CERTIFICATE OF NEED & ROUTE PERMIT APPLICATION for the Duluth Loop Reliability Project

MPUC Docket No. E015/CN-21-140
MPUC Docket No. E015/TL-21-141

minnesota power

AN ALLETE COMPANY

October 21 ,2021

duluthloop.com

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1.1 Introduction

Minnesota Power (or the "Applicant") is an investor-owned public utility headquartered in Duluth, Minnesota. Minnesota Power supplies retail electric service to 143,000 retail customers and wholesale electric service to 16 municipalities in a 26,000-square-mile electric service territory located in northeastern Minnesota. Minnesota Power generates and delivers electric energy through a network of transmission and distribution lines and substations throughout northeastern Minnesota. Minnesota Power's transmission network is interconnected with the regional transmission grid to promote reliability and Minnesota Power is a member of the Midcontinent Independent System Operator ("MISO") and the Midwest Reliability Organization ("MRO").

Minnesota Power submits this application to the Minnesota Public Utilities Commission ("Commission") for a Certificate of Need and Route Permit to construct the Duluth Loop Reliability Project ("Project" or "Duluth Loop Project").

The Duluth Loop Project includes: (1) construction of about 14 miles of new 115 kV transmission line between the Ridgeview, Haines Road, and Hilltop Substations; (2) construction of a new approximately one-mile extension connecting an existing 230 kV transmission line to the Arrowhead Substation; (3) upgrades to the Ridgeview, Hilltop, Haines Road, and Arrowhead substations; and (4) reconfiguration, rebuild, and upgrade to existing transmission lines and communications infrastructure in the Project area.

Minnesota Power will own all of the facilities proposed for the Duluth Loop Project.

1.2 Project Need and Purpose

The Duluth Loop Project is needed to replace the system support once provided by coal-fired baseload generators located along Minnesota's North Shore by addressing severe voltage stability concerns, relieving transmission line overloads, and enhancing the reliability of Duluth-area transmission sources.

The transmission system in the Duluth area has historically been supported by several coal-fired baseload generators located along Minnesota's North Shore. For decades, these local generators have contributed to the reliability of the transmission system by delivering power to the local area and providing system support. As Minnesota Power and its customers have transitioned away from reliance on coal to increasingly lower carbon sources of energy, the idling of the generators on the North Shore has led to an increased reliance on the transmission system to deliver replacement power and system support to the Duluth area and along the North Shore. In order to maintain a continuous supply of safe and reliable electricity while replacing the support once provided by these local coal-fired generators, the Duluth area transmission system must be upgraded. To accomplish this, transmission lines in an area known as the Duluth Loop are being constructed, reconfigured, and improved to enhance system stability and reliability.

The Duluth Loop is a network of 115 kV transmission lines and substations, which forms two parallel connections between the main Duluth-area transmission source of power and system support (the Arrowhead 230/115 kV Substation) and the North Shore (beginning at the Colbyville Substation on the far northeastern end of Duluth). Many of the customers in the Duluth area are served from substations connected to the Duluth Loop, including customers in Hermantown, Duluth Heights, Kenwood, Woodland, Lakeside, Hunter's Park, and Congdon and around the Miller Hill Mall, the Duluth International Airport, the universities, and the downtown hospital district, among others.

The Duluth Loop Project will replace the system support once provided by the North Shore coal-fired baseload generators and is needed to: (1) resolve severe voltage stability concerns; (2) relieve transmission line overloads; and (3) enhance the reliability of Duluth area transmission sources. Additional information on the need for the Duluth Loop Project is provided in **Chapter 3**.

Minnesota Power considered several alternatives to the proposed 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 proposed Project are discussed further in **Chapter 4**.

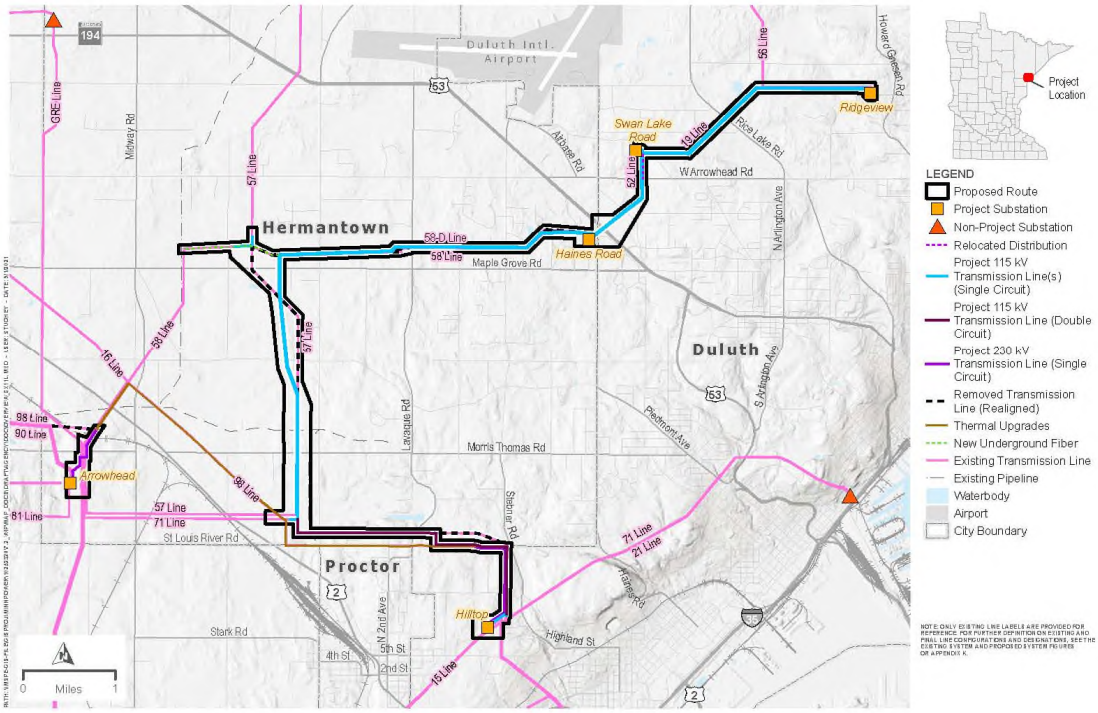
1.3 Proposed Route

The proposed route for the 115 kV transmission line ("Proposed 115 kV Route") begins at the existing Ridgeview Substation and follows existing 115 kV transmission lines west then south for about 3.9 miles to the existing Swan Lake Road Substation and the Haines Road Substation (**Map 1-1** (below) and **Map 2-1** in **Maps tab**). The Proposed 115 kV Route continues west from the Haines Road Substation following existing 115 kV transmission lines for approximately 3.5 miles before turning south along new corridor for about 1.5 miles then parallels an existing 115 kV transmission line for approximately 1.4 miles. The Proposed 115 kV Route turns generally east and south double-circuiting an existing 115 kV transmission line to Hilltop Substation.

The proposed route for the 230 kV transmission line ("Proposed 230 kV Route") begins at the Arrowhead Substation and goes north for about 0.9 miles to a connection with the existing 98 Line (**Map 1-1** (below) and **Map 2-3** in **Maps tab**). Approximately 0.5 miles of the existing 98 Line would be removed from the corner of the existing 90 and 98 Lines to the new connection point, including the span over the Canadian National Railroad.

The terms "Proposed Route" are used in this application when both the Proposed 115 kV Route and the Proposed 230 kV Route are being discussed as well as the required substation expansion and work areas. A more detailed description of the Proposed Route is provided in **Chapter 2**.

Map 1-1. Duluth Loop Project Overview



1.4 Project Schedule and Cost

Minnesota Power anticipates starting construction of the Project in 2023. The Project is scheduled to be in service in 2025.

The estimated cost for the Duluth Loop Project is between $50 million and $70 million ($2021). Additional details regarding the schedule and cost for the Project is provided in **Chapter 2**.

1.5 Potential Environmental Impacts

Minnesota Power analyzed the potential environmental impacts from the proposed Project. No significant unavoidable impacts will result from construction of the proposed Project. It is not anticipated that any homes or business will be displaced by the Project. Additional information about the potential environmental impacts of the proposed Project and proposed mitigation measures is provided in **Chapter 7**.

The Department of Commerce, Energy Environmental Review and Analysis is responsible for environmental review of the Project. The Certificate of Need rules require the preparation of an Environmental Report, whereas the Route Permit rules require preparation of an Environmental Assessment ("EA"). The Department of Commerce may elect to prepare an EA for the Project that analyzes potential environmental impacts from the Project and meets all statutory and rule requirements of both the Environmental Report and the EA.

1.6 Public Input and Involvement

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

The public and interested stakeholders will have the opportunity to review this application and to submit comments to the Commission about the Project. A copy of the application will be available on the on the Department of Commerce's Project website (http://mn.gov/commerce/energyfacilities) and on the Project's website at www.duluthloop.com. Additionally, a copy of this application will be available at the Duluth Public Library for the public to review.

A scoping meeting will be held in the Project area by the Department of Commerce, Energy Environmental Review and Analysis within 60 days of acceptance of this application as complete to answer questions about the Project and to solicit public comments and suggestions for matters to examine during its environmental review. In a few months, assuming the Department of Commerce chooses to prepare an EA that includes all requirements of an Environmental Report, a public hearing will be held in the Project area after the EA is complete. At this hearing, members of the public will be given an opportunity to ask questions and submit comments. Minnesota Power will also present further evidence to support its need and route for the Project. Minnesota Power anticipates that the Commission will hold a joint public hearing on both the Certificate of Need and the Route Permit pursuant to Minnesota Statutes § 216B.243, subdivision 4.

Persons interested in receiving notices and other announcements about the Project's Certificate of Need application can subscribe to the docket by visiting https://mn.gov/puc/, clicking on "eDockets", clicking on "eFiling Home/Login" in the left menu, clicking on the "Subscribe to Dockets" button, entering their email address and select "Docket Number" from the Type of Subscriptions dropdown box, then select "[21]" from the first Docket number drop down box and enter "[140]" in the second box before clicking on the "Add to List" button. You must then click the "Save" button at the bottom of the page to confirm your subscription to the Project's Certificate of Need docket. These same steps can be followed to subscribe to the Project's Route Permit docket (21-141).

Persons wanting to have their name added to the Project Route Permit proceeding mailing list (MPUC Docket No. E015/TL-21-141) may register by contacting the public advisor in the consumer affairs office at the Commission at consumer.puc@state.mn.us, or (651) 296-0406 or 1-800-657-3782. Please be sure to note: 1) how you would like to receive notices (regular mail or email) and 2) your complete mailing or email address.

A separate mailing list is maintained for the Certificate of Need proceeding. To be placed on the Project Certificate of Need mailing list (MPUC Docket No. E015/CN-21-140), mail, fax, or email Robin Benson at Minnesota Public Utilities Commission, 121 7th Place E., Suite 350, St. Paul, MN 55101-2147, Fax: 651-297-7073 or robin.benson@state.mn.us.

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

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1.7 Certificate of Need Process

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

The Commission has adopted rules for the consideration of applications for Certificates of Need. Minn. R. Ch. 7849. On February 26, 2021, Minnesota Power filed a Petition for Exemption under Minnesota Rule 7849.0200, subpart 6, requesting that the Applicant be exempt from certain filing requirements under Chapter 7849. The Commission approved the Petition in an order dated May 17, 2021 (Exemption Order). This application contains the information required under Minnesota Rules Chapter 7849, as modified by the Commission in its Exemption Order. A copy of the Commission's Exemption Order is provided in **Appendix E**. A Certificate of Need completeness checklist is provided in **Appendix A** with cross references indicating where the information required by Minnesota statute and rules can be found in this application.

1.8 State Routing Process

This application is submitted under the alternative permitting process set forth in Minnesota Statutes § 216E.03 and Minnesota Rules 7850.1700 to 7850.2700 and 7850.4000 to 7850.4400. The Duluth Loop Project qualifies for review under the alternative permitting process authorized by Minnesota Statutes § 216E.04, subd. 2(3) and Minnesota Rules 7850.2800, Subp. 1(C) because the 115 kV portion of the Project is a high voltage transmission line between 100 and 200 kV and the 230 kV portion of the Project is less than five miles in length.

Minnesota Power notified the Commission on August 18, 2021 that Minnesota Power intended to use the alternative permitting process for the Project. This letter complied

with the requirements of Minnesota Rule 7850.2800, Subp. 2, to notify the Commission of this election at least 10 days prior to submitting an application for a Route Permit. A copy of this letter is attached as **Appendix G**.

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

1.9 Request for Joint Certificate of Need and Route Permit Proceeding

Minnesota Statutes § 216B.243, subdivision 4 and Minnesota Rule 7849.1900, subpart 4 permit the Commission to hold joint proceedings for the Certificate of Need and Route Permit in circumstances where a joint hearing is feasible, more efficient, and may further the public interest.

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

1.10 Permittee

Minnesota Power is the requested permittee for the Duluth Loop Project. Phone and e-mail addresses for the Project are:

Project Phone Number – (218) 755-5512
Project e-mail address – connect@duluthloop.com

Minnesota Power's contact for the Duluth Loop Project is:

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1.11 Applicant's Request

Minnesota Power respectfully requests that the Commission approve a Certificate of Need and Route Permit for the proposed Project along the Proposed Route. The Commission has established criteria in Minnesota Rule 7849.0120 to apply in determining whether a Certificate of Need should be granted for a proposed high voltage transmission line. An applicant for a Certificate of Need must show that the probable result of denying the request would be an adverse effect on the future adequacy and reliability of the system, there is not a more reasonable and prudent alternative, the proposed facility will

provide benefits to society compatible with protecting the environment, and the project will comply with all applicable standards and regulations. Minnesota Power has demonstrated in the application that the proposed Project meets all the requirements to obtain a Certificate of Need. The Duluth Loop Project will replace the system support once provided by the North Shore coal-fired baseload generators and is needed to: (1) resolve severe voltage stability concerns; (2) relieve transmission line overloads; and (3) enhance the reliability of Duluth area transmission sources.

This application demonstrates that issuance of a Route Permit for construction of the proposed Project along the Proposed Route effectively considers and satisfactorily addresses factors as set forth in Minn. Stat. § 216E.03, subd. 7, and Minn. R. 7850.4100. The proposed Project will support the State's goals to conserve resources, minimize environmental and human settlement impacts and land use conflicts by using the existing transmission line corridors to the maximum extent feasible, and ensure the State's electric energy security through the construction of efficient, cost-effective transmission infrastructure.

2.1 Project Description

The Duluth Loop Project includes: (1) construction of about 14 miles of new 115 kV transmission line between the Ridgeview, Haines Road, and Hilltop Substations; (2) construction of a new approximate one-mile extension connecting an existing 230 kV transmission line to the Arrowhead Substation; (3) upgrades to the Ridgeview, Hilltop, Haines Road, and Arrowhead substations; and (4) reconfiguration, rebuild, and upgrade to existing transmission lines and communications infrastructure in the Project area.

2.1.1 Proposed Route

The Duluth Loop Project includes the construction of about 14 miles of new 115 kV transmission line and about one mile of new 230 kV transmission line (**Map 1-1**). The proposed route for the 115 kV transmission line is referred to as the Proposed 115 kV Route and the proposed route for the 230 kV line is referred to as the Proposed 230 kV Route. The terms “Proposed Route” are used in this application when both the Proposed 115 kV Route and the Proposed 230 kV Route are being discussed as well as the required substation expansion and work areas.

2.1.1.1 Proposed 115 kV Route

The Proposed 115 kV Route between the Ridgeview, Haines Road, and Hilltop Substations follows existing transmission lines for most of its length, utilizing existing transmission line corridors where practical to minimize environmental impacts (**Map 2-1 and Map 2-2** in **Maps tab**).

The Proposed 115 kV Route from north to south begins at the existing Ridgeview Substation and follows the existing 19 Line and 56 Line, within an east-west corridor, going west for about 1.2 miles from the Ridgeview Substation. Within this corridor, the proposed 115 kV transmission line will be located between the existing 19 and 56 Lines. This new line will become designated as the 19 Line and the existing 19 Line in this corridor will be reconstructed and be redesignated as part of the new 52 Line. At the point where the existing 56 Line turns north and the existing 19 Line turns southwest, the Proposed 115 kV Route will follow the existing 19 Line corridor. The centerline of the new construction shifts to the south side of the existing 19 Line and existing 52 Line to continue south and west for approximately 2.7 miles to enter the Haines Road Substation on the west side of Miller Trunk Highway. Throughout this segment, the existing conductor and structures will be replaced as needed.

