters in August of 2022, the Applicants first met with the Upper Sioux Community on January 20, 2023 in a combined meeting with Sherburne County, Mille Lacs Band of Ojibwe, and Lower Sioux Indian Community. This meeting is summarized in **Section 8.1.4.6** Sherburne County. The Applicants met with the Upper Sioux Community separately on March 2, 2023 with the Band's THPO, Samantha Odegard. The Applicants reviewed Project details and the Project Study Area and Route Corridor. Odegard indicated there are undocumented sites and some documented sites that may have been impacted by previous transmission line construction. Odegard recommended fieldwork to identify potential cultural resources, which Tribal Representatives could join or complete some of their own.

The Upper Sioux Community THPO reviewed the Project Route Corridor for resources or areas of interest. The Applicants met with Odegard again on April 10, 2023 to discuss the results of the initial review of the Project Route Corridor. During this meeting, the THPO stated the areas of greatest interest centered around the Riverton area and Big Elk Lake Park. Details about Big Elk Lake Park are discussed in **Section 8.1.4.6**. Odegard indicated she would continue to review materials upon receiving the more refined Proposed Route. Odegard provided a summary of results of her initial review via email on April 13, 2023. Subsequently, GIS data of the preliminary route was provided via email on April 17, 2023.

The Applicants held a third meeting with Odegard of the Upper Sioux Community on May 5, 2023. Odegard confirmed the Tribal Cultural Property survey of the future Big Elk Lake Park area was planned to be completed in June 2023, and site visits and more detailed conversations regarding Project plans within the park area may be conducted once survey results are determined. Odegard indicated that additional portions of the Proposed Route, besides the previously discussed Big Elk Lake Park, contain archaeological potential, including the Upper Long Lake Area (Proposed Route to run just to the lake's east) and the Elk River area. Odegard is aware of a few specific Tribally-recorded resources within or near the Proposed Route, determining their exact locations and whether they may be impacted will likely need additional review. Odegard recommended a pre-field survey windshield reconnaissance to review the Proposed Route and identify areas of Tribal interest for further field investigations.

The Applicants met again with Odegard on June 27, 2023 to provide a Project update and discuss the details of a pre-field survey visual reconnaissance (windshield) review. Odegard reiterated the Upper Sioux Community's interest in participating in the visual reconnaissance. In follow up to the meeting, GIS shapefiles of the Proposed Route, Proposed Right-of-Way, and Proposed Centerline were provided on June 30, 2023. Engagement with the Upper Sioux Community will continue throughout the Project.

8.1.3 State Agencies

8.1.3.1 State Historic Preservation Office

Following submittal of initial outreach letters in September of 2022, the Applicants held an initial meeting with the Minnesota SHPO, OSA, and MIAC on March 27, 2023. This meeting began with a Project overview, the anticipated cultural resources regulatory context for the project, and a review of Tribal engagement to date. A summary of preliminary results from the ongoing Phase 1a cultural resources literature review was reviewed. The meeting then focused on discussion of two specific regions within the Project Study Area: 1) the National Register of Historic Places Eligible Cuyuna Iron Range Historic Mining Landscape District; and 2) the Long Lake Area. The Applicants noted that, to avoid a pinch point near the Riverton Substation, an alternate route on the east side of the Cuyuna Country State Recreation Area through a portion of the historic mining district was being considered. SHPO commented that since the district is an industrial landscape, a transmission line may not have an adverse effect to the district's characteristic features and may not impact its eligibility to the National Register. However, more information clarifying the district's characteristic features within the area of potential effect to assess the transmission line's potential effect on the district is needed.

Regarding the Long Lake Area, the Applicants acknowledged the environmental and archaeological constraints of routing the new transmission line adjacent to the existing transmission line across the isthmus between Upper South Long Lake and South Long Lake. SHPO indicated the area is likely important to the Mille Lacs Band and they should be consulted. Consultation with the Mille Lacs Band of Ojibwe has been part of Project engagement efforts to date. The cultural resource literature review was distributed to SHPO and OSA on June 12, 2023.

8.1.3.2 Office of State Archaeologist

Please refer to the State Historic Preservation Office summary.

8.1.3.3 Indian Affairs Council

Please refer to the State Historic Preservation Office summary. The cultural resource literature review was distributed to MIAC on June 12, 2023.

8.1.3.4 Department of Natural Resources

The Applicants sent an initial Project introduction letter to MnDNR in September 2022. MnDNR staff attended the stakeholder meetings in October 2022 and agreed to schedule regular meetings about the Project. An initial meeting was held on December 20, 2022 which included staff from Ecological and Water Resources and Lands and Minerals. The Applicants provided an overview of the Project and overall process, and timing was discussed. Regular update meetings were held (See **Table 8-1**) where the Applicants provided updates on the current status and the MnDNR provided additional information on land status and review processes.

In May 2023, the Applicants submitted formal natural heritage review through the Minnesota Conservation Explorer for the Proposed Route. The results of MnDNR review were provided on June 30, 2023. See **Appendix R** for more information regarding MnDNR's natural heritage review. The Applicants will continue to work with the MnDNR to minimize impacts to sensitive species and habitats.

Also in May 2023, the Applicants submitted an initial MnDNR Utility Crossing Permit for the crossing of state lands. The MnDNR will use this initial submission to identify lands that may have restrictions due to funding. Once that review is complete, the Applicants will continue to work with the MnDNR to facilitate the crossing permit process. See **Appendix M** for more information on the meetings and initial information provided by the MnDNR.

On June 30, 2023, MnDNR provided a letter summarizing the results of their early coordination review of the Project. The Applicants met with the MnDNR on July 25, 2023, to discuss these comments and provide additional Project details to inform MnDNR's continued review of the Project. See **Appendix M** for a copy of the MnDNR comment letter and notes from the July 2023 meeting.

8.1.3.5 Minnesota Department of Transportation

The Applicants sent an initial project introduction letter to MnDOT in September 2022. As described previously, MnDOT Aeronautics joined a meeting with the Applicants and the FAA on November 3, 2022. MnDOT offered to review the corridor and potential impacts to airports including Hill City – Quadna Mountain Airport, Brainerd Airport, and St. Cloud Airport. On January 31, MnDOT provided an initial review of airports in and around the project Study Area. MnDOT Aeronautics staff also attended an open house meeting in May 2023 and in a subsequent email provided information of potential affects to airports at Hill City and St. Cloud. Another conference call with FAA and MnDOT Aeronautics staff was held on July 14, 2023. See **Appendix M** for more information on the meetings with MnDOT Aeronautics and the St. Cloud Regional Airport Authority, as well as outreach to the Hill City Airport.

