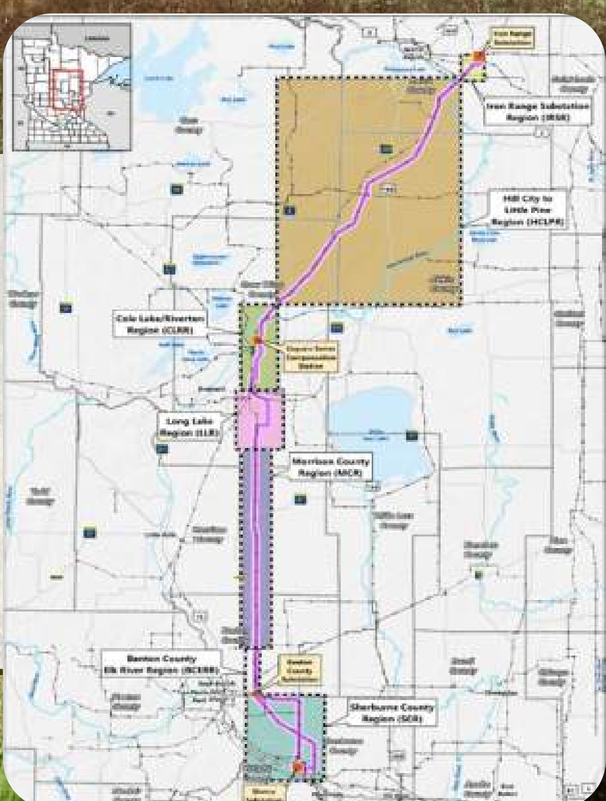
COMMERCE DEPARTMENT

Northland Reliability Project Environmental Assessment

The Human and Environmental Impacts of Addressing Electrical Grid Reliability Concerns in North Central Minnesota



June 2024

Docket Numbers E015, ET2/CN-22-416 and E002, E015, ET2/TL-22-415

Abstract

Responsible Government Unit
Minnesota Public Utilities Commission
121 Seventh Place East, Suite 350
St. Paul, MN 55101

Commission Representative
Craig Janezich
651-201-2203
craig.janezich@state.mn.us

Preparer
Minnesota Department of Commerce
85 7th Place East, Suite 280
Saint Paul, MN 55101

Commerce Representative
Jim Sullivan
651-539-1059
jim.sullivan@state.mn.us

Applicants
Minnesota Power
30 West Superior St.
Duluth, MN 55802

Applicant Representatives
Jim Atkinson
218-355-3561
jbatkinson@mnpower.com

Great River Energy
12300 Elm Creek Boulevard
Maple Grove, MN 55369

Dan Lesher
763-445-5975
dlesher@GREnergy.com

Minnesota Power and Great River Energy (Applicants) propose to construct approximately 180 miles of double-circuit 345 kilovolt (kV) transmission line from the Iron Range Substation near Grand Rapids, Minnesota to the Sherco and Big Oaks Substations near Becker Minnesota (Northland Reliability Project or project). The project includes equipment additions and reconfigurations within several substations as well as a new Cuyuna Series Compensation Station near Riverton, Minnesota.

The Northland Reliability Project requires two separate approvals from the Minnesota Public Utilities Commission (Commission)—a certificate of need (CN) and a route permit. The applicants submitted a joint CN and route permit application to the Commission in August 2023. The Commission subsequently authorized joint hearings and combined environmental review for the CN and route permit. The Commission requested that Department of Commerce (Department) Energy Environmental Review and Analysis (EERA) staff prepare an environmental assessment (EA) for the project.

This EA addresses the issues and mitigation measures identified in the Department's scoping decision of March 22, 2024. It evaluates the project's potential for human and environmental impacts and possible measures, including route alternatives, to mitigate these impacts. Additionally, this EA discusses system alternatives (i.e., alternatives other than a double-circuit 345 kV transmission line) that may meet the stated need for the project.

Public hearings for the project will be held in the project area and are anticipated to occur the week of July 22, 2024. Notice of the hearings will be issued separately. An administrative law judge (ALJ) from the Minnesota Office of Administrative Hearings will preside over the hearings. Upon completion of the hearings, the ALJ will submit a report to the Commission including recommendations to the Commission regarding the applicants' CN and route permit application. Commission decisions on a CN and route permit are expected in November 2024.

Additional materials related to this project and its permitting proceedings are available on the Department's website: http://mn.gov/commerce/energyfacilities and on the state of Minnesota's eDockets

system: https://www.edockets.state.mn.us/EFiling/search.jsp (enter the year “22” and the number “415” or “416”).

Persons interested in receiving future project notices and updates can place their names on the project mailing list by emailing docketing.puc@state.mn.us or calling 651-201-2246 and providing the docket number (22-415 or 22-416), their name, email address, and mailing address. Please indicate how you would like to receive notices—by email or U.S. mail.

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List of Preparers

Minnesota Department of Commerce
Energy Environmental Review and Analysis
Jim Sullivan and Ray Kirsch

Barr Engineering Co.

Environmental Assessment
Northland Reliability Project

June 2024

Table of Contents

Tables

Figures

Photos

Maps

Map Books

Appendices

Acronyms

AC	alternating current
ACSR	aluminum conductor steel reinforced
ACSS	aluminum conductor steel supported
AIMP	agricultural impact mitigation plan
ALJ	administrative law judge
AMA	Aquatic Management Area
Applicants	Minnesota Power and Great River Energy
AQI	Air Quality Index
AUAR	Alternative Urban Area-Wide Review
BEC	Boswell Energy Center
BGEPA	Bald and Golden Eagle Protection Act
BMP(s)	Best Management Practice(s)
BWSR	Board of Water and Soil Resources
CAA	Clean Air Act
CN	certificate of need
CO	carbon monoxide
CO_2	carbon dioxide
Commission	Minnesota Public Utilities Commission
CREAT	Climate Resilience Evaluation and Awareness Tool
CREP	Conservation Reserve Enhancement Program
CWA	Clean Water Act
dBA	decibel scale
DC	direct-current
SBS	Department of Natural Resources Sites of Biodiversity Significance
DNR	Department of Natural Resources
EA	environmental assessment
ECS	Ecological Classification System
EERA	Energy Environmental Review and Analysis
EJC	environmental justice concerns
EMI	electromagnetic interference
EPA	Environmental Protection Agency
ESA	Endangered Species Act
FAA	Federal Aviation Administration
FEMA	Federal Emergency Management Agency
FSA	Farm Service Agency
GBCA	Grassland Bird Conservation Areas
GHGs	Greenhouse gases
GIS	geographic information system
GPS	global position systems
GRE	Great River Energy
HVDC	High-voltage direct current
ICDs	implantable cardioverter defibrillators
IPaC	Information for Planning and Consultation
kV	kilovolt
kV/m	kV per meter
LGUs	local units of government

LRTP	Long-Range Transmission Plan
MDA	Minnesota Department of Agriculture
MEPA	Minnesota Environmental Policy Act
mG	milliGauss
MIAC	Minnesota Indian Affairs Council
MISO	Midcontinent Independent System Operator
MnDOT	Minnesota Department of Transportation
MPCA	Minnesota Pollution Control Agency
MWI	Minnesota Well Index
N_2O	nitrous oxide
NAAQS	National Ambient Air Quality Standards
NERC	North American Electric Reliability Corporation
NESC	National Electrical Safety Code
NHIS	Natural Heritage Inventory System
NHPA	National Historic Preservation Act
NLCD	National Land Cover Database
NO_2	nitrogen dioxide
NOMN	northern Minnesota
NPDES	National Pollutant Discharge Elimination System
SDS	Sanitary Disposal System
NRCS	Natural Resource Conservation Service
NRHP	National Register of Historic Places
O_3	ozone
OAH	Office of Administrative Hearings
OSA	Office of the State Archaeologist
PM_{10}	particulate matter less than 10 microns
$PM_{2.5}$	particulate matter less than 2.5 microns
PWI	public waters inventory
RCP	Representative Concentration Pathway
RICE	reciprocating internal combustion engine
ROI	Region of Influence
ROW	right-of-way
SBS	Sites of Biodiversity Significance
ScPDSI	Self-Calibrated Palmer Drought Severity Index
SDS	State Disposal System
SF_6	sulfur hexafluoride
SFIA	Sustainable Forest Incentive Act
SHPO	State Historic Preservation Office
SO_2	sulfur dioxide
SSURGO	Soil Survey Geographic
SWPPP	Stormwater Pollution Prevention Plan
SWPPP	Stormwater Pollution Prevention Plan
TMDL	total maximum daily load
TWh	Terawatt hours
USACE	U.S. Army Corps of Engineers
USFWS	U.S. Fish and Wildlife Service
VOR	very high-frequency omni-directional range
WCA	Wetland Conservation Act
WMA(s)	Wildlife Management Area(s)

Summary

This environmental assessment (EA) has been prepared for the Northland Reliability Project (the project), a 345 kV double-circuit transmission line proposed by Minnesota Power and Great River Energy (GRE) (applicants). It evaluates the potential human and environmental impacts of the project and possible mitigation measures, including routing alternatives. Additionally, it evaluates alternatives to the project itself.

This EA is not a decision-making document but rather a guide for decision-makers. The EA is intended to facilitate informed decisions by state agencies, particularly with respect to the goals of the Minnesota Environmental Policy Act (MEPA) — "to create and maintain conditions under which human beings and nature can exist in productive harmony, and fulfill the social, economic, and other requirements of present and future generations of the state's people" (Minn. Statute 116D.02).

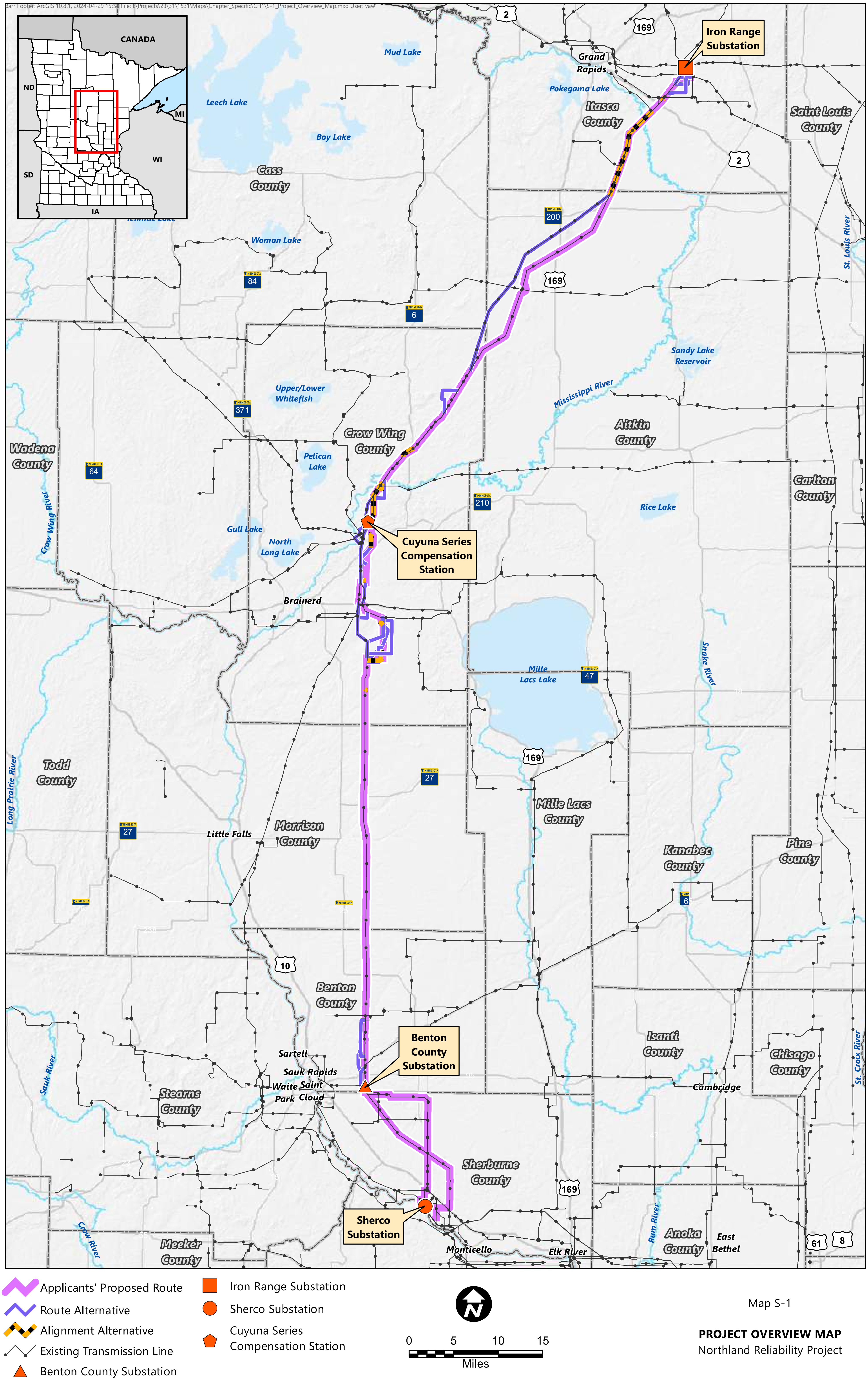
The Perceived Problem: Electrical Grid Reliability Concerns with the Shift to Renewable Energy

Over the past decades, the generation of electricity in Minnesota has evolved away from fossil-fueled baseload generating plants to renewable generating resources (e.g., wind and solar power). In 2011, over half of the electricity generated in Minnesota came from coal-fired electric power plants. In 2021, these plants produced only 27 percent of the electricity in Minnesota, while renewable generating resources provided 29 percent (reference (1)). This change in electrical generation has implications for the electrical transmission grid, among them, the grid may no longer connect generation resources in a manner that ensures reliable electrical service throughout the state.

Studies conducted by the applicants, along with the Midcontinent Independent System Operator (MISO), indicate that the electrical grid in north-central Minnesota will soon be unstable and unreliable if the transmission grid is not upgraded. Additionally, the grid in this area of the state will soon lose the voltage support provided by the Boswell Energy Center (BEC), a coal-fired generating plant in Cohasset, Minnesota. Unit 3 at the plant will cease operation by 2029; Unit 4 at the plant will cease operation by 2035. With these changes and without upgrades to the existing transmission grid, electrical service in north-central Minnesota would be unreliable; voltages at residences and businesses could be unstable.

A Possible Solution: The Northland Reliability Project

MISO and the applicants studied a number of possible solutions to this problem. After several years of study, MISO determined that a double-circuit 345 kV from the Iron Range substation near Grand Rapids, Minnesota, to the Sherco and Big Oaks substations in central Minnesota was the best solution. This solution – the Northland Reliability Project – most cost-effectively resolved the impending reliability issues in north-central Minnesota. MISO approved the project in the first phase (or "tranche") of its Long-Range Transmission Plan (LRTP) Tranche 1 Portfolio (reference (2)). MISO then assigned the development and construction of the Northland Reliability Project to the applicants. In August 2023, the applicants applied to the Minnesota Public Utilities Commission (Commission for a certificate of need (CN) and a route permit for the project (Map S-1).



Map S-1

PROJECT OVERVIEW MAP

Northland Reliability Project

The State of Minnesota's Role

Though MISO is charged with operating the electrical transmission grid in the Upper Midwest, and though it may propose projects, it is ultimately the state of Minnesota that determines whether specific transmission lines are needed by the state and, if so, where they should be located. This authority is vested in the Commission. Thus, even though a project may be proposed and approved by MISO, it is the Commission that determines whether and where the project is built.

For the Northland Reliability Project, the Commission must make two decisions: (1) whether the proposed project is needed or whether some other project would be more appropriate for the state of Minnesota; for example, a project of a different type or size, and (2) if the proposed project is needed, where it should be located.

To help the Commission with its decision-making and to ensure a fair and thorough airing of the issues, the state of Minnesota has set out a process for the Commission to follow in making its decisions. This process requires (1) the development of an EA and (2) public hearings before an administrative law judge (Minn. Statutes 216B and 216E). The goal of the EA is to describe the potential human and environmental impacts of the project ("the facts"); the goal of the hearings is to advocate, question, and debate what the Commission should decide about the project ("what the facts mean"). The entire record developed in this process, including all public input and testimony, is considered by the Commission when it makes its decisions on the applicants' CN and route permit applications.

Commission Decision Criteria

The Commission makes its decisions on the applicants' CN and route permit applications through criteria set out in Minnesota statutes and rules. Per Minn. Rule 7849.0120, in order to grant a CN, the Commission must find that:

A. The probable result of denial would be an adverse effect on the future adequacy, reliability, or efficiency of energy supply to the applicant, to the applicant's customers, or to the people of Minnesota and neighboring states.

B. A more reasonable and prudent alternative to the proposed facility has not been demonstrated by a preponderance of the evidence on the record.

C. The proposed facility, or a suitable modification of the facility, will provide benefits to society in a manner compatible with protecting the natural and socioeconomic environments, including human health.

D. The record does not demonstrate that the design, construction, or operation of the proposed facility, or a suitable modification of the facility, will fail to comply with relevant policies, rules, and regulations of other state and federal agencies and local governments.

For a route permit, the Commission is charged with selecting transmission line routes that minimize adverse human and environmental impacts while ensuring continuing electric power system reliability and integrity. Per Minn. Rule 7850.4100, the Commission must consider 14 factors when making a route permit decision:

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 right-of-way (ROW), 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 ROWs.

K. Electrical systems reliability.

L. Costs of constructing, operating, and maintaining the facility which are dependent on design and route.

M. Adverse human and natural environmental effects which cannot be avoided.

N. Irreversible and irretrievable commitments of resources.

Environmental Assessment

The Minnesota Environmental Policy Act requires that environmental review be conducted for major governmental actions with the potential to create significant environmental impacts (Minn. Statute 116D.04). To meet this requirement, the Commission has authorized the preparation of an EA. Department of Commerce (Department), Energy Environmental Review and Analysis (EERA) staff is responsible for preparing the EA on behalf of the Commission.

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

Public Participation

In their CN application, the applicants requested that the Commission approve a double-circuit 345 kV transmission line from the existing Iron Range Substation to a new Cuyuna Series Compensation Substation, to the existing Benton County Substation, finally connecting to the Sherco and Big Oaks Substations. In their route permit application, the applicants proposed a route for the project and discussed routing alternatives that were considered but not proposed by the applicants.

In preparing this EA, EERA staff solicited public comments on these applications. EERA staff solicited comments on (1) the human and environmental impacts that should be evaluated in the EA, (2) possible mitigation measures to study, including route alternatives, and (3) alternatives to the project itself that should be studied. This process of soliciting comments on the contents of the EA is known as “scoping.” EERA staff solicited comments through public meetings in October 2023 and through a comment period that ended on November 21, 2023. Based on the public comments received and after review by the Commission, the Department issued the scoping decision for this EA on March 22, 2024.

Public comments received during the scoping process increased the number of routing alternatives for the project. There is one route, 25 route alternatives, and 15 alignment alternatives that could be used for the project (Map S-1). The Commission could select and permit any of these alternatives or a combination of these alternatives.

Environmental Assessment Analysis and Routing Alternatives

The applicants are proposing to construct an approximately 180-mile-long double-circuit 345 kV transmission line between Grand Rapids, St. Cloud, and Becker, Minnesota. To facilitate analysis and discussion of the project, this EA divided the project into seven regions: the Iron Range Substation Region, the Hill City to Little Pine Region, the Cole Lake-Riverton Region, the Long Lake Region, the Morrison County Region, the Benton County Elk River Region, and the Sherburne County Region. The regions begin in the north, with the Iron Range Substation Region, and extend southward, ending with the Sherburn County Region. The regions were developed to facilitate analysis, as proposed route and alignment alternatives tended to be clustered in the same geographic areas along the route. A summary of the route and alignment alternatives located in each region is provided in Table S-1.

Table S-1 Summary of Route and Alignment Alternatives Analyzed in the EA

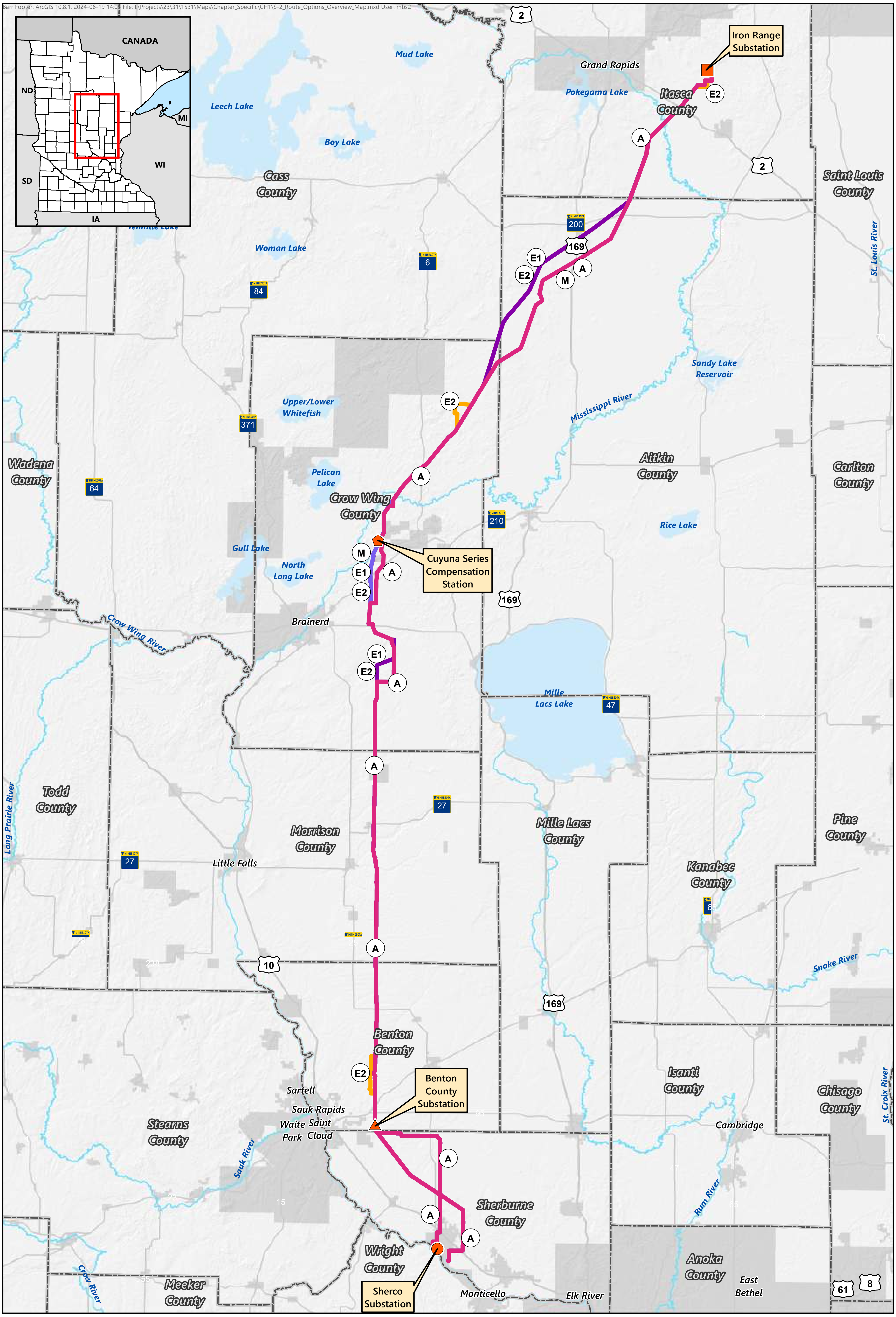
Region	Route Alternatives	Alignment Alternatives
Iron Range Substation	A1, A2, A3, A4	AA15
Hill City to Little Pine	B, C	AA1, AA2, AA16
Cole Lake-Riverton	D3, E1, E2, E3, E4, E5, F, G	AA3, AA4, AA6, AA7, AA8, AA9, AA10
Long Lake	H1, H2, H3, H4, H5, H6, H7, K	AA12, AA13, AA14, AA17
Morrison County	None	None
Benton County Elk River	J1, J2, J3	None
Sherburne County	None	None

Following the region-by-region analysis of each route and alignment alternative, four full route options (i.e., end-to-end routes from the Iron Range Substation to the Sherco and Big Oaks Substations) were identified and compared (Map S-2). These full route options are not meant to represent the only project routing possibilities. Rather, they are offered as examples of full-route options that could be assembled for the project, illustrating how various routing alternatives could be selected to build a full project route.

The full route options identified here were compiled by selecting routing alternatives or alignment alternatives within each region that could be feasibly connected to one another to create a full transmission line route between the existing Iron Range Substation, a new Cuyuna Series Compensation Substation, the existing Benton County Substation, the existing Sherco Substation, and the new Big Oaks Substation. Analyzing these four full route options against each other provides the opportunity to understand what impacts might look like if one of these full routes, or a similar route, were chosen for the project. The four full route options identified for analysis include:

- **The applicants' proposed route**. This is the route proposed by the applicants in their CN and route permit application.
- **The applicants' proposed route with modifications**. This route includes modifications proposed by the applicants in response to public comments and includes routing alternatives that would further consolidate the proposed new double-circuit 345 kV transmission line with existing transmission lines, particularly in the Cole Lake-Riverton Region. This route includes alignment alternatives AA3, AA9, and route alternative E1.
- **Example Route Option 1**. This route includes portions of the applicants' proposed route, including some modifications proposed by the applicants and routing alternatives proposed during the EA scoping comment period. This route includes route alternatives B, E1, H1 and alignment alternatives AA3 and AA16.
- **Example Route Option 2**. Similar to Route 1, this route includes portions of the applicants' proposed route, including some modifications proposed by the applicants and routing alternatives proposed during the EA scoping comment period. This route includes route alternatives A2, B, C, E1, H1, and J1 and alignment alternatives AA3 and AA16.

The summary of potential impacts that follow is limited to the four full route options that are identified above and analyzed in Chapter 7. Details of the potential human and environmental impacts of routing alternatives in specific regions of the project are discussed in Chapters 5 and 6.



Example Full Routes*

- Applicants' Proposed Route (A)
- Applicants' Proposed Route with Modifications (M)
- Example Route 1 (E1)
- Example Route 2 (E2)
- Benton County Substation
- Iron Range Substation
- Sherco Substation
- Cuyuna Series Compensation Station

* Routes follow Applicants' Proposed Route (A) except where noted.

0 5 10 15
Miles

Map S-2

EXAMPLE FULL ROUTES OVERVIEW MAP

Northland Reliability Project

Human and Environmental Impacts of the Project

Project construction and operation will impact human and environmental resources within the designated project area. Some impacts will be short-term and similar to those of any large construction project (e.g., noise, dust, soil disturbance). These impacts are fairly independent of the project route selected and can be mitigated by measures common to most construction projects.

Other impacts will exist for the life of the project and may include aesthetic impacts, impacts on land-based economies such as agriculture, forestry, and recreation and tourism as well as impacts to the natural environment and on rare and unique natural resources. These long-term impacts are generally not well mitigated by construction measures. That is, these impacts do not flow from how the project is constructed but rather through its design and location. Long-term impacts can be mitigated by prudent selection of the route and design for the project.

Many impacts are anticipated to be minimal—in and of themselves or with common mitigation measures—and fairly independent of the route selected for the project. These include:

- Impacts on human settlements (factor A)—noise, property values, electronic interference, cultural values, zoning and land-use compatibility, and public services.
- Impacts on public health and safety (factor B)—electric magnetic fields (EMF), implantable medical devices, stray voltage, induced voltage, and air quality.
- Impacts on rare and unique natural resources (factor F) – federal- and state-protected species.
- Impacts on electric system reliability (factor K).

However, other impacts are anticipated to vary with the route and design of the project. These impacts include:

- Impacts on human settlements (factor A)—aesthetics, displacement, and communities with environmental justice concerns (EJC).
- Impacts on land-based economies (factor C)—agriculture, forestry, mining, and recreation and tourism.
- Impacts on archaeological and historic resources (factor D).
- Impacts on the natural environment (factor E) - water resources, vegetation (flora), and wildlife (fauna).
- Impacts on rare and unique natural resources (factor F) - sensitive ecological resources.
- Use or paralleling of existing rights-of-way (factors H and J).
- Costs that are dependent on design and route (factor L).

Potential human and environmental impacts of the four full route options are summarized in Table S-2 and discussed further here.

Table S-2 Human and Environmental Impacts for the Applicants' Proposed Routes and Example Full Route Options

Resource	Element	Applicants' Proposed Route	Applicants' Proposed Route with Modifications	Example Route Option 1	Example Route Option 2
Length (miles)		182.3	180.5	177.6	179.6
Human Settlement	Residences within 0-75 feet (count)	3	3	2	3
	Residences within 75-250 feet (count)	102	111	109	117
	Residences within 250-500 feet (count)	164	172	194	209
	Residences within 500-1,000 feet (count)	380	377	385	396
Environmental Justice Concerns (EJC)	communities with EJ concerns crossed by the 150-ft ROW (count)	6	5	7	7
Land-Based Economies	Agricultural land in 150-ft ROW (acres)	1,260	1,302	1,298	1,325
Archaeology and Historic Architecture	Archaeological sites and historic architectural resources in 1,000-foot route width (count)	42	43	41	37

Resource	Element	Applicants' Proposed Route	Applicants' Proposed Route with Modifications	Example Route Option 1	Example Route Option 2
Water Resources	NHD stream crossings (count)	151	150	150	134
	PWI stream crossings (count)	82	79	79	59
	Impaired stream crossings (count)	46	46	46	28
	NHD lake crossings (count)	20	15	18	21
	Impaired lake crossings (count)	0	1	1	1
	PWI basin crossings (count)	9	14	16	15
	PWI wetland crossings (count)	10	7	7	6
	Total wetlands in 150-foot ROW (acres)	986	957	968	926
	Forested wetlands in 150-ft ROW (acres)	235	223	233	218
	Wetland crossings greater than 1,000 feet (count)	67	64	65	62
Vegetation	Forested landcover in 150-foot ROW (acres)	590	551	472	476
Wildlife	Wildlife Management Areas in 150-foot ROW (acres)	14	18	5	5
	Grassland Bird Conservation Areas in 150-foot ROW (acres)	1,241	1,241	1,241	1,252
	Shallow Wildlife Lake in 150-foot ROW (acres)	6	6	6	6

Resource	Element	Applicants' Proposed Route	Applicants' Proposed Route with Modifications	Example Route Option 1	Example Route Option 2
Rare and Unique Natural Resources	Sites of Biodiversity in 150-foot ROW (ranked moderate, high, or outstanding; acres)	954	914	743	735
	Native plant communities in 150-foot ROW (acres)	293	275	276	271
	High Conservation Value Forest in 150-foot ROW (acres)	124	124	33	33
	Lake of Biological Significance in 150-foot ROW (acres)	2	5	5	5
	Federal- or state-protected species documented in 150-foot ROW (count)	3	3	3	3
ROW Sharing and Paralleling	Transmission line (miles, percent)	159.3 (87)	166.7 (92)	167.8 (95)	160.0 (89)
	Roadway (miles, percent)	4.0 (2)	4.0 (2)	3.9 (2)	13.3 (7)
	Field, parcel, or section lines (miles, percent)	55.0 (30)	48.1 (27)	44.4 (25)	52.7 (29)
	Total ROW sharing and paralleling (miles, percent)	176.4 (97)	177.0 (98)	174.2 (98)	175.0 (98)
Estimated Cost	Total estimated cost (2022 dollars in millions)	$963	$980	$1,013 to $1,053	$1,035 to $1,075

Human Settlements

Potential project impacts on human settlements are assessed through an evaluation of several elements, including noise, property values, electronic interference, cultural values, zoning and land-use compatibility, and public services. For some of the human settlement elements, project impacts are anticipated to be minimal and independent of the route selected. Analysis of impacts to human settlements focuses on those elements that vary with the route selected – aesthetics, displacement, and communities with EJC.

Aesthetics

Aesthetic impacts differ only slightly among the full route options; impacts can be minimized by placing the transmission line away from residences and by following existing infrastructure and ROW. Proximity of residences to the applicants' proposed routes and full route options are shown in Table S-3 and depicted graphically in Figure S-1, while ROW paralleling and sharing are shown in Table S-4 and depicted graphically in Figure S-2.

Each of the four full routes would have similar aesthetic impacts based on the project's proximity to residences. The applicants' proposed route is near the fewest number of residences; example route option 2 is near the greatest number of residences. Each of the full route options minimizes aesthetic impacts by paralleling and/or sharing existing ROW for between 97 and 98 percent of the route. However, considering the amount of each route that would follow existing transmission lines, example route option 1 likely best minimizes aesthetic impacts because 95 percent of this route follows existing transmission lines.