From the Haines Road Substation, the Proposed 115 kV Route continues west generally along the existing 58 Line corridor. This corridor contains the currently energized 58 Line and a parallel deenergized line, known as 58D, which is currently supporting fiber optic communications. Both existing 58 Line and 58D will be rebuilt with new conductor and structures as necessary for approximately 3.5 miles to a point about 0.3 miles east of the

intersection of the existing 58 and 57 Lines. At this point, the Proposed 115 kV Route turns south in a new alignment for about 1.5 miles crossing Maple Grove Road and Hermantown Road to the existing 57 Line corridor located south of the Midway River. The Proposed 115 kV Route continues south following the existing 57 Line corridor for about 1.4 miles to the existing 71 Line. The conductor and structures will be replaced as needed on the existing 57 Line. Next, from the intersection with the existing 71 Line, 71 Line and the new 115 kV line (176 Line) will be reconstructed as a 115/115 kV double circuit line, going south for about 0.1 miles then east for 1.5 miles on the existing 71 Line corridor. At a point about 0.25 miles east of Lavaque Road, the proposed 71 Line/176 Line 115/115 kV double circuit line would turn south for about 0.1 mile, then east for about 0.75 miles, then south for approximately 0.75 miles, and west for about 0.25 miles to enter the Hilltop Substation. Several segments of the existing 98 Line will be shifted and rebuilt at the end of this alignment to facilitate the changes. Once this Project is constructed, the line configurations and designations will change based upon the bulleted list included in Section 2.1.5.1.

The following upgrades to existing infrastructure would be required to accommodate the Proposed 115 kV Route:

- Ridgeview Substation to the 56/19 Line split (**Appendix J-3, pages 1 and 2**) – The proposed 115 kV transmission line would be placed between the existing 19 and 56 Lines as it runs west from the Ridgeview Substation within existing Minnesota Power right-of-way (ROW) for about 1.2 miles. The existing transmission lines would be reconfigured as they enter the Ridgeview Substation to accommodate the new transmission line. Minnesota Power would replace the conductor and structures as needed on the existing 19 Line. H-Frame structures are planned for the new line and the rebuilt 19 Line.

- 56/19 split to the Swan Lake Road Substation (**Appendix J-3, pages 2 to 4**) – The proposed 115 kV transmission line would be placed to the east and south of the existing 19 Line for approximately 1.5 miles on an expanded ROW, crossing Rice Lake Road, to the Swan Lake Road Substation. Minnesota Power would replace the conductor and structures as needed on the existing 19 Line. H-Frame structures are planned for the new line and the rebuilt 19 transmission Line.

- Swan Lake Road Substation to the Haines Road Substation (**Appendix J-3, pages 4 to 6**) – The proposed 115 kV transmission line would be placed to the east and southeast of the existing 52 Line for approximately 1.2 miles on an expanded ROW, crossing West Arrowhead Road, Sundby Road, and Miller Trunk Highway before entering the Haines Road Substation. An existing distribution line that runs south from the Swan Lake Road Substation to Arrowhead Road would be moved to the east of the existing 52 Line (new 57 Line) and new 52 Line on a new ROW. Minnesota Power would replace the conductor and structures as needed on the existing 52 Line (new 57 Line). Wood H-Frame and steel monopole structures are planned for the new line and the rebuilt 52 Line from the Swan Lake Road Substation to the Haines Road Substation.

- Haines Road Substation to the 57 Line (**Appendix J-3, pages 6 to 12**) – The proposed 115 kV transmission line would exit the Haines Road Substation to the west and be placed on the existing 58D that is located north of the existing 58 Line. Immediately west of the Haines Road Substation to the west of Westburg Road, the proposed 115 kV transmission line and the existing 58 Line would be moved and rebuilt to the south to address right-of-way encroachments and provide more clearance from the commercial buildings along the north side of Market Street (**Appendix J-3, page 6**) and from the commercial buildings along the south side of Lighting Drive (**Appendix J-3, page 7**). The proposed 115 kV transmission line would continue on the existing 58D for about three miles to a point 0.3 miles east of the intersection of the existing 58 and 57 Lines. The existing 58 Line would be rebuilt from the Haines Road Substation to the intersection of the existing 58 and 57 Lines to accommodate the placement of the new line directly to the north. A new ROW would be needed in some sections.

  Both the new line and rebuilt 58 Line would be reconfigured on Minnesota Power's property north of the Hermantown City Hall (**Appendix J-3, page 9**).

  The existing 58 Line that runs northwest to the existing 57 Line intersection would be reconfigured so that the two transmission lines do not cross. The existing 58 Line would be removed for a distance of about 0.3 miles (**Appendix J-3, page 9**). A fiber optic connection to the 57 Line would need to be re-established, therefore a new underground fiber optic connection would be installed for about 0.75 miles along the existing 58 Line corridor (**Appendix J-3, pages 10, 11, and 12**).

  Monopole structures are planned for the new line and the rebuilt 58 transmission Line from a point east of Sundby Road to the Haines Road Substation and from the Haines Road Substation to Minnesota Power's property north of the Hermantown City Hall (**Appendix J-3, pages 5 to 9**). H-Frame structures would be used from Minnesota Power's property north of the Hermantown City Hall to the intersection of the existing 58 and 57 Lines (**Appendix J-3, pages 9 and 10**).

- 57 Line south to 71 Line (**Appendix J-3, pages 10 and 13 to 17**) – The proposed 115 kV transmission line and the 57-Line would turn south and share a new 160-foot-wide ROW for approximately 1.6 miles before rejoining the existing 57 Line ROW. The existing 57 Line from this point back to the existing 58 Line intersection north of Maple Grove Road would be removed (approximately 1.8 miles). The existing 57 Line parallels the Midway River and would be rerouted to reduce the length of impact on the Midway River. The proposed 115 kV transmission line would parallel the proposed 57 Line ROW on west side for 1.4 mile to the intersection with the existing 71 Line. H-Frame structures would be used for the new line and rebuilt 57 Line with short section of monopole structures east of the Hermantown Cemetery.

- 71 Line Double-Circuit (**Appendix J-3, pages 17 to 21**) – The proposed 115 kV transmission line would be double-circuited with the existing 71 Line on new structures going south then east for about 1.5 miles on the existing 71 Line ROW.

At a point about 0.25 miles east of Lavaque Road, the proposed 115 kV line and the existing 71 Line double-circuit would turn south for about 0.1 mile, then east for about 0.5 miles just north of the existing 98 Line. At this point, the proposed 115 kV line and the existing 71 Line double-circuit and the existing 98 Line would shift south to maximize distance from residential properties and continue east for about 0.35 miles. The proposed 115 kV line and existing 71 Line double-circuited would then turn south and southwest for about 1.0 mile and enter the Hilltop Substation. The existing 71 Line through the Wild Rose Trail subdivision is proposed to be removed. The existing 98 Line would be rebuilt from the location where it shifts south into the Hilltop Substation (**Map 2-2**).

2.1.1.2 Proposed 230 kV Route

The Proposed 230 kV Route for the 230 kV line begins at the Arrowhead Substation and goes north for about 0.1 miles, then northeast for approximately 0.1 miles, then north for about 0.1 miles, then east for about 0.1 miles, then north and east for about 0.3 miles to a connection with the existing 98 Line (**Map 2-3 and Appendix J-3, pages 22 and 23**), which would then be redesignated 108 Line. The Proposed 230 kV Route is located mostly on Minnesota Power property with the exception of the northernmost 0.15 miles that spans the Canadian National Railroad and private property. The segment is parallel to existing 115 kV transmission lines. Approximately 0.5 miles of the existing 98 Line would be removed from the corner of the existing 90 Line and 98 Line to the new 108 Line tie-in, including the span over the Canadian National Railroad (**Appendix J-3, page 22**).

2.1.2 Route Width

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

For the Proposed 115 kV Route, Minnesota Power is requesting approval for a route width that varies from about 500 feet wide to approximately 1,800-feet wide (250 feet to 900 feet on either side of the centerline for the transmission line) (**Map 2-1**). Minnesota Power is requesting a wider route width in constrained areas. These constrained areas, as shown on **Figure J-3** in **Appendix J**, include the following areas:

- 19 and 52 Lines route width between approximately 560 feet and 610 feet (**Appendix J-3, pages 1 to 7**)
- 57 and 176 Lines route width is about 560 feet (**Appendix J-3, pages 7 to 18**)
- 71 and 176 double-circuit Lines route width is about 500 feet (**Appendix J-3, pages 18 to 22**)
- Ridgeview Substation route width is about 810 feet (**Appendix J-3, page 1**)

- Around the Haines Road Substation, Miller Creek, and Miller Trunk Highway span area has a route width of approximately 1,825 feet at the widest spot north to south (**Appendix J-3, pages 6 to 7**)
- Midway River area with the 57 and 176 Lines has a route width of approximately 1,710 feet at the widest spot east to west (**Appendix J-3, pages 11 to 18**)
- The Hermantown Cemetery with the 57 and 176 Lines has a route width of about 1,550 feet (**Appendix J-3, page 17**)
- Hilltop Substation has a route width of approximately 1,750 feet east to west (**Appendix J-3, page 22**)

For the Proposed 230 kV Route, Minnesota Power is requesting approval of a 500 foot wide route width (250 feet on either side of the centerline for the transmission line) with the exception of the area around Arrowhead Substation where additional route width is requested (**Appendix J-3, page 24**).

2.1.3 Transmission Line Right-of-Way

For new 115 kV transmission lines, Minnesota Power typically acquires a minimum right-of-way of up to 100 feet wide (50 feet on each side of the transmission line centerline). For new 230 kV transmission lines, Minnesota Power typically acquires a minimum right-of-way of up to 130 feet wide (65 feet on each side of the transmission line centerline). It is sometimes necessary to secure extra permanent right-of-way at angles to accommodate guy anchors if used. Narrower right-of-way widths at specific and isolated routing constraint points may or may not be possible and will need to be evaluated on a case-by-case basis. **Appendix K-1** through **Appendix K-4** show the dimensions of the proposed transmission structures and the right-of-way requirements for these structures.

2.1.4 Transmission Structure and Conductor Design

The proposed transmission structures for the Project are wood pole, H-frame structures and steel monopole structures. Structure heights and span lengths are a function of span properties, topography, wire, voltage, tension, route, and other factors. The height and span lengths provided here are typical values expected for the majority of tangent type structures based on similar facilities. Actual span lengths and structure heights may vary outside typical values as necessary.

The new 115 kV wood H-frame structures will be approximately 50 to 80 feet tall with spans of approximately 500 to 1,000 feet. The new 115 kV steel monopole structures will be approximately 65 to 110 feet tall with spans of approximately 250 to 700 feet.

The new 230 kV steel monopole structures will be approximately 65 to 110 feet tall with spans of approximately 250 to 700 feet. In certain locations such as angles, along highways, constrained areas, or environmentally sensitive areas, other specialty structure types may be required. Less common structure configurations for deadends, angles, crossings, and transpositions will also be necessary.

The proposed transmission line will be designed to meet or surpass relevant state codes including the National Electric Safety Code ("NESC") and Minnesota Power standards. Typical 115 kV and 230 kV tangent type structures are shown in **Appendix K**. **Table 2-1** summarizes the key specifications of the proposed transmission structures.

Table 2-1. Structure Design Summary

Line Type	Structure Type	Structure Material	Right-of-Way Width (feet)	Structure Height (feet)	Foundation	Foundation Diameter (feet)	Span Between Structures (feet)
115 kV Single Circuit	H-frame	Wood	100	50-80	Direct Embed	n/a[1]	500- 1,000
115 kV Single Circuit	Monopole	Steel	100	65-100	Concrete Pier	4-6	250-700
115 kV Double Circuit	Monopole	Steel	100	65-110	Concrete Pier	4-6	250-500
230 kV Single Circuit	Monopole	Steel	130	65-110	Concrete Pier	4-6	250-700

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

The conductors for the 115 kV transmission line will consist primarily of 666 ACSS on new construction and reconstruction. A 636 ACSR conductor may be used for the 115 kV transmission line in some areas to match existing conductors. The conductors for the 230 kV transmission line will consist of 954 ACSR to match existing conductors. Typical transmission line construction with H-Frame structures have two shield wires. Typical transmission line construction with monopole structures has a single shield wire but may have up to two. Typical transmission line construction has a single Optical Ground Wire ("OPGW") in a shield wire position for communication purposes, although this varies, and lines may have no OPGW or two OPGW cables.

2.1.5 Associated Facilities

2.1.5.1 Transmission Line Upgrades

The following reconfiguration, rebuild, and upgrades are required to existing transmission lines in the Project area as part of the Duluth Loop Project:

- Reconductor of 115 kV Haines Road – Swan Lake Road Line No. 52 (52 Line);
- Reconductor of 115 kV Swan Lake Road – Ridgeview Line No. 19 (19 Line);
- A segment of existing 115 kV Arrowhead – 15th Ave West Line No. 71 (71 Line) will be reconstructed as a double circuit line with the new 115 kV Hilltop – Haines Road Line No. 176 (176 Line).

[1] *To accommodate direct embedding holes will be augured, structure placed, and backfilled, as appropriate.*

- Existing 115 kV Arrowhead – Haines Road Line No. 58 (58 Line) will be uncrossed from existing 115 kV Arrowhead – Colbyville Line No. 57 (57 Line) to become 115 kV Arrowhead – Colbyville 115 kV Line No. 58 (58 Line);
- Existing 115 kV Arrowhead – Colbyville Line No. 57 (57 Line) will be uncrossed from existing 115 kV Arrowhead – Haines Road Line No. 58 (58 Line) and connected to existing 115 kV Haines Road – Swan Lake Road Line No. 52 outside of Haines Road Substation to become 115 kV Arrowhead – Swan Lake Road Line No. 57 (57 Line);
- Existing 230 kV Arrowhead – Iron Range Line No. 98/Tap to Hilltop (98 Line Tap) will be upgraded to a higher thermal rating; and
- Existing 98 Line Tap will be disconnected from existing 230 kV Arrowhead – Iron Range Line No. 98 and extended to the Arrowhead Substation to become the 230 kV Arrowhead – Hilltop Line No. 108 (108 Line).

A figure depicting these transmission line upgrades is provided as **Map 2-4** in **Maps tab**.

2.1.5.2 Substation Modifications

2.1.5.2.1 Hilltop Substation Modifications

The existing Hilltop Substation is located in Duluth, Minnesota. The substation will be expanded by about 0.1 acres on existing Minnesota Power property to accommodate the construction of a new 115 kV transmission line entrance. This new 115 kV transmission line entrance will include a substation deadend structure, circuit breaker, two switches, and bus work. The existing 230/115 kV transformer has a rating of 187 MVA and will be replaced with a 230/115 kV transformer with a rating of 373 MVA. The 115 kV circuit breaker, two switches, and some substation conductors on the low side of the 230/115 kV transformer will be replaced with higher ampacity equipment. A 230 kV circuit breaker will be added between the 230/115 kV transformer position and the 230 kV transmission line position. The three existing 115 kV transmission line circuit breakers will also be replaced as an additional asset renewal component of the project. A figure depicting the Hilltop Substation modifications is provided as **Appendix J-1** in **Appendix J**.

2.1.5.2.2 Ridgeview Substation Modifications

The existing Ridgeview Substation is located in Duluth, Minnesota. The Ridgeview Substation will be expanded by about 3.6 acres on existing Minnesota Power property to accommodate a new 115 kV transmission line entrance, a future 115 kV transmission line entrance, and a future capacitor bank in a ring bus configuration. The existing substation bus will be reconfigured and expanded to a six position 115 kV ring bus with three 115 kV transmission line positions, two 115/14 kV transformer positions, and a future 115 kV transmission line position. An aging 115/14 kV transformer will be replaced and relocated to a shared ring bus position with the future capacitor bank. A figure depicting the Ridgeview Substation modifications is provided as **Appendix J-2** in **Appendix J**.

2.1.5.2.3 Haines Road Substation Modifications

The existing Haines Road Substation is located in Hermantown, Minnesota. Within the existing substation, a 115 kV circuit breaker will be added to an existing transmission line entrance. Some existing substation conductors will be replaced with high ampacity conductors.