Three meetings were held with MnDOT Office of Land Management and Office of Environmental Services on March 30, 2023; May 1, 2023; and June 29, 2023. The Applicants provided an overview of the Project and the status of route development and stakeholder engagement. MnDOT provided initial review of crossings of state highways, scenic highways, and potential environmental issues on MnDOT right-of-way. Prior to the June 29, 2023 meeting, MnDOT provided a summary table of Office of Environmental Services comments and recommendations, as well as a memo summarizing their review of contaminated materials for the Project. These comments and recommendations were discussed at the June meeting. Additional meetings will be held as the Project development progresses. See **Appendix M** for more information on the meetings and the information provided by MnDOT Aeronautics and MnDOT Office of Environmental Services.

8.1.3.6 Minnesota Board of Water and Soil Resources

The Applicants sent an initial Project introduction letter to BWSR in September 2022. As the Project is developed the Applicants will coordinate with BWSR to obtain any necessary permits or approvals.

8.1.4 Local Government Units

8.1.4.1 Itasca County

The Applicants sent an initial Project introduction letter to Itasca County in September 2022. County officials were also invited to the stakeholder workshops in October 2022. The Applicants attended a county board meeting in February 2023 to provide an update on the Project. See **Appendix M** for more information on the meetings.

8.1.4.2 Aitkin County

The Applicants sent an initial Project introduction letter to Aitkin County in September 2022. County officials were also invited to the stakeholder workshops in October 2022. The Applicants attended two county board meetings in March and June 2023 to provide updates on the Project. See **Appendix M** for more information on the meetings.

8.1.4.3 Crow Wing County

The Applicants sent an initial Project introduction letter to Crow Wing County in September 2022. County officials were also invited to the stakeholder workshops in October 2022. The Applicants offered to attend a board meeting to provide an update to the county. See **Appendix M** for more information on the meetings.

8.1.4.4 Morrison County

The Applicants sent an initial Project introduction letter to Morrison County in September 2022. County officials were also invited to the stakeholder workshops in October 2022. The Applicants attended two county board meetings in April and June 2023 to provide updates on the Project. See **Appendix M** for more information on the meetings.

8.1.4.5 Benton County

The Applicants sent an initial Project introduction letter to Benton County in September 2022. County officials were also invited to the stakeholder workshops in October 2022. The Applicants attended two county board meetings in February and May 2023 to provide updates on the Project. See **Appendix M** for more information on the meetings.

8.1.4.6 Sherburne County

The Applicants sent an initial Project introduction letter to Sherburne County in September 2022. County officials were also invited to the stakeholder workshops in October 2022. The Applicants attended two county board meetings in February and June 2023 to provide updates on the Project. In addition, the Applicants attended a combined meeting on January 20, 2023 with Sherburne County Parks Staff, Upper Sioux Community, and Lower Sioux Indian Community to specifically discuss the future Big Elk Lake Park in Palmer Township. See **Appendix M** for more information on the meetings.

8.1.4.7 Local Government Units

8.1.4.7.1 Minnesota Association of Townships

On May 18, 2023, the Applicants met with Minnesota Association of Townships Board and presented information about the Project's need, route development, Proposed Route and right-of-way. Township members asked about potential impacts to local roads and farmland, and easement acquisition. They requested follow-up meetings with local township districts. See **Appendix M** for more information on the meetings.

8.1.4.7.2 Cities

The Applicants sent Cities located within the Study Area a Project introduction letter including an invitation to the stakeholder workshops in October 2022. In January 2023, Cities within the Study Area were included in the Phase 1 Engagement Events notifications. As the routing process progressed, the Cities located within the Notice Area were included in the Phase 2 Engagement Events notifications. The Applicant was available to meet with Cities, as requested. No city presentations were requested.

8.1.4.7.3 Townships

The Applicants sent Townships located within the Study Area a Project introduction letter including an invitation to the stakeholder workshops in October 2022. In January 2023, Townships within the Study Area were included in the Phase 1 Engagement Events notifications. As the routing process progressed, the Townships located within the Notice Area were included in the Phase 2 Engagement Events notifications. The Applicants were available to meet with Townships, as requested. The Applicants met with the Minnesota Association of Townships. While some Townships have requested presentations, Applicants continue to work with those Townships to schedule these meetings.

8.2 Public Outreach

8.2.1 Outreach Kickoff and Engagement Planning

The Project team developed a public engagement plan in late summer 2022 that consisted of two engagement phases: Route Corridor and Preliminary Route notifications. The phases consisted of several engagement methods that included in-person stakeholder workshops, virtual self-guided public open houses, in-person public open houses, direct mailings, social media posts, a dedicated email and hotline to field questions and comments, an interactive online comment map, a Project website, detailed maps that could be downloaded and printed from the Project website, and mailed project information packets.

See **Appendix N** for engagement materials.

8.2.2 Key Communication Channels

The following communication channels were made available throughout the project.

8.2.2.1 Project Website

The Project website (northlandreliabilityproject.com) launched on December 21, 2022 and will remain open throughout Project permitting and construction. The website provides an overview of the Project, informs the public of the engagement opportunities, and allows stakeholders an opportunity to provide feedback and ask questions through an interactive comment map or general comment form. The website has been and will continue to be updated through Project development, permitting, and construction. Website analytics are availability in **Appendix N.**

8.2.2.2 Project Email and Information Line

The email address (Connect@northlandreliabilityproject.com) and an information hotline (218-864-6059) were created to field public comments about the Project. A local area code was chosen for the phone number so it would be familiar to area stakeholders.

8.3 Stakeholder Workshops: Study Area

Minnesota Power and Great River Energy hosted six stakeholder workshops in October 2022, to gain input and insights from agencies, local leaders and key stakeholders. The purpose of these workshops was to introduce community leaders to the project, learn more about their communities, answer their questions and gather information on opportunities and constraints within the Study Area. The workshop format consisted of a presentation, a question-and-answer portion, a mapping exercise and discussion, and a comment form.

Details regarding each workshop are provided in **Table 8-2**.