Table S-3 Proximity of Residences to Applicants' Proposed Routes and Example Full Route Options

Residences, Distance from Anticipated Alignment	Applicants' Proposed Route	Applicants' Proposed Route with Modifications	Example Route Option 1	Example Route Option 2
Residences within 0-75 feet	3	3	2	3
Residences within 75-250 feet	102	111	109	117
Residences within 250-500 feet	164	172	194	209
Residences within 500-1,000 feet	380	377	385	396
Total Residences within 1,000 feet	649	662	690	725

Figure S-1 Proximity of Residences to the Applicants' Proposed Routes and Example Full Route Options

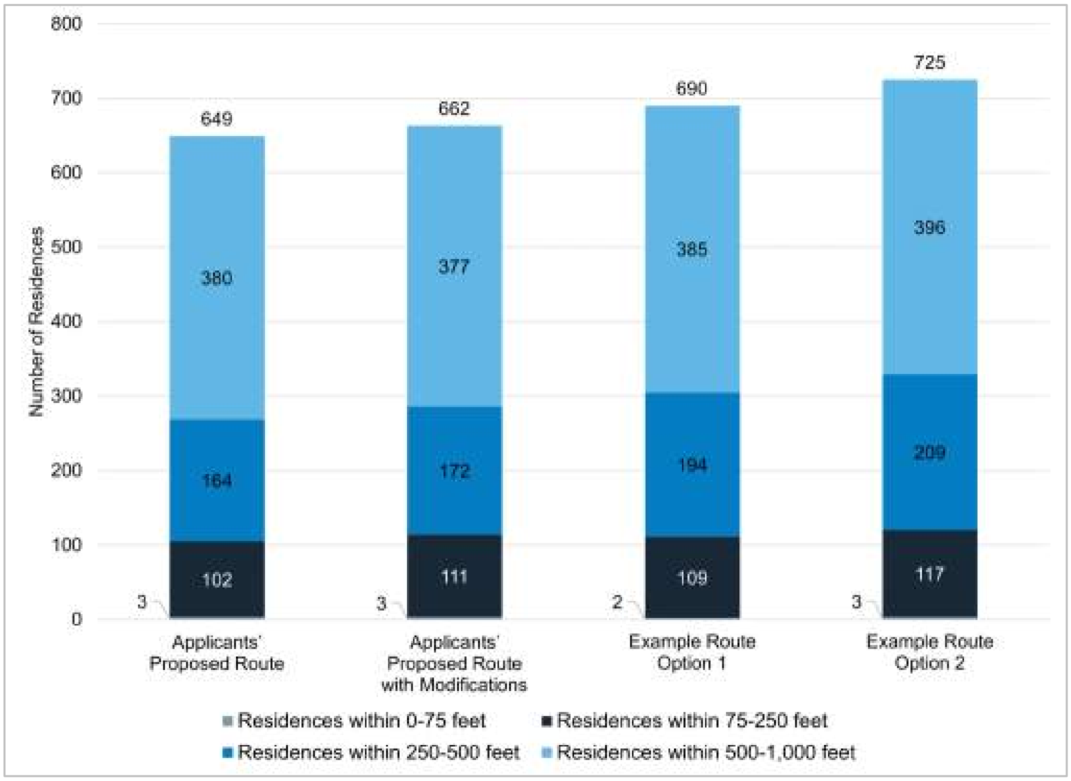
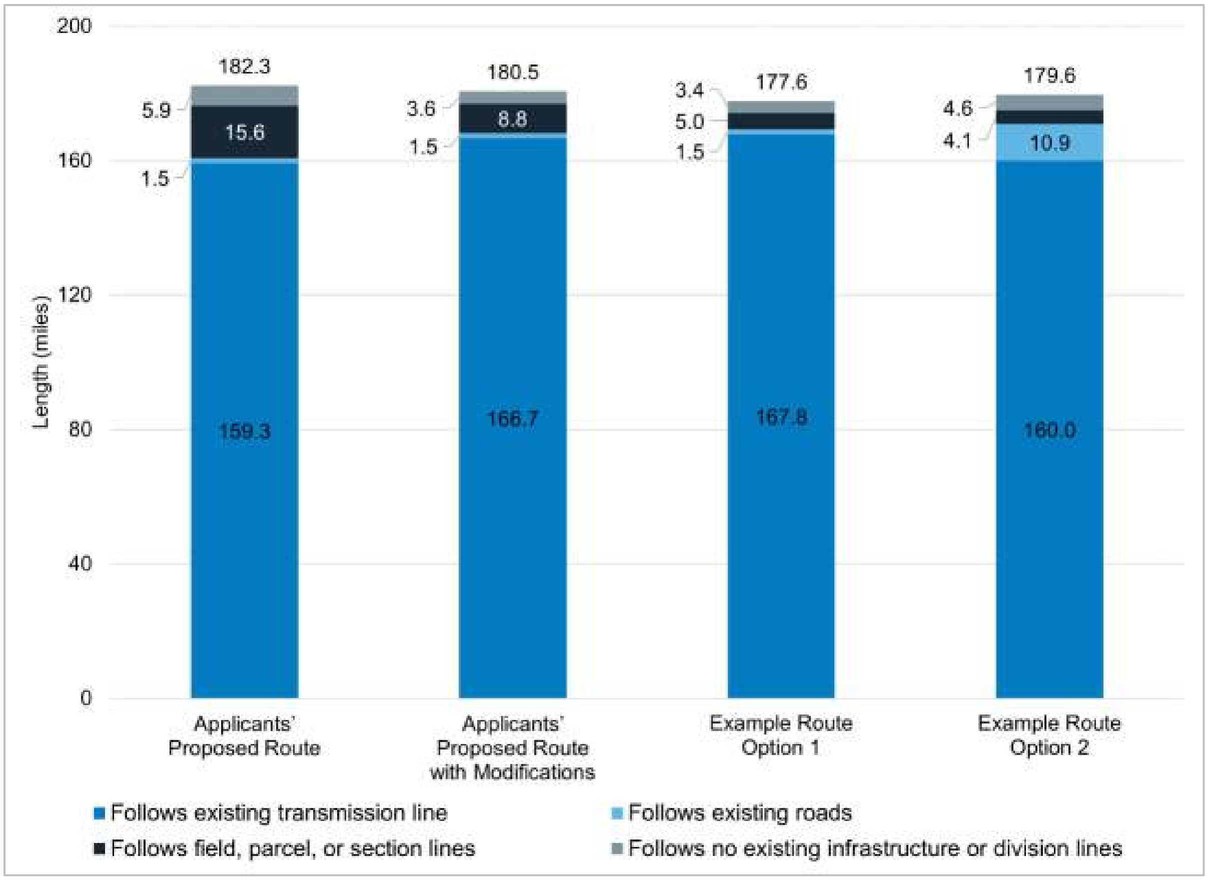


Table S-4 ROW Paralleling and Sharing of Applicants' Proposed Routes and Example Full Route Options

Infrastructure	Applicants' Proposed Route miles (percent)	Applicants' Proposed Route with Modifications miles (percent)	Example Route Option 1 miles (percent)	Example Route Option 2 miles (percent)
Follows Existing Railroad	1.0 (1)	1.0 (1)	1.0 (1)	1.0 (1)
Follows Existing Roads	4.0 (2)	4.0 (2)	3.9 (2)	13.3 (7)
Follows Existing Transmission Line	159.3 (87)	166.7 (92)	167.8 (95)	160.0 (89)
Total – Follows Transmission Line, Road, or Railroad	160.8 (88)	168.2 (93)	169.2 (95)	170.9 (95)
Follows Field, Parcel, or Section Lines	55.0 (30.2)	48.1 (26.6)	44.4 (25)	52.7 (29)
Total – ROW Paralleling and Sharing	176.4 (97)	177.0 (98)	174.2 (98)	175.0 (98)
Total Length of Route Alternative	182.3	180.5	177.6	179.6

Portions may share or parallel more than one type of infrastructure ROW or division/boundary line; therefore, the sum may be greater than 100 percent.

Figure S-2 **ROW Sharing and Paralleling - Applicants' Proposed Routes and Example Full Route Options**



Displacement

Residences or other buildings are typically not allowed within the transmission line ROW for electrical safety code and maintenance reasons. Any residences or other buildings located within a proposed ROW are, therefore, generally relocated or displaced.

The applicants' proposed route, proposed route with modifications, and example route option 2 may each result in the potential displacement of three residences, while example route option 1 may result in the potential displacement of two residences. In addition, each of these full routes could result in the potential displacement of several non-residential buildings (i.e., storage sheds, agricultural outbuildings, etc.) located within the 150-foot ROW (Table S-5).

Table S-5 Proximity of Residences and Non-Residences to Applicants' Proposed Routes and Example Full Route Options

Residences and Non-Residences, Distance from Anticipated Alignment	Applicants' Proposed Route	Applicants' Proposed Route with Modifications	Example Route Option 1	Example Route Option 2
Residences within 0-75 feet	3	3	2	3
Non-Residences within 0-75 feet	14	13	11	14
Total Residences and Non-Residences within 75 feet	17	16	13	17

Non-residential buildings within the 150-foot ROW may or may not be displaced as a result of the project. Though buildings are generally not allowed within the ROW of a transmission line, there are instances where the activities taking place in these buildings are compatible with the safe operation of the line (e.g., storage, animal production, etc.). For all residences and buildings in the ROW, the applicants would need to conduct a site-specific analysis to determine if the residence or building would be displaced.

Environmental Justice

Utility infrastructure can adversely impact low-income, minority, or tribal populations (communities with EJCs). Each of the full route options would cross several communities with EJCs (Table S-2). However, no adverse or permanent impacts to the identified communities with EJCs are anticipated. While each of the full routes included in this analysis intersect EJC communities, they are not anticipated to experience disproportionately adverse impacts as a result of the project, particularly because the transmission line will parallel and/or share existing ROW for the majority of these full route options (97 to 98 percent).

Land-Based Economies

Potential impacts to land-based economies are assessed through several elements. It addresses those elements of land-based economies that vary with the route selected – agricultural, forestry, mining, and recreation and tourism resources.

Agriculture

Impacts to agricultural land in the 150-foot ROW of the full route options would be relatively similar (Table S-2). The applicants' proposed route has the least amount of agricultural land within the ROW, totaling 1,260 acres (38 percent) (Table S-2). In contrast, example route option 2 has the most agricultural land within the ROW, with 1,325 acres (41 percent), representing a difference of approximately 65 acres (Table S-2).

Forestry

Impacts to designated forestry resources in the 150-foot ROW of the full route options would be relatively similar (Table S-2). Forestry land within the ROW of these options ranges between 472 acres (example route option 1) to 590 acres (applicants' proposed route).

There are designated forestry resources in the form of Minnesota Department of Natural Resources (DNR) state forest, Minnesota School Trust Land, and Forest for the Future land within the ROW of the full route options (Table S-6). The ROW of example route option 2 contains the fewest designated forestry resources (328 acres), while the applicants' proposed route with modifications contains the most (427 acres).

Table S-6 Designated Forestry Resources Within the 150-foot ROW of Applicants' Proposed Routes and Example Full Route Options

Forestry Acreage	Applicants' Proposed Route	Applicants' Proposed Route with Modifications	Example Route Option 1	Example Route Option 2
Acres of DNR state forest within 150-foot ROW	258	264	206	188
Acres of Minnesota School Trust Land[1] within 150-foot ROW	137	144	123	104
Acres of Forests for the Future[2] land within 150-foot ROW	19	19	32	36
Total Acreage	414	427	361	328

Data Sources: references (3); (4)

1 Minnesota School Trust Lands are DNR-administered lands that are set aside to provide a continual source of funding for public education (reference (4).

2 Minnesota's Forests for the Future Program is a conservation program administered by the DNR to encourage the protection of privately-owned forest lands through conservation easements or land purchases (reference (5)).

New transmission line construction through forested lands would be required for all full route options; however, example route option 1 minimizes forestry impacts most effectively by having the least amount of forested lands in its ROW. Example route option 1 also shares the most ROW with existing roadway and transmission line infrastructure (97 percent) (Table S-2). In areas of ROW paralleling and sharing, impacts to forestry resource lands have already occurred. Placement of transmission infrastructure in these locations may increase areas of forestry impact but would not introduce new impacts to an otherwise undisturbed forested setting.

Mining

Potential effects on mining operations are likely to occur if the construction or operation of a transmission line prevents access to and recovery of resources. The construction of a transmission line could limit the ability to mine these resources depending on the proximity of the resources to the project route selected.

There are no mining resources in the vicinity of the applicants' proposed route or the applicants' proposed route with modifications. Example route options 1 and 2 each have the same two aggregate mines located in their ROW, though both routes would follow an existing transmission line ROW through one of these aggregate mines, minimizing the introduction of new impacts.

Recreation and Tourism

Recreation and tourism opportunities in the project vicinity primarily consist of scenic byways, state forests, Wildlife Management Areas (WMAs), off-road vehicle trails, snowmobile trails, and water trails. Each full route option contains recreation and tourism opportunities. Compared to example route options 1 and 2, the applicants' proposed route and applicants' proposed route with modifications have the following additional recreational resources in their rights-of-way: two scenic byways, two state forests, two WMAs, eight off-road vehicle trails, one snowmobile trail, and one water trail (Table S-7).

Table S-7 Recreational Resources Crossed by the 150-foot ROW of Applicants' Proposed Routes and Example Full Route Options

Route	Applicants' Proposed Route	Applicants' Proposed Route with Modifications	Example Route Option 1	Example Route Option 2
Scenic byways crossings (count)	4	4	2	2
State forest crossings (count)	6	6	4	4
WMA crossings (count)	2	2	0	0
Off-road vehicle trail crossings (count)	13	13	5	5
Snowmobile trail crossings (count)	8	8	7	7
Water trail crossings (count)	2	2	1	1

Example route options 1 and 2, as well as the applicants' proposed route with modifications, would each cross through a portion of the Cuyuna Country State Recreation Area. However, example route options 1 and 2 would cross this recreation area within existing transmission line ROW in an area of double-circuiting. An additional 80 feet of ROW from within the Cuyuna Country State Recreation Area would be needed to accommodate the double-circuiting and placement of the route through this area. As a result, only minor impacts to the Cuyuna Country State Recreation Area are anticipated. The applicants' proposed route with modifications would cross this recreation area parallel to existing road ROW at the far eastern edge of the recreation area and outside of the area used for recreation.

Since transmission line construction and operation generally has minimal permanent and temporary impacts to trails and introduction of new impacts would be minimized to the extent possible by ROW sharing and paralleling, recreation and tourism impacts as a result of the project are expected to be minimal. This said, example route options 1 and 2 are the most likely to minimize the project's impacts on recreation and tourism in the area.

Archaeological and Historic Resources

Between 37 and 43 archaeological and historic architectural resources are located within the 1,000-foot route width of the full route options (Table S-2). These resources are further classified in Table S-8. Most of these cultural resources have been previously determined to be ineligible for the National Register of Historic Places (NRHP) and therefore no additional work related to these cultural resources would be required for the project to proceed, regardless of which route is selected. However, the project has the potential to adversely affect those cultural resources that have not been evaluated for the NRHP, or which are listed on or have been determined eligible for listing on the NRHP (i.e., significant cultural resources).

Table S-8 Summary of Archaeological and Historic Architectural Resources within the 1,000-foot Route Width of Applicants' Proposed Route and Example Full Route Options

	Applicants' Proposed Route	Applicants' Proposed Route with Modifications	Example Route Option 1	Example Route Option 2
Count of NRHP-listed or -eligible Resources	5	5	6	6
Count of Unevaluated Cultural Resources	19	19	16	15
Count of Resources Previously Determined Not Eligible for NRHP	18	19	19	16

While the overall counts of cultural resource types are similar across all full route options, example route options 1 and 2 have less impact on archaeological and historic architectural resources. This is due to their use of existing infrastructure in proximity to significant cultural resources.

Of the significant cultural resources located within the route width of the applicants' proposed route and the applicants' proposed route with modifications, three NRHP-listed/-eligible historic architectural resources (XX-RRD-NPR007/ XX-RRD-NPR021, and CW-XXX-00001) have the potential for project impacts. Resource XX-RRD-NPR007/ XX-RRD-NPR021 consists of a duplicate recording of railroad ROW between the Lake Superior and Mississippi (LS&M)/ St. Paul and Duluth (StP & D) main line at Carlton and ND State Line at Moorhead, and resource CW-XXX-00001 consists of the Cuyuna Iron Range Historic Mining Landscape District. The applicants' proposed route would cross each of these resources in a brand-new location, which may alter these resource's setting, feeling, appearance, and/or association. Where example route options 1 and 2 cross these resources, the crossing occurs where an existing transmission line is present. Due to paralleling an existing transmission line, example route options 1 and 2 do not have the potential to introduce new impacts to the resources' setting, feeling, appearance, and/or association.

SH-BK-00012 (listed in the NRHP) and XX-RRD-00001 (eligible for the NRHP) would not be adversely affected by the project regardless of the route selected because these resources are located in an area that consists of double-circuiting on an existing transmission line. As a result, no new impacts to these cultural resources are anticipated because no new ROW would be acquired, nor would new visual or other impacts be introduced as a result of the project because the transmission line in proximity to these resources is existing.

Archaeological sites that are not evaluated or are listed in or eligible for the NRHP may also be impacted by the project if any of these sites are present within the footprint of ground disturbance. Ground disturbing activities have the potential to impact these resources if they cannot be avoided by the project. The primary means to minimize impacts to archaeological and historic architectural resources is prudent routing or structure placement – (i.e., avoiding known archaeological and historic resources). If they cannot be avoided, impacts to these resources could be mitigated by measures developed in consultation with State Historic Preservation Office (SHPO) prior to construction.

Natural Environment

Potential impacts to the natural environment are assessed by looking at several specific elements. For some of the elements of the natural environment, project impacts are anticipated to be minimal and independent of the route selected and therefore are not discussed in the following sections. This section addresses those elements that do vary with the route selected – water resources, vegetation, and wildlife.

Water Resources

Impacts to floodplains and groundwater are anticipated to be minimal and independent of the route selected for the project. This discussion addresses watercourses and waterbodies, and wetlands.

Watercourses and Waterbodies

Each of the full route options would cross streams and waterbodies, as summarized in Table S-2. Example route option 2 minimizes stream crossings, including NHD streams, impaired streams, and public waters inventory (PWI) streams. However, the difference in stream crossings between example route option 2 and the other three full route options stems from the J1 route alternative in the Benton County Elk River region (which is part of example route option 2) being located in a new transmission line ROW west of the Elk River, while the other three full routes would use the applicants' equivalent to parallel an existing transmission line ROW while crossing the Elk River multiple times.

The applicants' equivalent in the Benton County Elk River region would cross the Elk River 26 times; this count is high due to the meandering nature of the Elk River. Waterbody crossings would be relatively comparable across each of the full route options. However, the applicants' proposed route with modifications would have fewer NHD lake crossings than the other three routes. The applicants' proposed route would have fewer PWI basin crossings but more PWI wetland crossings than the other three routes.

Wetlands

Wetlands within the rights-of-way of the full route options consist of emergent wetlands, forested wetlands, and shrub-dominated wetlands. The applicants' proposed route has the most acres of wetland (986 acres) and forested wetland (235 acres) within its 150-foot ROW, while example route option 2 has the least acres of wetland (926 acres) and forested wetland (218 acres) (Table S-2). Although wetlands would be spanned to the extent possible, each of the full route options would cross between 62 (example route option 2) and 67 (applicants' proposed route) wetland areas wider than 1,000 feet, which may require one or more structures to be placed in a wetland (Table S-2).

Vegetation

Each of the full route options would impact forested vegetation within their 150-foot ROW. Impacts to forested vegetation would be minimized with example route option 1 (472 acres) and example route option 2 (476 acres; Table S-2). The applicants' proposed route would impact 590 acres of forested vegetation in its ROW, while the applicants' proposed route with modifications would impact 551 acres of forested vegetation in its ROW (Table S-2). Each of the full route options would minimize impacts associated with forest fragmentation by following existing transmission line and/or road rights-of-way for the majority of their length (Table S-2).

Wildlife

Impacts to wildlife habitat would be relatively comparable for the full route options in that they would all cross WMAs, Grassland Bird Conservation Areas (GBCA), and a DNR-identified shallow wildlife lake. The applicants' proposed route and the applicants' proposed route with modifications would cross the edge of the Birchdale and Moose Willow WMAs, while example route options 1 and 2 would only cross solely the edge of the Birchdale WMA. Example route option 2 would cross slightly more acres of GBCA than the other routes (Table S-2). Each of the full route options would minimize impacts associated with habitat fragmentation by following existing transmission line and/or road rights-of-way for the majority of their length (Table S-2).

Rare and Unique Natural Resources

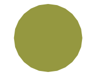
Based on data reviewed from the Natural Heritage Inventory System (NHIS) database, there are no differences among the full route options with respect to documented federal- or state-protected species. Each of the full route options have one documented federally protected species (the northern long eared bat) and the same 15 state protected species documented within 1 mile of them. In addition, three of the 15 state protected species, including the loggerhead shrike, Blanding's turtle, and rock sandwort, have also been documented within the 150-foot ROW of each full route option. Potential impacts to these species can be mitigated by incorporating species-specific Best Management Practices (BMPs).

Each of the full route options would intersect several DNR Sites of Biodiversity Significance (SBS), with example route options 1 and 2 intersecting approximately 200 acres less than the applicants' proposed route and the applicants' proposed route with modifications (Table S-2). Each of the full route options would intersect native plant communities, with the applicants' proposed route intersecting slightly more than the other routes (Table S-2). Each of the full route options would also intersect High Conservation Value Forest, with example route options 1 and 2 intersecting approximately 90 fewer acres. All four full route options would intersect Lakes of Biological Significance while paralleling an existing transmission line ROW. The applicants' proposed route would traverse approximately 2 acres of one Lake of Biological Significance, while the other three routes would traverse approximately 5 acres of two Lakes of Biological Significance (Table S-2).

Relative Merits Summary

This discussion and presentation rely on text and a color graphic to describe the relative merits of the full route options (Table S-9). The color graphic and related notes for a specific routing factor or element are not meant to be indicative of the best route for the project but are provided as a relative comparison to be evaluated together with all other routing factors. For example, routes that are "red" for a particular factor or element are not meant to indicate a fatal flaw with a specific full route option. For routing factors where impacts are anticipated to vary with the full route options, the graphic represents the magnitude of anticipated difference between these anticipated impacts and compares them across the four full route options. For routing factors that express the state of Minnesota's interest in the efficient use of resources (e.g., the use and paralleling of existing rights-of-way), the graphic represents the consistency of the full route options with these interests and compares them to one another.

Table S-9 Guide to Relative Merits of the Applicants’ Proposed Routes and Example Full Route Options

Anticipated Impacts or Consistency with Routing Factor	Symbol
Minimal: Impacts are anticipated to be minimal with mitigation – OR – route option is very consistent with this routing factor.	
Moderate: Impacts are anticipated to be minimal to moderate with mitigation; special permit conditions may be required for mitigation – OR – route alternative is very consistent with the routing factor, but less so than other route alternatives. Indicates that this route option may not be the least impactful with respect to this routing factor.	
Significant: Impacts are anticipated to be moderate to significant and likely unable to be mitigated – OR – route alternative is not consistent with the routing factor or consistent only in part. Indicates that this route option has notably more impacts with respect to this routing factor than other route options.	

Relative merits of the full route options for all routing factors / elements for which impacts are anticipated to vary among route options are shown and discussed in Table S-10.

Table S-10 Relative Merits of Applicants' Proposed Routes and Example Full Route Options

Routing Factor/Resource	Applicants' Proposed Route	Applicants' Proposed Route with Modifications	Example Route Option 1	Example Route Option 2	Summary
Human Settlement – Aesthetics	◒	●	●	◒	Each of the four full routes would have similar aesthetic impacts based on proximity to residences. The applicants' proposed route is near the fewest number of residences; example route option 2 is near the greatest number of residences. Route option 1 uses the most existing transmission line ROW (95 percent), while the applicants' proposed route with modifications is second with 92 percent. Route option 2 and the applicants' proposed route each use less than 90 percent of existing transmission line ROW (89 percent and 87 percent, respectively).
Human Settlement – Displacement	◒	◒	●	◒	Route option 1 has the fewest residences and non-residences within the 150-foot ROW (2 residences and 11 non-residences). The other three full route options each have 3 residences and between 13 and 14 non-residences within the 150-foot ROW. As such, route option 1 best minimizes displacement.
Human Settlement – Environmental Justice Concerns	◒	●	◒	◒	The applicants' proposed route with modifications would only cross five EJ communities, where the other route options would cross six to seven EJ communities. However, since these full route examples mostly follow existing transmission line ROW, these EJ communities should not be adversely or disproportionately affected by the project and differences are marginal.
Land-Based Economies – Agriculture	◒	◒	◒	◒	There is only a difference of approximately 65 acres of agricultural land between each of the full route options. Impacts would be similar regardless of the route selected.
Land-Based Economies – Forestry	◒	◒	●	◒	Route option 1 minimizes forestry impacts by having the least amount of forested lands in its ROW and by sharing the most ROW with existing roadway and transmission line infrastructure (97 percent).

Routing Factor/Resource	Applicants' Proposed Route	Applicants' Proposed Route with Modifications	Example Route Option 1	Example Route Option 2	Summary
Land-Based Economies – Mining					Route options 1 and 2 have two aggregate mines within their rights-of-way; the applicants' proposed route and the applicants' proposed route with modifications do not. Impacts to the aggregate mines likely can be mitigated; thus, differences between the route options are marginal.
Land-Based Economies – Recreation and Tourism					The applicants' proposed route and applicants' proposed route with modifications have the following additional recreational resources in their rights-of-way compared to the route options 1 and 2: two scenic byways, two state forests, two Wildlife Management Areas (WMAs), eight off-road vehicle trails, one snowmobile trail, and one water trail. Example route options 1 and 2 would each require new ROW within the boundaries of the Cuyuna Country State Recreation Area.
Archaeological and Historic Architectural Resources					The applicants' proposed route and the applicants' proposed route with modifications would both cross significant cultural resources in an area of new ROW, where route options 1 and 2 would cross these same resources using existing transmission line ROW. Otherwise, counts of cultural resources are similar across each full route option.
Natural Environment – Watercourses and Waterbodies					Route option 2 would have the least number of stream crossings. However, it should be noted that the difference in stream crossings between route option 2 and the other three route options stems from the J1 route alternative in the Benton County Elk River region (which is part of example route option 2) being located in a new transmission line ROW west of the Elk River. In contrast, the other three full route options would use the applicants' equivalent to parallel an existing transmission line ROW while crossing a meandering section of the Elk River multiple times. The applicants' proposed route would avoid crossing an impaired lake and would have the least number of PWI basin crossings but would have the most PWI wetland crossings.
Natural Environment – Wetlands					The ROW of route option 2 has the least acres of wetland, including forested wetland.

Routing Factor/Resource	Applicants' Proposed Route	Applicants' Proposed Route with Modifications	Example Route Option 1	Example Route Option 2	Summary
Natural Environment – Vegetation	◒	◒	●	●	Route options 1 and 2 would have less impact on forested vegetation.
Natural Environment – Wildlife	◒	◒	●	◒	Route option 1 minimizes impacts to wildlife and associated habitat by avoiding the Moose Lake WMA.
Rare and Unique Natural Resources	◒	◒	●	●	Route options 1 and 2 minimize impacts to Sites of Biodiversity Significance and High Conservation Value Forests.
Use or Paralleling of Existing ROW	◒	●	●	◒	Total ROW paralleling and sharing is nearly equal across all route options. There is some variation in the paralleling of existing transmission line rights-of-way. Route option 1 uses the most existing transmission line ROW (95 percent), while the applicants' proposed route with modifications is second with 92 percent. Route option 2 and the applicants' proposed route each use less than 90 percent of existing transmission line rights-of-way (89 percent and 87 percent, respectively).
Costs Dependent on Design and Route (2022 dollars in millions)	$963.7	$980.4	$1,013 to $1,053	$1,035 to $1,075	The applicants' proposed route is the least expensive, while example route option 2 is the most expensive. Factors affecting cost include double-circuiting long sections of transmission line in route options 1 and 2 as well as specialty structures that would be required near the Hill City/Quadna Mountain airport.

1 Introduction

This environmental assessment (EA) has been prepared for the Northland Reliability Project (the project), a 345 kilovolt (kV) double-circuit transmission line proposed by Minnesota Power and Great River Energy (GRE) (together, the applicants). This EA evaluates the potential human and environmental impacts of the project and possible mitigation measures, including route and alignment alternatives.

This EA is not a decision-making document, but rather a guide for decision-makers. The EA is intended to facilitate informed decisions by state agencies, particularly with respect to the goals of the Minnesota Environmental Policy Act "to create and maintain conditions under which human beings and nature can exist in productive harmony and fulfill the social, economic, and other requirements of present and future generations of the state's people" (Minn. Statute 116D.02).

1.1 Purpose and Need

The project is needed to address transmission system reliability concerns in northern and central Minnesota related to the region's transition away from coal-fired generation. During the transition from coal-fired to renewable generation, the project would increase transmission capabilities and access to renewable generation in the Upper Midwest. Reliability issues have been analyzed for a decade and include regional voltage and transient stability issues identified by the applicants and the Midcontinent Independent System Operator (MISO). The project addresses the region's reliability issues and would provide voltage support, improve system strength, and provide 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 by MISO's Board of Directors in July 2022 in its annual MISO Transmission Expansion Plan 2021 (MTEP21) report (reference (2)). 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.

1.2 Project Description

The project includes the construction of approximately 180 miles of double-circuit 345 kV transmission line across Aitkin, Benton, Cass, Crow Wing, Itasca, Morrison, and Sherburne Counties (Map 1-1). The project consists of two major segments and makes use of existing high-voltage transmission lines and other right-of-way (ROW). The two major segments include:

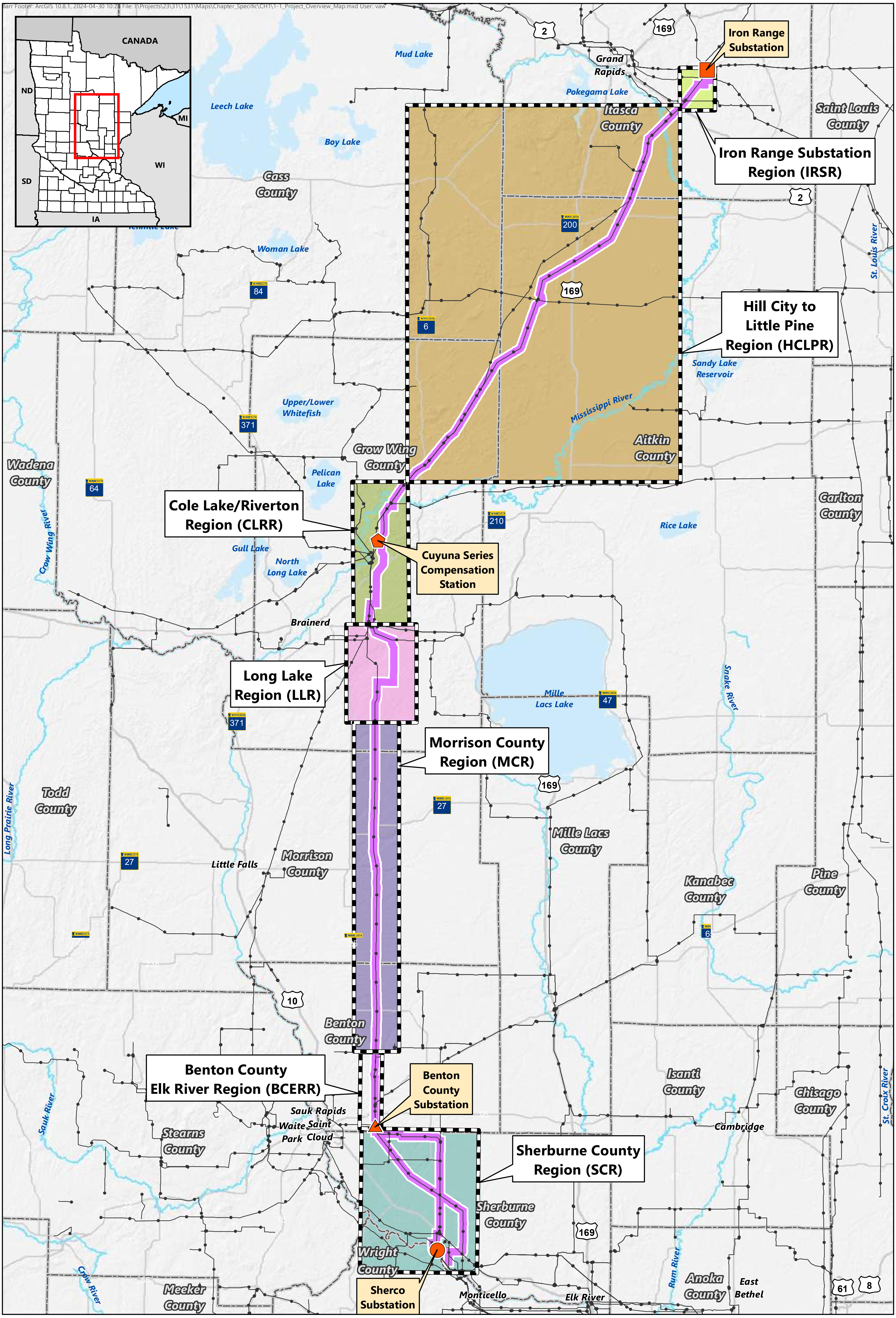
- Segment 1: construct a new, approximately 140-mile-long, double-circuit 345 kV transmission line connecting Minnesota Power's existing Iron Range Substation, a new Cuyuna Series Compensation Station, and GRE's existing Benton County Substation. The proposed double-circuit 345 kV transmission line in Segment 1 would generally be located near and utilize existing high-voltage transmission line and other ROW where feasible.

- Segment 2: replace existing high-voltage transmission lines.

    - Replace GRE's existing, approximately 20-mile, 230 kV transmission line with a new, approximately 24-mile, double-circuit 345 kV transmission line from GRE's existing

Benton County Substation to the new Xcel Energy Big Oaks Substation, generally within existing ROW.

- Replace GRE's existing, approximately 20-mile, 345 kV transmission line with a new, approximately 18-mile, double-circuit 345 kV transmission line structures from GRE's existing Benton County Substation to Xcel Energy's existing Sherco Substation, generally within existing ROW. This transmission line will be constructed as a single-circuit 345 kV transmission line on double-circuit structures built to accommodate a second 345 kV circuit in the future.



Applicants' Proposed Route
Regions of Analysis
Existing Transmission Line
Benton County Substation
Iron Range Substation
Sherco Substation
Cuyuna Series Compensation Station

0 5 10 15
Miles

Map 1-1

PROJECT OVERVIEW MAP
Northland Reliability Project

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

- Expansion of the existing Iron Range Substation, near Grand Rapids, expansion of the existing Benton County Substation, near St. Cloud, and rerouting existing transmission lines at the Iron Range and Benton County substations.
- Construction of a new Cuyuna Series Compensation Station near the existing Riverton Substation and rerouting an existing transmission line in the Riverton area.

The applicants 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. GRE 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.

The applicants' proposed route 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 rights-of-way rather than creating new ones. Locating the project along existing transmission line rights-of-way minimizes the potential impact of the project.

1.3 State of Minnesota's Role

Though MISO is charged with ensuring reliable, low-cost electrical energy throughout the mid-continent of North America, and though it may review and approve projects, it is ultimately the state of Minnesota that determines whether specific transmission lines are needed by the state and, if so, where they should be located. This authority is vested in the Minnesota Public Utilities Commission (Commission). Thus, even though a project may be approved by MISO, it is the Commission that determines whether a project is built, and where it will be constructed.

The project must obtain two approvals from the Commission – a certificate of need (CN) and a route permit. The project also requires approvals (e.g., permits, licenses) from other state agencies and federal agencies with permitting authority for specific resources (e.g., the waters of Minnesota). A route permit supersedes and preempts zoning restrictions, building, and land-use regulations promulgated by local units of government (Minn. Statute 216E.10).

The applicants applied to the Commission for a CN and route permit for the project on August 4, 2023. With this application, the Commission has before it two distinct considerations: (1) whether the proposed project is needed or whether some other project would be more appropriate for the state of Minnesota (e.g., a project of a different type or size, or a project that is not needed until further into the future), and (2) if the proposed project is needed, where it is best located.