2.1.5.2.4 Arrowhead Substation Modifications

The existing Arrowhead Substation is located in Hermantown, Minnesota. Within the existing substation, a 230 kV transmission line entrance will be added to accommodate the proposed 230 kV reconfiguration establishing the Arrowhead – Hilltop 230 kV Line (108 Line). This new 230 kV transmission line entrance will include a substation deadend structure, circuit breaker, two switches, and bus work.

2.1.5.3 Communication Infrastructure Modifications

Modifications to communications infrastructure in the Project area will be completed as part of the Duluth Loop Project to improve overall communication capabilities of the transmission system. To accommodate reconfigurations, some sections of existing OPGW to an adjacent splice box will be replaced due to age and condition. Communications infrastructure modifications are anticipated to occur in the following areas:

- Replace aging OPGW on existing 230 kV tap to Hilltop (98 Line Tap) and continue this communications path on new 108 Line into the Arrowhead Substation;
- Replace aging OPGW on existing 115 kV Hilltop – Hibbard Line No. 7 (7 Line) and route this communications path into the Hilltop Substation;
- Replace aging OPGW on existing 71 Line near the Hilltop Substation and route this communications path into the Hilltop Substation;
- Replace aging OPGW on 19, 52, 57, and 58 Lines; and
- Construct an underground fiber communications path in the existing transmission corridor between reconfigured 57 Line and 58 Line.

The location of these communication infrastructure modifications are shown in **Map 2-5** in **Maps tab**.

2.1.6 Design Options to Accommodate Future Expansion

The proposed 115 kV and 230 kV transmission lines are designed to meet the current and projected load serving needs in the Project area. The new ACSS conductor on the proposed 115 kV transmission line was selected to accommodate some future load growth in the area. New transmission structures will not be capable of supporting an additional transmission circuit in the future.

The proposed substation modifications are designed to provide for interconnection with existing, proposed, and potential future transmission facilities.

As discussed in Section 4.5.1 (Alternative 115 kV Endpoints, Colbyville Substation), a future consideration that is enabled by the Project as proposed would involve relocating the termination of the existing Big Rock – Colbyville 115 kV Line from the Colbyville Substation to the Ridgeview Substation. The future 115 kV transmission line position at the Ridgeview Substation is being developed to accommodate this future consideration.

As discussed in the 2019 Minnesota Biennial Report, the Duluth 230 kV Project (MPUC Tracking Number 2007-NE-N1) remains a future consideration that is preserved by the Project as proposed. The Duluth 230 kV Project involves adding a second 230/115 kV transformer at the Hilltop Substation and upgrading an existing line from 115 kV to 230 kV between the Arrowhead and Hilltop substations. The Duluth Loop Project as proposed increases the reliability and capacity of the Hilltop 230/115 kV transformer, allowing the Duluth 230 kV Project to be delayed.

2.2 Project Costs

2.2.1 Construction Costs

The estimated cost to construct the Duluth Loop Project is between $50 million and $70 million ($2021 dollars). The cost estimates below are based on preliminary engineering considerations of the Proposed 115 kV Route and the Proposed 230 kV Route. If the Commission selects a route other than these two proposed routes, the Project cost estimates may change.

Table 2-2. Current Project Cost Estimates

Project Component	Low End (2021$) ($Millions)	High End (2021$) ($Millions)
115 kV Transmission Lines	$28.2	$42.6
230 kV Transmission Lines	$5.5	$8.3
Ridgeview Substation	$9.1	$10.6
Hilltop Substation	$5.6	$6.6
Arrowhead Substation	$1.2	$1.4
Haines Road Substation	$0.4	$0.5
Project Cost Totals	**$50.0**	**$70.0**

2.2.2 Operation and Maintenance Costs

Once constructed, the operation and maintenance costs for Duluth Loop Project will be minimal for several years since the transmission line will be new and vegetation maintenance on the route corridor will occur prior to construction. Minnesota Power's vegetation management costs for all of its transmission lines (100 kV and above) on its system was approximately $660 per line mile in 2020. In addition to vegetation management, Minnesota Power also performs other general maintenance on its transmission facilities such as repairing aged or worn equipment or facilities. Minnesota

Power's maintenance costs, excluding vegetation management, for its transmission lines (100 kV and above) was approximately $520 per mile in 2020. The O&M costs provided are the average O&M costs for Minnesota Power's transmission facilities. The specific O&M costs for an individual transmission line vary based on the location of the line, the number of trees located along the right-of-way, the age and condition of the line, the voltage of the line, and other factors.

2.2.3 Effect on Rates

The Commission's rules require an applicant to provide the annual revenue requirements to recover the costs of a proposed project. **Table 2-3** below summarizes the estimated Minnesota jurisdictional revenue requirements and rate impacts by customer class for the first full year following the in-service date of the Project (i.e., 2026).

Table 2-3. Estimated Retail Customer Rate Impact[2]

First Full Year Revenue Requirements	$8,341,864
Rate Class Impacts	
Residential (average current rate, cents/kWh)	11.860
Increase (cents/kWh) /2 [3]	0.108
Increase (%)	0.91%
Average Impact ($ / month)	$0.77
General Service (average current rate, cents/kWh)	11.814
Increase (cents/kWh) /2	0.108
Increase (%)	0.92%
Average Impact ($ / month)	$2.83
Large Light & Power (average current rate, cents/kWh)	9.173
Increase (cents/kWh) /2	0.108
Increase (%)	1.18%
Average Impact ($ / month)	$248.92
Large Power (average current rate, cents/kWh)	6.978
Increase (Demand & Energy Combined) (cents/kWh) /2	0.118
Increase (%)	1.69%
Average Impact ($ / month)	$53,593
Lighting (average current rate, cents/kWh)	18.762
Increase (cents/kWh) /2	0.108
Increase (%)	0.58%
Average Impact ($ / month)	$0.24

[2] Average current rates are 2021 estimated rates based on 2019 Rate Case resolution (Docket E-015/GR-19-442) without riders adjusted to include current rider rates. Current rider rates included Renewable Resources Rider rates, Transmission Cost Recovery Rider rates, Conservation Program Adjustment rates, and estimated 2021 Fuel and Purchased Energy. Average $/month impact based on 2022 budgeted billing units.

[3] Increase shown is the incremental increase due to the new Project in 2021 dollars.

2.3 Project Schedule

The anticipated permitting and construction schedule for the Project is provided in **Table 2-4**. It is anticipated that construction of the Project will being in the fall 2023. This schedule is based on information known as of the date of the filing of this Application and may be subject to change.

Table 2-4. Anticipated Project Schedule

Activity	Anticipated Date
Certificate of Need and Route Permit Application Filed	Fall 2021
Certificate of Need and Route Permit Issued	Spring 2023
Land Acquisition Begins	Spring 2023
Right-of-Way Clearing Begins	Winter 2023
Project Construction Begins	Fall 2023
Project In-Service	December 2025

3.1 Summary of Need

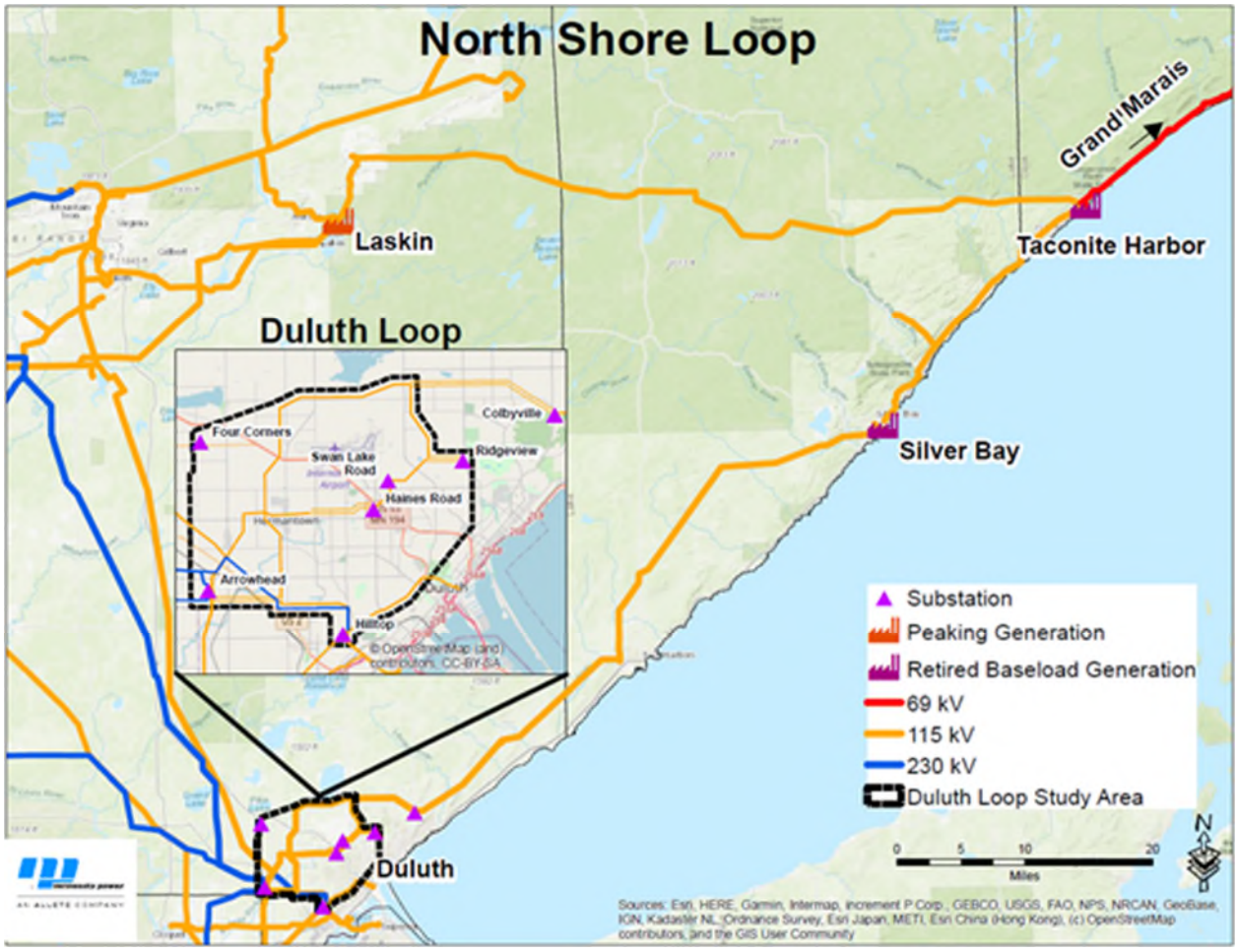
The Duluth Loop Project is needed to replace the system support once provided by coal-fired baseload generators located along Minnesota's North Shore. The Duluth Loop Project is needed to address severe voltage stability concerns, relieve transmission line overloads, and enhance the reliability of Duluth-area transmission sources, all of which are needs that have resulted from the retirement of these generation sources. The Duluth Transmission Study prepared by Minnesota Power to study the need for the Project and alternatives to the Project is provided as **Appendix I**.

3.2 Background on Need

3.2.1 Changing Generation Portfolio on the North Shore

The transmission system in the Duluth area has historically been supported by several coal-fired baseload generators located along Minnesota's North Shore. For decades, these local generators have contributed to the reliability of the transmission system by delivering power to the local area and providing system support. As Minnesota Power and its customers have transitioned away from reliance on coal to increasingly lower-carbon sources of energy, the idling of the generators on the North Shore has led to an increased reliance on the transmission system to deliver replacement power and system support to the Duluth area and along the North Shore. In order to maintain a continuous supply of safe and reliable electricity while replacing the support once provided by these local coal-fired generators, the Duluth area transmission system must be upgraded. To accomplish this, Minnesota Power is proposing to connect the transmission lines in an area known as the "Duluth Loop" to enhance system stability and reliability. The Duluth Loop is shown alongside the larger "North Shore Loop" in **Figure 3-1**.

Figure 3-1. Duluth Loop and North Shore Loop



3.2.2 Duluth and the North Shore Loop

The North Shore Loop, shown in **Figure 3-1**, is a single continuous 140 mile 115 kV transmission path between the Colbyville Substation in Northeast Duluth and the Laskin Substation in Hoyt Lakes, with significant load-serving substations in Duluth, Two Harbors, Silver Bay, Finland, and Taconite Harbor. The area east of Taconite Harbor along Minnesota's North Shore is served by a single 69 kV connection from Taconite Harbor. Adjacent to the Colbyville end of the North Shore Loop is the Duluth Loop. The Duluth Loop, shown in the inset in **Figure 3-1** and illustrated electrically in **Figure 3-2**, is a network of 115 kV transmission lines and substations, which form two parallel connections between the regional 230/115 kV transmissions source at the Arrowhead Substation and the North Shore Loop connection at the Colbyville Substation. Many customers in the Duluth area are served from substations connected to the Duluth Loop, including customers in Hermantown, Duluth Heights, Kenwood, Woodland, Lakeside, Hunter's Park, and Congdon and around the Miller Hill Mall, the Duluth International Airport, the universities, and the downtown hospital district, among others.

Figure 3-2. Relevant Duluth Area Transmission System

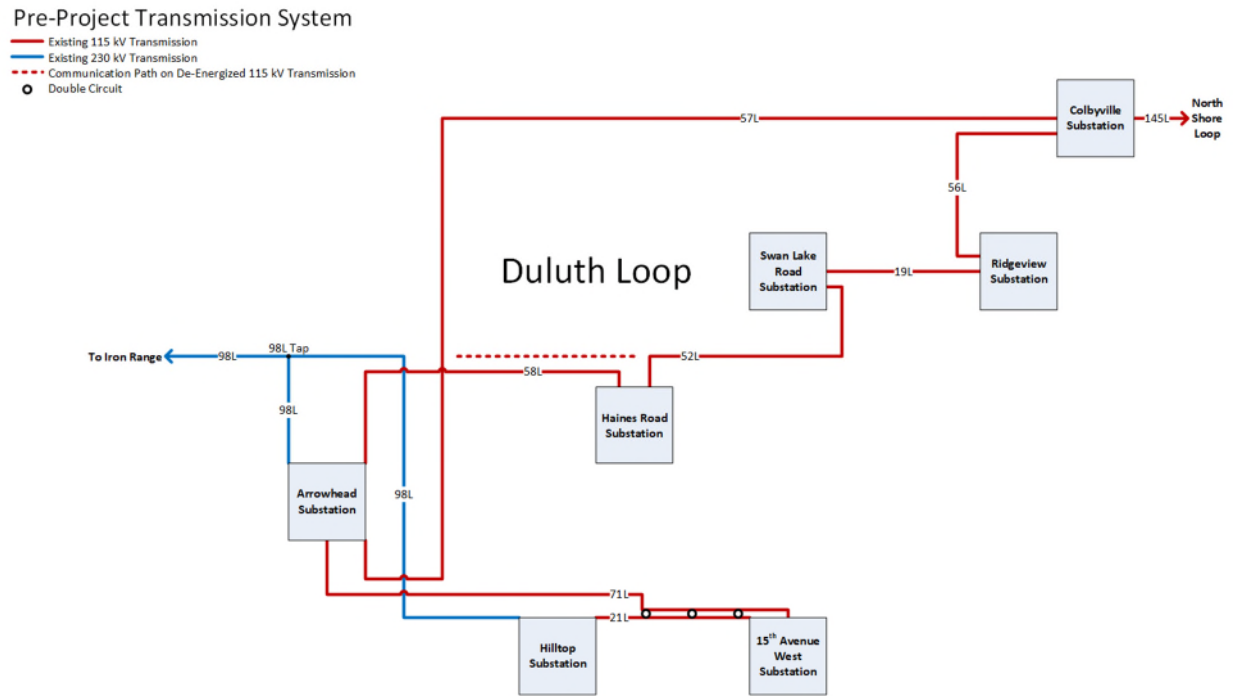
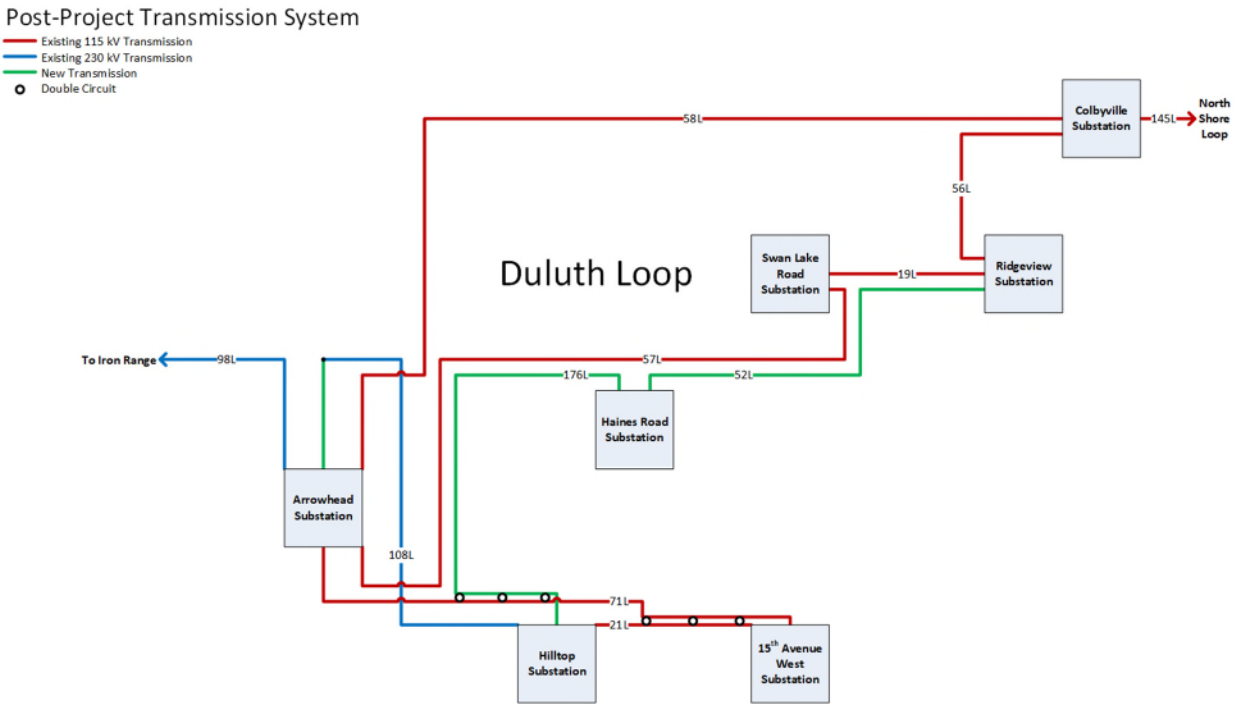