Table 8-2. Stakeholder Workshop Attendees

Workshop County	Date	Time	Number of Attendees
Itasca	Tuesday, October 11	8:30 – 10 a.m.	12
Aitkin	Tuesday, October 11	3 – 4:30 p.m.	14
Crow Wing	Wednesday, October 12	11 a.m. – 1:30 p.m.	8
Sherburne	Tuesday, October 18	8:30 – 10 a.m.	12

Workshop County	Date	Time	Number of Attendees
Benton	Tuesday, October 18	3 – 4:30 p.m.	20
Morrison	Wednesday, October 19	11 a.m. – 1:30 p.m.	14
	TOTAL		**80**

For the stakeholder workshops, there were several materials prepared to provide to attendees or to guide staff on conducting conversations related to the routing process.

- Project overview handout
- Large tabletop aerial maps
- PowerPoint presentation

Comments were collected from workshop attendees through writing during a mapping exercise, comment forms, and asked questions. The following key themes arose during the stakeholder workshops:

- Right-of-way and easement
- Sustainability
- Reliability
- Existing structure relations
- Structure look (size and type)
- Project timeline
- Renewables
- Tax revenue
- Restoration

Feedback from stakeholder workshop attendees also helped to inform what information should be included at the public open houses and where they should be located. A complete set of stakeholder workshop materials, attendee information, and comment analysis is available in **Appendix N**.

8.4 Engagement Phase 1: Route Corridor

Minnesota Power and Great River Energy hosted the first phase of engagement after the fall workshops from January 23 through February 17, 2023, to provide opportunities to learn about the Project, provide input on the Route Corridor, and ask questions either at an in-person event, online, or through phone, email, or mail.

- **Phase 1 Notifications**
  - Stakeholder Letter and Email - A letter with an enclosed Route Corridor map was mailed and emailed to Project stakeholders. The letter gave an overview of the Project and detailed the engagement opportunities. The distribution list included federal, state and local agencies, Tribal representatives, and non-

government organizations. A total of 581 letters were mailed on January 3, 2023. An additional reminder email was sent to the same stakeholders on January 23, 2023.

  - Landowner Postcard - A postcard was mailed to a total of 8,430 landowners within the Study Area on January 6, 2023. The mailing list was generated from county parcel data records within the Route Corridor. The postcard included information about the project, engagement opportunities, how to provide a comment, and contact information.
  - Press Release - 275 media outlets received the release on January 12, 2023. Media outreach resulted in local media coverage, including stories in the Benton County News and Patriot News.
  - Social Media - Facebook, Twitter, and Instagram were used to promote the Northland Reliability Project in-person public open houses and virtual engagement opportunities in January and February 2023.
  - Paid Advertisements - Paid advertisements were placed in 13 local newspapers with distribution in the Project area announcing the public open houses and other engagement opportunities. The paid advertisements newspaper name, run dates, county, and circulation numbers are shown in **Appendix N**.

- **Phase 1 Engagement Events**
  - In-Person Public Open Houses

    There were seven open house locations with both midday and early evening options offered to accommodate schedules, for a total of 14 public open houses.

    Each open house provided the same information including Project displays and detailed maps for the attendees to review and provide input. Attendees were paired with a Great River Energy or Minnesota Power staff person who provided a guided tour, walking the attendee(s) through the displays and maps and answering their questions along the way. Attendees also had the opportunity to sit with a GIS/mapping specialist to view their specific locations of concern, discuss potential constraints or opportunities for their parcel(s), and get a PDF map emailed to them. The feedback received through in-person and virtual open houses was considered by the Applicants as part of the routing process. A complete set of Phase 1 Engagement Event materials is available in **Appendix N**.

    252 participants attended the open houses. **Table 8-3** details the total number of attendees from each open house and by county.

Table 8-3. Public Open House Attendance by Location

Open House County	Date	Time	Attendees	County Total
Morrison	Tuesday, Jan. 24	11 a.m. – 1 p.m.	29	49
		4 – 6 p.m.	20	
Benton	Wednesday, Jan. 25	11 a.m. – 1 p.m.	26	41
		4 – 6 p.m.	15	
Sherburne	Thursday, Jan. 26	11 a.m. – 1 p.m.	15	27
		4 – 6 p.m.	12	
Itasca	Monday, Jan. 30	11 a.m. – 1 p.m.	22	31
		4 – 6 p.m.	9	
Aitkin	Tuesday, Jan. 31	11 a.m. – 1 p.m.	18	24
		4 – 6 p.m.	6	
Crow Wing - Ironton	Wednesday, Feb. 1	11 a.m. – 1 p.m.	27	80
		4 – 6 p.m.	3	
Crow Wing - Brainerd	Thursday, Feb. 2	11 a.m. – 1 p.m.	29	
		4 – 6 p.m.	21	
	TOTAL		**252**	

- **Virtual Self-Paced Open House**
  - The self-paced virtual open house included the same content presented during the in-person public open houses in a website-type format. It provided an opportunity for viewers to attend at their convenience to learn more about the Project, the routing process and provide input.
- **Information Packets**
  - Packets of Project information were created and available for download from the Project website, self-guided virtual open house, mail, or email. A total of 16 packets were requested. The packet of materials included the same information from the in-person and virtual open houses.
- **Additional Open House**
  - A community member along Segment 2 reached out to the Applicants and requested an additional open house to allow neighbors and community members, who missed the scheduled open houses to have another opportunity to learn about project, ask questions, and provide input on routing. The Applicants did not send out notices for this open house. The community member contacted nearby residents and invited them to attend. This open house took place on Wednesday, March 1 from 10 a.m. to Noon at the Palmer Township Hall. There was no formal presentation. This open house provided the same information as the Phase 1 open houses in January and February, including project displays and detailed maps for the attendees to review and provide input. A total of 23 participants attended the open house.

- **Phase 1 Comments**
    - More than 300 public comments were collected in a variety of ways, both in-person and virtually through the project hotline, email, interactive comment map, online comment form, mailed comment form, online constraints and opportunities form, in-person comment form, GIS station and tabletop maps comments. All comments were reviewed and considered. The majority of the comments were directed at the Route Corridor land use and routing. A summary of Phase 1 comments is available in **Appendix N**.

8.5 Engagement Phase 2: Preliminary Route

A second phase of engagement was hosted from May 1 - 12, 2023 to provide opportunities to learn about the Preliminary Route and to collect public comments.