The state of Minnesota has established an administrative procedural framework to guide and support Commission decision-making that upholds a fair and rigorous exploration of the issues at hand. This process requires: (1) the development of an EA and (2) public hearings before an administrative law judge. The goal of the EA is to describe the potential human and environmental impacts of the project ("the facts"); the goal of the hearings is to advocate, question, and debate what the Commission should decide about the project ("what the facts mean"). The entire record developed in this process—the EA and the report from the administrative law judge, including all public input and testimony—is considered by the Commission when it makes its decisions on the applicants' CN and route permit applications.

1.4 Organization of Environmental Assessment

This EA is based on the applicants' joint CN and route permit application, public comments received during the scoping comment period for this EA, and input from the Commission. The project has been separated into regions for analysis and discussion purposes (Map 1-1). These regions and the applicants' proposed route are described in more detail in Chapter 3.This EA addresses the matters identified in the project scoping decision (Appendix A) and is organized as follows:

	Summary	Provides a summary of the project – its potential impacts and possible mitigation measures
Chapter 1	Introduction	Provides an overview of the stated project need, the project itself, and the state of Minnesota's role, and discusses the organization of the document.
Chapter 2	Regulatory Framework	Describes the regulatory framework associated with the project, including the state of Minnesota's certificate of need and route permitting processes, the environmental review process, and the permits and approvals that would be required for the project.
Chapter 3	Overview of Project and Routing Alternatives	Describes the project and regions, including possible routes and alignment alternatives. Chapter 3 also describes the engineering, design, and construction of the project.
Chapter 4	Alternatives to the Proposed Project	Discusses the feasibility, availability, and potential impacts of system alternatives (i.e., alternatives other than a double-circuit 345 kV transmission line that may meet the stated need for the project).
Chapter 5	Affected Environment, Potential Impacts, and Mitigation Measures	Discusses the resources in the project area and the potential human and environmental impacts of the project and identifies measures that could be implemented to avoid or mitigate potential impacts. Chapter 5 discusses those impacts and mitigation measures that are common to all of the route and alignment alternatives studied in the EA. Also included is a discussion of the potential cumulative effects of the project.
Chapter 6	Impacts and Mitigation Measures by Region	Analyzes the potential human and environmental impacts of routing alternatives by region and possible mitigation measures.
Chapter 7	Relative Merits of the Project as a Whole	Discusses the merits of the applicants' proposed route, a modified version of the applicants' proposed route, and other example end-to-end routes, relative to the routing factors of Minnesota Rule 7850.4100.
	References	Provides references for resources used in development of the EA.

1.5 Sources of Information

The primary EA information sources are the joint CN and route permit application submitted by the applicants. Additional sources of information are indicated in Chapter 8. Data provided by the applicants and from state agencies during the preparation of the EA is also included.

A number of spatial data sources, which describe the resources in the project area, were used in preparing this EA (Appendix B). Spatial data from these sources can be imported into geographic information system (GIS) software, where the data can be analyzed and potential impacts of the project and routing alternatives quantified (e.g., acres of forested wetlands within the anticipated project ROW).

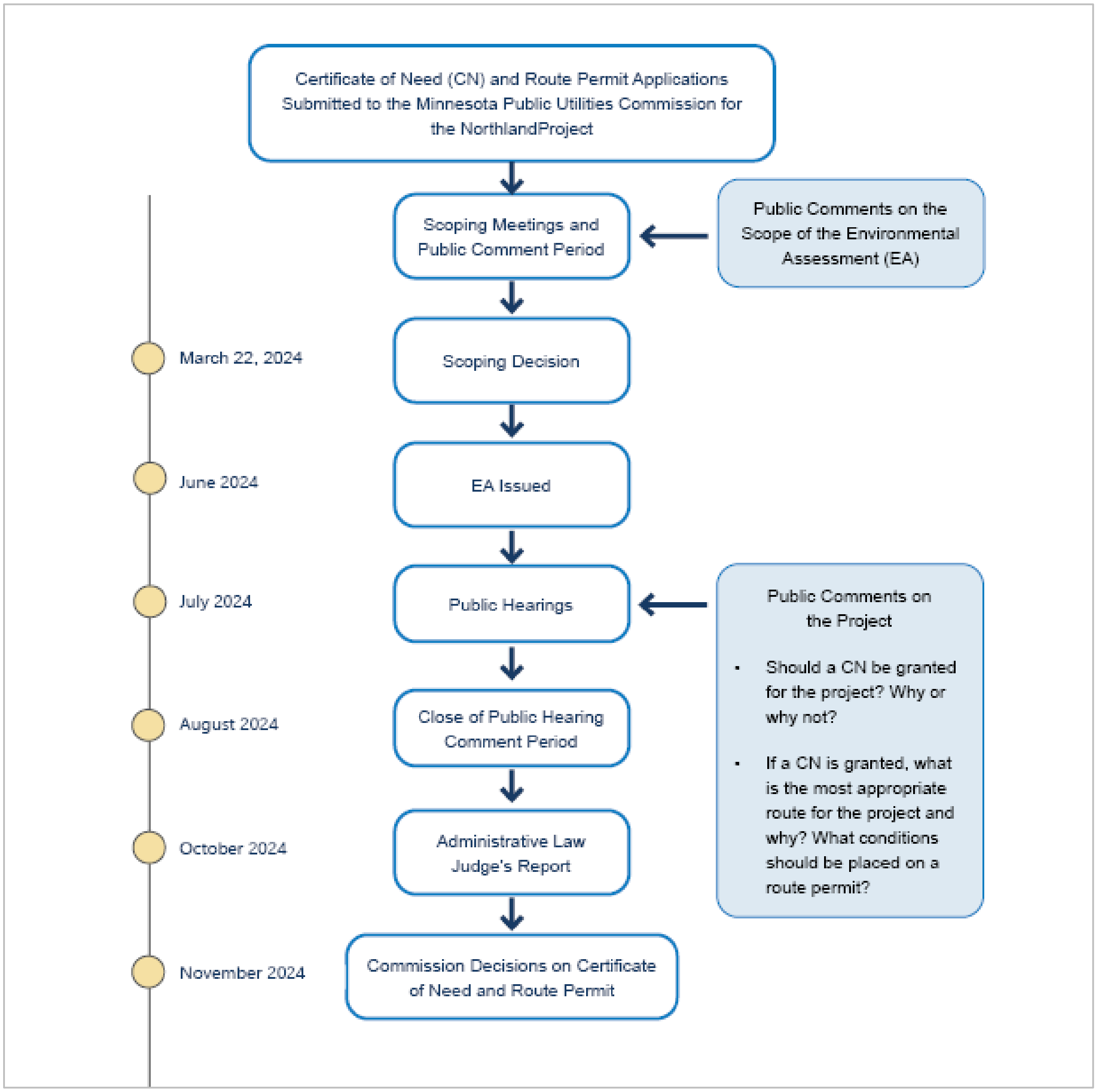
2 Regulatory Framework

The project requires two approvals from the Commission – a CN and a route permit. The Department of Commerce, Energy Environmental Review and Analysis (EERA) is responsible for environmental review of the project. The project will also require approvals from other state and federal agencies with permitting authority over related actions.

2.1 Certificate of Need

Construction of a large energy facility in Minnesota requires a CN from the Commission (Minn. Statute 216B.243). The project, a double-circuit 345 kV transmission line with a proposed length of over 100 miles, meets the definition of a large energy facility and requires a CN. On August 4, 2023, the applicants filed a joint CN and route permit application for the project. On November 15, 2023, the Commission accepted the application as complete and directed that the CN application be reviewed using the Commission's informal review process. The Commission referred the joint application to the Office of Administrative Hearings (OAH) and authorized joint public hearings and combined environmental review of the CN and route proceedings (Figure 2-1).

Figure 2-1 Commission's Environmental Review and Permitting Process for the Project



2.1.1 Certificate of Need Criteria

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

- The probable result of denial would be an adverse effect on the future adequacy, reliability, or efficiency of energy supply to the applicant, to the applicants' customers, or to the people of Minnesota and neighboring states.

- A more reasonable and prudent alternative to the proposed facility has not been demonstrated by a preponderance of the evidence on the record.

- The proposed facility, or a suitable modification of the facility, will provide benefits to society in a manner compatible with protecting the natural and socioeconomic environments, including human health.

- The record does not demonstrate that the design, construction, or operation of the proposed facility, or a suitable modification of the facility, will fail to comply with relevant policies, rules, and regulations of other state and federal agencies and local governments.

If the Commission determines that the applicant has met these criteria, a CN is granted. The CN decision does not determine the route the transmission line would take; the route is determined by the Commission's route permit.

The Commission's CN decision determines the type of project, the size of the project, and the project's termini (its start and end points). The Commission could place conditions on the granting of a CN; likewise, it has discretion to approve the project as proposed or with modifications. If the Commission denies the CN, this indicates that the Commission believes a more reasonable and prudent alternative is to not build the project (the "no-build alternative," see Chapter 4.1).

Within 12 months of the submission of a CN application, the Commission must approve or deny a CN for the project (Minn. Statute 216B.243). The Commission may extend this time if it has good cause and must issue an order explaining the good cause justification for an extension.

2.2 Route Permit

Construction of a high-voltage transmission line in Minnesota requires a route permit from the Commission (Minn. Statute 216E.03). The project, a double-circuit 345 kV transmission line, meets the definition of a high-voltage transmission line and requires a route permit from the Commission. As noted in Chapter 2.1, the applicants filed a joint CN and route permit application on August 4, 2023. The Commission accepted the application as complete on November 15, 2023. The Commission referred the application to the OAH and authorized joint public hearings and combined environmental review of the CN and route proceedings (Figure 2-1).

2.2.1 Route Permit Criteria

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

Minn. Statute 216E.03, identifies considerations that the Commission must take into account when designating transmission lines routes, including minimizing environmental impacts and minimizing human settlement and other land-use conflicts. Specifically, the Commission considers the following 14 factors when making a route permit decision (Minn. Rule 7850.4100):

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

The Commission must make specific findings that it has considered locating a route for a new transmission line along an existing transmission line ROW or parallel to existing highway ROW and, to the extent these are not used for the route, the Commission must state the reasons why (Minn. Statute 216E.03). The Commission may not issue a route permit for a project that requires a CN until a CN has been approved by the Commission, though these approvals may occur consecutively at the same Commission meeting (Minn. Statute 216B.243, and Minn. Rule 7849.1900).

The Commission is charged with making a final decision on a route permit within one year after finding the route permit application complete. The Commission may extend this time limit for up to three months for just cause or upon agreement of the applicants. Once a CN and route permit are issued by the

Commission, the applicants could exercise the power of eminent domain to acquire land for the project (see Chapter 3.4.1 for additional information regarding ROW acquisition and eminent domain).

2.3 Environmental Review

The Minnesota Environmental Policy Act (MEPA) requires an environmental review to be conducted for major governmental actions with the potential to create significant environmental impacts (Minn. Statute 116D.04). The Commission has determined that an EA will be prepared for the project. Department of Commerce (Department), EERA staff is responsible for preparing the EA on behalf of the Commission.

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

When there are two approvals before the Commission for a single transmission line project, the environmental reviews required for each approval may be combined. For this project, the Commission has authorized EERA to combine the environmental reviews required for the CN and route permit. Thus, EERA is developing a combined EA—an EA that addresses the potential human and environmental impacts of issuing a CN and route permit for the project.

The EA must be completed and made available prior to the public hearing for the project.

2.3.1 Scoping

The first step in preparing an EA is scoping. The purpose of scoping is to provide citizens, local governments, tribal governments, and agencies an opportunity to focus the EA on those issues and alternatives that are relevant to the proposed project.

EERA and Commission staff jointly held seven EA scoping and public information meetings in October 2023, to provide information about the permitting process and the project, answer questions, and gather input on topics to study in the EA. The meetings were held in Hill City, Ironton, Brainerd, Pierz, Clear Lake, and Sauk Rapids with an additional virtual meeting held for those who could not attend in person. Approximately 232 people attended these meetings and provided 62 comments (Appendix A).

A written comment period, held from October 5, 2023, to November 21, 2023, provided the public an opportunity to submit comments on potential impacts and mitigation measures for consideration in the scope of the EA. During the written comment period, 65 citizens, one tribal government, two state agencies, the applicants, and seven non-profits submitted comments. Public comments included impacts and mitigation measures suggested for study in the EA, including specific routing alternatives.

EERA staff provided a summary of the scoping process and recommendations to the Commission. The Commission concurred with EERA's recommendations regarding routing alternatives and required EERA to add an additional routing alternative that was provided after the close of the public comment period. The Department issued the scoping decision for the EA on March 22, 2024 (Appendix A). The scoping decision identifies the route and alignment alternatives that are evaluated in this EA and those alternatives that were not carried forward for evaluation. As a result of public scoping comments, 25 route alternatives and 15 alignment alternatives are included for study in this EA. EERA staff provided notice of the scoping decision to those persons on the project mailing list and to all landowners along alternatives newly proposed during the scoping process.

2.4 Public Hearing

Upon completion of the EA, public hearings will be held in the project area. The hearings will be presided over by an administrative law judge (ALJ) from the OAH. In accordance with the Commission's order in this matter, the hearing on the CN will be held jointly with the hearing for the route permit. At the public hearing, citizens will have the opportunity to submit comments, present evidence, and ask questions. Citizens can advocate for or against the granting of a CN; they can also advocate for what they believe is the most appropriate route for the project and for any conditions to include in a route permit. Members of the public can also comment on the EA regarding any information that might be inaccurate or missing in the document.

After the public hearing, the ALJ will submit a report to the Commission with findings of facts, conclusions of law, and recommendations regarding a CN and a route permit for the project. EERA staff will respond to comments on the EA received during the hearing comment period, but staff is not required to revise or supplement the EA document. Upon completion of the environmental review and hearing process, the record will be presented to the Commission for final decisions.

2.5 Commission Decision

After considering the entire record, including the EA, input received during the public hearings, and the ALJ's findings and recommendations, the Commission will determine whether to grant a CN for the project as proposed, grant a CN contingent upon modifications to the project, or deny the CN. The Commission may also issue a conditional CN.

If a CN is granted, the Commission will also determine the final transmission line route. Route permits include a permitted route and an anticipated alignment, as well as conditions specifying construction and operating standards. Route permits also typically include mitigation plans and project-specific mitigation measures. Decisions by the Commission on the CN and route permit are anticipated in November 2024.

2.6 Other Permits and Approvals

A route permit from the Commission is the only state permit required for the project routing. A route permit supersedes local planning and zoning and binds state agencies (Minn. Statute 216E.10); therefore, state agencies are required to engage in the Commission's permitting process to aid in the Commission's decision-making and to indicate routes that are not permittable.

However, several federal, state, and local permits may be required for construction and operation of the project. All permits subsequent to the issuance of a route permit and necessary for the project must be obtained by the applicants. The information in this EA may be used by the subsequent permitting agencies as part of their environmental resource impact evaluation. Table 2-1, Table 2-2, and Table 2-3 list permits and approvals that could be required for the project, depending on the final design.

Table 2-1 Potential Federal Permits and Approvals Required for the Northland Reliability Project

Unit of Government	Type of Application	Purpose
U.S. Army Corps of Engineers – St. Paul District (USACE)	Section 404 Clean Water Act – Dredge and Fill	Protects water quality through authorized discharges of dredged and fill material into water of the United States
U.S. Army Corps of Engineers – St. Paul District (USACE)	Section 10 – Rivers and Harbor Act	Protects water quality through authorized crossings of navigable waters
U.S. Army Corps of Engineers – St. Paul District (USACE)	Section 106 of the National Historic Preservation Act	Requires federal agencies to avoid, minimize, and/or mitigate project-related effects to historic properties
U.S. Fish and Wildlife Service (USFWS)	Bald and Golden Eagle Protection Act Consultation	Review to prevent take of bald or golden eagles
U.S. Fish and Wildlife Service (USFWS)	Migratory Bird Treaty Act Consultation	Review to prevent take of protected migratory bird species
U.S. Fish and Wildlife Service (USFWS)	Section 7 Endangered Species Act Consultation	Establishes conservation measures for endangered species
Federal Aviation Administration (FAA)	Part 7460 Review	Review to Prevent airspace hazards due to structures taller than 200 feet
Native American Tribes	Coordination in support of Section 106 of the National Historic Preservation Act to determine impacts on traditional cultural properties and/or other resources of tribal significance	Coordination to prevent impacts to traditional cultural properties and/or other resources of tribal significance

Table 2-2 Potential State Permits and Approvals Required for the Northland Reliability Project

Unit of Government	Type of Application	Purpose
Minnesota Department of Natural Resources (DNR)	License to Cross Public Waters	License to prevent impacts associated with crossing public waters
Minnesota Department of Natural Resources (DNR)	License to Cross Public Lands	License to prevent impacts associated with crossing public lands
Minnesota Department of Natural Resources (DNR)	State Lease for Access Roads	Lease to cross state-managed lands on access roads
Minnesota Department of Natural Resources (DNR)	State Threatened and Endangered Species Consultation	Consultation to avoid, minimize, and mitigate impacts to state-listed species
Minnesota Pollution Control Agency (MPCA)	National Pollutant Discharge Elimination System (NPDES) Construction Stormwater Permit	Minimizes impacts to waters due to construction of the project
Minnesota Pollution Control Agency (MPCA)	Section 401 Clean Water Act – Water Quality Certification	Ensures project will comply with state water quality standards
Minnesota Pollution Control Agency (MPCA)	Spill Prevention, Control and Countermeasure Plan	Ensures project will develop and implement a plan to prevent discharge of oil
Minnesota State Historic Preservation Office (SHPO)	National Historic Preservation Act Section 106 consultation; Minnesota Field Archaeology Act; Minnesota Historic Sites Act	Ensures adequate consideration of impacts on significant cultural resources
Minnesota Department of Agriculture (MDA)	Agricultural Impact Mitigation Plan	Establishes measures for protection of agricultural resources
Minnesota Department of Transportation (MNDOT)	Utility Permit	Authorizes accommodation of utilities along highway rights-of-way
Minnesota Department of Transportation (MNDOT)	Driveway Access	Authorizes access to driveways along highways
Minnesota Department of Transportation (MNDOT)	Oversize/Overweight Permit	Authorizes the use of roads for oversize or overweight vehicles
Minnesota Board of Water and Soil Resources (BWSR)	Wetland Conservation Act	Coordination with BWSR and local governments to ensure conservation of wetlands

Table 2-3 Potential Local and Other Permits and Approvals Required for the Northland Reliability Project

Unit of Government	Type of Application	Purpose
Local/County Governments	Road Crossing, Driveway, Oversize or Overweight, and Land Permits	Permits from local governments to ensure proper use of local roads and lands
City	Municipal Stormwater Permit	Ensures stormwater discharge is in compliance with local ordinances
Other utilities (pipelines, railroads, etc.)	Crossing Permits/Agreements/Approvals	Notifications to railroads and utilities

2.6.1 Federal Approvals

The United States Army Corps of Engineers (USACE) regulates potential impacts to waters of the United States. Dredged or fill material, including material that moves from construction sites into these waters, could impact water quality. The USACE requires permits for projects that may cause such impacts. The USACE is also charged with coordinating with the State Historic Preservation Office (SHPO) and Native American tribes regarding potential impacts to significant cultural resources pursuant to Section 106 of the National Historic Preservation Act (NHPA).

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

The Federal Aviation Administration (FAA) regulates civil aviation, including the airspace used for aviation. The FAA requires permits for tall structures that could adversely impact aviation.

2.6.2 State of Minnesota Approvals

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

A general National Pollutant Discharge Elimination System (NPDES) / Sanitary Disposal System (SDS) construction stormwater permit from the Minnesota Pollution Control Agency (MPCA) is required for stormwater discharges from construction sites. A permit is required if a project disturbs 1 acre or more of land. The general NPDES/SDS permit requires (1) use of best management practices (BMPs), (2) a stormwater pollution prevention plan, and (3) adequate stormwater treatment capacity once the project is constructed. The NPDES/SDS permit ensures that state water quality standards are not compromised. If new transformers are added to the Iron Range Substation or Benton County Substation that result in changes to oil storage, a Spill Prevention, Control and Countermeasure (SPCC) plan update would be needed.

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

The Minnesota Department of Agriculture (MDA) ensures the integrity of Minnesota's food supply while protecting the health of its environment and the resources required for food production. MDA assists in the development of agricultural impact mitigation plans (AIMPs) to avoid and mitigate impacts to agricultural lands.

A permit from the Minnesota Department of Transportation (MnDOT) is required for transmission lines that are adjacent to or cross over Minnesota trunk highway ROW. MnDOT's utility accommodation policy generally allows utilities to occupy portions of highway ROW where such occupation does not put the safety of the traveling public or highway workers at risk or unduly impair the public's investment in the transportation system.

The Minnesota Board of Water and Soil Resources (BWSR) oversees implementation of Minnesota's Wetland Conservation Act (WCA). The WCA is implemented by local units of government (LGUs). For linear projects that cross multiple LGUs, BWSR typically coordinates the review of potential wetland impacts among the affected LGUs. The WCA requires anyone proposing to impact a wetland to (1) try to avoid the impact, (2) try to minimize any unavoidable impacts, and (3) replace any lost wetland functions.

2.6.3 Local Approvals

The Commission's route permit supersedes local planning and zoning regulations and ordinances. However, the applicants must obtain all local approvals necessary for the project that are not preempted by the Commission's route permit, such as approvals for the safe use of local roads.

2.6.4 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 railway. The need for such approvals will be determined after the final route is selected, and the applicants have indicated that these approvals would be obtained after a route permit has been issued by the Commission.

2.6.5 Conservation Programs

There are lands throughout the project area that are part of various conservation programs, including but not limited to Reinvest in Minnesota (RIM), Conservation Reserve Enhancement Program (CREP), the Sustainable Forest Incentive Act (SFIA), and Forest for the Future. The applicants indicate that they will work with landowners, local governmental entities administering such programs, and sponsoring federal agencies on a site-specific basis to coordinate the approvals necessary for placing the project on these lands.

2.6.6 Electric Safety and Reliability Costs

The project must meet the requirements of the National Electrical Safety Code (NESC). Utilities must comply with the most recent edition of the NESC, as published by the Institute of Electrical and Electronics Engineers, Inc., and approved by the American National Standards Institute, when constructing new facilities or upgrading existing facilities (Minn. Statute 326B.35).

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

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

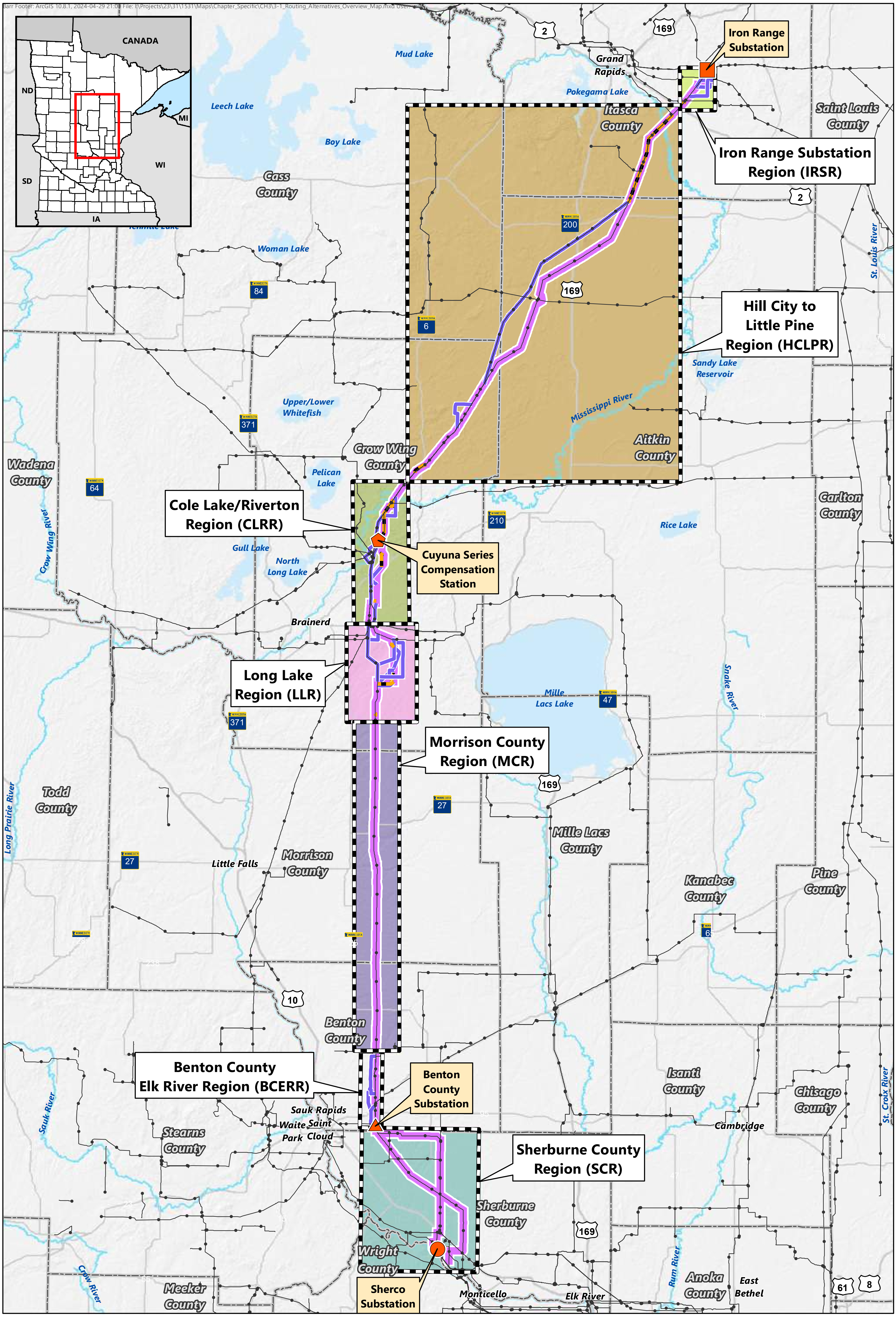
3 Overview of Project and Routing Alternatives

The applicants are proposing to construct an approximately 180-mile-long double-circuit 345 kV transmission line between Grand Rapids, St. Cloud, and Becker, Minnesota. To facilitate analysis and discussion of the project, this EA divides the project into eight regions (Map 3-1). The regions begin in the north, with the Iron Range Substation Region, and extend southward, ending with the Sherburn County Region.

In addition to the applicants' proposed route, there are 25 route alternatives and 15 alignment alternatives that could be used for the project (Map 3-1). Any of these alternatives, or a combination of these alternatives, could be selected and permitted by the Commission. Each of the routing alternatives is described in Chapter 3 and Appendix A, with accompanying maps in Appendix C.

This chapter describes the transmission line structures that could be used for the project and the project's associated facilities. Additionally, this chapter discusses how the project would be constructed and its anticipated costs and schedule. Several terms used throughout this Chapter and the remaining document have specific meaning and are defined here for clarity.

- **ROW** means the land interest required within a route for the construction, maintenance, and operation of a high-voltage transmission line (Minn. Rule 7850.1000).
- **ROW sharing** means that the new transmission line would be co-located with an existing transmission line or other existing infrastructure ROW (e.g., transportation corridors, pipelines, etc.) to partially share that existing ROW and lessen the overall easement width required from landowners.
- **ROW paralleling** refers to siting a transmission line such that it would run adjacent to existing rights-of-way (e.g., transportation corridors, pipelines, and other electrical transmission lines), thereby lessening impacts to the landscape and environment. ROW paralleling does not lessen the overall ROW width required from landowners for the new transmission line.
- **Double-circuiting** refers to a transmission line design whereby transmission structures are designed to carry two alternating current (AC) lines, as opposed to a single circuit (i.e., one line). Double-circuiting is advantageous because two transmission lines use the same ROW and same structures in a double-circuit design.



Applicants' Proposed Route
Route Alternative
Alignment Alternative
Regions of Analysis
Existing Transmission Line
Benton County Substation
Iron Range Substation
Sherco Substation
Cuyuna Series Compensation Station

0 5 10 15
Miles

Map 3-1

ROUTING ALTERNATIVES OVERVIEW MAP
Northland Reliability Project

3.1 Route and Alignment Alternatives

Route and alignment alternatives are presented here by region from north to south. Each region includes a portion of the applicants' proposed route. A detailed overview of each routing alternative is also provided in Map Book 3A.

3.1.1 Iron Range Substation Region

The Iron Range Substation region, located in Trout Lake and Blackberry Townships, Itasca County, is the northernmost region of the project. This region includes the Iron Range Substation area, which is the northern endpoint of the project. In addition to the applicants' proposed route, the region has four route alternatives (A1, A2, A3 and A4) and one alignment alternative (AA15) (Map 3-2).

3.1.1.1 Applicants' Proposed Route – Iron Range Substation Region

The applicants' proposed route begins at Minnesota Power's existing Iron Range Substation and continues south for approximately 1 mile before turning due west for 0.75 mile where it crosses County Road 10. It then turns south for 0.5 mile and turns west again for 0.75 mile. The transmission line then travels southwest for approximately 3.1 miles where it meets US Highway 2 at the southern end of the Iron Range Substation region.

3.1.1.2 Route Alternative A1

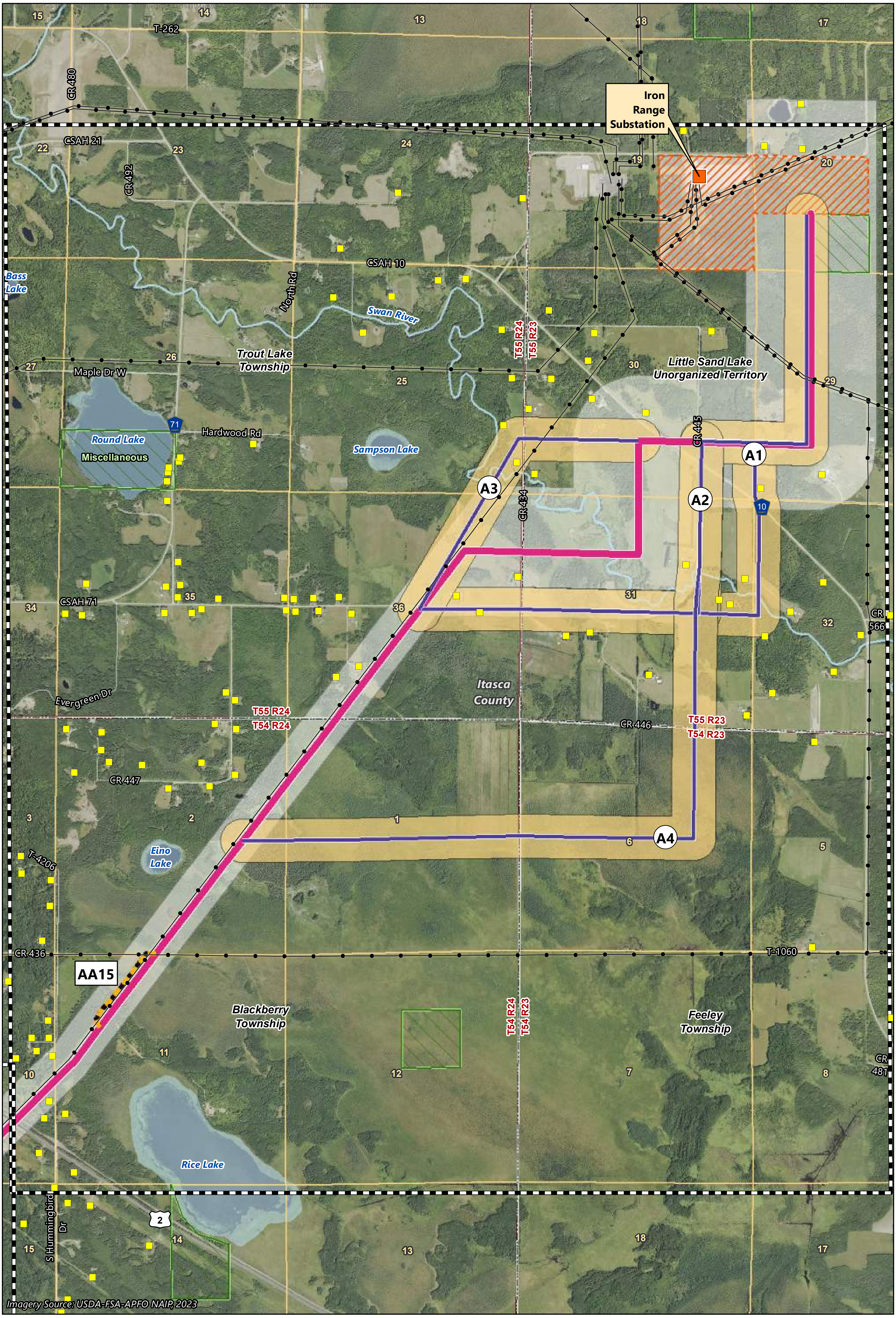
The A1 route alternative is 3.4 miles long and generally follows the applicants' proposed route but shifts west away from state property and onto the applicants' property at the northern end near the Iron Range Substation. Route alternative A1 then turns south and crosses County Road 10 southeast of the applicants' proposed route, ultimately crossing the Swan River at a previously disturbed bridge location. Route alternative A1 does not include any transmission line ROW sharing, paralleling, or double-circuiting.

3.1.1.3 Route Alternative A2

The A2 route alternative is 3.4 miles long and generally follows the applicants' proposed route but shifts west away from state property and onto the applicants' property at the northern end near the Iron Range Substation. Route alternative A2 veers southward, intersecting County Road 10 southeast of the applicants' proposed route. The route then follows County Road 445 until it reaches a junction with a lengthy driveway bordering an agricultural field. At this point, it shifts westward, crossing the Swan River at a previously disturbed bridge site. Route alternative A2 does not include any transmission line ROW sharing, paralleling, or double-circuiting.

3.1.1.4 Route Alternative A3

Route alternative A3 is 1.4 miles long and diverges from the applicants' proposed route just west of County Road 10. From that point, route alternative A3 continues west for 0.5 mile, then turns southwest after crossing County Road 434, where it continues for approximately 0.85 mile, crossing the Swan River at a previously disturbed bridge location, before rejoining the applicants' route. Route alternative A3 would cross an existing transmission line in two locations (once to cross over the existing transmission line and once to cross back). It does not include any transmission line ROW sharing, paralleling, or double-circuiting.