Figure 3-3. Post-Project Duluth Area Transmission System



The Duluth Loop Project illustrated electrically in **Figure 3-3** is needed to replace the system support once provided by the North Shore coal-fired baseload generators and will: (1) resolve severe voltage stability concerns; (2) relieve transmission line overloads;

and (3) enhance the reliability of Duluth-area transmission sources. These need drivers show up in internal Minnesota Power transmission studies and MISO annual transmission assessments. These need drivers are described in more detail in the following section.

3.3 Project Need Drivers

3.3.1 Severe Voltage Stability Concerns

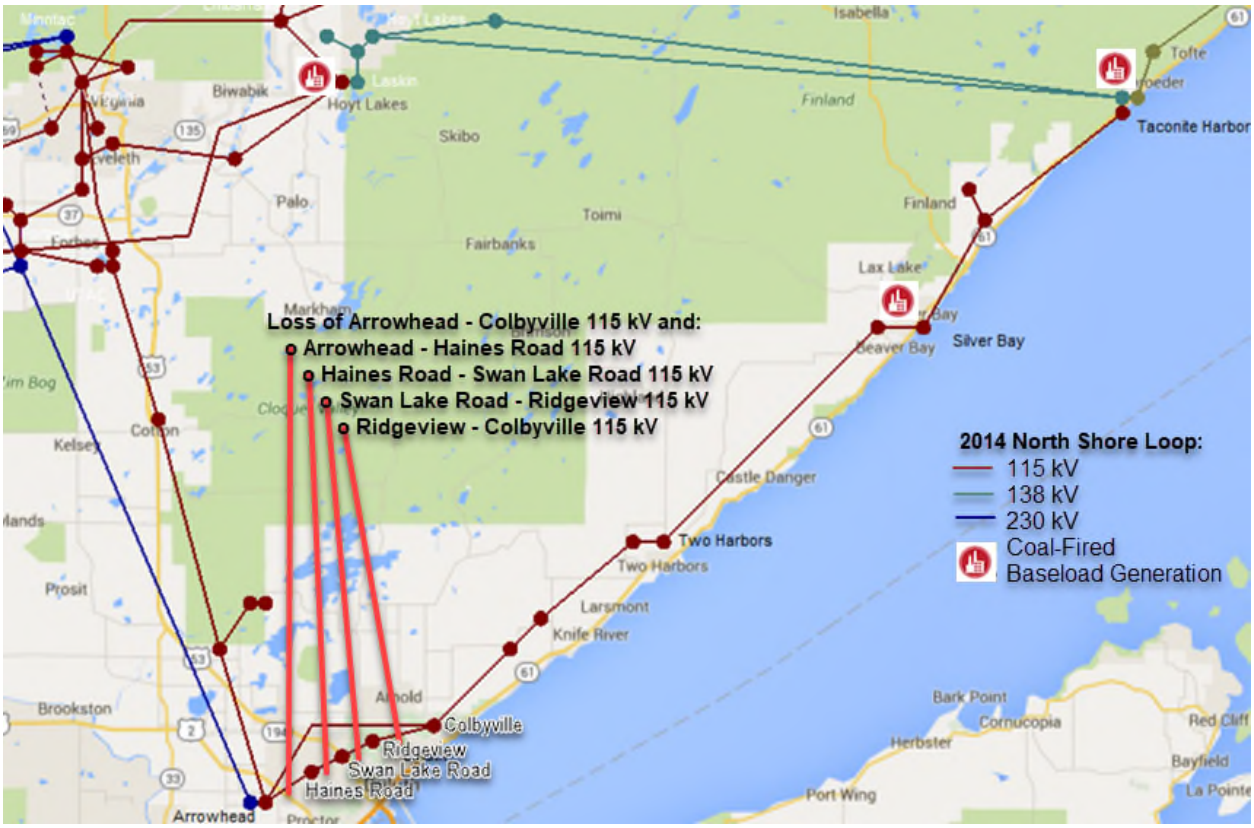
3.3.1.1 Voltage Collapse Scenarios

For most transmission outages in the Duluth Loop, the loss of a second Duluth Loop transmission line during the outage would leave the North Shore and all or part of the Duluth Loop served by a single 140-mile-long transmission line originating in the Hoyt Lakes area. Without the generation support previously provided by the local baseload generators on the North Shore, the transmission system is no longer able to support the large amount of Duluth Loop load over such a long distance. The expected result would be a post-contingency voltage collapse in the Duluth Loop area that would then extend up the North Shore toward Silver Bay. A voltage collapse is what occurs when the voltage in some part of the system cannot recover following a contingency event, resulting in loss of system voltage control and extremely low voltages which can lead to damages to end-user electrical equipment and possibly localized blackouts.

Figure 3-4 illustrates the four primary Duluth Loop voltage collapse scenarios of concern. These scenarios all involve an outage of Arrowhead – Colbyville 115 kV (57 Line) along with an outage of one of the following other transmission lines:

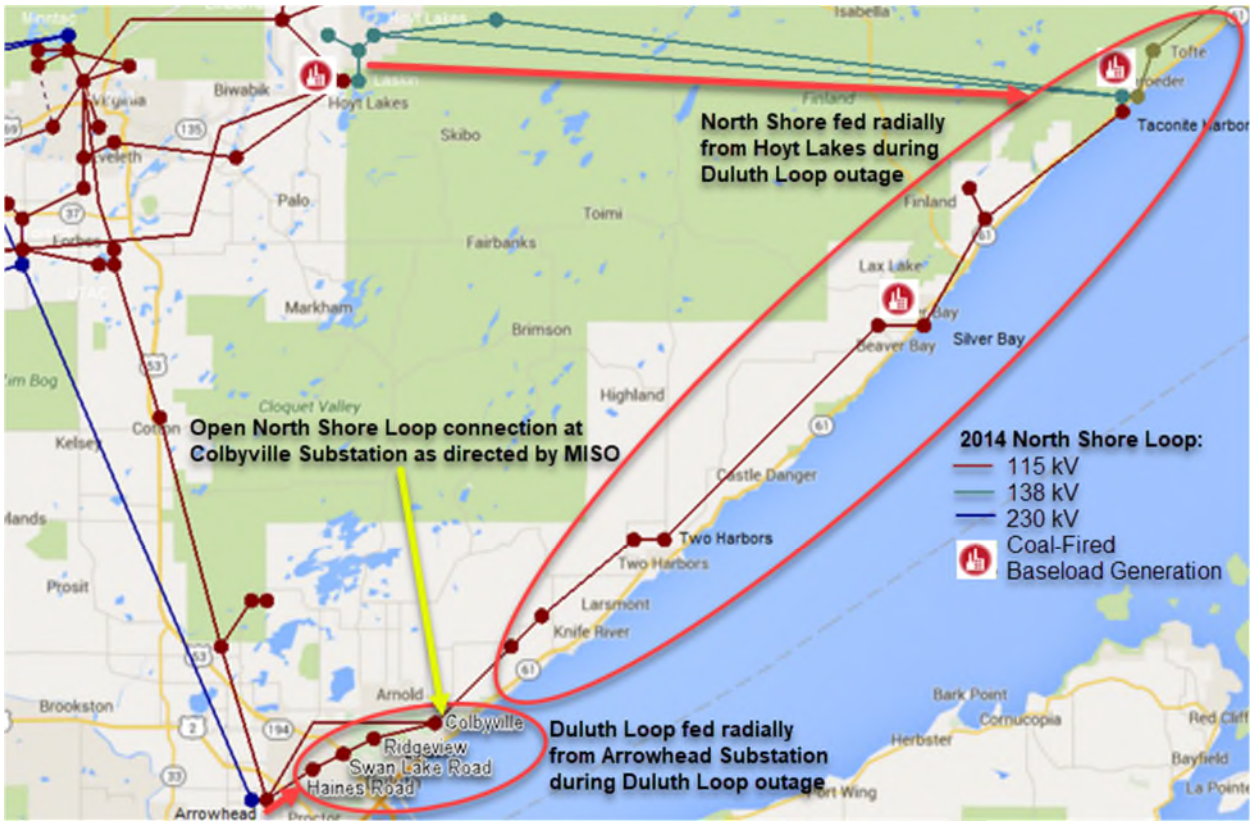
- Arrowhead – Haines Road 115 kV (58 Line)
- Haines Road – Swan Lake Road 115 kV (52 Line)
- Swan Lake Road – Ridgeview 115 kV (19 Line)
- Ridgeview – Colbyville 115 kV (56 Line)

Figure 3-4. Duluth Loop Voltage Collapse Scenarios



To manage the risk of low voltage or voltage collapse in real-time operations during an outage of a transmission line in the Duluth Loop, the MISO may direct Minnesota Power to open the North Shore transmission connection at the Colbyville Substation, separating Duluth from the North Shore during planned outages in the Duluth Loop. As illustrated in **Figure 3-5**, this causes the Duluth Loop load to be served by a single transmission path from the Arrowhead Substation and the load along the North Shore to be served by a single transmission path from the Hoyt Lakes area. This operational solution serves mostly to contain the problem rather than resolve it. With customers on either side of the open point at the Colbyville Substation served from a single transmission line source, the loss of another transmission line anywhere in the Duluth Loop or the North Shore Loop would sever the only remaining source of power to many residential, commercial, and industrial customers.

Figure 3-5. North Shore Loop Connection Open at Colbyville Substation



3.3.1.2 Voltage Stability Limit Calculation

In order to understand the Duluth Loop voltage collapse issue and begin to develop a long-term solution for it, the maximum Duluth Loop load level was identified which could be served radially from Silver Bay without causing a voltage collapse. This condition is called the "stability limit" – the last point at which the system is stable. This load level was found by scaling load at substations between the Silver Bay Hillside and Haines Road substations in a power flow model. Consistent with typical transmission planning practices for voltage stability issues, the practical voltage stability threshold (or operating limit) was defined to be 90% of the stability limit in order to preserve some margin between the operating limit and the point of voltage collapse.

As generation in the North Shore Loop was retired, idled, or transitioned to peaking operation, the Duluth Loop voltage stability threshold was steadily reduced, effectively reducing reliable load-serving capability for the Duluth Loop. This is clearly shown when comparing the calculated Duluth Loop voltage stability threshold over time, as shown in **Table 3-1**.

Table 3-1. Duluth Loop Voltage Stability Thresholds

Year	North Shore Loop Generators Online (Output)	Voltage Stability Threshold
2014	All North Shore Loop Generators Online (459 MW)	108 MW
2020	Only Laskin Energy Center Online (118 MW)	65.7 MW
2020	No North Shore Loop Generators Online (0 MW)	54.0 MW

In order to better understand the significance and risk associated with the identified voltage stability issue, historical data for the Duluth Loop and along the North Shore was evaluated using these defined stability thresholds.

3.3.1.3 Voltage Stability Limit and Historical Data Analysis

Generator transitions in the North Shore Loop have significantly impacted the ability to serve Duluth Loop and North Shore load from Silver Bay during the loss of both transmission paths between the Arrowhead and Colbyville substations. **Figure 3-6** to **Figure 3-9** below illustrate the severity of the Duluth Loop voltage stability issues relative to historical load levels in the area. Each plot shows the historical loading on the transmission system between a Duluth Loop substation and the North Shore Switching Station. Silver Bay Hillside is the first substation towards the City of Duluth from the North Shore Switching Station. Historical data for 2019 represents a typical year for the area with heavy winter peak loading, moderate to high summer peak loading, and lighter loading in the shoulder months. These plots also show the voltage stability thresholds from **Table 3-1** along with the hours, days, and consecutive days which loading was below the threshold. The green line indicates the stability threshold with all historical North Shore Loop generation online. The orange line indicates the stability threshold with only Laskin generation online. The red line indicates the stability threshold with no North Shore Loop generation online, which is the normal condition in today's system.

Figure 3-6 below shows 2019 historical loading between the Haines Road and Silver Bay Hillside substations. Historical loading is depicted by the black dots in **Figure 3-6**. For time periods where loading remains below the voltage stability thresholds, a maintenance outage would be acceptable on the Arrowhead – Colbyville 115 kV line or the Arrowhead – Haines Road 115 kV line without incurring the risk of a voltage collapse for loss of a second Duluth Loop 115 kV line.

With all North Shore Loop generation online as indicated by the green line, there were significant opportunities for maintenance outside the summer and winter peak seasons, with up to 116 consecutive days at one point throughout the year for maintenance work to occur on these lines.

With only Laskin generation online as indicated by the orange line, there are no days throughout the year during which loading is within the voltage stability threshold for the entire day. This means there are very limited opportunities for maintenance work to occur without putting Duluth and the North Shore at additional reliability risk.

With no North Shore Loop generation online as indicated by the red line, there also are no days throughout the year and only 45 hours total when loading is within the voltage stability threshold. This means that any planned maintenance in the Duluth Loop will result in putting a considerable amount of load at risk of outage with no other available mitigation. With the transition away from local baseload generation in the North Shore Loop, outages along either the Arrowhead – Colbyville 115 kV Line or the Arrowhead – Haines Road 115 kV Line have become significant reliability issues which must be resolved.