- **Phase 2 Notifications**
    - Stakeholder Letter and Email – A letter with an enclosed overview handout was mailed and emailed to project stakeholders on April 10, 2023. The letter provided a Project update, described the Preliminary Route, and detailed upcoming engagement opportunities. The stakeholder list used for this distribution was updated throughout the Project.
    - Landowner Postcard – A postcard was mailed to 8,802 landowners and residents within the route corridor on April 14, 2023. The phase one mailing list was updated based on information gathered after the phase one postcard mailing. The postcard included information about the Project, the Preliminary Route, engagement opportunities, and ways to provide feedback and contact the project team.
    - Press Release – Minnesota Power and Great River Energy sent a release to 275 media outlets on April 20, 2023.
    - Social Media – Facebook, Twitter, and Instagram were used to promote the Northland Reliability Project public open houses and virtual engagement opportunities in April and May 2023. There were three social media campaigns that were run from April 17 to May 12. A mix of organic posts, events, and zip code-targeted advertisements were used for each campaign resulting in 55,125 impressions.
    - Paid Advertisements – Two weeks of paid advertisements (26) were placed in 13 local newspapers with distribution in the Project area announcing the public open houses and other engagement opportunities. The paid advertisements newspaper name, run dates, county, and circulation numbers are available in **Appendix N**.
- **Phase 2 Engagement Events**
    - In-Person Public Open Houses - Minnesota Power and Great River Energy invited the public to attend public open houses for the Northland Reliability Project, ask questions and provide input on the preliminary route. There were six open houses offered May 2 – 4, 2023.

      There were no formal presentations but instead attendees were welcome to come anytime during the time options to learn more about the Project. Each open house provided the same information including Project displays and detailed maps for the attendees to review and provide input. Attendees were paired with a Great River Energy or Minnesota Power staff person who acted as a tour guide, walking the attendee(s) through the displays and maps and answering their questions along the way. Attendees also had the opportunity to sit with a GIS specialist to view their specific locations of concern, discuss potential constraints or opportunities for their parcel(s), and get a PDF map emailed to them. All comments and input provided to GIS specialists were recorded and considered. A complete set of Phase 2 Engagement Event materials is available in **Appendix N**.

  - A total of 213 participants attended the series of open houses. **Table 8-4** outlines the total number of attendees from each open house and by county.

Table 8-4. Public Open House Attendance by Location

County	Location	Date	Time	Attendance
Aitkin	Spang Town Hall Hill City	May 2	10 a.m. – noon	29
Crow Wing	Taconite Canteen Ironton	May 2	4 – 6 p.m.	52
Crow Wing	Daggett Brook Town Hall Brainerd	May 3	10 a.m. – noon	53
Morrison	Pierz Ballroom Pierz	May 3	4 – 6 p.m.	25
Benton	Sauk Rapids Government Center Sauk Rapids	May 4	10 a.m. – noon	21
Sherburne	Palmer Township Hall Clear Lake	May 4	4 – 6 p.m.	33

  - Virtual Self-Paced Open House
    The self-paced virtual open house included the same content presented during the in-person public open houses. It provided an opportunity for viewers to attend at their convenience to learn more about the Project, the routing process and provide input. Information about the self-guided virtual open house was included on notification and outreach materials in addition to being linked from the Project website. This virtual open house was available from May 1 to 12, 2023.

    There were a total of 234 users who visited the virtual open house 318 times.

- **Information Packets**
  - Packets of Project information were created and available for download from the Project website, self-guided virtual open house, mail, or email. A total of 34 packets were requested. The packet of materials included the

same information from the in-person and virtual open houses. A pre-addressed comment form was also included for packet recipients to provide input to the project team.

- **Phase 2 Comments**
  - More than 200 public comments were collected in a variety of ways, both in-person and virtually through the Project hotline, email, interactive comment map, online comment form, mailed comment form, online constraints and opportunities form, in-person comment form, GIS station and tabletop maps comments. All comments were reviewed and considered. The majority of the comments were directed at the Preliminary Route land use and routing. A summary of Phase 2 comments is available in **Appendix N**.

9 REQUIRED PERMITS, APPROVALS, AND CONSULTATIONS

In addition to the Certificate of Need and Route Permit sought in this Application, several other permits will be required to construct the Project depending on the final route selected and the conditions encountered during construction. A list of the local, state and federal permits and approvals that may be required for this Project is provided in **Table 9-1**. Any required permits will be obtained by the Applicants prior to commencing construction in an area subject to permit requirements.

Table 9-1. Permit or Approval List

Permit	Jurisdiction
Local Approvals	
Road Crossing/Right-of-Way Permits	County, Township, and/or City
Lands Permit or Easement	County, Township, and/or City
Oversize/Overweight Load Permits	County, Township, and/or City
Driveway/Access Permits	County, Township, and/or City
Municipal Stormwater Permit	City
Minnesota State Approvals/Consultations	
Endangered Species Consultation	MnDNR – Ecological Services
Utility Licenses to Cross Public Lands and Waters	MnDNR – Lands and Minerals
State Lease for Access Roads	MnDNR – Lands and Minerals
National Pollutant Discharge Elimination System Construction Stormwater Permit	MPCA
Section 401 Clean Water Act Water Quality Certification	MPCA
Spill Prevention, Control and Countermeasure Plan update	MPCA
Wetland Conservation Act	Board of Water and Soil Resources, Soil and Water Conservation District, County, City,
Minn. Stat. Ch. 138 Minnesota Field Archaeology Act and Historic Sites Act	SHPO, OSA, Minnesota Historical Society, and MIAC
Driveway/Access Permit	MnDOT
Utility Accommodation on Trunk Highway Right-of-Way	MnDOT
Oversize and/or Overweight Permit	MnDOT
Federal Approvals/Consultations	
Section 404 Dredge and Fill Permit	USACE

Permit	Jurisdiction
Section 10 Rivers and Harbors Act	USACE
Endangered Species Act Consultation	USFWS
Migratory Bird Treaty Act Consultation	USFWS
Bald and Golden Eagle Protection Act Consultation	USFWS
Part 7460 Airport Obstruction Evaluation	Federal Aviation Administration
Other Approvals	
Crossing Permits/Agreements/Approvals	Other utilities such as pipelines, railroads

9.1 Local Approvals

After the Commission approves a route and any appropriate design engineering is completed, the Applicants will work with LGUs to obtain any of the following approvals if necessary.

9.1.1 Road Crossing/Right-of-Way Permits

These permits may be required to cross or occupy county, township, or city road right-of-way.