Applicants' Proposed Route
Route Width
Route Alternative
Alignment Alternative
Route Alternative Width
Existing Transmission Line
Iron Range Substation
Substation Siting Area
Residence
PWI Waterway
PWI Basin
Region Boundary

Feet
0 1,000 2,000

Map 3-2

IRON RANGE SUBSTATION REGION

Northland Reliability Project

3.1.1.5 Route Alternative A4

Route alternative A4 is 3.7 miles long and diverts from the applicants' proposed route near County Road 10, where it turns south for approximately 1.75 miles and then turns west for approximately 2 miles before rejoining the applicants' proposed route. Route alternative A4 does not include any transmission line ROW sharing, paralleling, or double-circuiting.

3.1.1.6 Alignment Alternative AA15

One alignment alternative is included in the Iron Range Substation region. Alignment Alternative AA15 would shift the applicants' proposed route from private property onto Itasca County tax forfeit lands. The AA15 alignment alternative is 0.4 mile long and shifts the alignment west of the applicants' proposed route south of County Road 436. Alignment alternative AA15 would require crossing over existing transmission infrastructure and then crossing back. Alignment alternative AA15 would parallel an existing transmission line ROW for its entire length.

3.1.2 Hill City to Little Pine Region

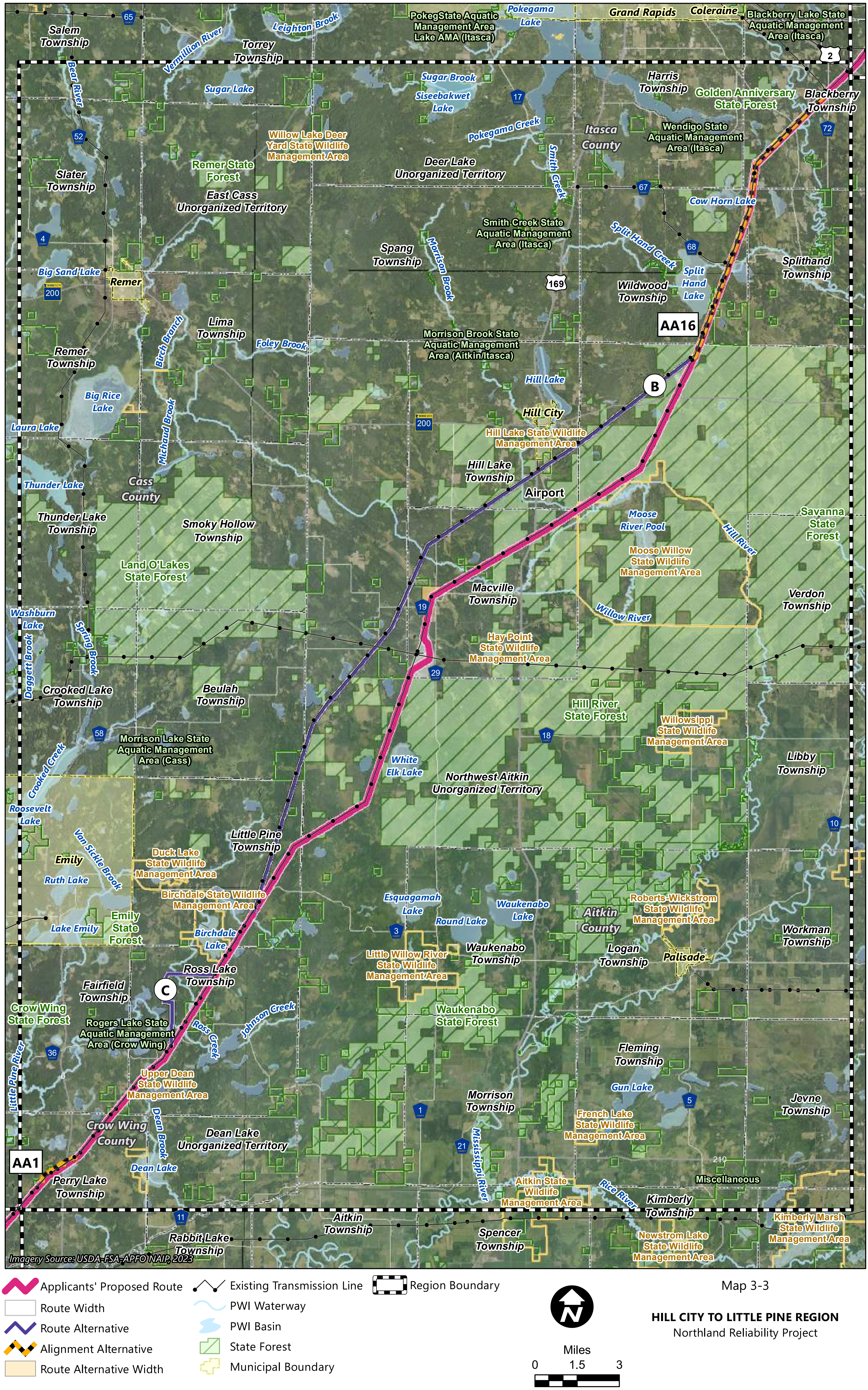
The Hill City to Little Pine region is in Aitkin, Cass, Crow Wing, and Itasca counties. The region includes the applicants' proposed route, two route alternatives (B and C) and three alignment alternatives (AA1, AA2, and AA16) (Map 3-3).

3.1.2.1 Applicants' Proposed Route – Hill City to Little Pine Region

The applicants' proposed route generally moves southwest through the Hill City to Little Pine region, following a portion of Minnesota Power's existing 230 kV line (92 Line). The applicants' proposed route begins at US Highway 2 where it moves southwest for approximately 4.75 miles, crossing the Mississippi River. The applicants' proposed route then moves more southerly as it crosses Danson Road, continuing for approximately 11.5 miles, where it then turns westerly north of Hill River State Forest and continues for 8.6 miles. The applicants' proposed route turns south and jogs east of an Enbridge pump station and continues along the 92 Line ROW for approximately 27 miles, where it crosses the Mississippi River at the southern end of the region.

3.1.2.2 Route Alternative B

Route alternative B is 26.4 miles long and shifts west from the applicants' proposed route to potentially reduce natural resource impacts. Route alternative B turns west 1.5 miles north of State Highway 200 and parallels an existing transmission line ROW for a majority of the route length. Route alternative B continues southwest crossing the Hill River Ditch, Willow River, Moose River, and East Lake, before rejoining to the applicants' proposed route approximately 0.8 miles south of County Road 1. A portion of route alternative B, in an area where it parallels an existing transmission line ROW, is adjacent to the Hill City/Quadna Mountain Airport. Specialty structures would be required near the Hill City/Quadna Mountain Airport to lower structure heights to less than 80 feet for approximately 0.5 to 1 mile. This lower height would be required to maintain airport clear-zone requirements.



Map 3-3

HILL CITY TO LITTLE PINE REGION

Northland Reliability Project

3.1.2.3 Route Alternative C

Route alternative C is 4.6 miles long and shifts west from the applicants' route. Route alternative C generally follows existing roads and disturbed corridors. This route turns west from the applicants' proposed route along Lens Road and then turns south to follow County Road 106 for 2.6 miles before rejoining the applicants' proposed route approximately 0.5 mile south of County Road 36. Route alternative C would cross an existing transmission line in two locations (once to cross over the existing transmission line and once to cross back). It would also require at least three heavy-angle structures to accommodate 90-degree and angled turns along the route. Route alternative C does not include any transmission line ROW sharing, paralleling, or double-circuiting.

3.1.2.4 Alignment Alternative AA1

Alignment alternative AA1 is 1.6 miles long and shifts west of the applicants' proposed route to avoid private property. This alternative crosses State Highway 6 further north than the applicants' proposed route and crosses Wood Road further northwest than the applicants' proposed route. Alignment alternative AA1 does not include any transmission line ROW sharing, paralleling, or double-circuiting. It would cross an existing transmission line in two locations (once to cross over the existing transmission line and once to cross back). It would also require at least two heavy-angle structures to accommodate proposed 90-degree and angled turns.

3.1.2.5 Alignment Alternative AA2

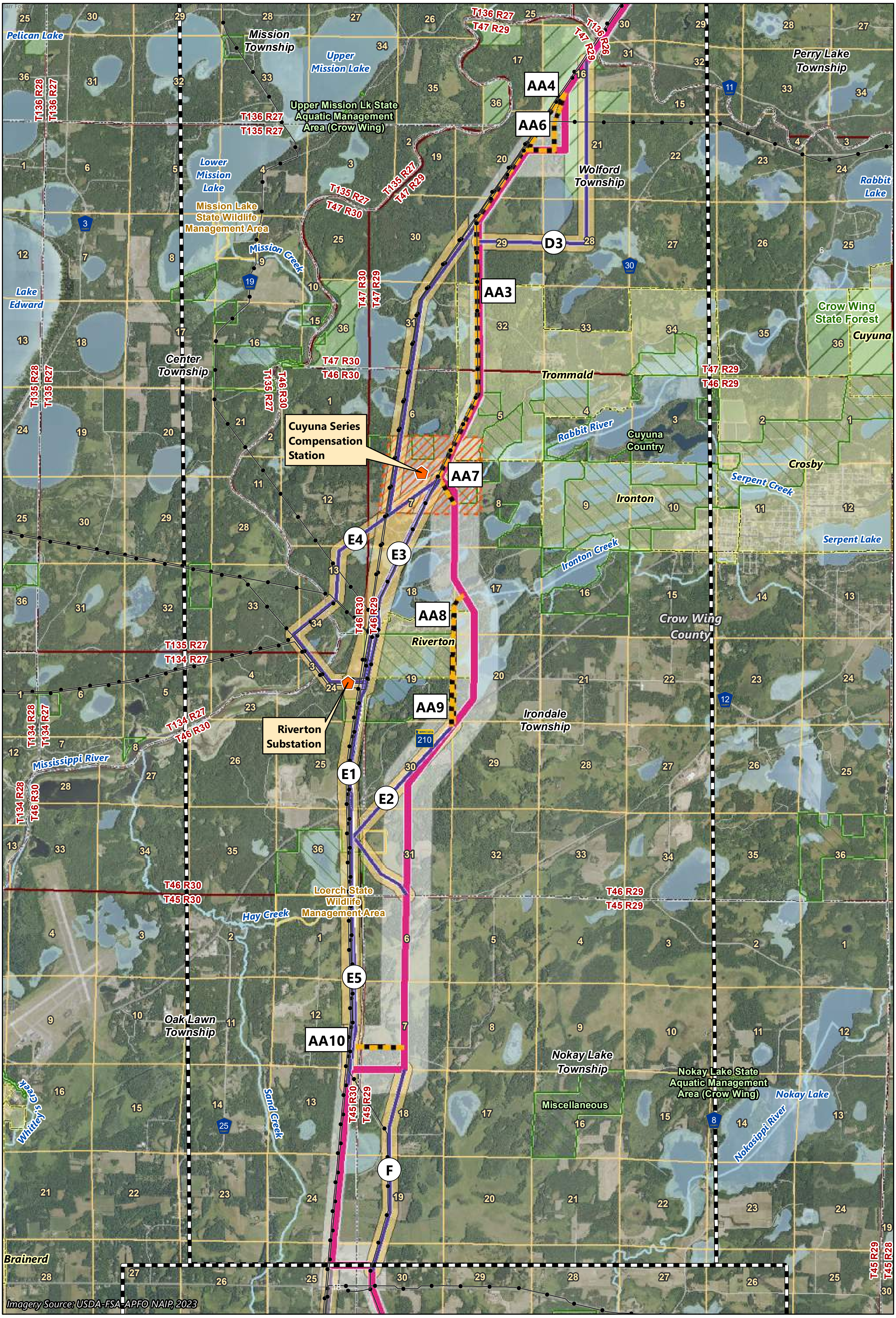
Alignment alternative AA2 is 0.6 mile long and shifts west of the applicants' proposed route to avoid private property. Alignment alternative AA2 crosses State Highway 6 further north than the applicants' proposed route and follows the highway south for approximately 0.2 miles before rejoining the applicants' proposed route. Alignment alternative AA2 does not include any transmission line ROW sharing, paralleling, or double-circuiting. It would cross an existing transmission line in two locations (once to cross over the existing transmission line and once to cross back). It would also require at least two heavy-angle structures to accommodate proposed 90-degree and angled turns.

3.1.2.6 Alignment Alternative AA16

Alignment alternative AA16 is 11 miles long and would entail double-circuiting two existing transmission lines in order to allow alignment alternative AA16 to utilize that existing ROW, to minimize potential impacts in the area. Alignment alternative AA16 is located west of the applicants' proposed route. Alignment alternative AA16 continues southwest for approximately 5.75 miles before rejoining the applicants' proposed route just south of the Itasca County and Aitkin County border.

3.1.3 Cole Lake-Riverton Region

The Cole Lake-Riverton region is located in the central portion of the project in Crow Wing County (Map 3-4). The Cole Lake-Riverton region contains the applicants' proposed route, eight route alternatives (D3, E1, E2, E3, E4, E5, F, and G) and seven alignment alternatives (AA3, AA4, AA6, AA7, AA8, AA9, and AA10). The five route alternatives labeled E1 through E5 offer route alternatives around the town of Riverton.



Applicants' Proposed Route
Route Width
Route Alternative
Alignment Alternative
Route Alternative Width
Existing Transmission Line
Riverton Substation
Cuyuna Series Compensation Station
Substation Siting Area
PWI Waterway
PWI Basin
State Forest
Municipal Boundary
Region Boundary

Miles
0 0.5 1

Map 3-4

COLE LAKE/RIVERTON REGION

Northland Reliability Project

3.1.3.1 Applicants' Proposed Route – Cole Lake-Riverton Region

The applicants' proposed route moves southwesterly through the Cole Lake region, beginning at the Mississippi River crossing and ending at the new Cuyuna Series Compensation Station. The route moves southwest for 0.75 mile along the 92 Line before deviating and turning southerly then westerly for 1 mile to avoid residences. It rejoins the 92 Line for approximately 3.75 miles where it crosses Miller Kae Road and South Black Bear Road before arriving at the new Cuyuna Series Compensation Station. As the applicants' proposed route leaves the Cuyuna Series Compensation Station, it extends southeast for approximately 7.8 miles along new ROW, crossing the western portion of Hay Lake, before joining GRE's 230 kV MR Line (MR Line). The route shares the MR Line ROW for approximately 2 miles then turns due east for 0.5 mile at the southern end of the region.

3.1.3.2 Route Alternative D3

Route alternative D3 is 3.3 miles long and is shifted east and south from the applicants' proposed route in an effort to reduce potential impacts. Route alternative D3 diverges south from the applicants' proposed route just south of County Road 11 and heads south for approximately 2 miles, and then turns west for 1.3 miles before rejoining with the applicants' proposed route. Route alternative D3 does not include any ROW sharing, paralleling, or double-circuiting; however, it would cross one existing transmission line.

3.1.3.3 Alignment Alternative AA3

Alignment alternative AA3 involves double-circuiting two existing transmission lines, which would then allow placement of the project within existing transmission line ROW. Alternative AA3 is approximately 5 miles long and would terminate at the new Cuyuna Series Compensation Station.

3.1.3.4 Alignment Alternative AA4

Alignment alternative AA4 is a shorter version of AA3. Alignment alternative AA4 would double-circuit two existing transmission lines so that the project could be constructed within existing transmission line ROW. Alignment alternative AA4 is approximately 0.8 miles long.

3.1.3.5 Alignment Alternative AA6

Alignment alternative AA6 is 1 mile long; it would divert from the applicants' proposed route north of River Road and head due south along Cole Lake Way for approximately 0.7 miles, then turn due west for 0.3 mile before rejoining the applicants' proposed route. Alignment alternative AA6 does not include any ROW sharing, paralleling, or double-circuiting; however, it would cross one existing transmission line.

3.1.3.6 Route Alternative E1

Route alternative E1 is 7.2 miles long and diverts from the applicants' proposed route north of Bluegill Road and heads southwest for approximately 7.2 miles before rejoining the applicants' proposed route on Woodrow Road. Route alternative E1 was proposed to avoid impacts to the Cuyuna County State Recreation Area by using existing transmission line ROW. Route alternative E1 would double-circuit two existing transmission lines, which would then allow placement of the project route within existing transmission line ROW (Photo 3-1). Although this alternative would cross into a Wildlife Management Area (WMA), it would utilize existing transmission line ROW through this area. Route alternative E1 would require modifying existing transmission lines in the area and may also need a wider route width in certain areas.

Photo 3-1 View of Route Alternative E1 ROW from CR 159

3.1.3.7 Route Alternative E2

Route alternative E2 is 4.4 miles long and diverts from the applicants' proposed route just south of State Highway 210 where it heads southwest for 1.75 miles before turning due south for 2.6 miles and rejoining the applicants' proposed route. Where the line turns and heads south, route alternative E2 would share existing transmission line ROW for approximately 2.6 miles.

3.1.3.8 Route Alternative E3

Route alternative E3 is, for the most part, a shorter version of route alternative E1. It is 5.2 miles long and diverts from the applicants' proposed route north of Bluegill Road and heads southwest for approximately 4.2 miles, generally following route alternative E1. However, just south of State Highway 210, route alternative E3 would break away from route alternative E1 and turn southeast for 1 mile to rejoin the applicants' proposed route.

3.1.3.9 Route Alternative E4

Route alternative E4 is 11 miles long; it diverts from the applicants' proposed route 1 mile north of Miller Lake Road. It then heads southwest of the applicants' proposed route and west of the town of Riverton, where it begins a sinuous route edging west around Hay Lake, with two Mississippi River crossings. Route alternative E4 then heads due south for approximately 4.5 miles before rejoining the applicants' proposed route at Woodrow Road. Route alternative E4 would share existing transmission line ROW for approximately 8 of its 11 miles. Route alternative E4 would cross six existing transmission lines and would require at least two heavy-angle structures to accommodate 90-degree and angled turns along the route.

3.1.3.10 Route Alternative E5

Route alternative E5 is 8.1 miles long; it diverts from the applicants' proposed route approximately 0.7 mile north of Bluegill Road, heading west of the town of Riverton, around Hay Lake, and then south to rejoin the applicants' proposed route at Woodrow Road. This route was proposed as a shorter alternative to route alternative E4. It would share existing transmission line ROW for approximately 6.3 miles and would also cross the Mississippi River two times. Route alternative E5 would cross six existing transmission lines and would require at least two heavy-angle structures to accommodate 90-degree and angled turns along the route.

3.1.3.11 Route Alternative F

Route alternative F is 2.4 miles long and was proposed to reduce impacts to natural resources. Route alternative F diverts from the applicants' proposed route 0.25 mile south of Woodrow Road and continues traveling south for approximately 2.5 miles before rejoining the applicants' proposed route just north of State Highway 18. Route alternative F would parallel existing transmission line ROW for approximately 1.5 miles.

3.1.3.12 Route Alternative G

Route alternative G is 3.5 miles long and was proposed to avoid impacts to residential areas. Route alternative G would divert from the applicants' proposed route approximately 0.35 mile north of State Highway 18 and continue south for approximately 1.75 miles. From there, it would turn due east for approximately 1.15 miles and turn north for approximately 0.75 mile to rejoin the applicants' proposed route west of Burgwald Road. Route alternative G would parallel existing transmission line ROW for approximately 1.7 miles and would require at least one heavy angle structure to accommodate a 90-degree turn along the route.

3.1.3.13 Alignment Alternative AA7

Alignment alternative AA7 is 0.3 mile in length and diverts from the applicants' proposed route 0.7 mile north of Bluegill Road. Alignment alternative AA7 removes one angled turn from the applicants' proposed route, straightening the proposed transmission line ROW in this area. Alignment alternative AA7 does not include any transmission line ROW sharing, paralleling, or double-circuiting.

3.1.3.14 Alignment Alternative AA8

Alignment alternative AA8 is 1.5 miles long and diverts from the applicants' proposed route where it crosses County Road 128. Alignment alternative AA8 heads southwest along the east side of County Road 128 and then follows the east side of County Road 59 due south around the Cuyuna Recreational Area until it rejoins the applicants' proposed route just south of State Highway 210. Alignment alternative AA8 does not include any transmission line ROW sharing, paralleling, or double-circuiting.

3.1.3.15 Alignment Alternative AA9

Alignment alternative AA9 is 1.6 miles long and diverts from the applicants' route where it crosses County Road 128. Alignment alternative AA9 routes around the Cuyuna Recreation Area by heading southwest along the east side of County Road 128 for approximately 0.5 mile before following the west side of

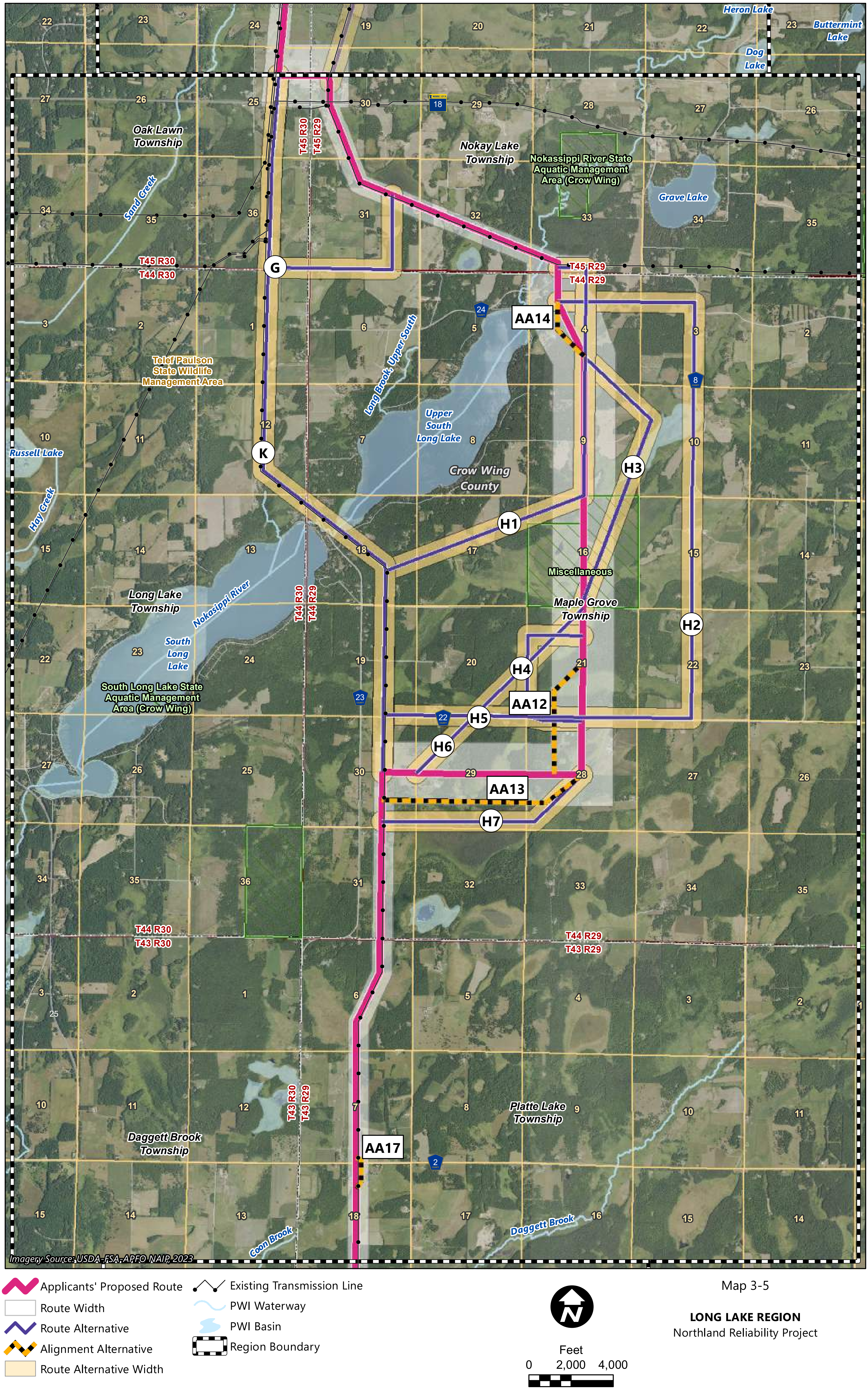
County Road 59 due south for approximately 1.1 miles until it rejoins the applicants' proposed route just south of State Highway 210. Alignment alternatives AA8 and AA9 present similar proposals; however, alignment alternative AA9 would share existing transmission line ROW.

3.1.3.16 Alignment Alternative AA10

Alignment alternative AA10 diverts from the applicants' proposed route approximately 0.1 mile north of Woodrow Road and runs parallel (but offset by 0.25 mile) to the applicants' proposed route for 0.75 mile, then turns due south for 0.25 mile where it rejoins the applicants' proposed route. Alignment alternative AA10 would share an existing transmission line ROW for approximately 0.25 mile.

3.1.4 Long Lake Region

The Long Lake region is located in the central portion of the project, south of the Riverton region (Map 3-5). The Long Lake region contains the applicants' proposed route, eight route alternatives (H1, H2, H3, H4, H5, H6, H7, and K), and four alignment alternatives (AA12, AA13, AA14, and AA17) (Map 3-5).



Map 3-5

LONG LAKE REGION
Northland Reliability Project

3.1.4.1 Applicants' Proposed Route – Long Lake Region

The applicants' proposed route moves generally southeast through the Long Lake region, paralleling GRE's 69 kV RW Line (RW Line) for approximately 3 miles where it then turns south then west along a new ROW for 6.5 miles. The route then rejoins the MR line just east of County Road 23 and continues south for approximately 3.75 miles, paralleling the MR line this entire for this entire distance, to where the Long Lake region ends.

3.1.4.2 Route Alternative H1

Route alternative H1 is 6 miles long and diverts eastward of the applicants' proposed route just north of County Road 24 and heads south for 2 miles around an Aquatic Management Area (AMA), along a portion of the applicants' proposed route. Route alternative H1 then turns southwest for just under 2 miles before turning due south for 1.8 miles where it would parallel an existing transmission line ROW before rejoining the applicants' proposed route south of County Road 22.

3.1.4.3 Route Alternative H2

Route alternative H2 is 8.2 miles long and routes around an AMA. This route alternative diverts due east from the applicants' proposed route south of County Road 24 for approximately 1.25 miles before turning due south along County Road 8 for 1.75 miles. From there, route alternative H2 continues south along County Road 108 to County Road 22. Route alternative H2 then turns due west along County Road 22 for approximately 2.75 miles before turning south and paralleling an existing transmission line ROW where it proceeds for 0.5 mile to reconnect with the applicants' proposed route. Route alternative H2 would require at least one heavy angle structure to accommodate a 90-degree turn in the route.

3.1.4.4 Route Alternative H3

Route alternative H3 is 2.6 miles long and was proposed to avoid private land enrolled in a state program. Route alternative H3 diverts from the applicants' proposed route 0.75 mile north of Crust Road, where it progresses southeast for 0.8 mile before turning southwest for 1.75 miles before rejoining the applicants' proposed route in an undeveloped area 1 mile north of County Road 22. Route alternative H3 does not include any transmission line ROW sharing, paralleling, or double-circuiting. It would also require at least one heavy angle structure to accommodate an angled turn in the route.

3.1.4.5 Route Alternative H4

Route alternative H4 is 2.1 miles long and was proposed to avoid private land by rerouting through tax-forfeited land. Route alternative H4 diverts southwest from the applicants' proposed route 0.75 mile north of County Road 22. It would progress southwest for 2 miles before rejoining the applicants' proposed route at the edge of an agricultural field southeast of the County Road 22 and County Road 23 intersection. Route alternative H4 does not include any transmission line ROW sharing, paralleling, or double-circuiting. It would also require at least one heavy angle structure to accommodate an angled turn in the route.

3.1.4.6 Route Alternative H5

Route alternative H5 is 2.4 miles long and was proposed to avoid private property and certain natural resources. This route alternative diverts from the applicants' proposed route 0.75 mile north of County Road 22, where it turns west for 0.5 mile and then due south for 0.75 mile. It then runs west along County Road 22 for 0.5 mile before heading southwest for 0.75 mile where it then rejoins the applicants' proposed route southwest of the County Road 22 and County Road 23 intersection. Route alternative H5 does not include any transmission line ROW sharing, paralleling, or double-circuiting. It would also require at least four heavy-angle structures to accommodate 90-degree and angled turns in the route.

3.1.4.7 Route Alternative H6

Route alternative H6 is 1.7 miles long and was proposed to cross less private property and natural resources. Route alternative H6 diverts from the applicants' proposed route where it crosses County Road 22 and heads due west along the road for 1 mile before it progresses southwest for 0.75 mile. It rejoins the applicants' proposed route southeast of the County Road 22 and County Road 23 intersection. Route alternative H6 does not include any transmission line ROW sharing, paralleling, or double-circuiting. It would also require at least three heavy-angle structures to accommodate angled turns in the route.

3.1.4.8 Route Alternative H7

Route alternative H7 is 2 miles long and was proposed to avoid private property and certain natural resources. This route alternative diverts from the applicants' proposed route 0.5 mile south of the County Road 22 crossing. Route alternative H7 turns southwest for 0.6 mile before heading due west for 1.4 miles where it rejoins the applicants' proposed route on the east side of County Road 23. Route alternative H7 does not include any transmission line ROW sharing or paralleling, or double-circuiting. It would also require at least one heavy angle structure to accommodate an angled turn in the route.

3.1.4.9 Route Alternative K

Route alternative K is 6.8 miles long and generally runs west of the applicants' proposed route. Route alternative K diverts from the applicants' proposed route 0.25 mile north of State Highway 18, where it runs due south for 3.5 miles before turning southeast for 1.4 miles. Route alternative K then progresses due south for 1.9 miles before rejoining the applicants' proposed route southeast of the County Road 22 and County Road 23 intersection. Route alternative K would share existing transmission line ROW for its entire length, including where the line would cross between South Long Lake and North Long Lake.

3.1.4.10 Alignment Alternative AA12

Alignment alternative AA12 is 1.1 miles long and was proposed to avoid private property. Alignment alternative AA12 is located approximately 0.25 mile east of the applicants' proposed alignment, near where the line crosses County Road 22. Alignment alternative AA12 does not include any transmission line ROW sharing, paralleling, or double-circuiting. It would also require at least two heavy-angle structures to accommodate an angled turn in the route.

3.1.4.11 Alignment Alternative AA13

Alignment alternative AA13 is 1.9 miles long and was proposed to avoid private property and certain natural resources. Alignment alternative AA13 diverts from the applicants' proposed alignment 0.5 mile south of County Road 22 and progresses southwest before heading due west for approximately 1.5 miles where it rejoins the applicants' proposed alignment east of County Road 23. Alignment alternative AA13 does not include any transmission line ROW sharing, paralleling, or double-circuiting. It would also require at least one heavy-angle structures to accommodate an angled turn in the route and cross one existing transmission line.

3.1.4.12 Alignment Alternative AA14

Alignment alternative AA14 is 0.6 mile long and diverts from the applicants' proposed alignment 0.35 mile south of County Road 24, where it progresses due south for 0.25 mile then turns southeast for 0.4 mile before rejoining the applicants' proposed alignment south of Schilling Road. Alignment alternative AA14 does not include any transmission line ROW sharing, paralleling, or double-circuiting.

3.1.4.13 Alignment Alternative AA17

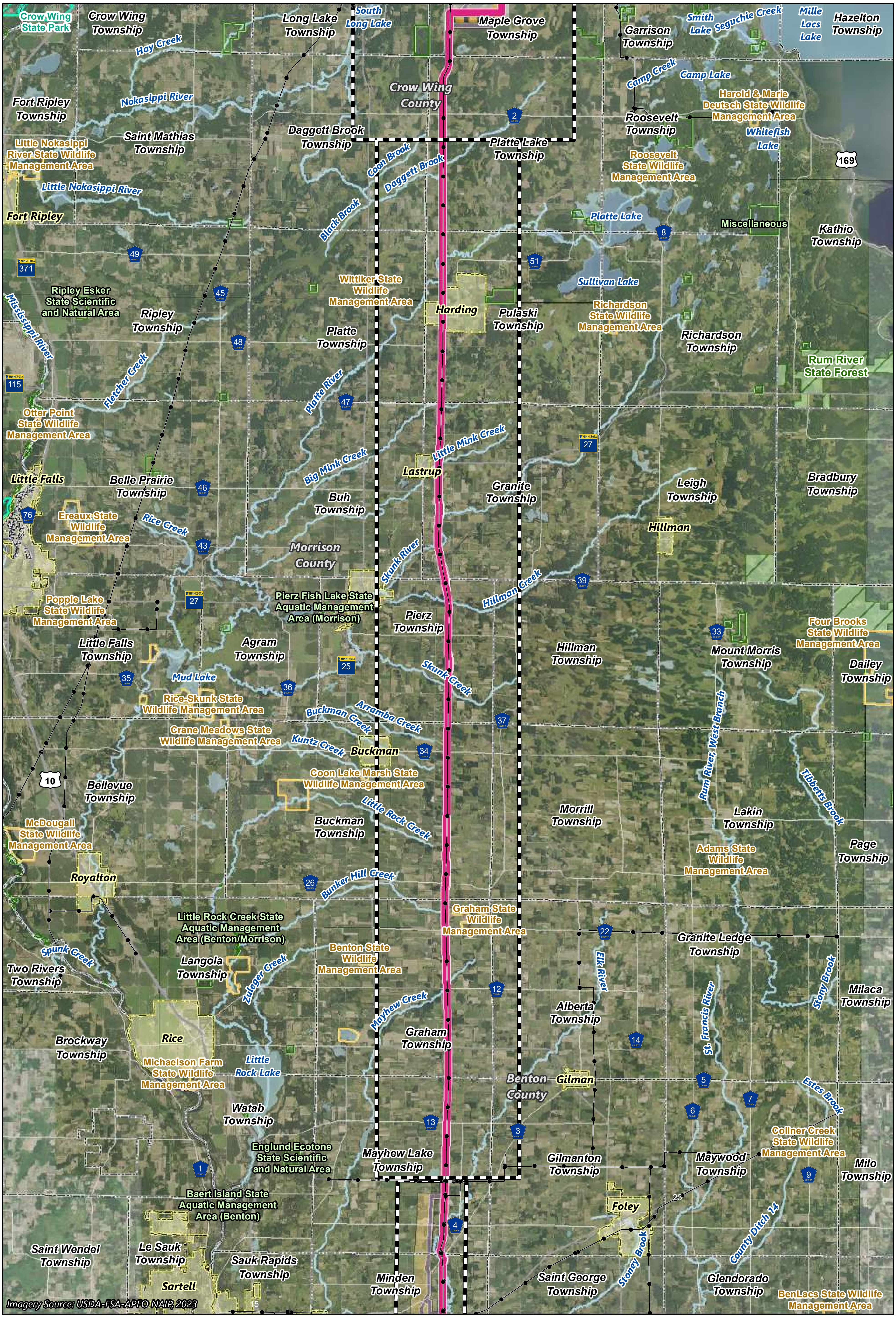
Alignment alternative AA17 is 0.3 mile long and located where the applicants' proposed route crosses County Road 2. Alignment alternative AA17 is west of the applicants' proposed alignment. Alignment alternative AA17 does not include any transmission line ROW sharing or paralleling, or double-circuiting. It would also require at least two heavy-angle structures to accommodate angled turns in the route. Alignment alternative AA17 would also cross an existing transmission line in two locations (once to cross over the existing transmission line and once to cross back).