Figure 3-6. Historical Load v/ Voltage Stability Thresholds (Haines – Silver Bay)

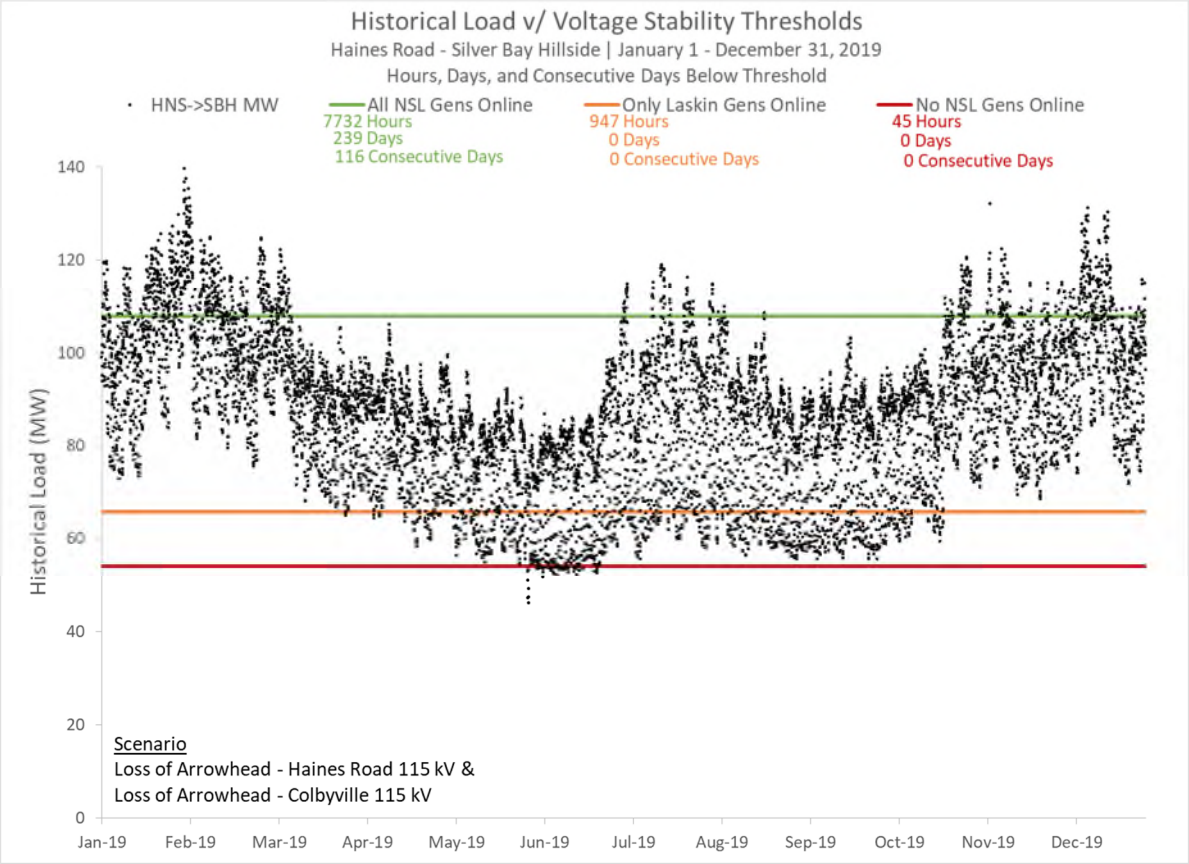


Figure 3-7 to **Figure 3-9** below show 2019 historical loading between the Swan Lake Road, Ridgeview, and Colbyville substations and the Silver Bay Hillside substation. As illustrated by these figures, the risk of voltage collapse diminishes as less Duluth Loop load is potentially being served from the North Shore Loop. Historical loading from Swan Lake Road to Silver Bay Hillside is above the Duluth Loop voltage stability threshold, similar to Haines Road discussed above, showing that there is significant risk of voltage collapse when taking the Haines Road – Swan Lake Road 115 kV Line out of service. Loading from Ridgeview to Silver Bay Hillside is well above the voltage stability threshold during summer and winter peak seasons and marginal during the shoulder months, providing some opportunity for planned maintenance on the Swan Lake Road – Ridgeview 115 kV Line without incurring risk of voltage collapse. This opportunity would

be unpredictable from year to year, depending heavily on local weather and electricity usage patterns and eroding with any substantive load growth. Loading from Colbyville to Silver Bay Hillside is within the voltage stability threshold for most of the year, demonstrating that outages on the Ridgeview – Colbyville 115 kV Line can generally be taken without risk of voltage collapse as long as peak load periods (typically in winter months) are avoided.

Figure 3-7. Historical Load v/ Voltage Stability Thresholds (Swan Lake – Silver Bay)

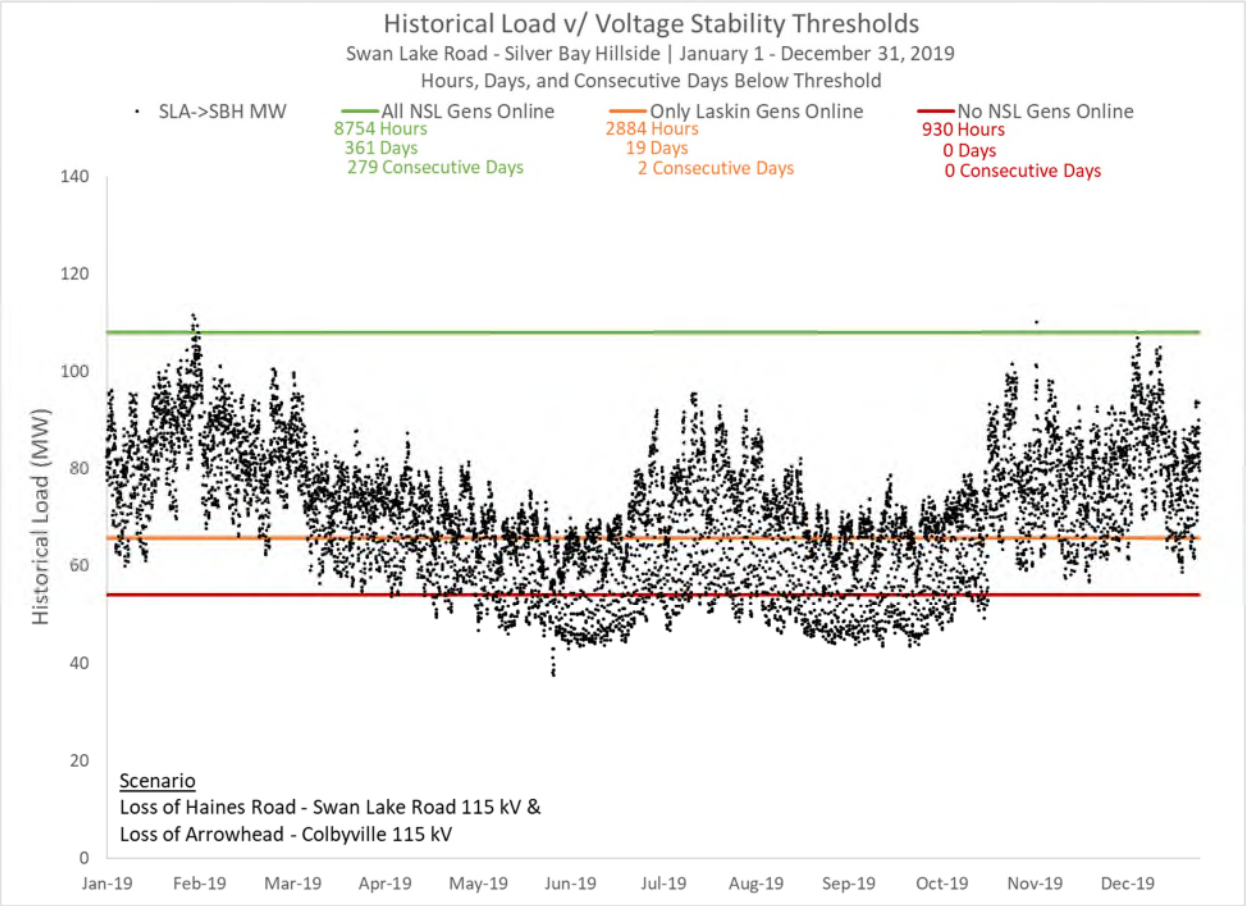


Figure 3-8. Historical Load v/ Voltage Stability Thresholds (Ridgeview – Silver Bay)

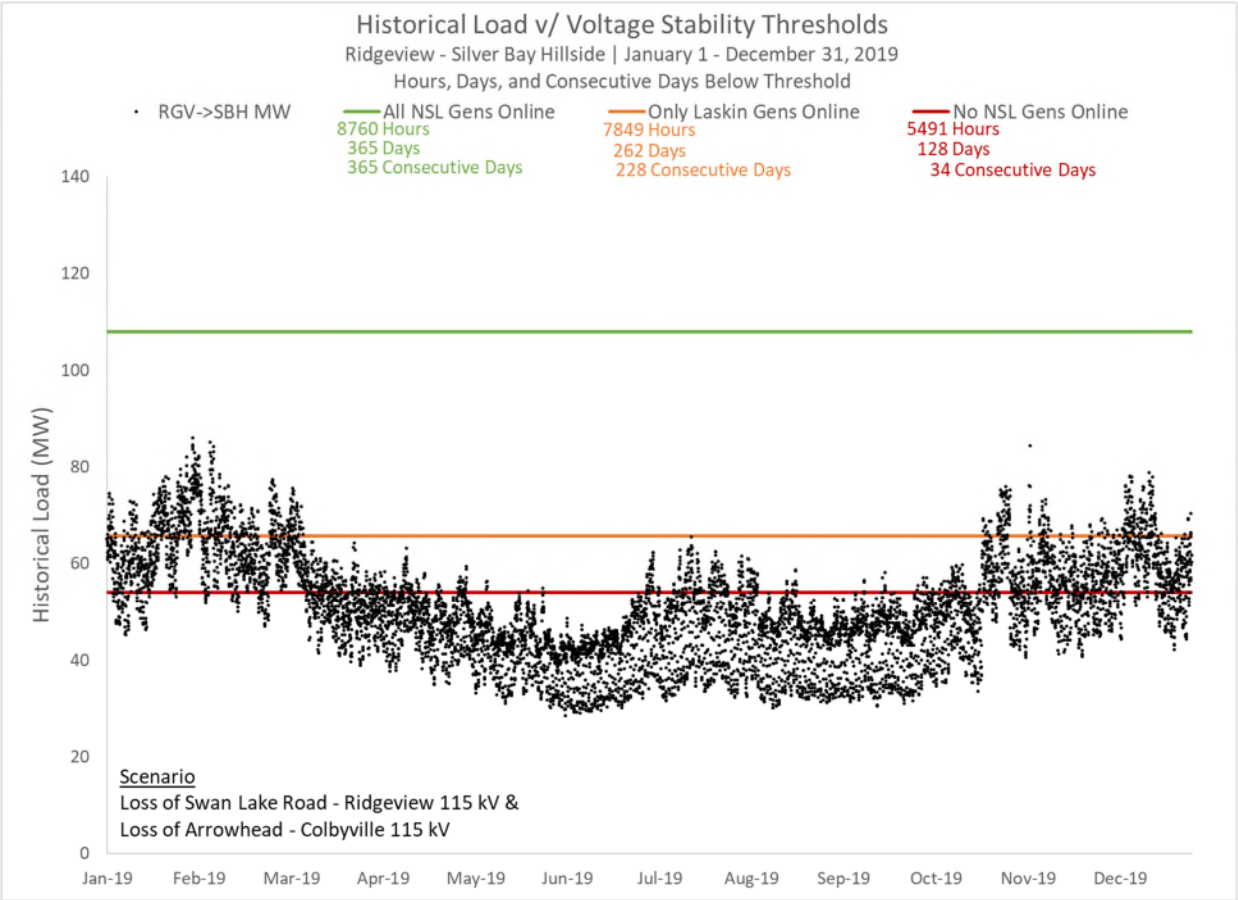
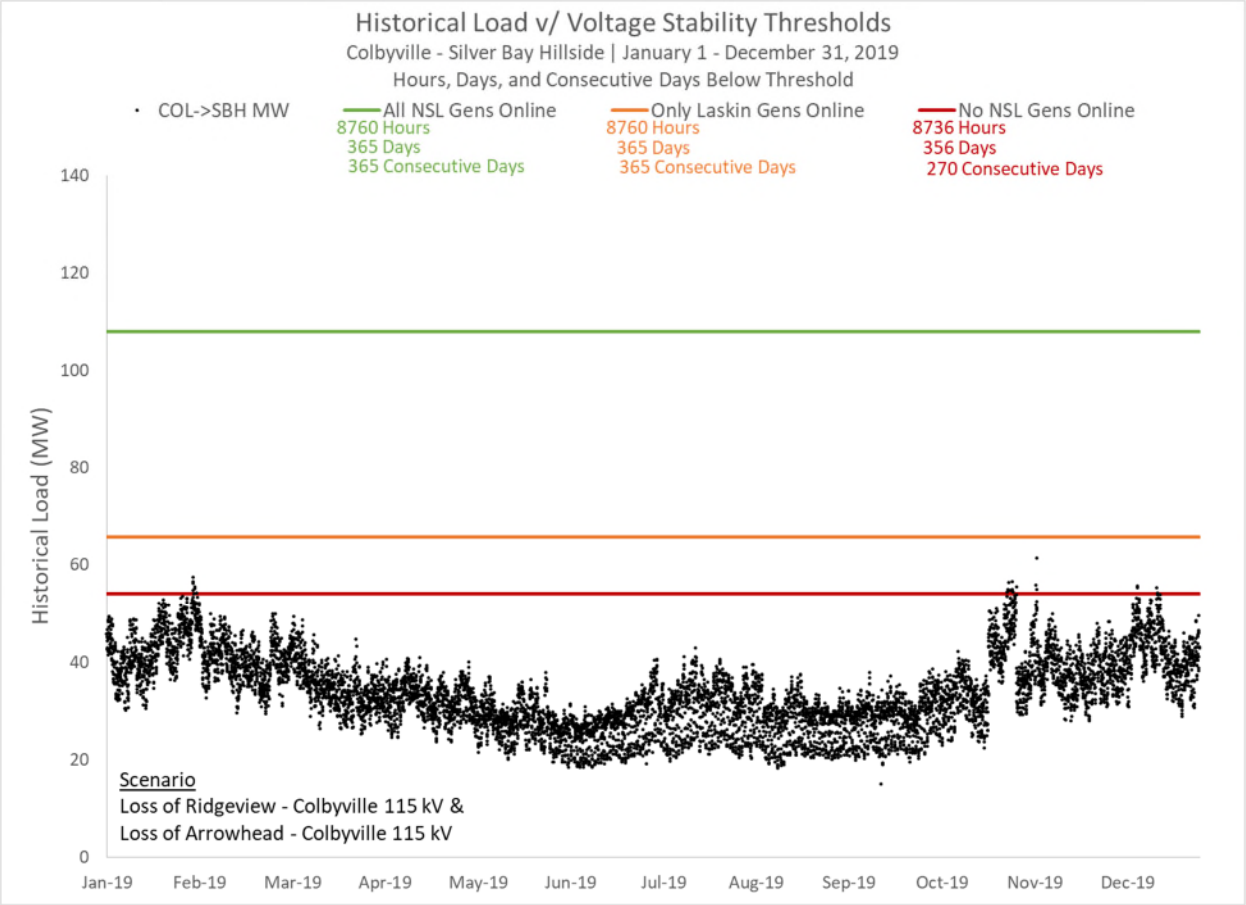


Figure 3-9. Historical Load v/ Voltage Stability Thresholds (Colbyville – Silver Bay)



The following conclusions may be derived from the above historical data analysis:

- Loss of Arrowhead – Colbyville 115 kV line and Arrowhead – Haines Road 115 kV line (**Figure 3-6**) poses a risk of voltage collapse practically any time the condition is encountered, and must be resolved
- Loss of Arrowhead – Colbyville 115 kV line and Haines Road – Swan Lake Road 115 kV line (**Figure 3-7**) also poses a risk of voltage collapse practically any time the condition is encountered, and must be resolved
- Loss of Arrowhead – Colbyville 115 kV line and Swan Lake Road – Ridgeview 115 kV line (**Figure 3-8**) poses a risk of voltage collapse any time the condition is encountered during peak load periods and also at times during shoulder months, and should be resolved
- Loss of Arrowhead – Colbyville 115 kV line and Ridgeview – Colbyville 115 kV line (**Figure 3-9**) is manageable, with only limited risk of voltage collapse during peak seasons where it would be appropriate to continue to utilize the operating guide in the event of unplanned outages

Analysis of 2019 historical data illustrates how the idling of North Shore Loop generation and associated loss of the support they historically provided to the transmission system has impacted Minnesota Power's ability to perform maintenance on transmission lines and substation components that require a transmission outage on any of the Duluth Loop 115 kV lines.