9.1.2 Land Permit or Easements

These permits or easements may be required to cross or occupy county, township, or city lands.

9.1.3 Oversize/Overweight Load Permits

These permits may be required to move over-width or heavy loads on county, township, or city roads.

9.1.4 Driveway/Access Permits

These permits may be required to construct access roads or driveways from county, township, or city roadways.

9.1.5 Municipal Stormwater Permit

Portions of the Project may be located within the City of St. Cloud and the City of Becker. Applicants will work with the applicable cities to determine if any specific municipal stormwater permits or construction conditions will be necessary for those portions of the Project.

9.2 State Approvals

9.2.1 Endangered Species Consultation

The MnDNR Natural Heritage and Nongame Research Program collects, manages, and interprets information about nongame species. Consultation was requested from the MnDNR for the Project regarding rare and unique species. The Applicants will work with the MnDNR regarding Project-specific construction considerations after the Commission approves a route for the Project.

9.2.2 License to Cross Public Land and Waters

The MnDNR Division of Lands and Minerals regulates utility crossings over, under, or across any state land or public water identified on the Public Waters and Wetlands Maps. A license to cross Public Lands and Waters is required under Minnesota Statutes Section 84.415 and Minnesota Rules Chapter 6135. The Project will cross both MnDNR Public Lands and Waters; therefore, licenses will be required. The Applicants will work with the MnDNR to obtain these licenses once a route is approved, and sufficient engineering work is completed to support the MnDNR's application process.

9.2.3 State Lease for Access Roads

The MnDNR Division of Lands and Minerals provides services to MnDNR resource managers in processing leases for crossing state-managed lands. State leases will be needed in tandem with utility licenses, described in **Section 9.2.2**, to allow for access roads to the Project. The Applicants will work with the MnDNR to obtain these leases once a route is approved, and sufficient engineering work is completed to support the MnDNR's process.

9.2.4 NPDES Permit

An NPDES/SDS stormwater permit from the MPCA is required for discharges associated with construction activities disturbing one or more acres of land (Minnesota Rule 7090.0030). A requirement of the permit is to develop and implement a SWPPP, which includes BMPs to identify and minimize discharge of pollutants from stormwater runoff at the site. Construction of transmission lines and expansion of associated substations (Iron Range and Benton County) and addition of the Cuyuna Series Compensation Station will disturb more than one acre of land. Applicants will coordinate the development of a comprehensive SWPPP for the Project and obtain any required permit(s) from the MPCA once the Commission approves a route.

9.2.5 Section 401 Water Quality Certification

A CWA Section 401 Water Quality Certification is necessary to obtain a federal permit to conduct any activity that could result in a discharge to navigable waters. A Section 401 certification is a part of the Section 404 process and would be obtained with the joint applications for and the Section 404 permit (see **Section 9.3.1**). However, if the Regional

General Permit applies to the Project, the Section 401 certification has already been provided and no additional application is required.

9.2.6 Spill Prevention, Control and Countermeasure Plan

A Spill Prevention, Control and Countermeasure ("SPCC") plan update would be required for the Iron Range Substation or Benton County Substation should there be new (added or changed) transformers to the facilities that result in changes to the overall oil storage at these substations. A new SPCC plan may be required for the new Cuyuna Series Compensation Station.

9.2.7 Wetland Conservation Act

The Minnesota Board of Water and Soil Resources administers the WCA, under Minnesota Rules Chapter 8420. The Project would require a permit under these rules for anticipated permanent impacts to wetlands from transmission line structures, Iron Range and Benton County Substation expansions, and Cuyuna Series Compensation Station construction. The Applicants will apply for these permits (which is a joint application with the Section 404 permit), or for an exemption if applicable once the Commission approves a route for the Project and more detailed transmission engineering is completed.

9.2.8 Minnesota Field Archaeology Act and Historic Sites Act

Minnesota Statutes, Chapter 138 designates the State Historic Preservation Office and assigns responsibility for the state's historic preservation program with the State Historic Preservation Office. Chapter 138 includes both the Minnesota Field Archaeology Act and Minnesota Historic Sites Act. The Minnesota Field Archaeology Act directs state agencies to consult with SHPO, OSA, and MIAC when projects occurring on lands the agencies control will impact known or suspected archaeological sites. The Applicants will work with state agencies to facilitate consultation with the OSA, SHPO, and MIAC regarding potential impacts to known or suspected archaeological sites for compliance with the Minnesota Field Archaeology Act. The Minnesota Field Archaeology Act also requires an archaeological license be acquired from the OSA and Minnesota Historical Society prior to conducting any archaeological work on non-federal public land. If the Project requires archaeological survey on any non-federal public land, the Applicants and their contractors will work with the OSA and Minnesota Historical Society to obtain any necessary licenses prior to completing survey. The Minnesota Historic Sites Act establishes the State Historic Sites Network and the State Register of Historic Places and directs state agencies to consult with SHPO before undertaking or licensing projects that may affect properties on the Network or on the State or National Registers of Historic Places. The Applicants will work with state agencies to consult with SHPO regarding potential effects the Project may have on properties on the Network or listed in the State Register of Historic Planes or the NRHP.

9.2.9 Driveway/Access Permit

A MnDOT Driveway/Access Permit is required whenever there is a request for change in access to or from a MnDOT right-of-way or a change in use of MnDOT property. The Applicants and their contractors will work with MnDOT should access from a MnDOT road be required for construction once the Commission approves a route for the Project and more detailed transmission engineering is completed.

9.2.10 Utility Accommodation on Trunk Highway Right-of-Way

MnDOT requires the submission of an Application for Utility Accommodation on Trunk Highway Right-of-Way when utilities request permission to place, construct, and reconstruct utility facilities within a trunk highway right-of-way, whether the utility facility runs longitudinally, skewed, or perpendicular to the centerline of the highway. The Applicants continue to consult with MnDOT on the Project. The Applicants will work with MnDOT and submit the Utility Accommodation Form 2525 once the Commission approves a route for the Project and more detailed transmission engineering is completed.

9.2.11 Oversize and/or Overweight Permit

A MnDOT Oversize/Overweight Permit is required when a vehicle is transporting an oversize and/or overweight load on Minnesota trunk highways. For oversize and/or overweight transportation on county, township, and municipal roads, permits from local road authorities are required. If the Project requires the transport of oversize or overweight loads on local and state road properties, the Applicants and their contractors will work with MnDOT and local road authorities to obtain any required permits.