3.1.5 Morrison County Region

The Morrison County region is located in the south-central portion of the project (Map 3-6). This region crosses through Crow Wing, Morrison, and Benton County. This region contains the applicants' proposed route. It includes no route or alignment alternatives.

3.1.5.1 Applicants' Proposed Route – Morrison County Region

The applicants' proposed route moves south through the Morrison County region, paralleling the MR Line ROW through the entirety of the region, with multiple river and creek crossings. The route continues due south for approximately 36 miles to the southern end of the Morrison County region near 75th Street Northeast.



Applicants' Proposed Route
Route Width
Route Alternative
Alignment Alternative
Route Alternative Width
Existing Transmission Line
PWI Waterway
PWI Basin
State Forest
Municipal Boundary
Region Boundary

Miles
0 1.5 3

Map 3-6

MORRISON COUNTY REGION

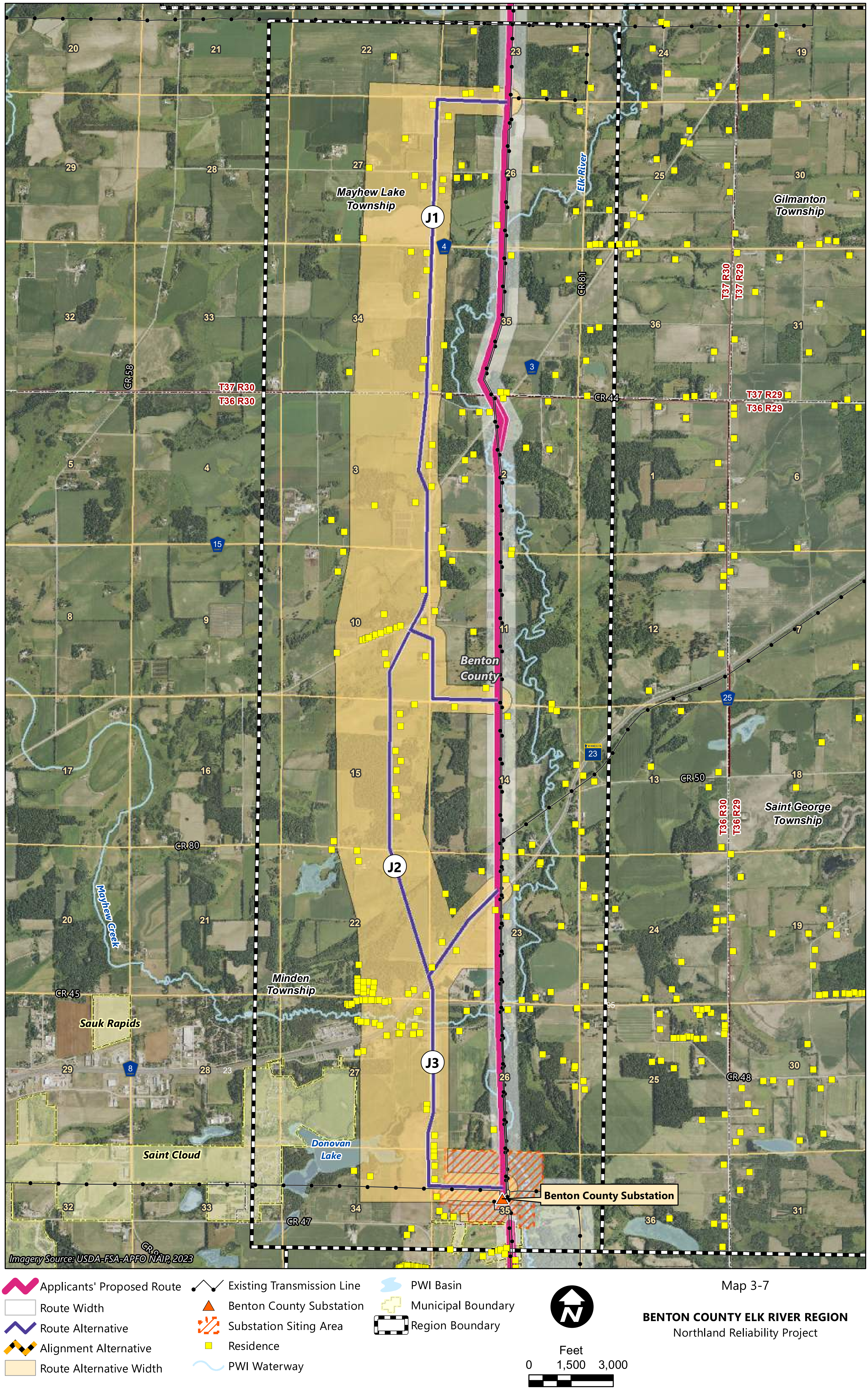
Northland Reliability Project

3.1.6 Benton County Elk River Region

The Benton County Elk River region is in the southern part of the project and contains the Benton County Substation at its the southern end (Map 3-7). The Benton County Elk River region contains the applicants' proposed route, and three route alternatives (J1, J2, J3) (Map 3-7). The J route alternatives have a route width of 0.5 mile to provide flexibility in identifying the optimal alignment through this area.

3.1.6.1 Applicants' Proposed Route – Benton County Elk River Region

The applicants' proposed route moves generally south throughout the Benton County Elk River region, paralleling the MR Line starting near 75th Street Northeast and ending at the Benton County Substation. This portion of the route is approximately 5 miles in length, crossing roads, agricultural fields, forested areas, and rivers. Although the applicants' proposed route parallels existing transmission lines, this route generally follows the Elk River. Due to the meandering nature of the Elk River, the applicants' proposed route would have multiple river crossings in addition to portions of the ROW being located in the river's 100-year floodplain.



Map 3-7

BENTON COUNTY ELK RIVER REGION

Northland Reliability Project

3.1.6.2 Route Alternative J1

Route alternative J1 is 5.1 miles long and diverts from the applicants' proposed route along 75th Street NE. Route alternative J1 heads west for 0.5 mile along 75th Street NE then turns due south along the west side of 55th Ave NE and then follows Golden Spike Road NE for 3.5 miles. Route alternative J1 then turns southeast for 1 mile along 55th Avenue NE and 35th Street NE before rejoining the applicants' proposed route. Route alternative J1 does not include any transmission line ROW sharing or paralleling, or double-circuiting but it was designed to parallel existing transportation rights-of-way. It would also require at least six heavy-angle structures to accommodate angled turns in the route.

3.1.6.3 Route Alternative J2

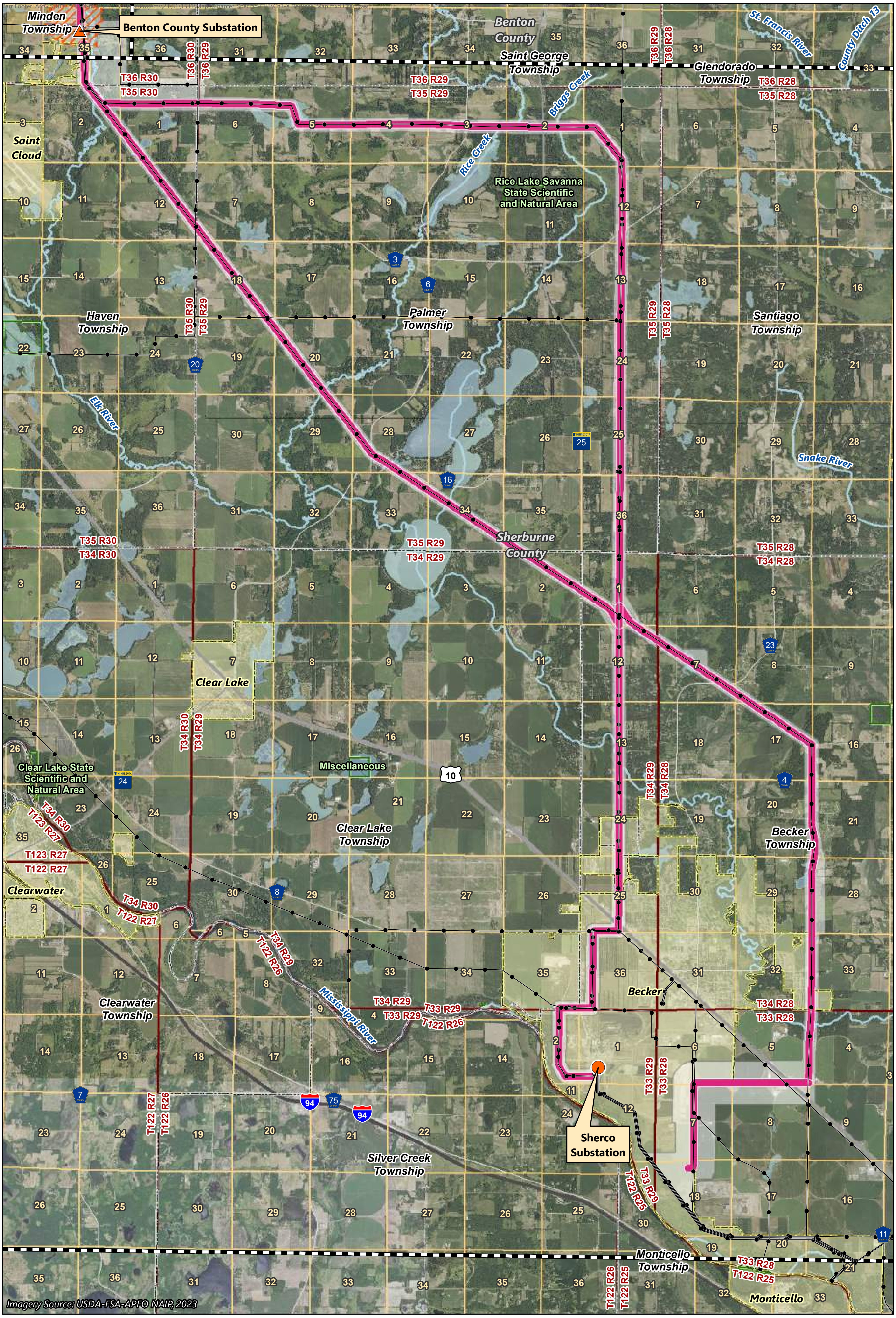
Route alternative J2 is 8.4 miles long and diverts from the applicants' proposed route along 75th Street NE. Route alternative J2 heads west for 0.5 mile along 75th Street NE then turns due south along the west side of 55th Avenue NE where it follows Golden Spike Road NE, 52nd Avenue NE, and 55th Avenue NE for approximately 7.5 miles before turning east for 0.5 mile to the Benton County Substation. This last 0.5-mile of the route alternative would parallel existing transmission line ROW; however, the remaining 7.9 miles of the route alternative does not include transmission line ROW sharing or paralleling, or double-circuiting. Route alternative J2 would also require at least six heavy-angle structures to accommodate angled turns along the route.

3.1.6.4 Route Alternative J3

Route alternative J3 is 2.7 miles long and diverts from the applicants' proposed route where it crosses Highway 23 NE. This route alternative heads southwest for approximately 0.75 mile before turning due south along 55th Avenue NE for approximately 1.4 miles where it then turns east for 0.5 mile to the Benton County Substation. Route alternative J3 would parallel an existing transportation ROW for the first 0.75-mile and would parallel existing transmission line ROW for the last 0.5-mile of the proposed route. Route alternative J3 would also require at least four heavy-angle structures to accommodate angled turns along the route.

3.1.7 Sherburne County Region

The Sherburne County region is the southernmost region of the project (Map 3-8). The majority of the region is contained within Sherburne County, but small portions also occur in Wright and Stearns Counties. This region starts at the Benton County Substation and ends south of Xcel Energy's new Big Oaks Substation. The Sherburne County Region includes two existing transmission lines owned by the applicants, and work occurring in this region would consist mainly of upgrades to these two lines. This region includes no route or alignment alternatives. The applicants' proposed route follows, and would replace, existing transmission lines, except for approximately 1.5 miles of proposed new transmission line that would connect to the future Big Oaks Substation (Map 3-8). The 1.5 miles of new transmission line would parallel an existing road.



Applicants' Proposed Route
Route Width
Route Alternative
Alignment Alternative
Route Alternative Width
Existing Transmission Line
Benton County Substation
Sherco Substation
Substation Siting Area
PWI Waterway
PWI Basin
Municipal Boundary
Region Boundary

Feet
0 3,000 6,000

Map 3-8

SHERBURNE COUNTY REGION
Northland Reliability Project

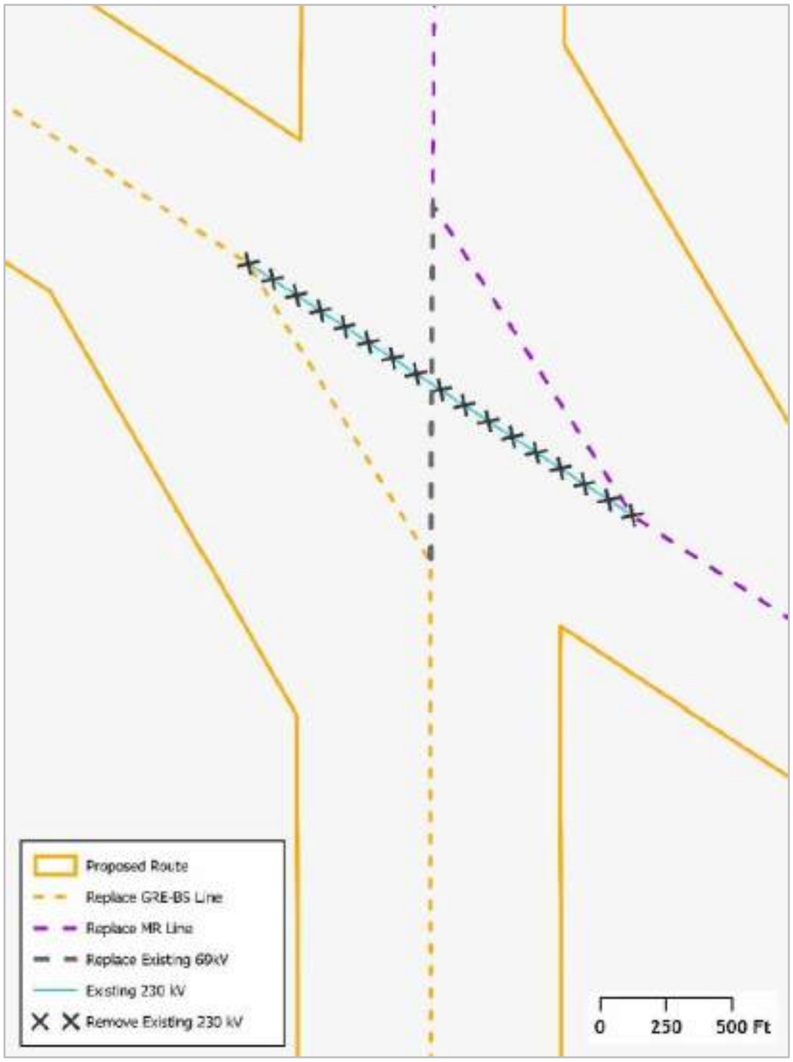
Within the Sherburne County region, GRE's existing 230 kV transmission line (MR Line) would be replaced with a new double-circuit 345 kV transmission line from the Benton County Substation to the new Xcel Energy Big Oaks Substation. The replacement would be within the existing MR Line ROW. The approximately 21.3-mile route that utilizes the MR Line exits the Benton County Substation and travels due east for approximately 7 miles, before turning southeasterly for the remaining portion of the line. The route deviates from the existing MR Line at 137th Street, where a new transmission line would be constructed parallel to 137th Street heading west for approximately 1.5 miles. The route then meets an existing transmission line ROW and travels south for the last mile along Sherburne Avenue, before ending at the new Big Oaks Substation.

GRE's existing 345 kV transmission Line (GRE-BS Line) would be replaced with new 345 kV transmission line structures from the Benton County Substation to Xcel Energy's existing Sherco Substation. The replacement would be within the existing GRE-BS Line ROW. This line would be constructed as a single-circuit 345 kV transmission line but on double-circuit capable structures, in order to accommodate a second 345 kV circuit in the future. The approximately 17.7-mile route departs from the Benton County Substation heading southeast until 125th Avenue where it then turns due south along the west side of the City of Becker and enters the Sherco Substation. Additionally, 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 would be designed to carry a 115 kV circuit on triple-circuit structures. The existing GRE 69 kV EW Line would then be co-located on these structures, with the 69 kV line upgraded to a 115 kV circuit sometime in the future as a separate project.

3.1.7.1 Line Uncrossing

A portion of the work in the Sherburne County region also includes "uncrossing" two existing transmission lines. Currently, GRE's 230 kV MR Line and their 345 kV GRE-BS Line, which are both being replaced as part of the Project, cross over each other approximately 0.5 mile north of 82nd Street (i.e., the existing 345 kV GRE-BS Line traverses over the top of the existing 230 kV MR Line). Crossing transmission lines increases resiliency risk; 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. The Project would rebuild these two transmission lines and reconfigure them such that the new lines would not cross. This work would also include rebuilding a 0.26-mile 69 kV connector segment that is located between the two transmission lines.

Figure 3-1 Uncrossing Detail



Source: reference (6)

3.2 Engineering and Design

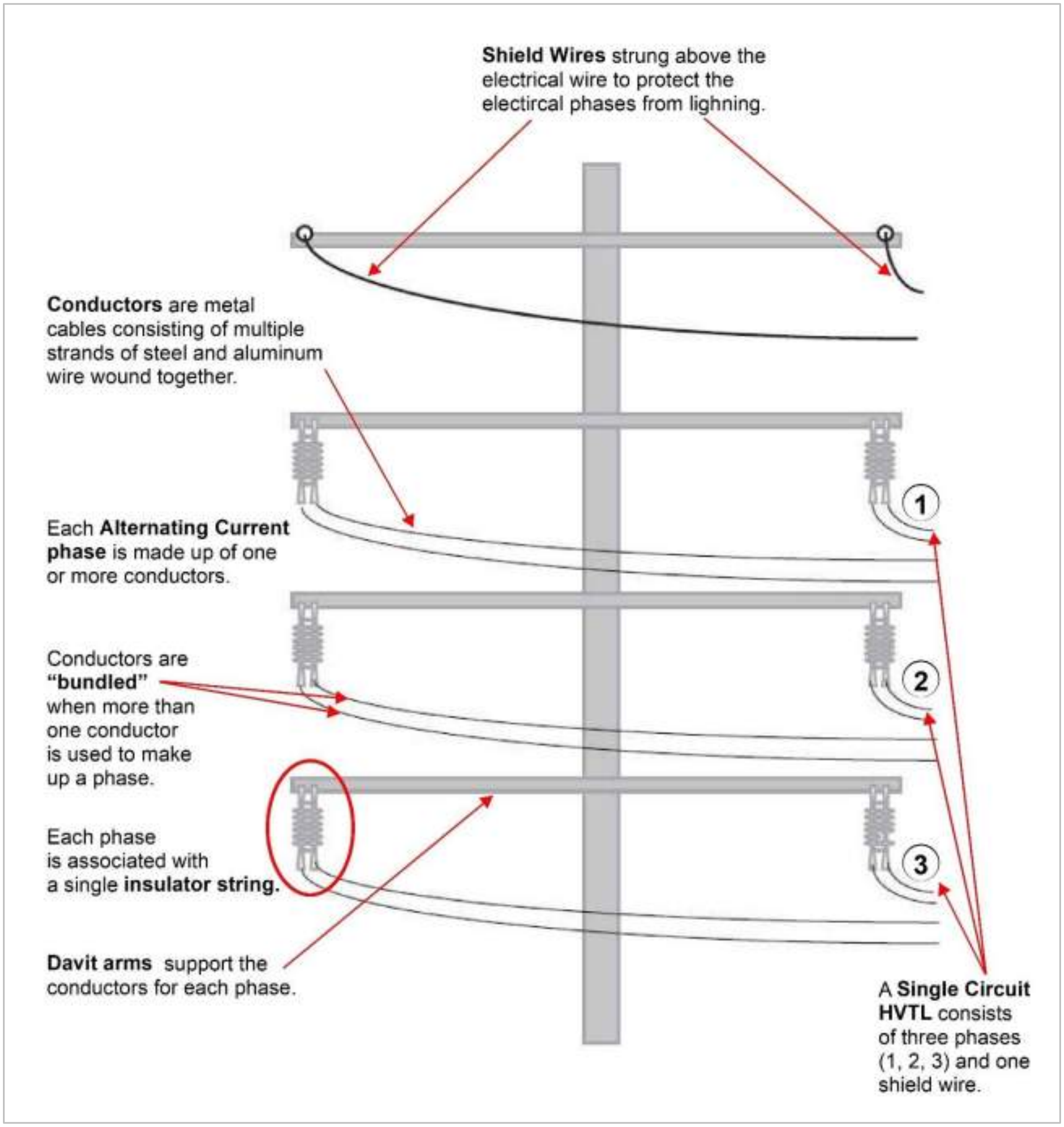
The applicants have proposed three structure types for the project allowing for several possible configurations, as well as double-circuiting with existing transmission lines. This Chapter describes the structures and configurations that may be used for the project.

3.2.1 Transmission Lines

Transmission line circuits consist of three phases, each phase at the end of a separate insulator and physically supported by a structure that holds it above ground. A phase consists of one or more conductors: single, double, or bundled. A typical conductor is a cable consisting of aluminum wires stranded around a core of steel wires. There may also be shield wires strung above the phases to prevent damage from lightning strikes.

Transmission lines are usually either single-circuit (carrying one three-phase conductor set) or double-circuit (carrying two three-phase conductor sets). The majority of the project is proposed as a double-circuit 345 kV line and would therefore be constructed on double-circuit capable structures (Figure 3-2). The project also includes two small sections of triple-circuit capable structures which are typically used in limited situations due to reliability, resiliency, cost, and safety implications. Triple-circuit structures were proposed by the applicants in specific areas to avoid a degradation in the reliability or maintainability of the transmission system.

Figure 3-2 Typical Double-Circuit Transmission Line



3.2.2 Structures

The project would be constructed primarily using double-circuit, 345 kV structures (Figure 3-3) consisting of tubular steel, self-weathering, monopole structures with V-string insulators. The benefits of this structure design include a reduced footprint and ROW needs due to the use of a monopole, allowing for vertically orienting the two circuits using V-string insulators to limit conductor blowout. Technical drawings and the dimensions of the transmission structures can be found in Appendix D.

Figure 3-3 Example Double-Circuit, Monopole 345 kV Structures with V-String Insulators

Portions of the project in the Sherburn County Region would be designed and constructed on triple-circuit capable structures with a 69 kV underbuild position to accommodate GRE's existing 69 kV transmission line (EW Line). An underbuild places a smaller electric distribution line beneath a transmission line circuit on the same pole, reducing the need for additional structures. The 69 kV portion carried on the triple-circuit structures would be constructed to 115 kV standards but would not be capable of operating above 69 kV due to the remainder of the EW Line remaining at its existing 69 kV design capacity.

There may be various locations along the route where existing transmission lines would 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 construction and typical monopole or H-frame structures. Structure designs would be driven by an effort to minimize human and environmental impacts, to the extent practicable.

The double-circuit 345 kV structures would range in height from 130 to 170 feet, with spans of 800 to 1,000 feet between structures. A monopole structure is typically installed on a concrete foundation, while an H-frame structure can be installed on concrete foundations or embedded directly into the ground.

Table 3-1 provides a summary of the design features associated with structure types that may be used, reconfigured, or replaced for the project.

Table 3-1 Typical Structure Design Characteristics

Line Type	Structure Type	Structure Material	ROW 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 [1]	NA	700-900
Single-Circuit 115 kV	H-frame	Wood	100	60-80	Direct Embed	NA	600-800
Single-Circuit 69 kV Rebuild [2]	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 are typical values expected for the majority of tangent structures based on similar facilities. Actual values may vary.

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

2 Single-circuit 69 kV transmission line will be replaced in Segment 2 of the project for a GRE line from West Becker Switch and West End Substation, and the new 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.

3.2.3 Conductors

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 would be capable of carrying 3,000 amps.

Twisted-pair conductors may be used to minimize potential conductor movement caused by galloping. Galloping is the motion of conductors that can occur due to wind acting on conductors coated with a layer of ice or wet snow. Under certain wind conditions, the conductors can begin to move significantly, usually vertically. Significant galloping can lead to faults, as well as damage to hardware and structural components.

3.2.4 Associated Facilities

Associated facilities proposed for the project include the Iron Range 500 kV/345 kV substation expansion, the Cuyuna 345 kV Series Compensation Station, and the Benton County 345 kV substation expansion (Map 1-1).

The existing Iron Range 500 kV Substation would be expanded by approximately 15 acres on, property owned by Minnesota Power, to facilitate interconnection of the project at its northern endpoint. The 15-acre expansion is an estimate; the size, shape, and precise location may change per engineering design standards.

Minnesota Power's new Cuyuna Series Compensation Station would be located on Minnesota Power owned property approximately 2 miles north of the existing Riverton Substation. The Cuyuna Series Compensation Station would be 25 acres and include 345 kV series capacitor banks that are necessary for reliable operation and optimal performance of the project. Additionally, a portion of the site would be developed as a construction laydown yard and permanent material storage yard due to its location near the midpoint of the project.

The existing GRE Benton County Substation would be expanded by approximately 8.5 acres on property owned by GRE to facilitate interconnection of the project.

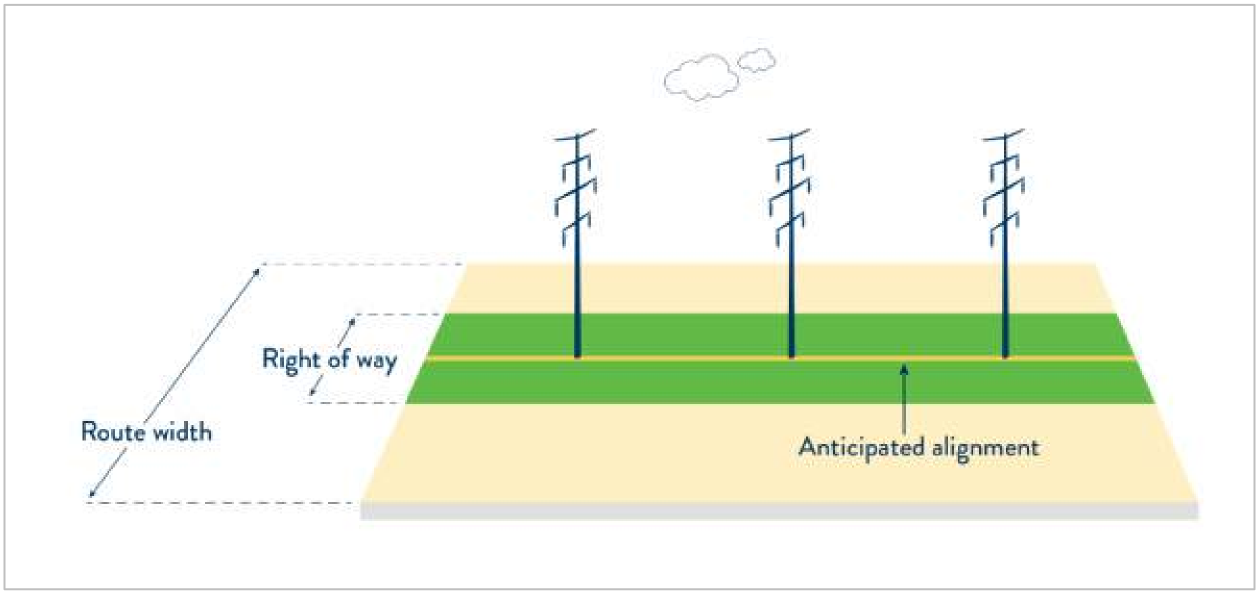
The substation modifications would be designed to allow future maintenance to be done with minimum impact on substation operation and provide necessary clearance from energized equipment to ensure safety.

The project would terminate at the new Big Oaks substation, which will be a 345 kV switching station located northwest of the Monticello Nuclear Generating Plant in Becker, Minnesota. The Big Oaks substation is being permitted and constructed as part of MISO LRTP Project #2, the Alexandria to Big Oaks 345 kV Transmission Project (PUC Docket Nos. ET10/TL-23-159 & E015/CN-22-538; OAH Docket No. 25-2500-39723).

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

When the Commission issues a route permit, it approves a route, a route width, and an anticipated alignment within that route width (Figure 3-4). The Commission may include conditions in a route permit. These conditions could address the route width or anticipated alignment in a specific area of the project, for example, requiring the alignment of a specific portion of the route to be north rather than south of a road or requiring that the route width be narrower in a certain area.

Figure 3-4 Route Width, Right-of-Way, and Anticipated Alignment Schematic



3.3.1 Route Width

The route width is typically larger than the actual ROW needed for the transmission line (Figure 3-4). This additional width provides flexibility in constructing the line yet is not of such extent that the placement of the line is undetermined. The route width allows the applicants to work with landowners to address their concerns and to address engineering issues that may arise after a permit is issued. The route width, in combination with the anticipated alignment, is intended to balance flexibility and predictability.

The transmission line must be constructed within the route designated by the Commission unless, after permit issuance, permission to proceed outside of the route is sought by the applicants and approved by the Commission (Minn. Rule 7850.4800).

In general, where the route follows or replaces an existing high-voltage transmission line, the applicants are requesting a route width of 500 feet on either side of the existing transmission line centerline for a total of a 1,000-foot route width. In areas where the route follows more than one existing transmission line, the route width requested is 500 feet from each outermost existing line (1,000 – 1,120 feet wide). In areas where the route uses new ROW, the applicants are requesting a route width of 1,500 feet on either side of the centerline for a total route width of 3,000 feet. The wider route width is requested to allow for flexibility to minimize impacts to resources and to work with landowners.

The applicants requested wider route widths in specific areas along the existing transmission line ROW, which include the following:

- Iron Range Substation region, 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.
- Hill City to Little Pine region, Minnesota Power's high-voltage direct current (HVDC) line – where the route crosses Minnesota Power's existing ±250 kV HVDC line in Section 31 of Macville Township in Aitkin County, the applicants request a route width of 4,400 feet. An Enbridge pump station and associated 230 kV tap line owned by GRE are located east of the 92 Line, and the 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.
- Cole Lake region, 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.
- Cole Lake region and Riverton region, 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.
- Benton County Elk River region, 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 and in proximity to Elk

River and to allow for a more perpendicular crossing of Golden Spike Road in Section 2 of Minden Township in Benton County.

- Benton County Elk River region, 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.
- Sherburne County region, 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.
- Sherburne County region, 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.
- Sherburne County region, 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.
- Sherburne County region, 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.

3.3.2 Right-of-Way

A ROW is the specific area required for the safe construction and operation of the transmission line, where such safety is defined by the NESC and the NERC reliability standards. The ROW must be within the designated route and is the area for which the applicant obtains rights from private landowners to construct and operate the line.

Once the Commission issues a route permit, the applicants would conduct detailed survey and engineering work. Additionally, the applicants would contact landowners to gather information about their property and their concerns and discuss how the transmission line ROW might best proceed across the property. A transmission line ROW across private property is typically obtained by an easement agreement between the applicants and landowners.

The applicants have indicated that the project requires a 150-foot-wide ROW (75 feet on either side of the centerline). However, to the extent practicable, the new double circuit 345 kV transmission line would be co-located with existing high-voltage transmission lines or other ROWs, which would allow partial ROW sharing and would lessen the overall easement required for the project. In the Sherburne County Region, new transmission lines would generally follow the existing high-voltage transmission lines centerline, with the majority of the new lines utilizing the existing ROW, though exceptions exist in certain areas.

The applicants requested wider rights-of-way for a route alternative proposed in their scoping comments (Appendix E) – Route Alternative E1:

- A 215-foot ROW would be required for the portion of route alternative E1 from the Cuyuna Series Compensation Station to Little Rabbit Lake in order to accommodate double-circuiting the existing 230 kV transmission line into the existing ROW.

- An additional 80 feet of ROW west of the existing line in the portion of route alternative E1 starting south of Little Rabbit Lake and ending at the Riverton Substation would also be required.
- In the portion of route alternative E1 south of the Riverton Substation to the Highway 210 crossing, an additional 100 feet of ROW is required on the east side of the corridor, with the exception of the Highway 210 crossing realignment area.
- In the portion of route alternative E1 south of Highway 210 to where it would rejoin the applicants' proposed route, an additional 100 feet of ROW is needed to accommodate the double-circuit 345 kV line. This additional ROW would be located on the east side of the corridor for the first 1.4 miles and then shifts to the west side for the remaining 1.4 miles.

3.3.3 Anticipated Alignment

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

After coordinating with landowners and completing detailed engineering plans, the applicants would establish the final project alignment and designate pole placements. These final plans, known as "plans and profiles," must be provided to the Commission so that they can confirm that the applicants' plans are consistent with the route permit and all permit conditions prior to construction of the project. This confirmation ensures that the built project alignment is consistent with the anticipated alignment in the Commission's permit.

3.4 Construction and Maintenance Procedures

Construction of the project would not begin until all necessary federal, state, and local approvals have been obtained, easements have been acquired for ROW, and final plans and profiles have been approved by the Commission. The precise timing and order of ROW clearing and construction along the line would depend on the receipt of all necessary approvals for each line segment constructed, system loading issues, when existing transmission lines can be taken out of service for construction to proceed, and available workforce.