3.3.1.4 The Project Resolves Voltage Stability Concerns

The proposed Duluth Loop Project will resolve these voltage stability concerns by constructing a new 115 kV transmission line between the Hilltop and Ridgeview substations. This new 115 kV transmission line will establish a third parallel transmission path in the Duluth Loop, replacing the redundancy once provided by the local baseload generators and providing sufficient load-serving capability and flexibility to operate and maintain the system without putting customers at risk when transmission facilities are out of service.

3.3.2 Transmission Line Overloads

3.3.2.1 Transmission Line Overload Scenarios

During most transmission outages impacting the Taconite Harbor Substation, a majority of load along the North Shore is served through the Duluth Loop. Under this scenario, a subsequent outage along either transmission connection between the Arrowhead and Colbyville substations could cause significant overloads along the remaining connection. These scenarios are illustrated in **Figure 3-10** and **Figure 3-11**.

Figure 3-10. Overloads on Arrowhead – Colbyville 115 kV

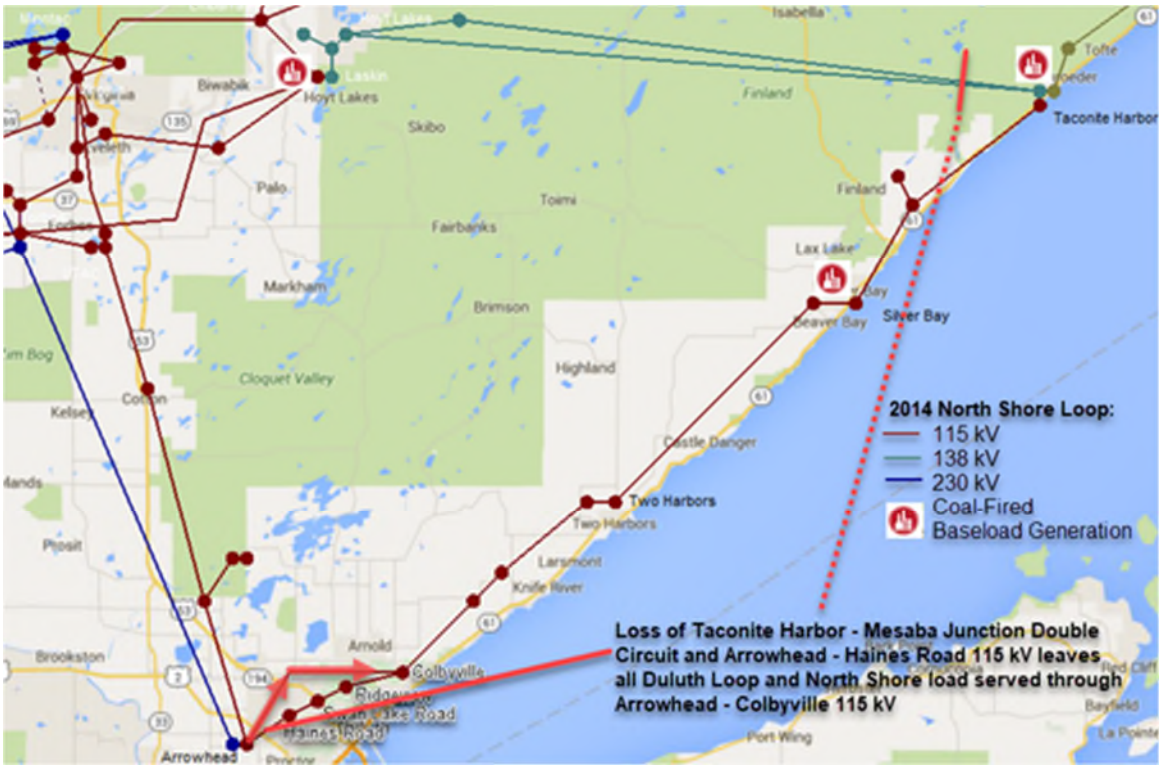
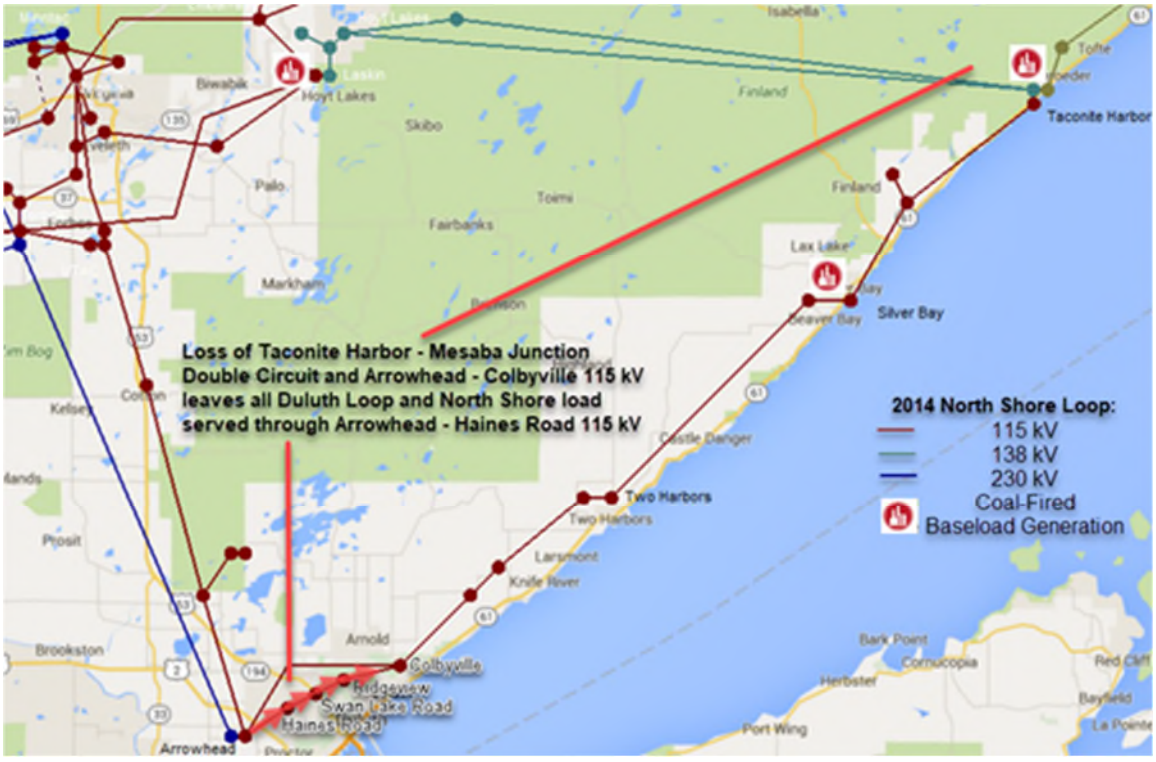


Figure 3-11. Overloads on Arrowhead – Haines Road – Swan Lake Road – Ridgeview – Colbyville 115 kV



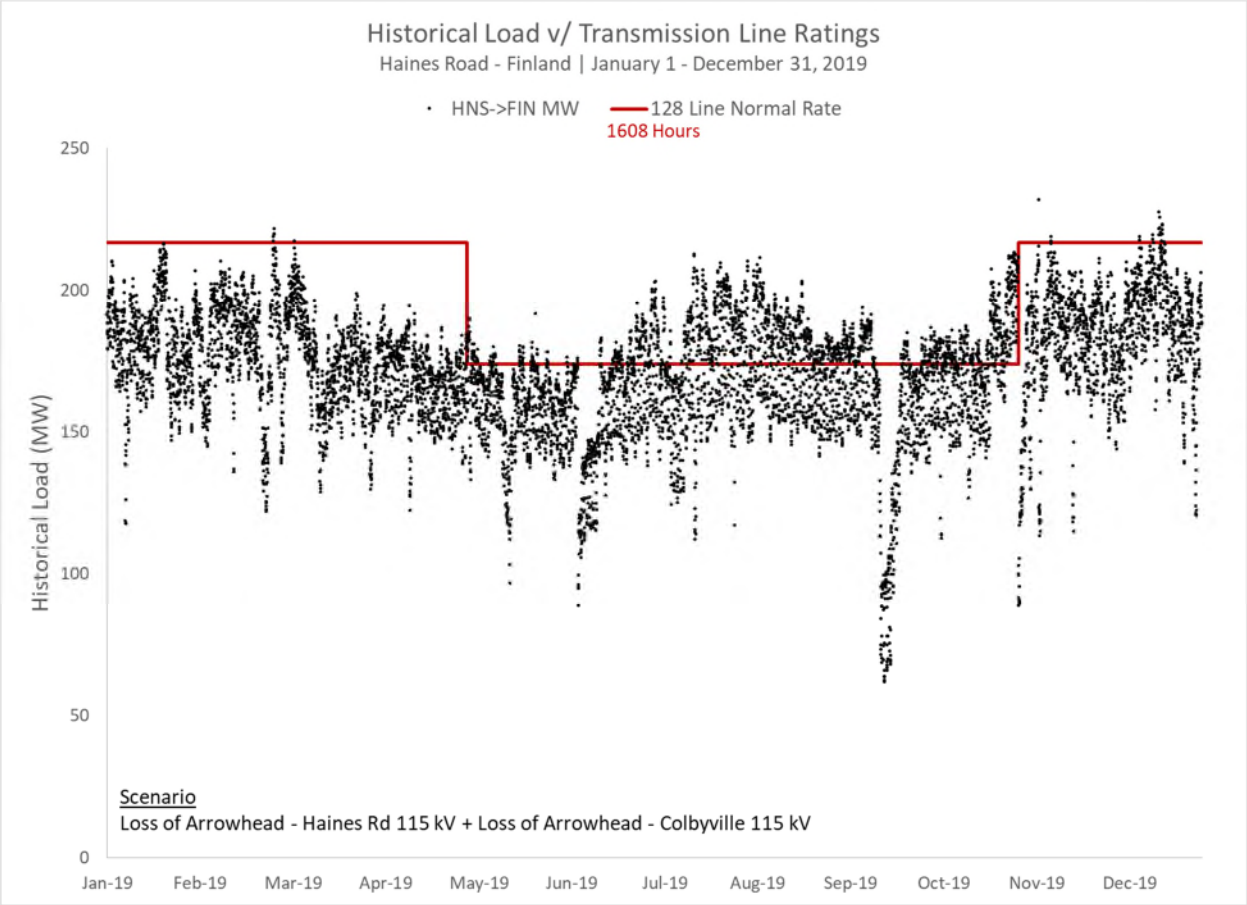
Alternately, if the system at Taconite Harbor and on the North Shore is intact and an outage occurs on both transmission connections between the Arrowhead and Colbyville substations, significant overloads could occur on transmission lines between the Taconite Harbor, North Shore, and Big Rock substations. These scenarios are shown in **Figure 3-4**, the Duluth Loop voltage collapse scenarios.

3.3.2.2 Transmission Line Overloads and Historical Data Analysis

Generator transitions on the North Shore have significantly increased the loading on Duluth Loop and North Shore Loop area transmission lines. **Figure 3-12** to **Figure 3-15** below illustrate the severity of potential transmission line overloads relative to historical load levels in the area. The plots illustrate post-contingent transmission line loading utilizing historical load data for the Duluth Loop and North Shore Loop transmission system, which is possible because of the configuration of the transmission system that becomes radial following the most limiting contingencies. Historical data for 2019 represents a typical year for the area with heavy winter peak loading, moderate to high summer peak loading, and lighter loading in the shoulder months.

Figure 3-12 below shows historical loading between the Haines Road and Finland substations along with the seasonal ratings of Taconite Harbor – North Shore 115 kV (128 Line) as indicated by the red line. For the historical data which was considered, loss of Arrowhead – Haines Road 115 kV (58 Line) and Arrowhead – Colbyville 115 kV (57 Line) resulted in the highest loading scenario on 128 Line. As noted above, in most cases this contingency would cause a voltage collapse. However, even if the contingency were stable, it would have caused overloads on 128 Line for 1,608 hours or 18.4% of the year. The Duluth Loop Project provides a redundant transmission connection parallel to 57 Line and 58 Line that will prevent 128 Line from being forced to carry load exceeding its capacity.

Figure 3-12. Historical Load v/ 128 Line Ratings (Haines – Finland)



With the Duluth Loop Project proposed 115 kV transmission connection between the Hilltop and Ridgeview substations, the loss of Ridgeview – Colbyville 115 kV (56 Line) and 57 Line becomes the highest loading scenario on 128 Line. **Figure 3-13** below shows historical loading between the Colbyville and Finland substations along with the seasonal ratings of 128 Line as indicated by the red line. For the historical data which was considered, there would have been no overloads on 128 Line if the Duluth Loop Project is constructed. This demonstrates that the Duluth Loop Project connection to the Ridgeview Substation is sufficient to resolve the overload concerns on 128 Line.

Figure 3-13. Historical Load v/ 128 Line Ratings (Colbyville – Finland)