9.3 Federal Approvals

9.3.1 Section 404 Permit

A CWA Section 404 permit is required from the USACE for discharges of dredged or fill material into waters of the United States. Once the Commission approves a final route and a more detailed design of the two substation expansions and transmission line is completed, the Applicants will determine if impacts exceed the permitting threshold. If impacts exceed the permitting threshold, the Applicants will apply for any required permits. Applicants anticipate that the Project will qualify for the Regional General Permit.

On May 25, 2023, the US Supreme Court issued its decision in *Sackett v. EPA*, 598 U.S. ____ (2023), holding that "the CWA extends to only those 'wetlands with a continuous surface connection to bodies that are 'waters of the United States' in their own right,' so that they are 'indistinguishable' from those waters."[94] Further guidance regarding *Sackett* is anticipated to be forthcoming from the agencies during the Project permitting and the Applicants will continue to work closely with the agencies in this regard.

[94] *Sackett*, slip op. at 27.

9.3.2 Section 10 of the Rivers and Harbors Act

A permit under Section 10 of the Rivers and Harbors Act is required from the USACE if construction of any structure over a navigable water of the United States will affect the course, location, or condition of the water body. The Applicants will acquire permits for all navigable watercourse crossings along the Proposed Route. The Applicants will work with the USACE regarding Project-specific construction considerations after the Commission approves a route for the Project. Applicants anticipate that the Project will qualify for the Regional General Permit, which includes Section 10 approvals.

9.3.3 Endangered Species Consultation

The Endangered Species Act ("ESA") provides protective measures for federally-listed threatened and endangered species, including their habitats, from unlawful take (16 U.S.C. §§ 1531–1544). The ESA defines take to mean "harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or to attempt to engage in any such conduct." ESA Section 7(a)(2) requires consultation with USFWS if a federal agency undertakes, funds, permits, or authorizes any action that may impact endangered or threatened species or designated critical habitat. This includes issuing a federal permit, such as a Clean Water Act Section 404 permit from USACE.

The Applicants requested USFWS review of the Project regarding federally-listed species and designated critical habitat. The Applicant will determine effects of the Project on endangered or threatened species and/or designated critical habitat within the Proposed Route. If the Project will result in effects, a permit for incidental take will be obtained. USACE and/or USFWS will be consulted regarding Project-specific construction considerations after the Commission approves a route for the Project.

9.3.4 Migratory Bird Treaty Act

Migratory birds are protected under the Migratory Bird Treaty Act of 1918 ("MBTA") (16 U.S.C. §§ 703–7121). The MBTA makes it unlawful to take, possess, buy, sell, purchase, or barter any migratory bird listed in 50 C.F.R. § 10, including feathers or other parts, nests, eggs, or products, except as allowed by implementing regulations (50 C.F.R. § 21). The Applicants will design the transmission lines consistent with the APLIC guidelines to reduce the potential risk of avian collision and electrocution. The Applicants will work with the USFWS and MnDNR to identify any areas that may require marking transmission line shield wires and/or to use alternate structures to reduce the likelihood of avian collisions. Tree clearing during avian nesting season can also result in incidental take of avian species. The Applicants will work with the USFWS regarding Project-specific construction considerations and timing after the Commission approves a route for the Project.

9.3.5 Bald and Golden Eagle Protection Act

The Bald and Golden Eagle Act of 1940 (16 U.S.C. §§ 668-668d) prohibits anyone without a permit from "taking" bald and golden eagles. Take is defined to include a number of actions including disturb. The regulations define disturb as "to agitate or bother a bald or golden eagle to a degree that causes, or is likely to cause, based on the best scientific information available, 1) injury to an eagle, 2) a decrease in its productivity, by substantially interfering with normal breeding, feeding, or sheltering behavior, or 3) nest abandonment, by substantially interfering with normal breeding, feeding, or sheltering behavior" (50 C.F.R. § 22.6). The Applicants will review the final route for eagle activity, including nesting, and work with the USFWS regarding Project-specific construction considerations after the Commission approves a route for the Project.

9.3.6 Section 106 of the National Historic Preservation Act

Section 106 of the National Historic Preservation Act enacted in 1966 requires federal agencies to consider potential effects to historic properties (significant cultural resources) during projects they carry out, fund, permit, license, or approve within the United States. If Section 106 compliance is needed because of required federal permitting and approvals, the Applicants will coordinate with the applicable federal agency to support such compliance.

9.3.7 Obstruction Evaluation / Airport Airspace Analysis Process

FAA notice is required for structures 200 feet above ground level or those that exceed an imaginary surface at airports extending outward and upward from public use airports at slopes defined in Title 14 Code of Federal Regulations Chapter 77.9. Filing is also required if requested by the FAA. Form 7460-1 shall be submitted to the FAA for notice of construction. After receiving favorable Determinations of No Hazard from the FAA, supplemental notice may be required, in the form of a 7460-2 Part 1, or 7460-2 Part 2. Pre-construction notice is submitted by the 7460-2 Part 1, within the prescribed time annotated on Determinations. Following construction completion, as-built information will be submitted using Form 7460-2.

9.4 Other Approvals

Other approvals and/or crossing agreements may be required where Project facilities cross an existing utility such as a pipeline, solar facility, or a railway. The need for such approvals will be determined after a final route is selected, and these approvals will be obtained after a Route Permit has been issued by the Commission.

10.1 Certificate of Need Criteria

Pursuant to Minn. Stat. § 216B.243, the Commission has established criteria under Minn. R. 7849.0120 that it will apply to determine whether an applicant has established that a new proposed high-voltage transmission line is needed and shall be granted a Certificate of Need. The Applicants have described in this Application the reasons why the Commission should grant a Certificate of Need to build the Northland Reliability Project, as described in this Application. Those reasons are summarized below.

10.1.1 Denial Would Adversely Affect the Energy Supply

Denial of a Certificate of Need for the Project would adversely affect the future adequacy, reliability, or efficiency of energy supply to the Applicants, their customers and members, and to electric customers in the Upper Midwest. As the Applicants and their customers and members have transitioned away from reliance on fossil fuel generation to more renewable sources, and fossil-fueled generators throughout the state have retired or ceased operations, the regional power system requires updates and new facilities. The Project is needed to (1) maintain a continuous supply of safe and reliable electricity, while replacing the support once provided by fossil fuel-fired generators, (2) enhance system resiliency during extreme weather events, (3) facilitate increased capacity for the delivery of energy from renewable resources and (4) prepare the system to meet changing customer and member needs. If the Project is not approved, each of these areas of performance of the regional transmission system would suffer negative impacts as would the Applicants’ customers and members.