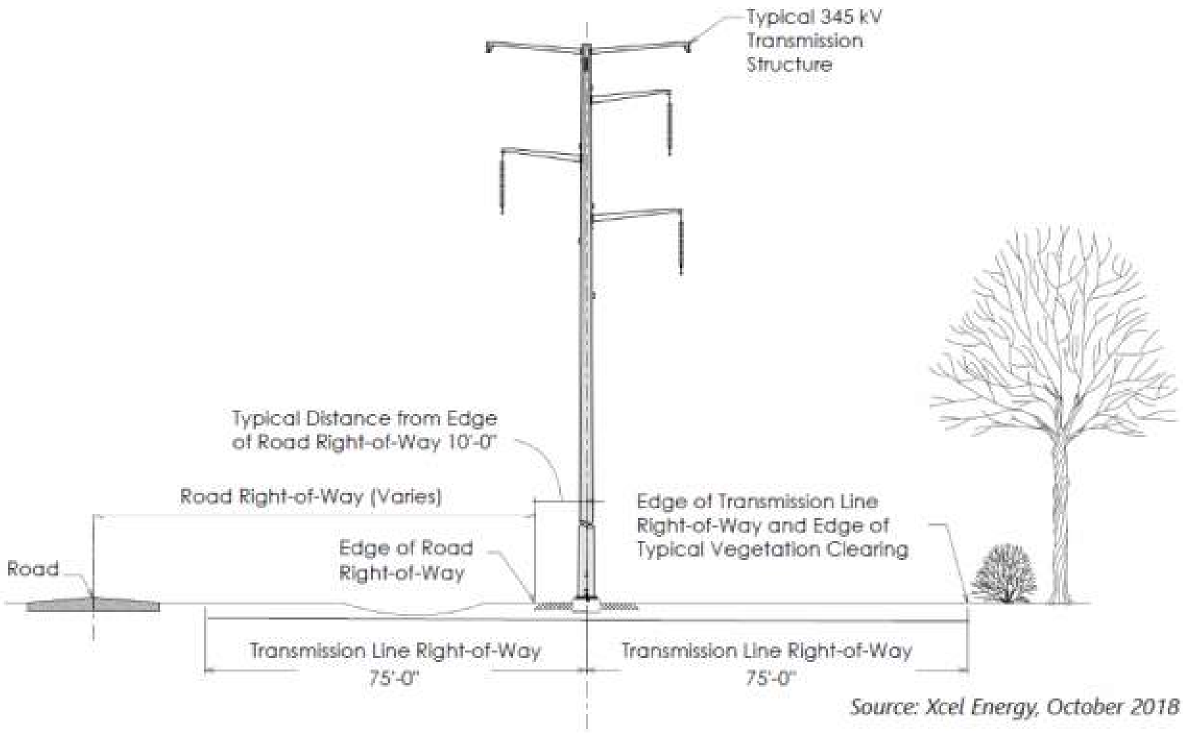
3.4.1 Right-of-Way Acquisition

For new 345 kV transmission lines, the applicants typically obtain ROW that is 150 feet wide (75 feet on each side of the transmission line centerline). Along the segment of the project from the Iron Range Substation to the Benton County Substation, the applicants would, where practicable, overlap the new 345 kV double-circuit transmission line ROW with existing high-voltage transmission ROWs for up to 30 to 40 feet. Along the segments of the project from the Benton County Substation to the new Big Oaks Substation and the Benton County Substation to Sherco Substation, the applicants do not anticipate it would be necessary to expand the existing ROW width. Instead, existing ROW is expected to adequately accommodate the project's ROW requirements, except near the Sherco Substation and the new Big Oaks Substation. New or modified ROW is anticipated near these two substations, 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 would still measure 150 feet).

The final ROW width would vary depending on factors such as proximity to or overlap with public road ROWs (Figure 3-5), transmission line structure types, transmission line structure locations relative to existing or future improvements, etc. Modifications to the ROW width acquired and/or utilized would be made on a case-by-case basis.

Figure 3-5 Schematic of Structure Placement along Roadways

Where possible, structures will be placed about 10 feet outside of the road right-of-way.



Source: Xcel Energy, October 2018

The applicants' proposed route largely follows existing high-voltage transmission line ROW; the applicants have existing easement rights for these existing lines. To accommodate the new construction and proposed rebuilds and reconfigurations when additional or different land rights are required, the applicants would work with landowners to either secure those new or amended easement rights.

One of the first steps in the construction process is to acquire an easement from each of the landowners along the permitted transmission line route. Prior to contacting these landowners, the applicants would conduct a title search to identify all persons and entities that have a recorded interest in the affected real estate. Once ownership has been determined, a ROW agent would contact each landowner to discuss where the structure(s) would be located on the property, as well as the easement boundaries. The proposed transmission line location could be staked with landowner permission.

The ROW agent would collect area land value data to determine the amount of just compensation to be paid for the rights to construct, operate, and maintain the transmission line in the easement. Based on this data, a fair market value offer would be developed, necessary documents to acquire the easement would be prepared, and an offer made to the landowner.

If a negotiated settlement could not be reached with a landowner, the applicants may acquire an easement by exercising the power of eminent domain pursuant to Minn. Statute 117. The process of exercising the power of eminent domain is called condemnation.

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

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

There may be instances where a landowner elects to require the applicants to purchase their entire property rather than acquiring only an easement for the transmission facilities. The landowner is granted this right under Minn. Statute 216E.12 This statute, sometimes referred to as the “Buy-the-Farm” statute, applies only to transmission lines with a voltage of 200 kV or more and to properties that meet certain other criteria; thus, this statute could apply to many of the properties crossed by 345 kV transmission lines where new easements are being acquired by the applicants.

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

3.4.2 Right-of-Way Access

The applicants would evaluate construction access opportunities by identifying existing transmission line easements, roads, or trails adjacent to the permitted route. Where feasible, the applicants indicate that they would limit access and construction activities to the ROW acquired for the project to minimize impacts to landowner and adjacent properties (reference (6)). In some situations, private field roads, trails, or farm fields may be used to gain access to construction areas. Where no current access is available, where existing access is inadequate, or when access requires incorporation of areas outside the ROW, permission from landowners would be obtained prior to using any of these areas to access the ROW for construction.

Improvements to existing access or construction of new access could be required to accommodate construction equipment. Where applicable, the applicants would obtain permits for new access from local road authorities. The applicants would also work with appropriate road authorities to ensure proper maintenance of roadways traversed by construction equipment.

3.4.3 Equipment and Staging Areas

Construction activities would require the use of many different types of equipment, including, but not limited to, tree removal equipment, mowers, cranes, backhoes, line trucks, drill rigs, dump trucks, front-end loaders, bulldozers, flatbed trucks, concrete trucks, helicopters, cranes, and various trailers for hauling equipment. Excavation equipment is often set on wheel or track-driven vehicles. Where possible, construction crews would use equipment that minimizes land impacts.

Construction staging areas would be required for the project and would be identified after a route is permitted. To the extent practicable, staging areas would be located on previously disturbed sites and would be used as receiving locations for delivery and storage of construction materials and equipment until they are needed for the project. Preferable staging areas would be large enough to lay down material and pre-assemble certain structural components or hardware. For staging areas outside the project ROW or not located on property owned by the applicants, rights to use these areas would be obtained individually from the affected property owner or agency.

3.4.4 Construction Process

Construction for the project would begin once all required approvals are obtained, property and ROWs are acquired, and final design is complete. Approximately 75-150 construction workers would be required to build the project, depending on sequencing and timing. Project construction would be comprised of two phases. The first phase would include tree clearing in the Iron Range Substation region, Hill City to Little Pine region, Cole Lake-Riverton region, Long Lake region, Morrison County region, and the Benton County Elk River region. In the Sherburne County region, the first phase would consist of removing the existing transmission lines. The applicants would carefully plan this work to maintain service to customers. The transmission lines in the Sherburne County Region would be taken out of service for construction and placed back into service sequentially so as not to have the two lines out at the same time.

The second construction phase would involve structure installation and stringing of conductor wire. The applicants would employ standard construction practices developed from experiences with past projects in addition to industry-specific BMPs. BMPs address ROW clearance, erecting transmission line structures, and stringing transmission lines.

Most project structures would require a drilled pier concrete foundation, which requires excavation of a hole to place the foundation (Photo 3-2). The size of the hole needed to place the foundation is approximately eight feet in diameter for a 345 kV double-circuit transmission structure foundation and 25 feet, or more, deep (Photo 3-3). 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 depend on structure design and soil conditions.

Photo 3-2 Drilling a Hole for a Structure Foundation

The diameter and depth of the hole depend on structure design and soil conditions
Source: reference (7)

Photo 3-3 Finished Structure Foundation

Structure foundations are typically 4 to 10 feet in diameter
Source: reference (7)

Once foundations are constructed, structures are moved from staging areas and delivered to the foundations. Structures are then lifted into place with a crane and bolted to the foundations (Photo 3-4). Insulators and other hardware are then attached. Once structures are in place, conductors are strung. The applicants would 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 an 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. Where conductors cross streets, roads, or highways, temporary guard or clearance poles would be used to ensure that conductors do not obstruct or otherwise interfere with traffic. Conductor-marking devices such as bird flight diverters would be installed, as necessary, once conductors are in place.

Photo 3-4 Erecting Structure with a Crane

Structures are assembled before being lifted into place with a crane.
Source: reference (7)

Some soil conditions may require that construction mats be placed along the ROW or at a pole location to minimize soil disturbances. These mats can also be used to provide access across sensitive areas to minimize impacts such as soil compaction, rutting, or damage to plant species. When spanning sensitive areas is not feasible, one or more of the following practices may be required by the Commission's route permit to minimize impacts:

- Constructing during frozen ground conditions.
- Using construction mats when winter construction is not possible and wetlands and other sensitive areas could be impacted.
- Avoiding equipment fueling and maintenance activities in or near environmentally sensitive areas.

- Implementing BMPs such as use of silt fences, bio logs, erosion-control blankets embedded with seeds, and other measures. These measures would be outlined in the Stormwater Pollution Prevention Plan (SWPPP) being developed by the applicants for the project.

3.4.5 Restoration and Cleanup Procedures

The applicants indicate that construction crews would attempt to minimize ground disturbance to the extent feasible; however, some disturbance is anticipated during the normal course of construction (reference (6)). The applicants indicate that once construction is completed in an area, disturbed areas would be restored to their original condition to the maximum extent feasible (reference (6)). In accordance with MPCA construction stormwater permit requirements, temporary restoration before the completion of construction in some areas along the ROW could be required.

Once construction is complete and restoration activities have commenced, the landowner would be contacted to discuss any damage that occurred due to project activities. If fences, drain tile, or other property have been damaged, the applicants note that they would repair the damages or provide the landowner reimbursement for repairs (reference (6)). In some cases, an outside contractor may be hired to restore the damaged property as near as practicable to its original condition.

Construction activities on agricultural land would be conducted in accordance with an AIMP approved by the MDA. The applicants indicate that farmers would be compensated for damage to crops resulting from construction (reference (6)). The damaged area would be measured, and yield would be determined in consultation with the farmer and paid at current market rates. The applicants would also make payments for future year crop loss from soil compaction. In addition, the applicants note that farmers would be compensated for their expense in deep ripping, which involves the use of equipment with strong, deep working tines that penetrate compacted soil to mechanically break up the soil in heavily compacted areas. If a farmer does not have access to deep-ripping equipment, the applicants indicate that they would provide this service (reference (6)).

It is anticipated that the ground-level vegetation disturbed or removed from the ROW would naturally reestablish to pre-construction conditions. In areas where soil compaction or other construction-related disturbances impair reestablishment, the applicants indicate that they would reseed these areas with seed free from noxious weeds to promote vegetation reestablishment (reference (6)). Vegetation that is consistent with substation site operation outside the fenced area would be allowed to reestablish naturally at substation sites.

3.4.6 Maintenance Procedures

The project would be designed and maintained in accordance with the NESC and the applicants' standards. In general, transmission lines boast exceptional reliability and lengthy estimated service lives often spanning decades, and seldom undergo complete retirement. This type of infrastructure has very few mechanical elements and is designed and constructed to withstand weather extremes typical of the region.

Transmission lines and substations are engineered to function for decades, demanding only moderate maintenance throughout their operational lifespan. The applicants would be responsible for the operation and maintenance of the project, performing aerial and ground inspections annually, addressing and correcting any deficiencies identified during these examinations. Applicant inspections would be limited to the ROW and to areas where obstructions or terrain may require off ROW access.

The ROW would be managed to control encroachment that may interfere with transmission line operation, including vegetation management activities. The applicants would perform vegetation management activities within the ROW, including mechanical clearing, hand clearing, and herbicide application.

A certain amount of maintenance would be required at substations to ensure proper operation within NESC and NERC standards. Transformers, circuit breakers, batteries, protective relays, and other equipment would need to be serviced periodically in accordance with the manufacturer's recommendations. The substation site must be kept free of vegetation, and adequate drainage must be maintained.

3.5 Project Costs

The total project cost is estimated to be between $970 million and $1.35 billion (based on 2022 dollars), depending on the route and design options selected (Table 3-2). If a route other than the applicants' proposed route is selected, or non-standard construction conditions are imposed, the applicants indicate that the project cost estimate may change (reference (6)). The costs associated with specific route and alignment alternatives are discussed in Chapters 6 and 7.

Table 3-2 Project Cost Estimate – Applicants' Proposed Route

Project Component	Low ($Millions) (2022$)	Mid ($Millions) (2022$)	High ($Millions) (2022$)
Iron Range 500 kV/345 kV Substation Expansion	$70.4	$95.0	$108.9
Iron Range – Cuyuna 345 kV Double-Circuit	$312.0	$368.1	$420.7
Cuyuna 345 kV Series Compensation Station	$80.0	$99.3	$113.9
Cuyuna – Benton County 345 kV Double-Circuit	$312.0	$336.6	$384.7
Benton County 345 kV Substation Expansion	$25.5	$31.4	$36.0
Benton County – Big Oaks 345 kV Double-Circuit	$97.6	$133.9	$153.0
Benton County – Sherco 345 kV Line	$72.4	$92.8	$106.1
Realignments and Reroutes	-	$17.0	$19.5
Asset Retirements	-	$8.5	$9.8
Project Cost Totals	$970	$1,182	$1,353

Project operation and maintenance costs would consist of three components: the new transmission lines; substation expansions; and new compensation station. Operation and maintenance costs for the new transmission lines would rely on controlling regrowth of vegetation within the ROW. The applicants estimate that this would cost approximately $7,500 per mile per year. Additional operation and maintenance costs associated with the transmission line would vary based on the location of the line, number of trees located along the ROW, age and condition of the line, voltage of the line, and other factors. The operation and maintenance costs for substation expansions would include inspections to maintain and repair equipment, compliance inspections, vegetation removal, and drainage maintenance. Minnesota Power's substation maintenance costs typically range from $50,000-$100,000 annually. GRE'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 and would require additional operation and maintenance, therefore the costs are anticipated to be approximately $175,000 annually.

3.6 Project Schedule

It is anticipated that the Commission will make decisions on the applicants' CN and route permit application in late 2024. Land acquisition would begin in spring 2025, with construction expected to begin in summer/fall 2025. The project is expected to be in service by June 2030.

4 Alternatives to the Proposed Project

The project is one possible solution to provide voltage support, improve system strength, and provide local sources of power delivery in northern and central Minnesota. This chapter evaluates alternatives to the project that may also address this problem. These alternatives are known as system alternatives. As described in Chapter 2, the Commission must determine whether the project is needed or if another project would be more appropriate for Minnesota. For example, a project that connects different endpoints (substations). This chapter discusses the following system alternatives:

- No-build Alternative
- Alternative Endpoints
- Upgrading Existing Facilities
- Generation and Non-Wire Alternatives
- Alternative Voltages
- Alternative Number, Size, and Type of Conductor
- Direct-Current (DC) Alternatives
- Underground Alternative

This chapter discusses whether these system alternatives are feasible (whether they can be engineered, designed, and constructed) and available (whether the alternative is readily obtainable and at the appropriate scale) and, if so, whether they can meet the project need (Chapter 1.1). Additionally, this chapter discusses the potential human and environmental impacts of the alternatives.

4.1 No-Build Alternative

Under the no-build alternative, the project would not be constructed, and all other electrical transmission facilities would remain as is. The no-build alternative is feasible and available but would not meet the need for the project.

The no-build alternative does not address reliability and stability issues in northern and central Minnesota. Reliability issues are highest in the winter months when the need for electricity is highest in northern Minnesota. Because the project was evaluated and optimized by MISO as part of a broader regional portfolio, the reliability risk implications also extend beyond Minnesota (reference (2)). The project is needed to maintain regional reliability as utilities and Minnesota add new clean energy resources and modify the way they use existing fossil-fuel plants (reference (2)). Thus, the no-build alternative does not meet the need for the project.

4.1.1 Human and Environmental Impacts

There would be no direct human or environmental impacts resulting from this alternative. The no-build alternative would avoid the potential impacts of the project, as they are described in Chapters 5 and 6.

4.2 Alternative Voltages

Under this alternative, the project need would be met by a transmission line of a different size (i.e., a line with a voltage other than 345 kV). The discussion here proceeds in two parts—first discussing voltages lower than 345 kV and then voltages greater than 345 kV.

In general, transmission lines with voltages other than 345 kV are feasible and available and could meet the need for the project, at least in part. Voltages less than 345 kV either do not meet the need for the project or do not meet the need as well as the proposed 345 kV line. Alternatives with voltages greater than 345 kV are anticipated to have greater costs and impacts than the project.

4.2.1 Lower Voltage Alternatives

There are two possible voltages lower than 345 kV that could be used for the project that would involve local transmission systems – 115 kV and/or 230 kV.

The voltage stability concerns mitigated by the project are caused by a potential outage of the Forbes – Chisago 500 kV Line. Any alternative would need to establish an electrically parallel path that would stay in service when the Forbes – Chisago 500 kV Line is lost. For any solution to be effective in mitigating these voltage stability concerns, the applicants' studies have found that the solution must have a similar electrical impedance to the Forbes – Chisago 500 kV Line.

To achieve the required electrical impedance and be able to accommodate the necessary power transfer levels, the applicants' analysis indicates multiple 230 kV or 115 kV lines (circuits) would be needed. A 230 kV alternative would require more than five individual circuits, while a 115 kV alternative would require more than 22 individual circuits. The increase in the total number of new transmission line rights-of-way for the 230 kV and 115 kV alternatives would create human and environmental impacts greater than those for the proposed project. Based on this analysis, lower voltages such as 230 kV and 115 kV could meet the need for the project but would have greater human and environmental impacts. Thus, they are not a more reasonable or prudent system alternative.

4.2.2 Higher Voltage Alternatives

There are two possible higher voltages that could be used for the project – 500 kV and 765 kV.

There are currently no 765 kV transmission lines in the MISO region north and west of Illinois. Because of this, 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 ROW requirements for a higher voltage line, the total costs, impacts, and operational complexity would be substantially greater than those for a 345 kV line. The applicants assessed the current and future needs of the region and concluded that a double-circuit 345 kV line provides a greater degree of capacity, expandability, and long-term flexibility when compared to a 765 kV transmission line.

The applicants considered a 500 kV alternative to match the electrical impedance of the existing Forbes – Chisago 500 kV Line (described in Chapter 4.2.2). The Northern Minnesota Beyond Baseload Study (references (8); (9)) and MISO also considered a 500 kV alternative. In evaluating a single-circuit 500 kV alternative, the applicants found the proposed double-circuit 345 kV configuration 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 has a slightly higher cost with less redundancy and flexibility. Double-circuit 345 kV was selected for the project due to the redundancy benefits of the double-circuit configuration compared to a single-circuit alternative and the increased flexibility for future expansion and interconnection as the needs of the local and regional grid continue to evolve. Given similar performance and higher near-term cost, the applicants concluded that higher voltages such as 765 kV and 500 kV are not a more reasonable or prudent project alternative.

4.2.3 Human and Environmental Impacts

The types of human and environmental impacts from alternative voltage transmission lines would be similar to those of the project. Similarities would include aesthetic, agricultural, and natural resource impacts, with impact differences determined by rights-of-way, structure types, and associated facilities (e.g., transformers).

A lower voltage transmission line alternative would have substantially more human and environmental impacts than the proposed project due to the increase in number of circuits needed for a 230 kV or a 115 kV line. This increase in circuits would also increase the total number of new transmission line rights-of-way and would affect more properties along these rights-of-way.

Aesthetic and agricultural impacts have the potential to be greater with a 500 kV or 765 kV line. The lattice structures are more visible on the landscape and the structures have a much larger footprint. Though they may be in a smaller number of fields due to larger spans, the structure's impact on each field would be greater than a 345 kV structure.

4.3 Alternative Endpoints

It's possible that the project need could be met with substation endpoints other than the Iron Range and Benton County substations (i.e., alternative endpoints). The applicants' initial alternative endpoint analysis was combined with the evaluation of the 500 kV alternative voltage as part of the Northern Minnesota Beyond Baseload Study (references (8); (9)).

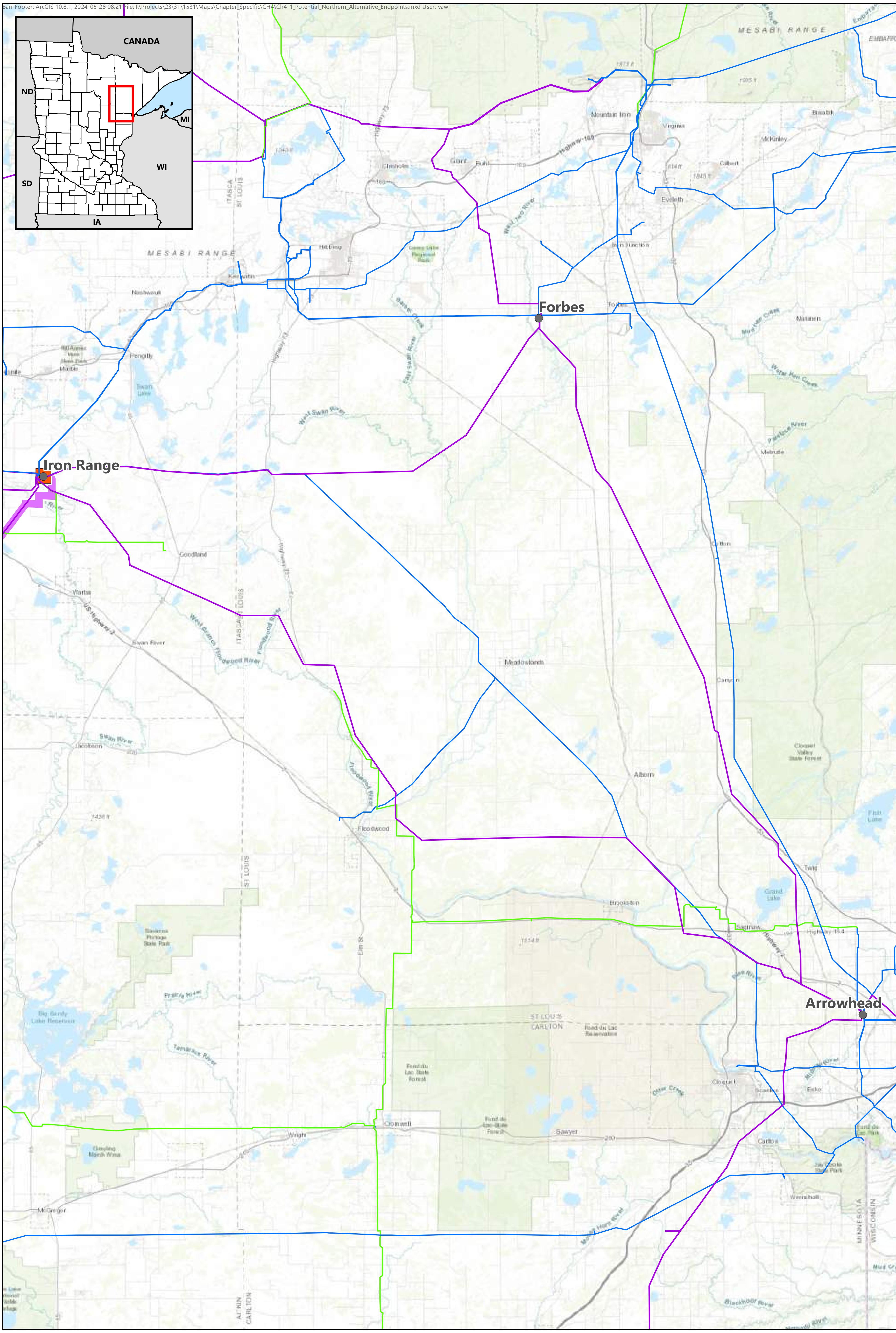
To be effective in mitigating voltage stability concerns, any alternative transmission solution must provide a new electrical connection parallel to the Forbes – Chisago 500 kV Line. This means that alternative endpoints must be situated similarly to the Forbes – Chisago 500 kV Line, with one end in northern Minnesota and the other end interconnecting to the existing 345 kV transmission backbone that connects 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 Chapters 4.3.1 through 4.3.3, alternative endpoint evaluation is discussed in two parts: 1) alternative northern endpoints and 2) alternative southern endpoints.

4.3.1 Alternative Northern Endpoints

Alternatives for the project's northern endpoint are based on the assessment discussed in Chapter 4.2.1, where the analysis supports excluding lower voltage alternatives. As a result, all northern alternative endpoints must start at an existing 500 kV or 345 kV substation. This narrows the list of alternatives to three – the Forbes 500 kV Substation, the Arrowhead 345 kV Substation, and the Iron Range 500 kV Substation (Map 4-1).

The Forbes 500 kV Substation presents geographic diversity and single point of failure concerns. 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 if it connected at Forbes. Using this substation as the northern endpoint would not meet the basic reliability and resiliency needs. The Arrowhead 345 kV Substation would require construction of additional ties between the substation and the transmission system on the Iron Range to comprehensively address project needs. The Iron Range 500 kV Substation 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.

Northern Minnesota does not have any other substations that offer existing 345 kV or above infrastructure. The applicants concluded that the Iron Range 500 kV Substation is the only reasonable northern endpoint that would meet the needs of the project (reference (2)).



Applicants' Proposed Route

Iron Range Substation

Alternative Endpoint

Electric Transmission Line Voltage

69 kV

115 kV / 161 kV

230 kV

345 kV

400 kV

0 2 4 6

Miles

Map 4-1

POTENTIAL NORTHERN ALTERNATIVE ENDPOINTS

Northland Reliability Project

4.3.2 Alternative Southern Endpoints

There are several alternatives for the project's southern endpoint (Map 4-2). 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 a broader geographic area to consider for southern alternative endpoints, as they simply need to connect into the existing 345 kV transmission system serving the Twin Cities. Potential southern alternative endpoints considered for the project are as follows:

- The Chisago 500 kV/345 kV Substation
- The Bison (Fargo) 345 kV Substation
- The Alexandria 345 kV Substation
- The Arrowhead 345 kV Substation
- The Monticello 345 kV Substation
- The Sherco 345 kV Substation
- The proposed Big Oaks 345 kV Substation
- The Benton County 345 kV Substation

The Chisago 500 kV/345 kV Substation alternative raises concerns about geographic diversity and single points of failure. This would result in failure to meet basic reliability and resiliency needs of the project (reference (6)).

The Bison (Fargo) 345 kV Substation, Alexandria 345 kV Substation, and Arrowhead 345 kV Substation all fail to resolve the basic voltage stability needs addressed by the project without additional modifications or improvements (reference (6)).

The Monticello 345 kV Substation alternative would require a new transmission line on new ROW to connect to the Benton County Substation. It would also require establishing a new Mississippi River crossing, developing two new 345 kV line terminals and large oil-filled shunt reactors to meet project needs. In view of all of these practical considerations, the applicants determined that the Monticello Substation is not a more reasonable or prudent alternative endpoint for the project (reference (6)).

The Sherco Substation was considered 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. Direct connection from the Iron Range Substation to the Sherco Substation would require a new transmission line on a new ROW from the Benton County Substation to the Sherco Substation, as opposed to replacing structures in existing transmission line rights-of-way. As a result, the applicants determined that establishing a direct connection from the Iron Range Substation to the Sherco Substation is not a more reasonable or prudent alternative for the project (reference (6)).

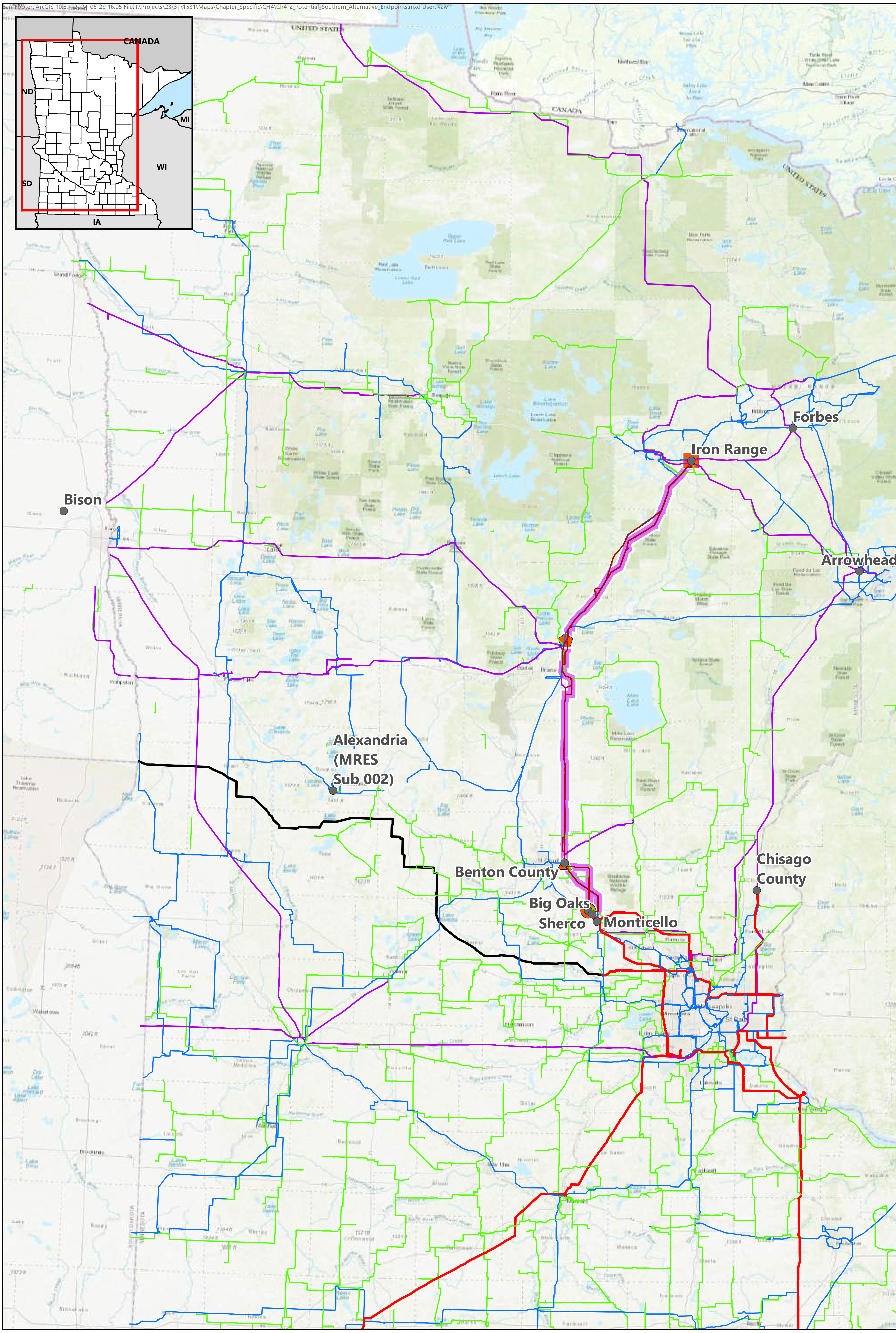
The Big Oaks 345 kV Substation is proposed as part of MISO LRTP Project #2, the Alexandria to Big Oaks 345 kV Transmission Project (PUC Docket Nos. ET10/TL-23-159 & E015/CN-22-538; OAH Docket No. 25-2500-39723). This alternative meets the need to provide additional outlet capability south of the Benton County Substation. Constructing a new double-circuit 345 kV line on existing transmission line

ROW from the Benton County Substation would strengthen the connection between the project and the Twin Cities area 345 kV backbone network. Therefore, the applicants concluded that the Big Oaks Substation was a reasonable southern alternative endpoint for the project after first interconnecting at the Benton County Substation (reference (6)).

The Benton County 345 kV Substation meets the project needs in four major areas: shunt reactor considerations; series compensated line considerations; practical routing and environmental considerations; and future flexibility. This alternative would shorten 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. The applicants determined that including the Benton County Substation interconnection with the project would provide added redundancy, improve resiliency, and increase local load-serving capacity to the St. Cloud area. The applicants concluded that including the interconnection to the Benton County Substation as part of the design of the southern endpoint was a reasonable and prudent option for the project (reference (6)).

4.3.3 Human and Environmental Impacts

The human and environmental impacts of the alternative endpoints vary. All the alternatives are 345 kV lines that proceed across predominantly agricultural landscapes. Assuming that many impacts could be mitigated through prudent routing, the differences in impacts would likely be related to the lengths of the lines. For example, relatively longer 345 kV lines would have relatively greater impacts. Ultimately the length of the project with the Benton County Substation endpoint is 20 miles shorter than the other alternatives. The lengths of the other 345 kV substation endpoint alternatives are similar to or longer than the project.



Map 4-2

POTENTIAL SOUTHERN ALTERNATIVE ENDPOINTS

Northland Reliability Project

4.4 Upgrading Existing Facilities

Existing facility upgrades considered for the project included additional dynamic reactive power additions (assumed to be Static Synchronous Compensators [STATCOMs], which are fast-acting devices that can provide or absorb reactive current and regulate voltage at the point of connection to the power grid (reference (10)), additional capacitor banks, and rebuilding overloaded transmission lines to a higher capacity. These upgrades were considered because they address the primary project needs by resolving regional reliability constraints resulting from baseload generator fleet transition.

These upgrades were developed in an iterative fashion to resolve voltage stability and transmission line overload constraints that would follow with the hypothetical loss of the Forbes – Chisago 500 kV Line in the most limiting case.

Where the voltage stability limit was reached and a voltage collapse occurred, a STATCOM was placed at the place 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 location 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.

The resulting existing system upgrades alternative included 2,350 megavolt-ampere (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 estimated cost for these upgrades to be at least $1.2 billion (reference (11)).

In addition to a higher cost than the project, the amounts of reactive resource additions needed to control voltage would create additional transmission system operational complexity. Heavy reliance on reactive resource additions also makes it challenging to anticipate voltage stability issues in real-time operations. In addition to operational complexities, constructability is another concern – it would require extended outages on 18 individual transmission lines as well as shorter outages at the 35 individual substations to integrate reactive resource additions.

Lastly, the existing facility upgrades described in Chapter 4.4.1 and 4.4.2 do not allow for 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, the applicants concluded that upgrading existing facilities, including reactive resource additions and transmission line upgrades, is not a more reasonable or prudent alternative to the project (reference (6)).