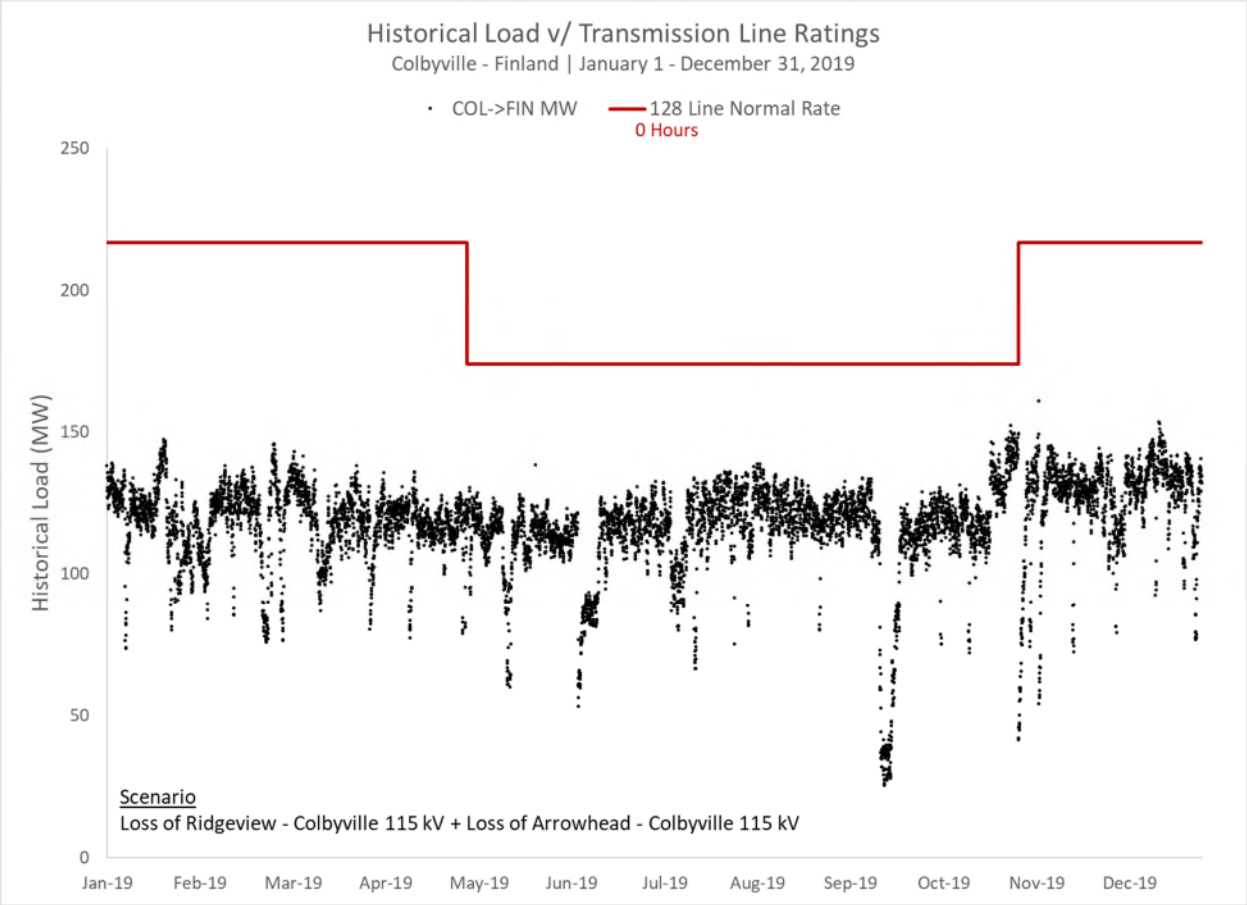
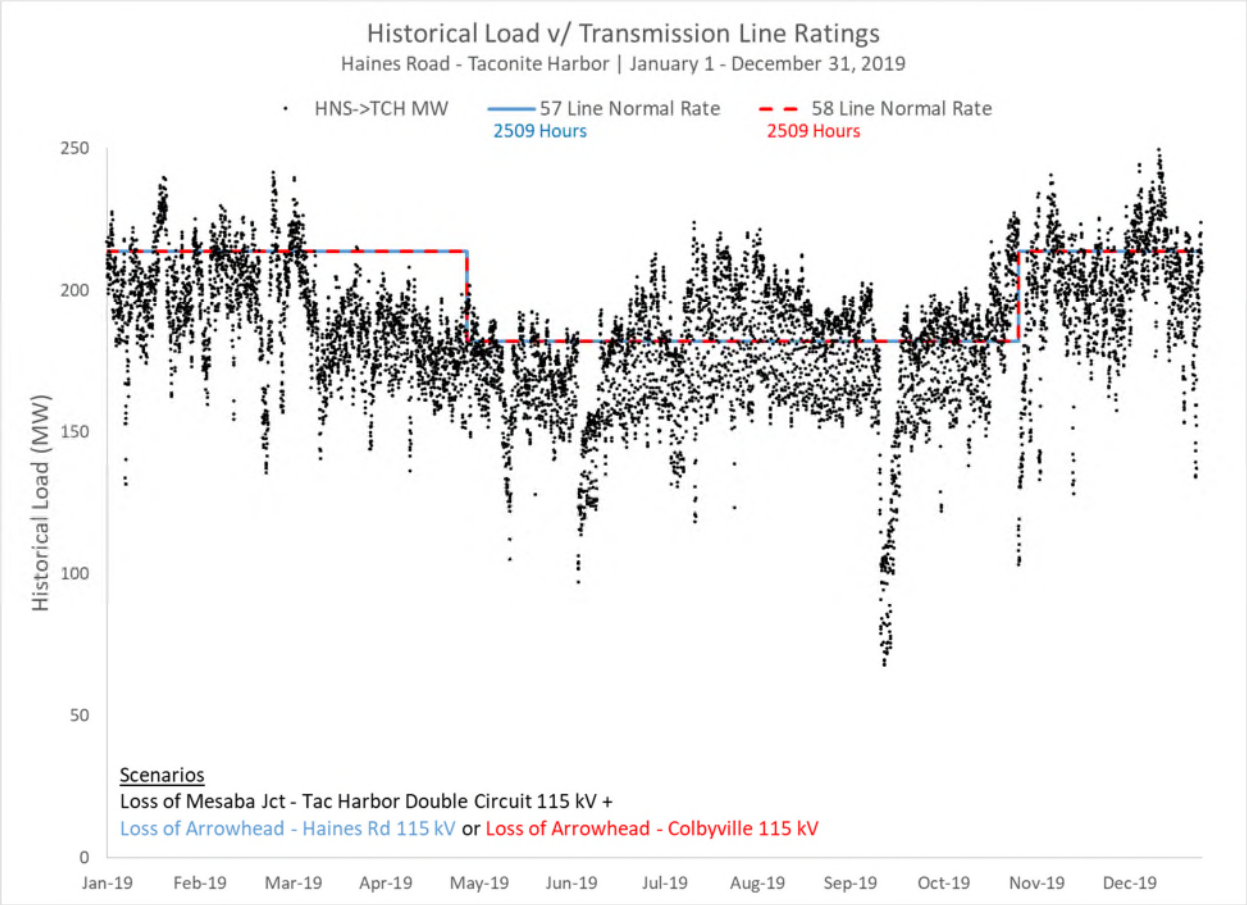


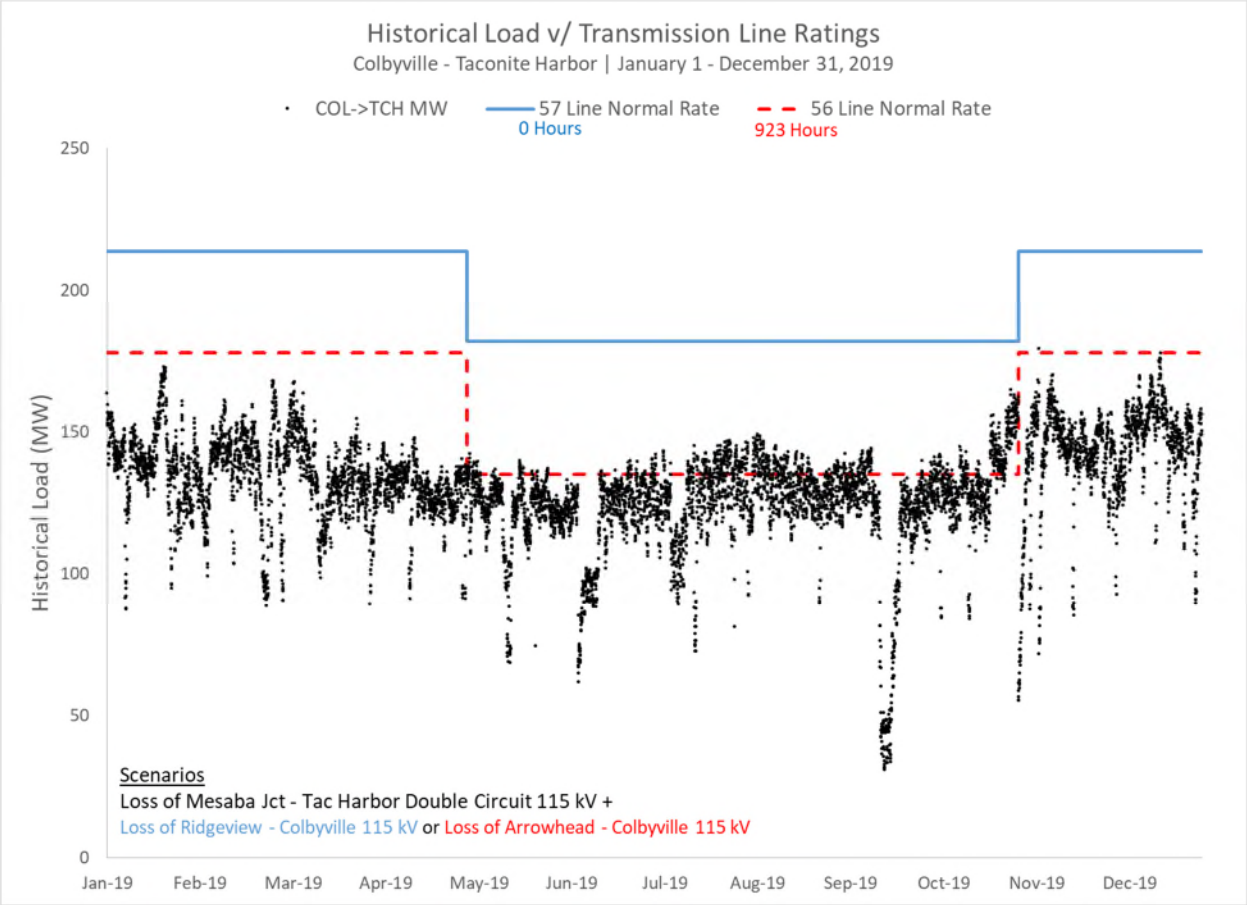
Figure 3-14 below shows historical loading between the Haines Road and Taconite Harbor substations along with the seasonal ratings of Arrowhead – Haines Road 115 kV (58 Line), as indicated by the red dashed line, and Arrowhead – Colbyville 115 kV (57 Line), as indicated by the blue line. For the historical data which was considered, loss of the Mesaba Junction – Taconite Harbor Double Circuit 115 kV lines (1 & 2 Line) and a connection from the Arrowhead Substation into the Duluth Loop, either 58 Line or 57 Line would have caused overloads on the remaining Duluth Loop line (57 Line or 58 Line) for 2,509 hours or 28.6% of the year. The Duluth Loop Project provides a redundant transmission connection parallel to 57 Line and 58 Line that will prevent either line from being forced to carry load exceeding its capacity under the conditions described above.

Figure 3-14. Historical Load v/ 57 & 58 Line Ratings (Haines – Tac Harbor)



With the Duluth Loop Project proposed 115 kV transmission connection between the Hilltop and Ridgeview substations, the loss of the 1 & 2 Line double circuit and a Duluth Loop connection into the Colbyville Substation becomes the highest loading scenario on either 56 Line or 57 Line. **Figure 3-15** below shows historical loading between the Colbyville and Taconite Harbor substations along with the seasonal ratings of 56 Line as indicated by the red dashed line and 57 Line as indicated by the blue line. For the historical data which was considered, there would have been no overloads on Arrowhead – Colbyville 115 kV and overloads on Ridgeview – Colbyville 115 kV for 923 hours or 10.5% of the year. This demonstrates that the Duluth Loop Project connection to the Ridgeview Substation is sufficient to resolve the overload concerns on 57 Line. Overloads on 56 Line are more prevalent during the summer months due to a lower summer rating, and a relatively minor capacity upgrade may still be necessary on this line at some point in the future. The capacity upgrade on 56 Line is not being proposed as a part of the Duluth Loop Project. The Company will monitor the situation and move the 56 Line capacity upgrade forward when necessary.

Figure 3-15. Historical Load v/ 56 & 57 Line Ratings (Colbyville – Tac Harbor)



Existing Haines Road – Swan Lake Road 115 kV line (52 Line) will become part of new Arrowhead – Swan Lake 115 kV (57 Line). Existing 52 Line will be upgraded so as not to limit the capacity of new 57 Line. Aging communications infrastructure on existing 52 Line is becoming problematic and will be replaced.

Approximately 1.3 miles of existing Swan Lake Road – Ridgeview 115 kV line (19 Line) will be rebuilt on a new alignment into the Ridgeview Substation. The remaining approximately 2.9 miles of 19 Line will be upgraded so as not to limit the capacity of the new segment of this line. Aging communications infrastructure on 19 Line is becoming problematic and will be replaced.

3.3.2.3 The Project Resolves Transmission Line Overloads Concerns

The proposed Duluth Loop Project will resolve these transmission line overloads by constructing a new 115 kV transmission line between the Hilltop and Ridgeview substations. This new 115 kV transmission line along with the associated transmission reconductors and reconfigurations will establish a third parallel transmission path in the Duluth Loop, replacing the redundancy once provided by the local baseload generators

and providing sufficient load-serving capability and flexibility to operate and maintain the system without putting customers at risk when transmission facilities are out of service.

3.3.3 Duluth Area 230/115 kV Transmission Source Reliability

3.3.3.1 Need for Improved Reliability of Duluth 230/115 kV Sources

Two 230/115 kV transformers at the Arrowhead Substation (373 MVA capacity each) and one at the Hilltop Substation (187 MVA capacity) deliver power to 115 kV transmission lines in the Duluth area from the regional 230 kV transmission network. The Hilltop Substation is served by a single, 72-mile long, 230 kV transmission line, which is a "three terminal line" that also connects to the Arrowhead and Iron Range substations. The configuration of the existing transmission system is shown in **Figure 3-2** in section 3.2.2 above.

The Duluth area and the North Shore's reliance on the Arrowhead and Hilltop 230/115 kV transformers has greatly increased with the transition away from local coal-fired baseload generators located along the North Shore. Without the local baseload generators online, these three transformers are the primary path for power to be delivered over the transmission system and into the Duluth area from the remote generation resources that have replaced the local generators. The addition of a new 115 kV connection from Hilltop to Ridgeview further increases the importance of the Hilltop Substation in particular. Therefore, as part of the Duluth Loop Project, the existing 230 kV system and the Hilltop Substation are being modified to provide improved reliability for critical 230/115 kV sources in the Duluth area. The 230 kV system modifications that will be made as part of the Duluth Loop Project will achieve the following improvements for the Duluth area:

- Reconfiguring the existing Iron Range – Arrowhead – Hilltop 230 kV "three terminal" transmission line into two separate transmission lines at the Arrowhead Substation will reduce total outage exposure to the Hilltop 230/115 kV Substation from 72 miles to 8 miles.
- Implementing significant relay protection improvements for the 230 kV transmission system, made possible by separating the existing three-terminal transmission line into separate transmission lines.
- Eliminating a single point of failure which disconnects two Duluth Area 230/115 kV transformers. To facilitate the reconfiguration of the three terminal transmission line, a 230 kV breaker will be added at the Arrowhead Substation. With this new breaker in place, there will no longer be a single point of failure that disconnects both the Arrowhead 230/115 kV "7TR" transformer and the Hilltop 230/115 kV transformer.
- Replacing the existing Hilltop 230/115 kV transformer with a larger-capacity transformer to ensure it has sufficient capacity to serve the needs of the Duluth area during outages of one or both Arrowhead 230/115 kV transformers. The need for this improvement is further discussed below.

Improving the reliability of these three critical Duluth Area 230/115 kV transformers, and especially the Hilltop 230/115 kV transformer, is essential for providing reliable delivery

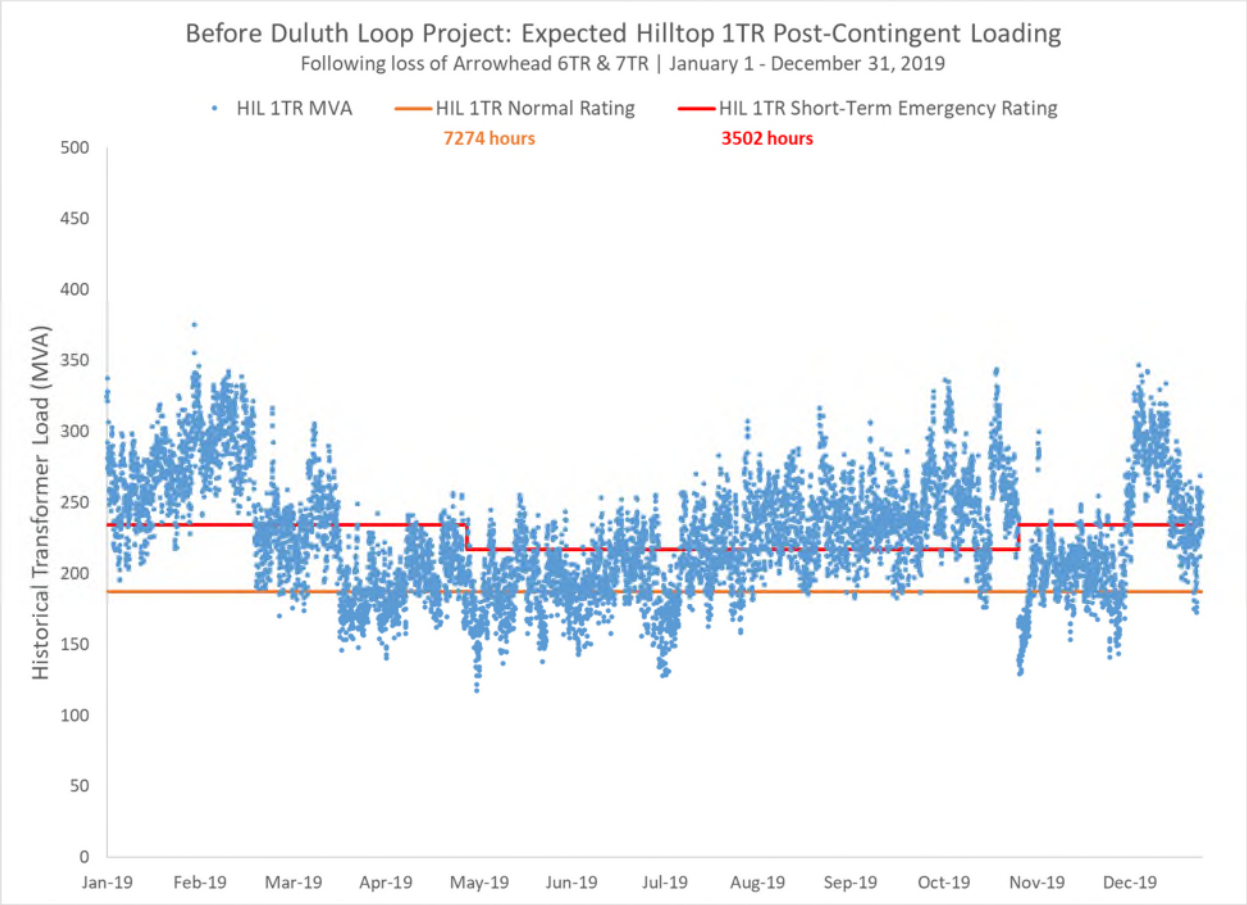
of power into the Duluth area and along the North Shore following the transition away from local baseload generation resources in the area. These improvements are tied in with the Duluth Loop Project because the establishment of a new 115 kV connection from Hilltop to Ridgeview further increases the importance of the Hilltop Substation and the need for a reliable Hilltop 230/115 kV source.