10.1.2 No Reasonable and Prudent Alternative

As discussed in **Chapter 4**, a more reasonable and prudent alternative was not demonstrated by the study work and analysis conducted by the Applicants. The Applicants evaluated multiple alternatives including: (1) size alternatives (different voltages or conductor arrays, AC/DC, and double-circuit); (2) generation and non-wires alternatives; (3) no build alternatives and reasonable combinations of alternatives. After evaluating these alternatives, the Applicants concluded that none of these alternatives is a more reasonable and prudent alternative to the Project.

10.1.3 Project will Provide Benefits to Society in a Manner Compatible with Protecting the Environment

The Project will support the state’s decarbonization goals and ensure that the power grid in northern and central Minnesota continues to operate reliably as energy resources in Minnesota and the regional power system continue to evolve. As generation resources shift from fossil fuels to more renewables, the Project is one part of the solution to: (1) provide system support as fossil-fueled baseload generation is retired; (2) enhance system resiliency during extreme weather events (such as during polar vortex events);

(3) facilitate increased capacity to safely and reliably deliver clean energy from where it is produced to where it is needed by customers and members, particularly during the winter season; and (4) plan proactively to meet changing customer and member power needs due to decarbonization and electrification. In addition, consistent with the Commission's routing criteria, the Project will be routed in a manner compatible with protecting the natural and socioeconomic environment.

10.1.4 Project will Comply with All Applicable Requirements

The Applicants have identified the other permits and approvals that may be required for the Project in **Chapter 9**. The Applicants have demonstrated that it will comply with all applicable requirements and obtain all necessary permits.

10.2 Route Permit Factors

According to Minn. Stat. § 216E.02, subd. 1, it is the policy of the State of Minnesota to locate high-voltage transmission lines in an orderly manner that minimizes adverse human and environmental impacts and ensures continuing electric power system reliability and integrity. Under Minn. R. 7850.4000, the Commission's rules require that applicants for route permits meet applicable standards and factors under Minn. Stat. §§ 216E.03 and 216E.04, and under other Minnesota law and Commission rules. The Commission shall issue a route permit for a high-voltage transmission line that is consistent with state goals to conserve resources, minimize environmental impacts and impacts to human settlement, minimize land use conflicts, and ensure the state's electric energy security through efficient, cost-effective transmission infrastructure.

The Proposed Route for the Project meets these factors by: utilizing existing high-voltage transmission line rights-of-way to the extent feasible (more than 85 percent of the Proposed Route), double-circuiting with an existing line where this configuration is not contrary to the operational requirements of the Project, including realignments of existing lines to reduce impacts to natural resources and residences, and upgrading existing transmission infrastructure (Segment 2).

10.3 Conclusion and Request for Commission Approval

For all the reasons set forth in this Application and as supported by the Appendices hereto, the Applicants respectfully request that the Commission issue a Certificate of Need and Route Permit authorizing construction of the Northland Reliability Project.

Term	Definition
12CP	MISO's 2023 projected average load share for cost allocation calculation purposes.
2021 IRP	Minnesota Power's 2021 Integrated Resource Plan (Docket No. E015/RP-21-33)
AC	Alternating-Current
ACSR	Aluminum Conductor Steel Reinforced
ACSS	Horizontally Bundled Aluminum Conductor Steel Supported
AMA	Aquatic Management Area
AMSL	Above Mean Sea Level
APC	Adjusted Production Cost
APLIC	Avian Powerline Interaction Committee
Applicants	Minnesota Power and Great River Energy
Application	This combined application for a Certificate of Need and Route Permit submitted by Applicants.
ATV	All-Terrain Vehicle
BEC	Minnesota Power's Boswell Energy Center
BMPs	Best Management Practices
BWSR	Minnesota Board of Water and Soil Resources
CAGR	Compound Annual Growth Rate
CC	Combined Cycle
CH_4	Methane
CO_2	Carbon Dioxide
Commission	Minnesota Public Utilities Commission
CT	Combustion Turbine
CWA	Clean Water Act
dBA	A-Weighted Decibel
DC	Direct-Current
DER	Distributed Energy Resources
Dkey	USFWS Determination Key
DOD	U.S. Department of Defense
EA	Environmental Assessment
EERA	Department of Commerce, Energy Environmental Review and Analysis
EMF	Electric and Magnetic Fields

Term	Definition
Environmental Justice Study Area	Area within one-quarter mile of the Proposed Centerline.
EPRI	Electric Power Research Institute
ESA	Endangered Species Act
Exemption Order	Commission Order dated June 21, 2023 approving the Applicants' request to be exempt from certain filing requirements under Minn. R. 7849.
FAA	Federal Aviation Administration
FACTS	Flexible AC Transmission System
FEMA	Federal Emergency Management Agency
FERC	Federal Energy Regulatory Commission
G	Gauss
GHG	Greenhouse Gas
GW	Gigawatts
GWh	Gigawatt-Hour
HVDC	High-voltage direct-current
ICD	Implantable Cardioverter/Defibrillator
IPaC	USFWS Information, Planning, and Consultation
IRPs	Integrated Resource Plans
kV	Kilovolt
kV/m	kV per meter
kWh	Kilowatt-Hour
L_{10}	Noise level exceeded 10 percent of the time
L_{50}	Noise level exceeded 50 percent of the time.
LEP	Limited English Population
LGU	Local Governmental Units
LHVTL	Large High-Voltage Transmission Line
LRTP	Long-Range Transmission Plan
LRTP Tranche 1 Portfolio	A portfolio of regionally beneficial projects identified by MISO, the independent not-for-profit system operator for the Midwest, and approved by the MISO Board of Directors in July 2022 in MISO's MTEP21.
mA	milliAmperes
MBS	MnDNR Minnesota Biological Survey
MBTA	Migratory Bird Treaty Act
MDA	Minnesota Department of Agriculture
mG	milliGauss