4.4.1 Double-Circuiting and Other Engineering Considerations

Double-circuiting is the construction of two separate transmission circuits on the same structure. Placing two transmission circuits on common structures generally reduces ROW 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.

As most of the project would be constructed adjacent to existing transmission lines, the applicants also considered triple-circuit structures to further reduce ROW requirements. Triple-circuiting is the construction of three transmission circuits on a common structure. Triple-circuiting is typically only used in limited applications due to reliability, resiliency, cost, and safety implications. Reliability standards established by NERC require that the planned transmission system be able to withstand potential contingencies – including the loss of a common structure. The triple-circuit 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 (reference (6)).

Triple-circuit structures were evaluated as an alternative, including with the existing 230 kV lines that are adjacent to the project for most of its length. Triple-circuit 345 kV/345 kV/230 kV structures are not a feasible 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.

The applicants found triple-circuiting to be a feasible option for the project along approximately ten miles of 345 kV/345 kV/69 kV triple-circuit structures in the Sherburne County Region. This is a distinct circumstance compared to potentially triple-circuiting other areas of the project because the system configuration in this area can withstand the potential loss of a common tower and still meet reliability standards. 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 portion of the project.

The applicants also considered replacing existing facilities with the proposed double-circuit 345 kV line. The project in the Sherburne County Region would replace existing facilities to minimize the need for new ROW. In the northern portion of the project, 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 feasible 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. 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 to the cost of the project.

Additionally, 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 existing transmission lines. Crossing high-voltage transmission lines increases resiliency risk, because if 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 line crossings creates a safety risk, as under normal operating conditions one line must remain energized while work is occurring on the other line. To cross existing transmission lines, structure height of the line that is crossing the existing line must also be increased. For the new transmission line, the lowest conductor is driven by clearance to ground. When crossing over an existing line, the height of the lowest conductor is driven by clearance between it and the top of the tallest wire on the existing line. As a result, new towers that cross existing lines are taller than standard transmission lines, introducing additional concerns such as FAA height clearance restrictions and safety concerns (reference (12)). Therefore, where practical, new lines are designed to minimize crossing existing transmission lines.

Most of the northern portion of the project is routed adjacent to an existing 230 kV line. In certain places along the route, it was less impactful to route on the west side of the existing 230 kV line and in other places on the east side. To route the line to both minimize impacts and to avoid crossing the existing transmission line multiple times (creating reliability and safety risks), the project would realign placement of the existing transmission line. For example: the northern portion of 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 of the project, 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.

4.4.2 Human and Environmental Impacts

The potential human and environmental impacts of upgrading existing facilities would be limited to construction impacts related to replacing existing infrastructure, but in most cases this alternative does not meet project needs. The impacts of double and triple-circuiting would vary in the type and extent of impacts due to differences in structure heights and spans.

4.5 Generation and Non-Wire Alternatives

There are various generation and non-wire project alternatives, including new peaking generation, distributed generation, renewable generation, battery energy storage, demand-side management, and reactive resources. These alternatives must be able to resolve regional reliability constraints resulting from baseload generator fleet transition, specifically voltage stability and other related concerns. Comprehensive project alternatives should also support an increase in renewable energy. These needs are more complex to assess. Most alternatives were screened first according to their effectiveness, to address the underlying voltage stability issues.

To address the voltage stability issues, the operational characteristics of any generation or non-wires alternative must reduce transfer on the northern Minnesota (NOMN) Interface enough to prevent voltage collapse due to loss of the Forbes – Chisago 500 kV Line. Transfer levels can 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 (Table K-1 in Appendix K of (reference (13)).

In the applicants' most recent analysis, the NOMN Interface, including the required stability margin, is 1,788 MW. With Minnesota Power's Boswell Energy Center (BEC) units offline, the NOMN Interface transfer level during the most limiting system conditions was calculated to be 2,562 MW using a 2031 Winter Peak model. To reduce NOMN Interface 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 (reference (6)).

4.5.1 Peaking Generation

The applicants' considered peaking generation as a project alternative. The peaking generation alternative would be 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 for peaking generation. The first option would be to install several banks of small reciprocating internal combustion engine (RICE) generators throughout northern Minnesota, which would require 100 or more individual RICE units (estimated to cost $2.2 billion total) (reference (11)). The second option would be to install larger natural gas combustion turbine (CT) generators at a handful of locations in northern Minnesota, which would require three to five new CTs (estimated to cost approximately $850 million to 1.3 billion total) (reference (11)). The third configuration option 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 $1.2 billion) (reference (11)).

The three solutions are feasible alternatives and would potentially bring additional benefits to the energy supply portfolio. However, they do not meet carbon dioxide (CO_2) emission reduction, renewable integration, or regional transfer capability needs addressed by the project (reference (6)). They also cannot directly provide the comprehensive regional benefits identified by MISO in the LRTP Tranche 1 Portfolio analysis (reference (6)). Additionally, 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.

4.5.2 Distributed Generation

The applicants considered distributed generation as a project alternative. Distributed generation, in this context, means dispatchable generation that is connected to the local distribution system and can run continuously when called upon, most likely on natural gas or other fossil fuels. Renewable distributed generation and battery energy storage are also possibilities. Fossil-fueled distributed generation has the same fundamental limitations as transmission-connected peaking generation discussed in Chapter 4.5.1, and likely at a greater cost due to the number of smaller generators in diverse locations that would be required. Fossil-fueled distributed generation also does not meet CO_2 emission reduction, renewable integration, or regional transfer capability needs addressed by the project. Therefore, the addition of new fossil-fueled distributed generators is not a more reasonable and prudent alternative to the project.

4.5.3 Renewable Generation

The applicants considered renewable generation, either solar or wind generation, as a project alternative. The renewable generation could be interconnected at a single location on the transmission system or at multiple locations on the transmission or distribution system. To adequately 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 gross capacity of each of these generation sources would need to be added.

Power from renewable generation 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 feasible system alternative. 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 (reference (6)).

4.5.4 Purchased Power

The applicants considered a purchased power alternative, where electrical power would be purchased from existing generation sources, rather than constructing a new generating facility. Purchased power is similar to power generation as discussed in Chapters 4.5.1, 4.5.2, and 4.5.3; however, with purchased power, the energy would come from what is currently available on the MISO grid as opposed to a specifically generated type of power. As detailed in the March 2024 MISO monthly operations report (reference (14)), 2024 energy fuel sources include 10 Terawatt hours (TWh) from coal generation, 19 TWh from hydro generation, 11 TWh from wind generation, 7 TWh from nuclear generation, 1 TWh from gas generation, and 1 TWh from solar generation. Purchased power has an increased cost risk because of the variability of the MISO market.

This alternative is feasible and available but does not meet project need. Purchased power would not connect Minnesota customers to the larger pool of renewable energy that is currently available in the Upper Midwest, because it would rely instead upon purchasing the power that is available on any given day from the MISO grid. This alternative would also not meet the project’s need to create stable and reliable energy. Therefore, the use of purchased power is not a more reasonable and prudent project alternative.

4.5.5 Energy Storage

The applicants considered energy storage, both by itself and combined with new renewable generation, as a system alternative. The energy storage alternative would need a battery or some other energy storage technology capable of being charged and discharged when called upon for as long as there is sufficient energy available. 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.

To provide adequate energy storage, a 7,840 MWh battery would be required. The CPLANET tool, created by the Electric Power Research Institute (EPRI), was used by the applicants to find optimal battery placement to address thermal overloads under varying conditions and address thermal issues as a proxy for voltage stability issues, since the two are closely tied in the project (reference (6)). 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 concerns to an acceptable standard. To alleviate the remaining voltage violations, 500 MVAR of STATCOM 68 would be needed 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. Any longer-duration storage solutions would be significantly more costly to implement.

The applicants utilized the Department of Energy's 2022 Grid Energy Storage Technology Cost and Performance Assessment (reference (15)) to estimate the cost of the 6,400 MWh energy storage solution. A lithium-ion LFP energy storage solution with a rated instantaneous charge/discharge of 800 MW and an energy rating of 6,400 MWh would cost an estimated $2.1 to $2.5 billion. The additional STATCOMs required to maintain voltage stability would be an additional cost of $100 million (reference (16)). The total energy storage solution cost would be $2.2 to $2.6 billion, which is approximately two times the cost of the project.

This alternative solution would not mitigate issues to the same level as the project, and any combination of energy storage and STATCOM would be substantial in both size and cost. Therefore, the addition of new energy storage in northern Minnesota is not a more reasonable and prudent project alternative.

4.5.6 Demand Side Management and Conservation

The applicants considered demand-side management, which would consist of using less electricity or conserving electricity, as an alternative. Common examples include using LED light bulbs or high-efficiency air conditioners. Other examples include Xcel Energy's Saver's Switch program which cycles air conditioners on and off during times of peak electrical load (reference (6)). It would be 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 efficiency rebates. Although conservation programs would continue to be implemented in the project area to encourage efficient use of electricity, these programs are insufficient to reach the significant levels of load reduction (reference (6)). For these reasons, solutions involving demand-side management and conservation alone are not a more reasonable and prudent project alternative.

4.5.7 Reactive Power Additions

The applicants considered non-wire alternatives that would implement additional reactive power additions to support the area and prevent voltage collapse. Reactive power additions are transmission technologies capable of providing reactive power and voltage support to the system. This would be done using traditional electromechanical devices (switched capacitor banks and reactors), flexible alternating-current (AC) transmission system devices (static VAR compensators 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 other generation and non-wire 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 project needs. This is because transmission lines on the NOMN Interface and the underlying system become overloaded at higher NOMN Interface transfer levels than are achievable with reactive power (reference (6)). Additional existing system upgrades described in Chapter 4.4 would also be required. For these reasons, solutions involving only reactive power additions are not a more reasonable and prudent system alternatives.

4.5.8 Human and Environmental Impacts

Potential impacts associated with generation and non-wire alternatives would depend on the type of generation. The peaking generation, distributed generation, demand side management and conservation and reactive power additions would impact humans by not meeting the project's need to create stable and reliable energy. Renewable energy and energy storage would not generate the capacity needed to meet the project's needs. Wind farms create potential aesthetic and noise impacts. They also have the potential to impact birds and bats, which can be struck by rotating turbine blades. Natural gas plants (and other plants that use carbon-based fuels) create potential air impacts, including the emission of greenhouse gases (GHGs) and the exacerbation of global warming. Such plants also have potential aesthetic and noise impacts and may have impacts on water resources and associated natural resources. Impacts of solar farms include the temporary but long-term loss of land that could be used for other purposes (e.g., agriculture, as well as aesthetic impacts).

4.6 Alternative Number, Size, and Type of Conductor

Conductors used for the project are subject to change based on a conductor optimization study that would be completed during detailed project design. The applicants are considering two potential conductor configurations 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. The T2-ACSR conductor generally has a higher capital cost than a typical 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 Minnesota.

Conductors are generally bundled together to optimize corona performance and cost effectiveness, particularly at 345 kV and above. While the conductor optimization study would consider single conductors, three-conductor bundles, and various sizes of conductors, it is expected these conductor configurations would not meet performance criteria. Single conductors are not expected to meet performance criteria for audible noise, electric fields, radio frequency interference, and they would result in higher losses. Three-conductor bundles are not expected to have 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.

Utilizing larger conductors can reduce transmission losses; however, this long-term savings must exceed the initial cost increase to be considered as a feasible 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 designed to pinpoint the most advantageous project conductor configuration(s). The analysis will entail comprehensive technical and economic factors, considering various conductor sizes and configurations in light of mechanical and electrical performance criteria, long-term losses, and initial capital costs.

4.6.1 Human and Environmental Impacts

Conductors are a required component of the project, and the optimal conductor configuration will be determined following completion of the conductor optimization study. The human and environmental impacts of the conductors would vary with the number of conductor bundles. Impacts could include noise, electric fields, and radio frequency interference; however, all of these impacts are anticipated to be minimal. Outside of these, impacts would be similar to those of the project.

4.7 Direct-Current Alternatives

HVDC lines are typically proposed for transmitting large amounts of electricity over long distances. HVDC line losses are significantly less over long distances than an AC line. HVDC lines require conversion stations at each delivery point because the 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. HVDC lines are typically proposed for large regional transmission projects that involve hundreds of miles of new transmission line. HVDC becomes a cost-effective alternative to AC transmission when the total line length is greater than 350-400 miles (reference (6)).

Because the total length of the project is around 180 miles, HVDC would add significant costs to the project. 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. As a result, the applicants determined that there is no justification in terms of reliability, economy, or performance for an HVDC line (reference (6)).

4.7.1 Human and Environmental Impacts

An HVDC line transmission line would have human and environmental impacts similar to the proposed project.

4.8 Underground Alternative

Undergrounding is an alternative that is seldom used for high-voltage transmission lines like those proposed for the project. One of the primary reasons is that they are significantly more expensive than overhead lines. The construction cost of locating the entire length of the project's proposed transmission underground is estimated to be as much as 5 to 10 times greater per mile than if it were to be constructed overhead (reference (17)). 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. 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 transmission line. This would further increase the total additional cost of building an underground line instead of an overhead line.

Beyond initial costs, another important consideration of undergrounding high-voltage transmission lines is consistency with existing lines and standards. The applicants do not have any buried lines at voltages of 115 kV or 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. This would result in increased costs and possibly a reduction in inventory levels of other items, which then results in diminished maintenance and emergency restoration responsiveness and effectiveness.

Edison Electric Institute's study on the undergrounding of overhead power lines (reference (17)) examined six years of major storm events to determine what trends and impacts these events are having on the industry. They also looked at what type of reliability advantage undergrounding may provide to customers. Available reliability data indicates that underground electric infrastructure has only a slightly better reliability performance than overhead electric systems. Utility experience has shown that during a major outage event, the entire utility system is affected, not just the overhead system.

Underground lines can also be more challenging to operate and maintain. Overhead lines are typically subject to more frequent outages than underground cables, but service can usually be quickly restored by automatic reclosing of circuit breakers (reference (6)). Circuit breakers on underground lines are typically not reclosed until there is verification that a fault has not occurred on the underground cable. As a result, 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 ROW 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, and cost drawbacks of high-voltage underground transmission lines, undergrounding is not a more reasonable and prudent project alternative (reference (6)).

4.8.1 Human and Environmental Impacts

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 ROW must be cleared of vegetation. For overhead transmission, excavation work is concentrated at the structure foundations; however, for underground transmission, excavation work would be needed along the entirety of the line, similar to a pipeline. This results in increased impact due to ground disturbance, 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 ROW needs to continue to be free of all woody vegetation to reduce soil moisture loss, because high-voltage underground conductors make use of soil moisture for conductor cooling, as well as to minimize potential for tree/shrub roots to conflict with the buried line. A permanent road must also be maintained along the ROW for maintenance and repair.

4.9 System Alternatives Summary

A comparison of how each of the system alternatives meet the need of the project, minimize human and environmental impacts, and meet the MISO-approved cost for the project in part or in whole are shown in Table 4-1 and Table 4-2.

The project’s northern end point, the Iron Range Substation, and the project’s southern end points, the Sherco and Big Oaks Substations, best meet project needs and come closest to meeting the MISO-approved cost for the project. The project has been routed next to existing transmission lines and would be upgraded to double-circuiting where possible. The applicants found triple-circuiting to be feasible along approximately 10 miles of 345 kV/345 kV/69 kV triple-circuit structures in Sherburne County and have proposed such.

Analysis by MISO and the applicants indicates that transmission lines with voltages less than 345 kV either do not meet the project need or do not meet the need as well. The 500 kV alternative has slightly lower losses and slightly higher incremental transfer capability, but it also comes at a slightly higher cost with less redundancy and flexibility; ultimately the 500 kV alternative does not meet the project need.

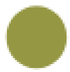
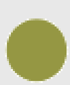
The no-build and demand side-management alternatives do not meet the project need. All of them are premised on not building the project. Not building the project would result in continued grid instability and reliability concerns. A combination of energy storage and renewable energy sources could meet part of the project need, but analyses by MISO and the applicants indicates that the magnitude of the size and cost would not meet the need as well as the project.

Undergrounding, while slightly more reliable than overhead transmission, would have a greater human and environmental impact on a project of this size. Undergrounding would increase project costs by five to 10 times.

Table 4-1 Guide to System Alternatives Summary Table

Consistency with System Alternative Characteristic	Color
Consistent	
Somewhat consistent or consistent in part	
Not consistent	

Table 4-2 Comparison of System Alternatives – Summary

System Alternative	Meets Stability and Reliability Needs	Costs Consist with MISO Analysis	Minimizes Human and Environmental Impacts	Summary
Northland Reliability Project				The project increases voltage stability and reliability in northern and central Minnesota. Impacts would depend, in part, on the route and structures selected for the project.
No Build		Not applicable		The no-build alternative does not meet stability and reliability needs. It would have no direct human or environmental impacts.
Transmission Line Voltage < 345 kV				Lower voltage transmission lines could meet the project need, but only with significant increase in structures, cost, and human and environmental impacts.
Transmission Line Voltage > 345 kV				Higher voltage transmission lines could meet the need for the project, with a higher costs and similar human and environmental impacts.
Alternative Endpoints				Alternative endpoints introduce reliability concerns for the project. Their benefits are anticipated to be less than the project. Impacts would be similar, depending on the route selected for the project.
Upgrading Existing Facilities				Upgrades to existing facilities would have operational complexities and constructability concerns, with a significant cost increase. The project is already proposed as a double circuit for most of its length.
Generation and Non-Wires				Generation and non-wire alternatives do not meet the project stability and reliability needs and generally have a significant cost increase. Renewable energy would meet project needs when combined with energy storage but would have a significant cost increase.
Alternative Number, Size and Type of Conductor				Alternative number, size and type of conductors could meet the project needs. There would be a significant cost increase, despite some long-term savings. Human and environmental impacts would be similar to the proposed project.
Direct-Current				Direct current alternatives would not be able to meet future transmission needs and would have significantly greater costs.
Underground				Undergrounding could meet project needs, but there would be a significant increase in cost. Human and environmental impacts would be more significant than the project.

5 Affected Environment, Potential Impacts, and Mitigation Measures

This chapter provides an overview of the human and environmental resources that could be affected by the project. It discusses the potential project impacts on these resources and the measures that could be used to avoid, minimize, and mitigate these impacts.

This chapter has two purposes. First, it provides the reader with a general understanding of the resources in the project area and the specific ways in which these resources could be impacted by the project. Second, it prepares the reader for Chapters 6 and 7, which discuss potential impacts relative to the routing alternatives for the project. Detailed tables summarizing the data used for impact analyses are included in Appendix F.

Project construction and operation would impact human and environmental resources. Some impacts would be short term and similar to those of any large construction project (e.g., noise, dust, soil disturbance). These impacts are fairly independent of the project route selected. They can be mitigated by measures common to most construction projects, for example, the use of erosion-control blankets and silt fencing.

Other impacts will exist for the life of the project and may include aesthetic impacts, impacts to agriculture, and impacts to natural resources. These long-term impacts are generally not well mitigated by construction measures, meaning these impacts do not flow from how the project is constructed but rather where it is located and its design. Long-term impacts can be mitigated through prudent route selection and project design.

5.1 Describing Potential Impacts and Mitigation

Chapters 5 and 6 of this EA analyze potential human and environmental impacts of the project on various resources. Understanding these impacts involves contextualizing their duration, size, intensity, and location. This form of contextual information serves as the basis for assessing the overall project impacts on resources.

- **Duration**—Impacts vary in length of time. Short-term impacts are temporary and generally associated with construction. Long-term impacts are associated with operation and usually end with decommissioning and reclamation. Permanent impacts extend beyond the decommissioning stage.

- **Size**—Impacts vary in size. To the extent possible, potential impacts are described quantitatively, for example, the number of impacted acres or the percentage of affected individuals in a population.

- **Intensity**—Impacts vary in the severity to which a resource is affected, in whatever context that impact occurs.

- **Location**—Impacts are location dependent. For example, common resources in one location might be uncommon in another.

Instead of assigning values based on resource significance, qualitative descriptors are employed. These descriptors provide a standardized language for comparing impact levels and characteristics of both the proposed and alternative routes. This approach offers the reader a clear, common understanding of potential route impacts that enhances the route comparison task. For this work, the qualitative descriptors are as follows:

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

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

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

5.1.1 Regions of Influence

Potential impacts to human and environmental resources are analyzed in this EA within specific regions of influence (ROI). The ROI for each resource is the geographic area within which the project may exert some influence. It is used in the EA as the basis for assessing the potential impacts to each resource as a result of the project. Regions of influence vary with the resource being analyzed and the potential impact (Table 5-1).

In this EA, the following ROI are used:

- **Seventy-five feet (ROW)**. A distance of 75 feet on each side of the anticipated alignment (150 feet total) is equivalent to the ROW for the project. ROW is used as the ROI for analyzing potential displacement impacts and impacts to land-based economies, the natural environment, and rare and unique natural species.
- **Five hundred feet (Route Width)**. A distance of 500 feet on each side of the anticipated alignment (1,000 feet total) is equivalent to the Route Width for the project. Route Width is used

as the ROI for analyzing potential impacts to public health and safety as well as direct effects to archaeological and historic resources.

- **One thousand feet**. A distance of 1,000 feet (2,000 feet total) from the anticipated alignment for the project is used as the ROI for analyzing potential aesthetic and property value impacts, public utilities, and zoning and land use compatibility. Impacts may extend outside of the 1,000-foot distance but are anticipated to diminish relatively quickly such that potential impacts outside of this distance would be minimal.

- **One Mile**. A distance of 1 mile from the project is used as the ROI for analyzing potential impacts to archaeological and historic resources, rare and unique species, airports and airstrips, socioeconomics, and communities of environmental justice concerns (EJC).

- **Project Area**. The project area, defined generally as the civil townships through which the project passes, is used as the ROI for analyzing potential impacts to cultural values, land use, emergency services, air quality, and tourism and recreation. These are resources for which impacts may extend throughout communities in the project area.

Table 5-1 Regions of Influence

Type of Resource	Specific Resource/Potential Impact to Resource	Region of Influence (ROI)
Human Settlement	Displacement	ROW (150 feet)
Human Settlement	Aesthetics, Property Values, Electronic Interference, Zoning and Land Use Compatibility	2,000 feet
Human Settlement	Cultural Values	Project Area
Human Settlement	Socioeconomics/EJ	One Mile
Transportation and Public Services	Roadways/Railways	2,000 feet
Transportation and Public Services	Public Utilities	2,000 feet
Transportation and Public Services	Emergency Services	Project Area
Transportation and Public Services	Airports	One Mile
Public Health and Safety	Electric and Magnetic Fields, Implantable Medical Devices, Stray Voltage, Induced Voltage	Route Width (1,000 feet)
Public Health and Safety	Air Quality	Project Area
Land-Based Economies	Agriculture, Forestry, Mining	ROW (150 feet)
Land-Based Economies	Tourism and Recreation	Project Area
Archaeological and Historic Resources	Archaeological Resources; Historic Architectural Resources	One Mile, Route Width (1,000 feet)
Natural Environment	Water Resources	ROW (150 feet)
Natural Environment	Soils	ROW (150 feet)
Natural Environment	Vegetation and Wildlife	ROW (150 feet)
Natural Environment	Geology	ROW (150 feet)
Rare and Unique Natural Resources	Protected Species	One Mile
Rare and Unique Natural Resources	Sensitive Ecological Resources	ROW (150 feet)

5.2 Environmental Setting

The project is located in the east central part of Minnesota and traverses Itasca, Aitkin, Crow Wing, Cass, Morrison, Benton, and Sherburne counties. The project's general environmental setting consists of forest, agricultural land, water resources such as lakes, streams, rivers, and wetlands, low density and rural residential development, and commercial development. The closest cities to the project include Hill City, Riverton, Ironton, Harding, Lastrup, St. Cloud, and Becker. The most important land uses in the area include forestry, agriculture, and tourism.

The Minnesota DNR and the U.S. Forest Service (USFS) have developed an Ecological Classification System (ECS) for ecological mapping and landscape classification in Minnesota that is used to identify, describe, and map progressively smaller areas of land with increasingly uniform ecological features (reference (18)). The ECS splits Minnesota into Ecological Provinces, Sections, and Subsections.

The project is primarily located in the Northern Laurentian Mixed Forest Province, which is characterized by broad areas of coniferous forest, mixed deciduous-coniferous forests, and coniferous bogs and swamps. The landscape ranges from rugged lake terrain with thin glacial deposits over bedrock, to hummocky or undulating plains with deep glacial drift, to large, flat, poorly drained peatlands (reference (18)).

The southern extent of the project is located in the Eastern Broadleaf Forest Province, which serves as a transition zone between semi-arid portions of Minnesota that were historically prairie and semi-humid mixed coniferous-deciduous forests to the northeast (reference (18)).

The project traverses the St. Louis Moraines, Tamarack Lowlands, Pine Moraines and Outwash Plains, and the Mille Lacks Uplands subsections in the Northern Laurentian Mixed Forest Province and the Anoka Sand Plain Subsection in the Eastern Broadleaf Forest Province (Map 5-1). These subsections are briefly summarized here, with additional information provided in Chapter 5.10.4.

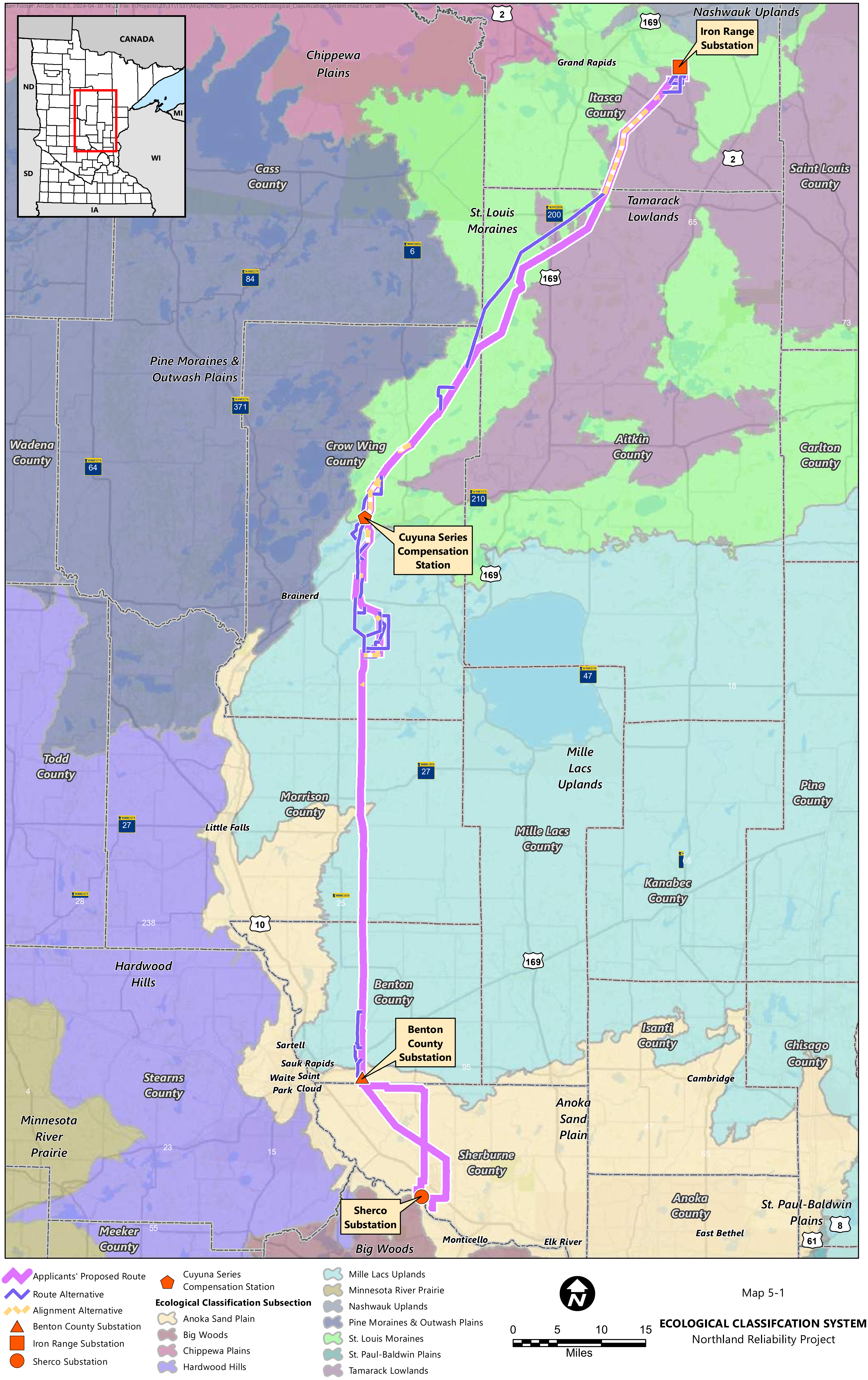
The Tamarack Lowlands Subsection is characterized by level to gently rolling topography. Major landforms include a lake plain (Glacial Lake Upham Plain) and a till plain (Aurora Till Plain) around the edges of the lake plain. Soils in the subsection include extensive areas of peat over both fine-textured (silt and clay-rich) and sandy lacustrine deposits. Presently, much of the land is in public ownership. Forestry and tourism, along with some agriculture, are the most common land uses (reference (18)).

The St. Louis Moraines Subsection is characterized by rolling to steep slopes, with end moraines representing the dominant landform. The subsection is dominated by loamy calcareous soils. Forestry and tourism are the major land uses in the subsection (reference (18)).

The Pine Moraines and Outwash Plains Subsection is characterized by a mix of end moraines, outwash plains, till plains, and drumlin fields. Soils in the subsection are predominantly coarse to moderately coarse in texture (sands and sandy loams). Current land uses include tourism, forestry, and some agriculture (reference (18)).

The Mille Lacks Uplands Subsection is characterized by gently rolling till plains and drumlin fields. Soils in the subsection are described as acid, stony, reddish sandy loams, silt loams, and loamy sands. Presently, forestry, recreation, and agriculture are the most common land uses (reference (18)).

The Anoka Sand Plain Subsection is characterized by small dunes, kettle lakes, and tunnel valleys that create level to gently rolling topography. Sandy terraces are found along the Mississippi River and its tributaries throughout the subsection. Soils in the subsection are generally sandy, droughty upland soils with some organic soils in ice block depressions and tunnel valleys and poorly drained prairie soils along the Mississippi River. Urban development and agriculture are the dominant land uses (reference (18)).



Nashwauk Uplands
Iron Range Substation
Grand Rapids
Chippewa Plains
Itasca County
Cass County
Saint Louis County
Tamarack Lowlands
St. Louis Moraines
Pine Moraines & Outwash Plains
Wadena County
Crow Wing County
Aitkin County
Carlton County
Cuyuna Series Compensation Station
Brainerd
Mille Lacs Uplands
Todd County
Morrison County
Little Falls
Mille Lacs County
Pine County
Kanabec County
Hardwood Hills
Benton County
Benton County Substation
Sartell
Sauk Rapids
Waite Park
Saint Cloud
Stearns County
Isanti County
Chisago County
Cambridge
Anoka Sand Plain
Minnesota River Prairie
Sherburne County
Anoka County
St. Paul-Baldwin Plains
East Bethel
Sherco Substation
Meeker County
Big Woods
Monticello
Elk River
CANADA
ND
SD
MI
WI
IA
Applicants' Proposed Route
Route Alternative
Alignment Alternative
Benton County Substation
Iron Range Substation
Sherco Substation
Cuyuna Series Compensation Station
Ecological Classification Subsection
Anoka Sand Plain
Big Woods
Chippewa Plains
Hardwood Hills
Mille Lacs Uplands
Minnesota River Prairie
Nashwauk Uplands
Pine Moraines & Outwash Plains
St. Louis Moraines
St. Paul-Baldwin Plains
Tamarack Lowlands
0 5 10 15
Miles
Map 5-1
ECOLOGICAL CLASSIFCATION SYSTEM
Northland Reliability Project

5.3 Human Settlements

Transmission lines have the potential to negatively impact human settlements through a variety of means. Transmission line structures and conductors could change the aesthetics of an area, displace homes or businesses, introduce new noise sources, lower property values, be incompatible with local zoning, and/or interfere with electronic communications.

Impacts to human settlements resulting from the project are anticipated to range from minimal to significant depending on the route selected. Impacts to human settlements could be minimized by prudent routing (i.e., by choosing routes and alignments that avoid residences, businesses, and other places where citizens congregate). Impacts could also be mitigated by limiting the aesthetic impacts of the structures themselves and by using structures which are, to the extent possible, harmonious with human settlements and activities.

5.3.1 Aesthetics

The aesthetic and visual resources of a landscape are defined as the existing natural and built features which affect the visual quality and character of an area. Determining the relative scenic value or visual importance in any given area depends, in large part, on the individual viewer, or community of viewers, whose perceptions are shaped by their values and experiential connection to the viewing area, as well as their physical relationship to the view, including distance to structures, perspective, and duration of the view.

For the purpose of this EA, it is assumed that landscapes which are, for the average person, harmonious in form and use are generally perceived as having greater aesthetic value. Infrastructure which is not harmonious with a landscape or affects existing landscape features, reflects a change in the aesthetic view that for some, or many, could negatively affect a viewer’s perception and expectation of the area. Assessing visual quality reflects the difference between the landscape change and the individual or communal reaction to that change. As noted above, individual or communal perspectives are complex, affected by individual or shared values and experiences with the land. As such, some viewers may perceive the project setting as having high visual quality while others may perceive the area to have less visual quality.

The northern portion of the project, which includes the Iron Range Substation Region and the Hill City to Little Pine Region, is characterized by a rural, forested, and generally undeveloped environment. Viewsheds in this area are characterized by forests and undeveloped land (i.e., land in a natural state that is devoid of man-made improvements).

The existing landscape in the central portion of the project, which includes the Cole Lake-Riverton Region, the Long Lake Region, and the Morrison County Region, is also rural. There is more agricultural land in the central portion of the project, and dominant natural features in the landscape include numerous lakes including Hay Lake, Upper South Long Lake, and South Long Lake. As the project moves further south it is characterized by nearly level to gently rolling plains used as agricultural lands (crop and pasture). Viewsheds in this area are generally broad and uninterrupted.

The southern portion of the project, which includes the Benton County Elk River Region and the Sherburne County Region, is characterized by agricultural land located on nearly level to gently rolling plains. Toward the southern terminus of the project, the setting transitions to one that is more suburban and developed, and also contains more topographic relief. Viewsheds in these areas are more limited and frequently interrupted by buildings, businesses, and streets.

The project is also shaped by a built environment, where existing transmission line rights-of-way, highways, and county roads, referred to as "horizontal elements," are consistent throughout the project length.

5.3.1.1 Potential Impacts and Mitigation Measures

The project's transmission line structures and conductors would create aesthetic impacts. These impacts are anticipated to be minimal to moderate. The degree of these impacts depends on:

- Proximity to homes, schools, churches, etc., where relatively more observers are present to experience aesthetic impacts. Map Book 5A provides an overview of residences and other buildings near the routing alternatives proposed for the project. These nearby residences and potential aesthetic impacts of specific routing alternatives are discussed further in Chapters 6 and 7.
- The presence of terrain and vegetation that could shield views of the transmission line and the preservation of such vegetation.
- The types of structures and structure designs used for the project.
- Use of existing ROW where the project would have an incremental impact relative to existing human modifications to the landscape (i.e., putting like with like). The ability of ROW sharing to mitigate potential aesthetic impacts of specific route alternatives is discussed further in Chapters 6 and 7.

The primary strategy for minimizing aesthetic impacts is prudent routing—that is, choosing routes where a transmission line is most harmonious with the landscape. Other minimization and mitigation measures include:

- Maximizing ROW sharing with existing linear rights-of-way (e.g., transmission lines, roadways, and railroads) to minimize incremental aesthetic impacts.
- Avoiding routing through areas with high-quality, distinctive viewsheds.
- Crossing rivers and streams using the shortest distance possible (i.e., perpendicular to the waterbody).
- Reducing structure heights to minimize impacts within scenic areas.
- Using structures and structure designs that minimize impacts.
- Using construction methods that minimize damage to vegetation near the transmission line.
- Placing structures to take advantage of existing natural screening to reduce the view of the line from nearby residences and roadways.
- Avoiding placing structures directly in front of residences.

- Including specific conditions in individual easement agreements with landowners along the route (e.g., requiring new plantings or landscaping).
- Using the protections of Minnesota Statute 216E.12, subdivision 4 (commonly known as the "Buy the Farm" statute), where available, to move residents away from potential aesthetic impacts.

5.3.2 Property Values

Property values have the potential to be affected by the placement of nearby transmission lines. Prior research has found that potential impacts to property values due to transmission lines are generally connected to three main factors. First, how the transmission line affects the viewshed and aesthetics of a property. Second, the real or perceived risks that buyers have of EMF. Third, the effects to agricultural production on properties that are used for farming operations.

The aforementioned factors play one role in the many interconnecting factors that affect property values. Because of this, it is difficult to measure how much and all the different ways that transmission lines and property values are correlated. A variety of methodologies have been used to research the relationship between transmission lines and property values. Some general conclusions can be drawn from this body of literature. This chapter highlights relevant outcomes of property value research with additional detail provided in Appendix G.

Research does not support a clear cause-and-effect relationship between property values and proximity to transmission lines, but has revealed trends that are generally applicable to properties near transmission lines:

- When negative impacts on property values occur, the potential reduction in value is in the range of 1 to 10 percent.
- Property value impacts decrease with distance from the line; thus, impacts are usually greater on smaller properties than on larger ones.
- Negative impacts diminish over time.
- Other amenities, such as proximity to schools or jobs, lot size, square footage of the home, and neighborhood characteristics, tend to have a greater effect on sale price than the presence of a transmission line.
- The value of agricultural property decreases when transmission line structures interfere with farming operations.

5.3.2.1 Potential Impacts and Mitigation Measures

Property value impacts could be mitigated by minimizing aesthetic impacts, perceived EMF health risks, and agricultural impacts. This can be achieved by selecting alignments that maximize the use of existing ROW and that place the transmission line away from residences and out of agricultural fields. There is potential for impacts to be mitigated by including specific conditions in individual landowner easement agreements along the transmission line. Impacts could also be mitigated by using the protections offered through Minnesota Statute 216E.12 (commonly known as the "Buy the Farm" statute), where available, to move away from potential property value impacts.

5.3.3 Zoning and Land-Use Compatibility

Minnesota authorizes counties and cities to create their own zoning ordinances to implement and work in conjunction with their comprehensive plans. Zoning is a method to regulate the way land is used and create patterns in the way they are used. Zoning is a regulatory device used by local governments to geographically restrict or promote certain types of land uses. Minnesota statutes provide local governments with zoning authority to promote public health and general welfare.

This project is subject to Minnesota's Power Plant Siting Act (Minn. Statute 216E). Under this statute, the route permit issued for a transmission line (Minn. Statute 216E.10):

> *shall be the sole site or route approval required to be obtained by the utility. Such permit shall supersede and preempt zoning restrictions, building or land use rules, regulations or ordinances promulgated by regional, county, local and special purpose government.*

Therefore, the applicants are not required to seek permits or variances from local governments to comply with applicable zoning codes. Nonetheless, impacts to local zoning are clearly impacts to human settlements, and the Commission considers impacts to human settlements as a factor in selecting transmission line routes.

Land cover along the project consists primarily of upland and wetland forests, open and shrub wetlands, and herbaceous agricultural vegetation, consisting of cultivated cropland and hay and pastureland. Several parcels of land under federal, state, county, and municipal ownership are found along the project route, but most of the parcels are under private ownership. Several state conservation easement lands are also found throughout the project.

The project would cross, from north to south, Itasca, Aitkin, Crow Wing, Cass, Morrison, Benton, and Sherburne counties (Map Book 5B). The closest cities to the project include Hill City, Riverton, Trommald, Ironton, Harding, Lastrup, St. Cloud, and Becker. The project route primarily crosses agricultural and farm residential zoning areas with scattered zoned areas of public and open land, single family residential, and natural environment.

In all referenced counties with the exception of Cass, the project passes through shoreland overlay districts. Minnesota Statutes Chapter 103F defines shoreland areas and describes limitations on uses and locations of structures in those areas. These limitations are established through special land use provisions to maintain and restore the natural beauty and attractiveness of shoreland and to provide environmental protection for the water resources.

The project route runs primarily through public and farm residential zoning districts within Itasca County. According to the Itasca County Zoning Ordinance and Itasca County Comprehensive Land Use Plan, transmission lines are considered essential services and are permitted uses within both (reference (19)). The following townships are along the project route in Itasca County: Trout Lake, Little Sand Lake, Blackberry, Wildwood, and Splithand. These townships defer to the zoning regulations of Itasca County.

Within Aitkin County, the project runs primarily through public, farm residential, natural environment, open and shoreland zoning districts. The Aitkin County Comprehensive Plan and Aitkin County Zoning Ordinance consider transmission lines to be an essential service and are a permitted use in all zoning districts (reference (20)). The project goes through the following townships: Northwest Aitkin, Macville, and Hill Lake. These townships defer to Aitkin county's zoning districts. The project goes through a small portion of city of Hill City in Aitkin County that is zoned as multi-family residential, where essential services are permitted.

In Crow Wing County the project route travels primarily through shoreland, forestry, agricultural, and rural residential districts. The Crow Wing County Comprehensive Plan and Zoning Ordinance state that transmission lines are considered a permitted or conditional use within these districts (reference (21). The project goes through the following townships within Crow Wing County: Ross Lake, Fairfield, Perry Lake, Wolford, Center, Nokay Lake, Maple Grove, Oak Lawn, Irondale, Long Lake, Little Pine, Center, and Platte Lake. These townships defer to Crow Wing county's zoning districts.

The project is in the rural residential zoning district within Morrison County. The Morrison County Comprehensive Plan and Land Use Control Ordinance consider transmission lines as a permitted use within this district (reference (22)). The project route is within the following townships: Pulaski, Harding, Granite, Pierz and Buckman. These townships defer to Morrison county's zoning districts.

The project route runs through primarily agricultural and rural service zoning districts in Benton County. The Benton County 2040 Comprehensive Plan and the Benton County Ordinance consider transmission lines to be essential services and are a permitted use in these zoning districts (reference (23)). In Benton County the project goes through Graham, Mayhew Lake, Saint George and Minden Townships. The project extends through a small portion of the city of St. Cloud in Benton County. The land is zoned as single family residential, where the project would be considered an essential service and a permitted use (reference (24)).

The project route travels primarily through agricultural and general rural zoning districts in Sherburne County. Transmission lines are considered a permitted or conditional use in these zoning districts (reference (25)). The route goes through the following townships within the county: Haven, Palmer, and Becker.

In Cass County the project route crosses public land in Beulah Township. The project is considered an essential service and allowed in all zoning and land use districts (reference (26)). In Becker Township the project goes through the agriculture, general rural, industrial, and heavy industrial districts. Transmission lines are considered to be public utilities and a permitted use in these zoning districts, per the township zoning code (reference (27)).

The City of Becker, within Sherburne County, has its own zoning districts per their zoning code (reference (28)). The project primarily crosses through residential and industrial zoning districts. Transmission lines are considered a public utility per their zoning code and are a permitted or conditional use. Xcel Energy and the City of Becker conducted an Alternative Urban Area-Wide Review (AUAR) of land adjacent to the Sherco Power Plant in Becker in January 2023. Xcel Energy and the City of Becker collaborated on the AUAR to explore options that would benefit existing infrastructure, support community development, and replace some of the tax base that would be lost when Xcel Energy's Sherco coal-fired power plant closes. The AUAR would result in 2,177 acres of land owned partially by Xcel Energy and partially by the City of Becker and Becker Township to transition into mostly industrial zoning districts (reference (29)).

5.3.3.1 Potential Impacts and Mitigation Measures

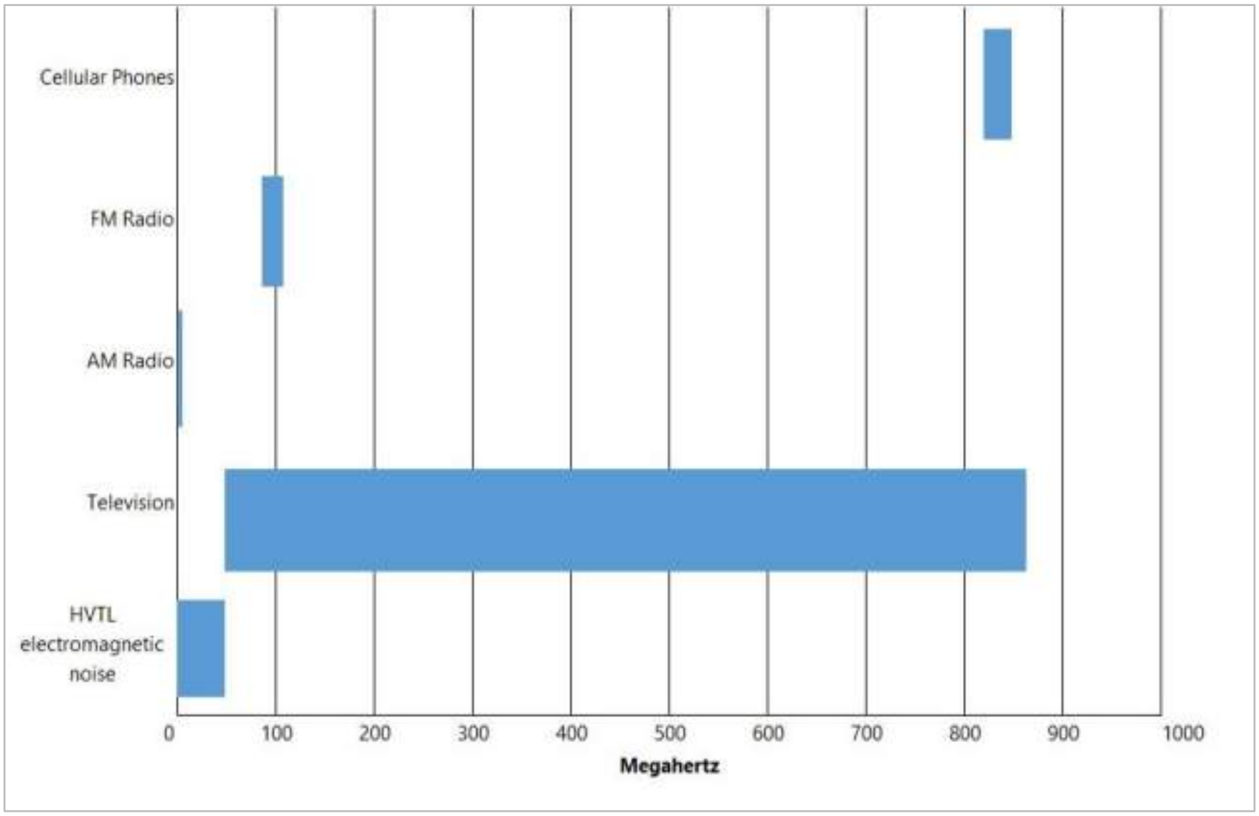
Potential project impacts to local zoning may be minimal to significant, depending on the project route selected. Potential impacts include reduced property values and taxes, incompatibility with land uses or planned community growth, and impacts to otherwise protected natural resources. The project is generally compatible with zoning in the more rural, agricultural areas. The project is less compatible with zoning and community planning in the shoreland district areas and more urban parts of Becker.

Project impacts to zoning and to current and future land uses can be mitigated by selecting routes and alignments that are compatible, to the extent possible, with community zoning and land-use plans. Land-use impacts can be mitigated by minimizing aesthetic impacts of the project, to the extent that zoning and land-use plans address aesthetics (e.g., landscaping). Land-use impacts can also be mitigated by using existing ROW to the maximum extent possible.

5.3.4 Electronic Interference

Electronic interference refers to a disturbance in an electronic signal that can impair the proper functioning of an electronic device. Transmission lines do not generally cause interference with radio, television, cellular phone, global position systems (GPS) or other communication signals and reception. Information on medical electronic devices is discussed in Chapter 5.5.2. Figure 5-1 compares the spectrum of transmission frequencies for several communication and media signals to the peak intensity disturbance associated with electromagnetic noise from transmission lines. Additional discussion is provided below for each major type of media or communication signal.

Figure 5-1 Frequencies of Electronic Communications and of Electromagnetic Noise Created by Transmission Lines



Source: references (30), (31), (32)

5.3.4.1 Radio and Television

Generally, transmission lines do not cause interference with radio and television (reference (33)). There are three potential sources for interference that are rare but do exist. These include gap discharges, corona discharges, and shadowing and reflection effects.

Gap discharge interference is the most noticed form of power line interference with radio and television signals, and 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. 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, as shown in Figure 5-1. The air ionization caused by corona generates audible noise, radio noise, light, heat, and small amounts of ozone (O_3). 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 EMF, 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 occurs for an AM radio station within a station's primary coverage area where good reception existed before the project was built, reception can be regained by adjusting or moving the receiving antenna system. Interference is unlikely to occur for AM radio frequencies, except for immediately under a transmission line, and interference would dissipate 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) (Figure 5-1). Also, the interference rejection properties inherent in FM radio systems make them fairly immune to amplitude type disturbances.

Because the United States has transitioned from analog to digital broadcasting, the potential for television interference from radio frequency noise is unlikely. Digital reception is considerably more tolerant of noise than analog broadcasts. Due to the higher frequencies of television broadcast signals (54 megahertz 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 effect comes from physically blocking communication signals and can impact two-way mobile radio communications and television signals. 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, the applicants would 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.

5.3.4.2 Internet and Cellular Phones

Wireless internet and cellular phones use frequencies in the 900 MHz ultra-high frequency (UHF) range—a range for which impacts from corona-generated noise are anticipated to be negligible. If internet service at a residence or business is provided by a satellite antenna, this service could be impacted by a line-of-sight obstruction. As with other satellite reception, any interference due to an obstruction could be resolved by moving the satellite antenna to a slightly different location.

5.3.4.3 Global Positioning Systems

GPS works by sending radio-frequency signals from a network of satellites to the receiver. Because of this, buildings, trees, and other physical structures have the potential to interfere with a GPS signal. Research has evaluated the potential for interference in the use GPS satellite-based microwave signals under or near power line conductors. Results of this research indicates it is unlikely that there would be electronic interference while using GPS (reference (34)). Interference would be more likely near a transmission line structure, and unlikely under a transmission line (reference (34)).

5.3.4.4 Potential Impacts and Mitigation Measures

No impacts to electronic devices are anticipated. Interference due to line-of-sight obstruction could occur in select areas but could be mitigated by prudent placement of transmission line poles and electronic antennas. In situations where interference with electronic devices does occur and is caused by the presence or operation of the transmission line, route permits issued by the Commission require permittees to take those actions which are feasible to restore electronic reception to pre-project quality (Appendix H).

5.3.5 Displacement

Displacement is the removal of a residence or building to facilitate the operation of a transmission line. For electrical safety code and maintenance reasons, utilities generally do not allow residences or other buildings within the transmission line ROW. Any residences or other buildings located within a proposed ROW are generally removed or displaced. Displacements are relatively rare and are more likely to occur in more populated areas where avoiding all residences and businesses is not always feasible.

Displacements can be avoided through several means including structure placement, the use of specialty structures, and modifications of the ROW width. The applicants indicated in their route permit application that they are committed to working with landowners to design adequate clearances from buildings and to address landowner concerns. Though the general rule is that buildings are not allowed within the transmission line ROW, there are instances where the activities taking place in these buildings are compatible with the safe operation of the line. The proximity of the line to buildings along specific routing alternatives is discussed further in Chapter 6 and 7.

5.3.5.1 Potential Impacts and Mitigation Measures

There are no churches, schools, daycares, or nursing homes within the rights-of-way of the routing alternatives for the project. There are up to 20 residences and 59 non-residential buildings (e.g., agricultural outbuildings or animal production structures) within these rights-of-way.

5.3.6 Noise

Noise is generally defined as unwanted sound. Noise levels are measured in units of decibel (dB) on a logarithmic scale and can be used to compare a wide range of sound intensities. Certain sound frequencies are given more weight since human hearing is not equally sensitive to all frequencies. The A-weighted decibel scale (dBA) scale accounts for the sensitivity of the human ear. (Table 5-2). Due to the logarithmic dBA, a noise level of 70 dBA is approximately twice as loud as a 60 dBA sound to the average human hearing.

Table 5-2 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 or gas lawnmower 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: Minnesota Rule 7030

The MPCA has developed protective standards for daytime and nighttime noise levels that vary based on land use at the location where the sound is heard (noise area classification, NAC). All project noises must be within the MPCA noise standards (Table 5-3). The noise standards are expressed as a range of permissible dBA over the course of a 1-hour period; L50 is the dBA that may be exceeded 50 percent of the time within an hour, while L10 is the dBA that may be exceeded 10 percent of the time within 1 hour (Minnesota Rule 7030).

Table 5-3 MPCA Noise Limits by Noise Area Classification

Noise Area Classification (NAC)	Daytime (dBA)L10	Daytime (dBA)L50	Nighttime (dBA)L10	Nighttime (dBA)L50
NAC 1: Residential and Other Sensitive Uses	65	60	55	50
NAC 2: Non-Residential Uses (retail, business and government services, recreational activities, transit passenger terminals)	70	65	70	65
NAC 3: Non-Residential Uses (manufacturing, fairgrounds and amusement parks, agricultural and forestry activities)	80	75	80	75

The primary project noise receptors are residences. Residences are in noise area classification 1 (NAC 1). Noise receptors could also include individuals working outside or using recreational facilities along the project. For most of the project, ambient noise levels are in the range of 30 to 50 dBA, with temporary, higher noise levels associated with wind, vehicular traffic, and the use of gas-powered equipment (e.g., tractors, chain saws).

Community noise levels are usually closely related to the intensity of human activity. Noise levels are generally considered low when below 45 dBA, moderate in the 45 to 60 dBA range, and high above 60 dBA (see Table 5-2). In rural areas, noise levels can be below 35 dBA. In small towns or wooded and lightly used residential areas, noise levels are more likely to be around 50 or 60 dBA. Levels around 75 dBA are more common in busy urban areas, and levels up to 85 dBA occur near major freeways and airports.

5.3.6.1 Potential Impacts and Mitigation Measures

Potential noise impacts from the project can be grouped into three categories: construction noise, transmission line noise, and substation noise.

5.3.6.1.1 Construction Noise

During project construction, temporary, localized noise from heavy equipment and increased vehicle traffic is expected to occur along the ROW during daytime hours. Construction activity and crews would be present at a particular location during daytime hours for a few days at a time but on multiple occasions throughout the period between initial ROW clearing and final restoration. Construction noise could temporarily affect residences, schools, businesses, libraries, parks, recreational areas, and related public spaces that are close to the ROW. Any exceedances of the MPCA daytime noise limits would be temporary in nature and no exceedances of the MPCA nighttime noise limits are expected for the project.

5.3.6.1.2 Transmission Line Noise

Noise from transmission lines (electrical conductors) is due to small electrical discharges which ionize surrounding air molecules. The level of noise from these discharges depends on conductor conditions, voltage levels, and the weather conditions. Noise emissions are greatest during heavy rain events when the conductors are consistently wet. However, during heavy rains, the background noise level is usually greater than the noise from the transmission line and few people are in close proximity to the transmission line in these conditions. As a result, audible noise is not noticeable during heavy rains.

In foggy, damp, or light rain conditions, transmission lines may produce audible noise higher than background levels. During dry weather, noise from transmission lines is a perceptible hum and sporadic crackling sound. Noise levels are anticipated to be within Minnesota noise standards (i.e., < 50 dBA), and would only be perceptible when ambient noise levels in the project area fall below 40 dBA.

The applicants modeled potential noise levels associated with the project. 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 L_{50} 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 5-4 for the edge of ROW (reference (6)).

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 scenarios where the project's new transmission line parallels existing transmission lines are also given in Table 5-4.

Because audible noise is primarily related to the transmission line's electric field, and electric fields are particularly dependent on the voltage of the transmission line, the values in Table 5-4 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 Values were calculated assuming minimum conductor-to-ground clearance (that is, at mid-span) and a height of 1 meter above ground (reference (6)).

Table 5-4 Calculated L_{50} Audible Noise for the Project

Project Configuration with Existing Transmission Lines	Configuration	Line Voltage	L50 Noise Levels 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: reference (6)

As indicated in Table 5-4, the most stringent MPCA noise standard is the nighttime L50 limit for the land use category that includes residential areas (NAC-1). The NAC-1 nighttime limit is 50 dBA. Modeling results in Table 5-4 indicate that project-related audible noise is expected to be within the most stringent MPCA noise standards for all transmission line configurations.

5.3.6.1.3 Substation Noise

Transformers and switchgear operation are the common noises associated with a substation. Noise emissions from this equipment have a tonal character that often sound like a hum or a buzz that corresponds to the frequency of the AC. Transformers produce a consistent humming sound, resulting from magnetic forces within the transformer core. This sound does not vary with transformer load. Switchgear produces short-term noises during activation of circuit breakers; these activations are infrequent.

The project includes expanding the existing Iron Range and Benton County Substations and the construction of a new Cuyuna Series Compensation Station. The applicants indicate that the additions will be designed such that MPCA noise limits will be met at the edge of the substation property. Accordingly, noise levels associated with the substations at receptors outside of the substation property (e.g., residences near the substations), will be within Minnesota noise standards.

5.3.6.1.4 Summary

Project noise impacts are anticipated to be minimal and within Minnesota's noise standards. Operational noise levels for the project are anticipated to be within state standards; however, the project would introduce a new noise source that, in certain situations (e.g., a calm evening) may be heard by residents in the project area. The primary means of mitigating this noise impact is selecting routing options that avoid areas where residents live, work, and congregate. Noise impacts from substation operations could also be mitigated by natural or built sound barriers (e.g., berms or plantings). Route permits issued by the Commission require compliance with Minnesota's noise standards.

5.3.7 Cultural Values

Cultural values are those community beliefs and attitudes which provide a framework for community unity and animate community actions. Cultural values are informed, in part, by history and heritage. The project traverses land that has been home to a variety of persons and cultures. Major infrastructure projects can be inconsistent with the cultural values of an area, resulting in a deterioration of a community's shared sense of self.

In the early to mid-1800s, the area was populated primarily by Dakota Sioux and Ojibwe peoples. By the mid-1800s, Canadian, French, and British fur traders began settling in this area. A large wave of European immigrants arrived around 1850, these settlers were primarily of German, Norwegian, Swedish, Dutch, and British heritage (reference (35)).

Cultural values are also informed by the work and recreation of residents and by geographical features. The project setting is primarily rural and agricultural. Farming and the ability to continue to farm and support livelihoods through farming tend to be strong values in these types of settings. Various recreational opportunities, including fishing, hunting, and snowmobiling, are also available near the project. These opportunities are supported by a variety of natural resources, including lakes, rivers, parks, and WMAs (reference (36)).

5.3.7.1 Potential Impacts and Mitigation Measures

Project impacts to cultural values are anticipated to be minimal. The project would not adversely impact the work of residents that underlie the area's cultural values, nor is it anticipated to adversely impact geographical features that inform these values. Potential impacts to recreation that may also impact cultural values are discussed in Chapter 5.7.

5.3.8 Socioeconomics

Socioeconomic factors provide an indication of how economic activity affects and is shaped by social processes. Socioeconomic measures indicate how societies progress, stagnate, or regress because of their actions and interactions within and between the local, regional, or global economic scales. Transmission line projects contribute to growth and progress at the local level over time; therefore, socioeconomic impacts of the project are anticipated to be positive.

Approximately 75-100 workers would be required for transmission line and substation construction. Transmission line and substation construction are anticipated to begin in the summer/fall of 2025 and be in service by June 2030. The project would generate minor, short-term positive economic impacts, driven by increased construction activity and the influx of contractor employees. Contractors would be used for all construction activities. Local businesses would likely experience short-term positive economic impacts through the use of the hotels, restaurants, and other services used by contractors during construction. In addition, construction materials, such as concrete, may be purchased from local vendors where feasible.

5.3.8.1 Potential Impacts and Mitigation Measures

The project would improve the socioeconomics of the region through the creation of jobs, generation of tax revenue, and providing more reliable electrical service to the surrounding communities.

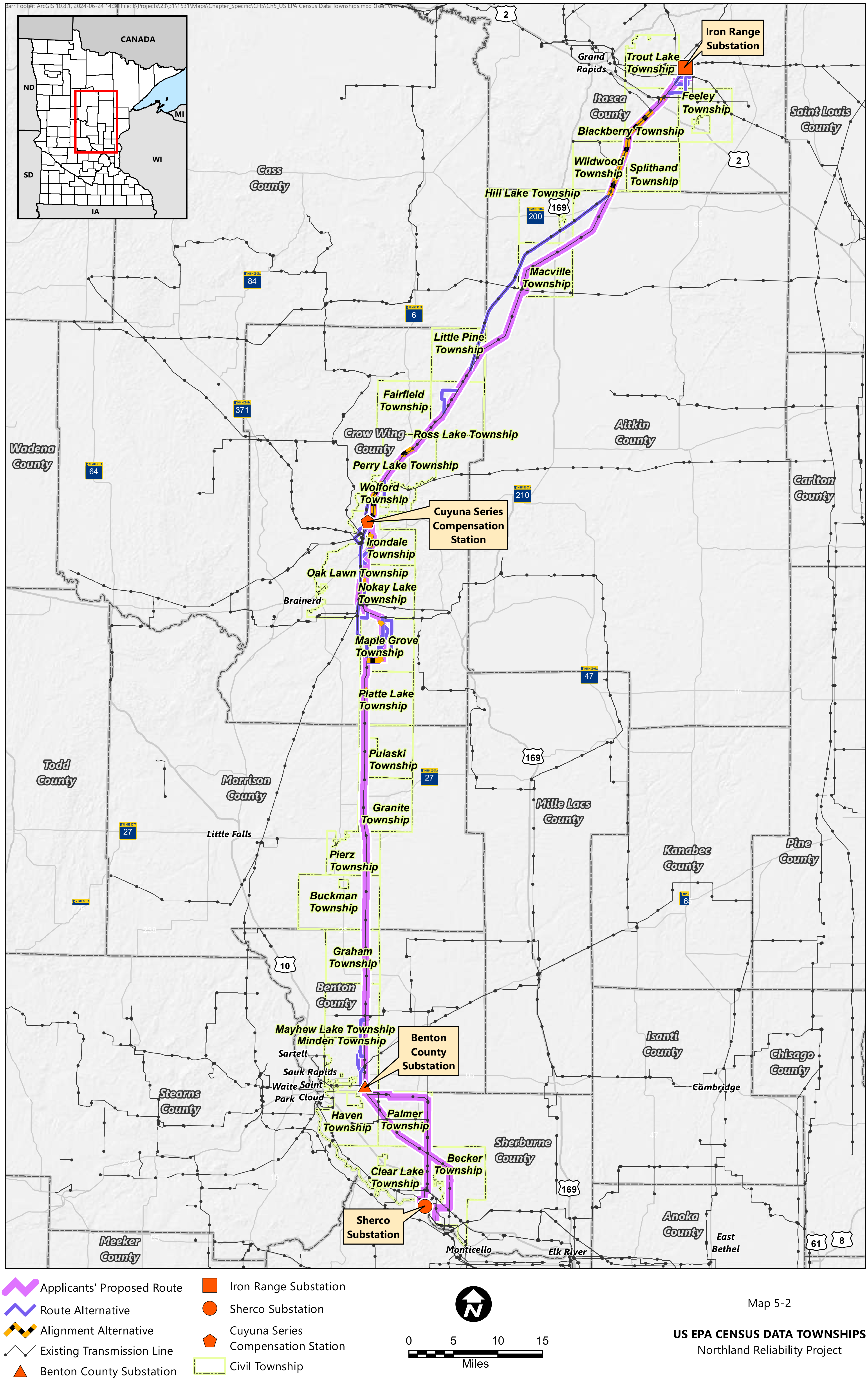
5.3.9 Environmental Justice

Utility infrastructure can adversely impact low-income, minority, or tribal populations. Environmental justice is the "fair treatment and meaningful involvement of all people regardless of race, color, national origin, or income, with respect to the development, implementation, and enforcement of environmental laws, regulations, and policies (reference (37))." The goal of this fair treatment is to identify potential disproportionately high and adverse effects from implementation of the project and identify alternatives that may mitigate these impacts (reference (38)).

Minn. Statute 216B.1691 was recently updated to reflect the definition of an EJC. The data defines eight townships within the project as being an EJC area based on the population residing in that township. This means that eight of the townships contain one of the following:

- 40 percent or more nonwhite populations
- 35 percent or more households with income ≤ 200 percent of the poverty level
- 40 percent or more residents with limited English proficiency
- Indian country (Minn. Statute 216B.1691)

Communities with EJCs were identified on a regional basis, comparing data for the townships intersected by the project with average data for the State of Minnesota. Data compiled from the 2020 U.S. Census is summarized in Table 5-5. Townships where census data was analyzed in relation to the project are shown on Map 5-2.



Map 5-2

US EPA CENSUS DATA TOWNSHIPS

Northland Reliability Project

Table 5-5 Census Data Summary

County	Area	Percent Below Poverty	Median Household Income	Total Township Population	Total Individuals with Income Below 200% of Poverty Level (Percent of Population)[1]	Percent Minority	Percent Non-English Spoken at Home
--	State of Minnesota	9.6	$82,338	5,599,770	1,238,999 (22)	23.0	22.0
Itasca County	Little Sand Lake Township	6.1	$56,667	269	41 (15)	2.9	0.0
	Trout Lake Township	9.0	$75,714	1,198	216 (18)	6.4	1.4
	Blackberry Township	1.0	$86,786	835	170 (20)	4.7	4.3
	Feeley Township	18.3	$76,250	290	72 (25)	3.9	2.2
	Splithand Township	11.7	$75,938	453	95 (21)	10.2	1.9
	Wildwood Township	5.9	$51,250	119	45 (38)[(2)]	8.9	0.0
Aitkin County	Hill Lake Township	8.5	$78,194	436	84 (19)	6.4	0.5
	Hill City	16.3	$43,125	510	243 (47) [(2)]	7.5	0.4
	Macville Township	23.3	$50,000	193	71 (36) [(2)]	6.4	0.0
	Northwest Aitkin Township	6.2	$51,970	292	64 (22)	5.6	0.0

County	Area	Percent Below Poverty	Median Household Income	Total Township Population	Total Individuals with Income Below 200% of Poverty Level (Percent of Population)[1]	Percent Minority	Percent Non-English Spoken at Home
Crow Wing County	Beulah Township	9.5	$46,250	95	44 (46) [(2)]	6.9	1.2
	Little Pine Township	16.7	Not available	66	31 (47) [(2)]	11.4	0.0
	Ross Lake Township	2.2	$100,625	228	62 (27)	0.06	0.4
	Fairfield Township	10.6	$67,500	293	48 (16)	2.5	1.4
	Perry Lake Township	3.8	$81,250	316	52 (16)	6.3	0.7
	Wolford Township	8.0	$89,375	387	71 (18)	5.7	1.3
	Trommald City	14.3	$50,729	106	63 (59) [(2)]	5.0	0.0
	Irondale Township	8.2	$71,250	1,142	268 (23)	6.1	0.0
	Riverton City	5.9	$57,083	136	50 (37) [(2)]	11.0	2.3
	Oak Lawn Township	6.9	$75,536	1,699	390 (23)	7.0	5.7
	Nokay Lake Township	11.0	$78,250	887	186 (21)	3.7	2.9
	Long Lake Township	6.1	$73,333	1,230	401 (32)	4.2	0.6
	Maple Grove Township	6.6	$73,646	650	131 (20)	7.7	0.8
Morrison County	Platte Lake Township	7.9	$93,750	355	68 (20)	3.1	2.1
	Pulaski Township	5.6	$61,875	268	71 (26)	1.6	6.3
	Harding City	19.4	$63,750	139	79 (56) [(2)]	5.6	4.4
	Granite Township	7.1	$75,694	453	95 (21)	3.2	1.0
	Pierz Township	6.0	$93,438	546	107 (20)	1.7	1.8
	Buckman Township	4.1	$93,750	790	122 (15)	5.3	3.5

County	Area	Percent Below Poverty	Median Household Income	Total Township Population	Total Individuals with Income Below 200% of Poverty Level (Percent of Population)[1]	Percent Minority	Percent Non-English Spoken at Home
Benton County	Graham Township	2.7	$111,250	586	68 (12)	5.6	1.3
	Mayhew Lake Township	8.0	$99,783	904	117 (13)	2.2	0.7
	Minden Township	1.6	$77,697	1,514	206 (14)	3.7	0.7
Sherburne County	Palmer Township	1.7	$101,150	2,512	304 (12)	4.9	1.0
	Becker Township	2.0	$128,207	5,461	334 (6)	5.1	0.7

Source: reference (39)
1 Counts of individuals do not include the margin of error listed in U.S. Census data.
2 Denotes meets the definition of EJC.