Term	Definition
MHEX	Manitoba Hydro Transfer Level
MHEX_S	Manitoba Hydro Export Interface
MHz	Megahertz
MIAC	Minnesota Indian Affairs Council
MISO	Midcontinent Independent System Operator, Inc.
MN TACT	Minnesota Transmission Owners' Assessment and Compliance Team
MnDNR	Minnesota Department of Natural Resources
MnDOT	Minnesota Department of Transportation
MPCA	Minnesota Pollution Control Agency
MRO	Midwest Reliability Organization
MTEP	MISO Transmission Expansion Plan
MTEP21	MISO's 2021 Transmission Expansion Plan
MTEP21 Futures	MISO MTEP21 future generation and transmission system scenarios.
MTEP22	MISO's 2022 Transmission Expansion Plan
MTEP23	MISO’s 2023 Transmission Expansion Plan
MVAR	Megavolt-Ampere
MVP	MISO Multi-Value Project
MW	Megawatts
MWh	Megawatt-Hour
MWI	Minnesota Wetland Inventory
N_2O	Nitrous Oxide
NAAQS	National Ambient Air Quality Standards
NAC	Noise Area Classification
NERC	North American Electric Reliability Corporation
NESC	National Electric Safety Code
NFHL	National Flood Hazard Layer
NHIS	National Heritage Information System
NLEB	Northern Long-Eared Bat
NO_2	Nitrogen Dioxide
NOMN	Northern Minnesota Voltage Stability
North Flow	System conditions arising from winter peak loading and heavy south-to-north transfers.

Term	Definition
Notice Area	The Notice Area extends (north to south) from the existing Iron Range Substation to the existing Sherco Substation and new Big Oaks Substation. The Notice Area is smaller than the Study Area but larger than the Proposed Route and encompasses potential route opportunities that were considered and is used noticing the Certificate of Need filing.
NPDES	National Pollution Discharge Elimination System
NRCS	Natural Resources Conservation Service
NRHP	National Register of Historic Places
NWI	National Wetlands Inventory
O&M	Operations & Maintenance
OSA	Office of the State Archeologist
PDSI	Palmer Drought Severity Index
PEM	Palustrine Emergent
PFO	Palustrine Forested
PLSS	Public Land Survey System
ppb	Parts Per Billion
Preliminary Route	The Preliminary Route extends (north to south) from the existing Iron Range Substation to the existing Sherco Substation and new Big Oaks Substation. The Preliminary Route is narrower in width (east to west) than the Route Corridor. More information on the Preliminary Route can be found in Section 5.2.2.
Project	The Northland Reliability Project
Proposed Centerline	The Proposed Centerline for the Project is where the Applicants, based on information available at the time of filing this Application, intend to place the centerline of the Project. The Proposed Centerline for the Project can be found on the maps contained in Appendix J, Detailed Mapbook Pages 1-64.
Proposed Right-of-Way	The Proposed Right-of-Way for the Project is located within the Proposed Route. The Proposed Right-of-Way extends approximately 75 feet on either side of the Proposed Centerline. In Segment 1, the Proposed Centerline will overlap with existing transmission line rights-of-way up to 30 to 40 feet, where practicable. In Segment 2, Applicants do not anticipate it will be necessary to expand the existing transmission line right-of-way widths, except near the existing Sherco Substation and new Big Oaks Substation where new or modified rights-of-way (not to exceed 75 feet on either side of a transmission line centerline) may be needed to accommodate transmission line configurations around these substations. More information on the Proposed Right-of-Way can be found in Section 6.1 and on the maps contained in Appendix J, Detailed Mapbook Pages 1-64.

Term	Definition
Proposed Route	The Proposed Route ranges from 1,000 feet to 6,600 feet wide (east to west) and extends (north to south) from the existing Iron Range Substation to the existing Sherco Substation and new Big Oaks Substation. More information on the Proposed Route can be found in Section 5.2.3 (see Section 1.3 and 5.2.3).
PSS	Palustrine Scrub/Shrub
PUB	Palustrine Unconsolidated Bottom
PWI	Public Water Inventory
RICE	Reciprocating Internal Combustion Engine
RIIA	Renewable Integration Impact Assessment
Rejected Route Alternative	A Rejected Route Alternative is a shorter routing segment considered and rejected by the Applicants for the Project (see Section 5.3).
Route Corridor	The Route Corridor extends (north to south) from the existing Iron Range Substation to the existing Sherco Substation and new Big Oaks Substation. The Route Corridor is narrower in width (east to west) than the Study Area. More information on the Route Corridor can be found in Section 5.2.2.
RRA	MISO's 2022 Regional Resource Assessment
RTO	Regional Transmission Organization
SDS	State Disposal System
SF_6	Sulfur Hexafluoride
SHPO	State Historic Preservation Office
SNA	Scientific and Natural Area
SPCC	Spill Prevention, Control and Countermeasure
Substation Siting Area	The Substation Siting Area is the area within which the proposed Cuyuna Series Compensation Station or the Iron Range Substation and Benton County Substation expansions will be located. The Substation Siting Area is larger than the area that will be needed for the fenced area of the proposed series compensation station or the expansions at the existing substations. The Substation Siting Area is intended to allow flexibility as design develops. Impact calculations presented in Chapter 7 are based on the size of area needed to construct the proposed Cuyuna Series Compensation Substation (25 acres), Iron Range Substation expansion (15 acres), and Benton County Substation expansion (8.9 acres) as described in Section 2.5.1. See Appendix J, Detailed Mapbook, Pages 24-25, 1, and 51.
SSR	System Support Resource
STATCOM	Static Synchronous Compensators

Term	Definition
Study Area	The Study Area ranges from 6 to 27 miles wide (east to west) and extends (north to south) from the existing Iron Range Substation to the existing Sherco Substation and new Big Oaks Substation. More information on the Study Area can be found in Section 5.2.1.
SVC	Static VAR Compensator
SWE	Snow Water Equivalent
SWPPP	Stormwater Pollution prevention Plan
T2-ACSR	Horizontally Bundled Twisted Pair-Type ACSR
THPO	Tribal Historic Preservation Officer
TMDL	Total Maximum Daily Load
TOs	MISO Transmission Owners
TW	Terawatt
TWh	Terawatt-Hour
USACE	U.S. Army Corps of Engineers
USDA	U.S. Department of Agriculture
USEPA	U.S. Environmental Protection Agency
USFWS	U.S. Fish and Wildlife Service
V	Volt
VOC	Volatile Organic Compounds
WCA	Wetland Conservation Act
WIN_NIGHT	LRTP Winer Night
Winter North Flow	Winter peak model with high south to north transfers through Minnesota.
WMA	Wildlife Management Area

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13 APPENDICES

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