3.3.3.2 Need for Increased Capacity at Hilltop Substation

The Hilltop Substation transformer is the smallest of the three Duluth-area 230/115 kV transformers, with a normal rating of 187 MVA compared to 373 MVA for both of the Arrowhead Substation transformers. During planned maintenance or unplanned outages of one Arrowhead transformer, there is considerable risk of extreme post-contingent overloading on the Hilltop transformer if the second Arrowhead 230/115 kV transformer were to trip offline. **Figure 3-16** below shows the expected post-contingent loading on the Hilltop 230/115 kV transformer for loss of both Arrowhead 230/115 kV transformers based on 2019 hourly historical load data and power flow modeling.

The orange line on **Figure 3-16** represents the normal or continuous rating of the Hilltop 230/115 kV transformer, while the red line represents the short-term emergency rating of the transformer. Minnesota Power's facility ratings methodology prescribes short-term emergency ratings for power transformers up to 125 percent of the transformer's nameplate rating. The duration for which this condition is acceptable varies from 30 minutes up to potentially continuous operation depending on ambient temperatures, direct winding temperature measurements from the transformer (if available), and the original manufacturing specifications (if known). Where other equipment in series with the transformer, such as substation conductors or other apparatus, is more limiting than the transformer itself, the magnitude and duration of the short-term emergency rating may be more restrictive. In the case of the Hilltop 230/115 kV transformer, the summer emergency rating is limited by a substation conductor and therefore is shown on the chart to be more restrictive. The summer normal rating and the winter normal and emergency ratings are all associated with the nameplate capacity of the transformer itself.

Figure 3-16. Expected Hilltop Transformer Post-Contingent Loading (Pre-Project)

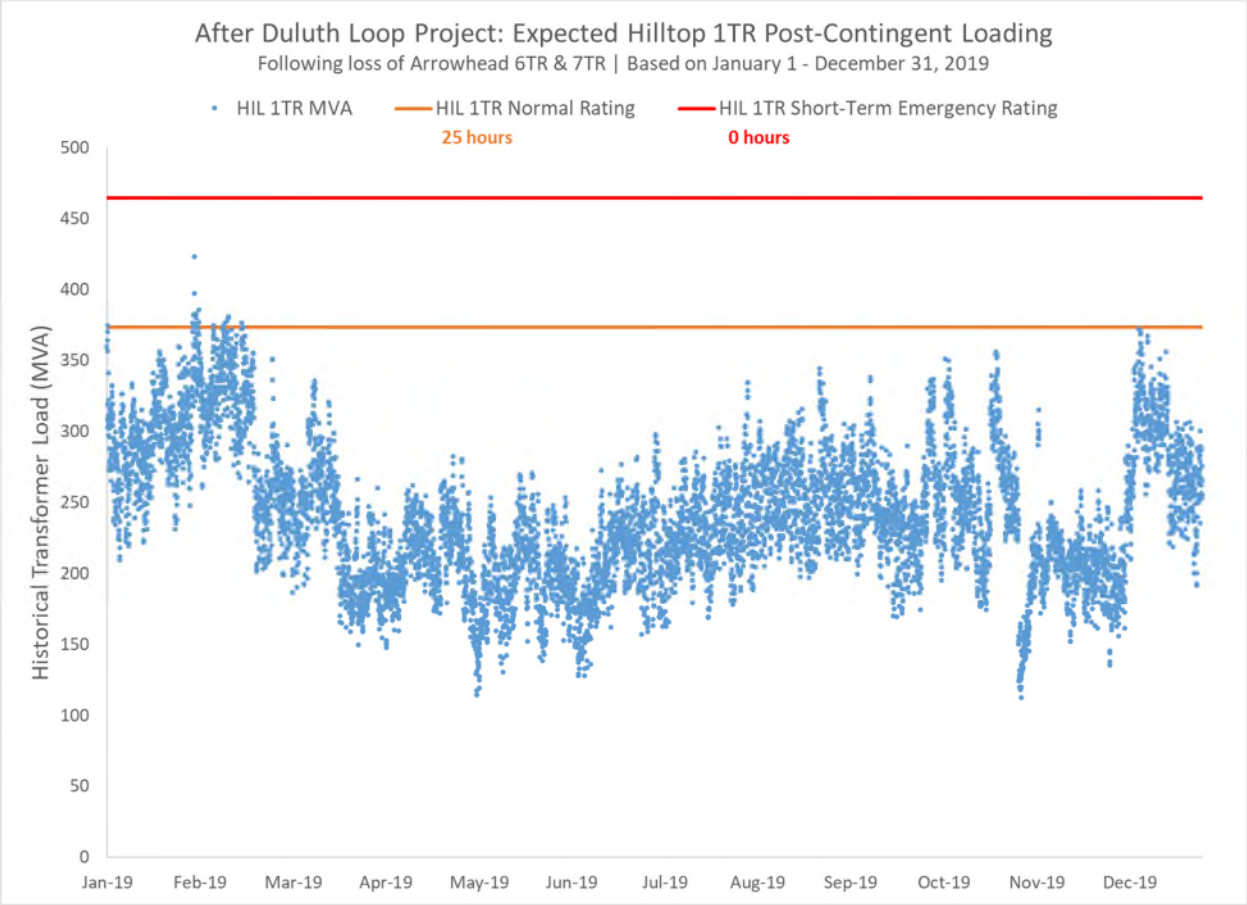


As shown in **Figure 3-16,** there are relatively few hours throughout the year during which an Arrowhead transformer could be taken out of service without risking overloads on the Hilltop transformer if the remaining Arrowhead transformer were to trip unexpectedly. If the overloads did occur, they would be so severe that they could potentially exceed the transformer's short-term emergency rating by over 100 MVA.

In practice, outages on the Arrowhead transformers would be avoided during the at-risk hours noted above or the system would be adjusted to reduce the loading on the Duluth area 230/115 kV transformers. However, with most of the dispatchable generation capability removed from the Duluth area, options for reducing loading on the Hilltop transformer to a manageable level during this scenario have become very limited. The problem is further compounded by the fact that the Arrowhead 230/115 kV transformers are nearing 50 years old and longer duration outages will become more likely due to age and condition-related issues such as component failures, increased maintenance, or targeted replacements. The Arrowhead transformers will also be targeted for replacement sometime in the next 10-15 years as part of Minnesota Power's normal asset renewal program activities – ensuring that long-duration outages will become necessary at some point.

As part of the Duluth Loop Project, the existing Hilltop Substation transformer will be replaced with a new 373 MVA rated transformer and other limiting equipment in series with the transformer will be replaced to ensure the full rated capability of the transformer is available at all times. The reconfiguration of the three-terminal Iron Range – Arrowhead – Hilltop 230 kV Line will further enhance reliability of the Hilltop Substation by establishing a dedicated Arrowhead – Hilltop 230 kV Line with significantly reduced outage exposure. The increased reliability and capacity for the Hilltop 230/115 kV transformer included in the Duluth Loop Project will help ensure that reliable 230/115 kV transmission sources are available for the Duluth area throughout the year. As shown in **Figure 3-17** below, there is very little risk of overloading the Hilltop transformer following completion of the Duluth Loop Project and what risk there is appears to be manageable and well within the emergency rating of the new transformer. Following completion of the Duluth Loop Project, the existing Hilltop transformer will be evaluated for redeployment to replace an existing older transformer of similar size on Minnesota Power's transmission system.

Figure 3-17. Expected Hilltop Transformer Post-Contingent Loading (Post Construction of Duluth Loop Project)



3.4 Historical Project Area Load Data

The customers that will benefit from the Duluth Loop Project are primarily served from the Haines Road, Swan Lake Road, Ridgeview, Colbyville, and French River substations. These include customers in Hermantown, Duluth Heights, Kenwood, Woodland, Lakeside, Hunter's Park, and Congdon and around the Miller Hill Mall, the Duluth International Airport, the universities, and the downtown hospital district, among others. In addition, load at the Clover Valley (GRE), Two Harbors, Big Rock, Waldo (GRE), and Silver Bay Hillside substations define the Haines Road – Silver Bay Hillside load serving capability referenced in the preceding discussion of Project need.

The coincident Summer and Winter peak demand for the Project area and the individual loading at each of these substations for the peak hour from the previous five years is shown by year in **Table 3-2**.

Table 3-2. Historical Coincident Peak Demand (MW)

	2016		2017		2018		2019		2020	
	SUM	WTR	SUM	WTR	SUM	WTR	SUM	WTR	SUM	WTR
Peak Date	8/2/2016 16:00	1/18/2016 18:00	7/6/2017 16:00	1/4/2017 18:00	7/9/2018 14:00	12/27/2017 17:00	7/15/2019 14:00	1/29/2019 18:00	7/2/2020 16:00	2/13/2020 7:00
Total Load	122.70	138.76	118.95	139.05	117.30	137.90	118.90	139.70	120.10	129.00
Subtotals By Substation										
Haines Road	26.20	28.90	25.70	27.70	24.20	27.80	23.80	28.10	24.30	23.50
Swan Lake Road	31.60	27.70	31.10	30.40	28.70	26.00	32.50	25.60	28.90	28.50
Ridgeview	22.00	27.10	25.50	27.10	21.90	31.40	22.90	29.80	23.80	22.70
Colbyville	18.60	26.80	16.20	23.20	18.80	20.30	19.70	27.40	22.70	22.60
French River	3.44	3.55	2.26	4.57	3.17	4.45	1.69	3.53	1.95	3.78
Clover Valley (GRE)	1.54	2.41	1.49	3.39	1.48	3.63	2.42	2.86	1.80	3.76
Two Harbors	3.42	3.54	2.25	4.54	3.15	4.42	1.69	3.51	1.95	3.76
Big Rock	4.80	4.90	4.80	4.90	5.10	5.20	4.80	5.20	4.60	4.30
Waldo (GRE)	7.62	9.85	7.86	11.33	7.87	12.38	7.05	11.29	7.58	12.38
Silver Bay Hillside	3.48	4.01	1.79	1.92	2.93	2.32	2.35	2.41	2.52	3.72

3.5 Estimated System Losses

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

Each new transmission line that is added to the electric system affects the losses of the system. In determining the amount of losses associated with a particular transmission project, it is not reasonable to consider only the projects' transmission facilities and calculate losses directly from operation of those new transmission facilities. Rather, it is necessary to look at the total losses of the system that result with and without the proposed project. In its Exemption Order, the Commission authorized Minnesota Power to provide line loss data for the system as a whole, rather than line loss data specific to an individual transmission line.[4] In this case, Minnesota Power considered the Minnesota Power transmission system, a large area primarily served by Minnesota Power and Great River Energy in Northeastern Minnesota, to determine the resulting effect of the Duluth Loop Project's transmission facilities on system losses.

Minnesota Power used power flow software PSS/E to calculate the losses at peak demand based on the MISO MTEP21 Reliability Analysis 2023 Winter Peak Model. The results are shown below in **Table 3-3**.

Table 3-3. Calculated Peak Demand Loss Savings

Project System Loss Savings	
Scenario	***System Losses (MW)***
Existing Transmission System	83.3
System with Duluth Loop Project	82.8
Difference	-0.5

Table 3-3 shows that the Project's proposed transmission infrastructure reduces the losses on the electrical system. Under winter peak demand conditions, the losses incurred on the Minnesota Power transmission system are 0.5 MW less when the Project is energized as compared to the existing system configuration.

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

Because demand for electric power is not constant and losses are related to the square of the current flowing through the transmission lines in the electric system, the losses will change over time, increasing as demand increases and decreasing as demand decreases. Because losses change over time, there is no precise method to calculate average annual loss reductions. One common method is to use the loss savings at peak demand to estimate the average annual loss savings based on the following formulas[5]:

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

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

Assuming a Minnesota Power load factor of 70 percent and using the calculated loss savings at peak demand (given in **Table 3-3**), the Project will reduce average transmission losses by an estimated 2,422 megawatt hours (MWh) annually.

3.6 Impact of Delay

Delays to the in-service date for the Duluth Loop Project will extend the use of the existing operational mitigation where MISO directs Minnesota Power to open the North Shore transmission connection at the Colbyville Substation. This separates Duluth from the North Shore during outages in the Duluth Loop, causing the Duluth Loop load to be served by a single transmission path from the Arrowhead Substation and the load along the North Shore to be served by a single transmission path from the Hoyt Lakes Substation. As discussed in Section 3.3, this operational mitigation merely serves to contain the problem rather than solving it. A significant number of residential, commercial, and industrial customers would continue to be exposed to unacceptable risk of outages due to the loss of a second Duluth Loop or North Shore transmission line. Similarly, customers in the Duluth area and on the North Shore would continue to be exposed to the risks described in Section 3.3 related to transmission line and transformer overloads and outage exposure to the Hilltop Substation.

3.7 Effect of Promotional Practices

Minnesota Power has not conducted any promotional activities or events that have triggered the need for the Project. Rather, the Project is driven by the need to replace the system support once provided by coal-fired baseload generators located along Minnesota's North Shore by addressing severe voltage stability concerns, relieving transmission line overloads, and enhancing the reliability of Duluth-area transmission sources.

3.8 Effect of Inducing Future Development

The Project is not intended to induce future development, but it may support future economic development in the Duluth area that otherwise would not be possible without further degrading the reliability of service to the Duluth area if the Duluth Loop Project is

[5] Gönen, Turan. *Electric Power Distribution System Engineering.* McGraw Hill, 1986. 55, 58-59.

not constructed. Without the local baseload generators in the North Shore Loop, the transmission system is no longer able to support the large amount of Duluth area load concentrated between the Haines Road, Swan Lake Road, Ridgeview, Colbyville, and French River substations over the long distance of the transmission system between Hoyt Lakes and Duluth. The Project will restore redundancy and load-serving capability to this area, mitigating the risk of voltage collapse and low voltage issues.

3.9 Socially Beneficial Uses of Facility Output

The purpose of the Project is to improve transmission system reliability in the Duluth area along the North Shore. Severe low voltage stability concerns and overloading conditions, as well as worsening conditions in the future will arise if the Project is not constructed. Low voltage conditions or deviations outside acceptable limits can damage electrical apparatus and end-user electronic equipment, which could result in significant economic costs to customers. Overloading conditions can result in costly outages and inconvenience to area customers.

4.1 Analysis of Alternatives

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

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

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

This chapter discusses the various alternatives to the Duluth Loop Project that Minnesota Power considered, including: 1) generation, demand-side management and non-wire alternatives; 2) various transmission alternatives including, alternative transmission configurations, endpoints, and voltages and upgrading the existing system, and 3) a no-

build alternative. As discussed below, none of these alternatives is more reasonable and prudent alternative to the proposed Project.

4.2 Generation and Non-Wire Alternatives

Minnesota Power evaluated various generation and non-wire solutions, including new peaking generation, distributed generation, renewable generation, battery energy storage, demand side management, and reactive resources as alternatives to the proposed Project. To be a viable alternative to the Project, a generation or non-wire alternative (or combination of alternatives) must address the three primary needs for the Project by: 1) resolving severe voltage stability concerns, 2) relieving transmission line overloads, and 3) enhancing the reliability of Duluth-area transmission sources. After a brief overview of the nature of operational characteristics required from generation and non-wire solutions to adequately address the three primary needs for the Project, the rest of this section will provide discussion of each of the generation and non-wire solutions considered by Minnesota Power.

To adequately resolve the severe voltage stability issues that are resolved by the Project, the operational characteristics of any generation or non-wire alternative must enable it to effectively offset a significant amount of load in the Duluth Loop during an outage of either the Arrowhead – Colbyville 115 kV Line ("57 Line") or the Arrowhead – Haines Road 115 kV Line ("58 Line"). This generation will be utilized to proactively reduce the amount of load effectively seen by the transmission system in order to remain within the Duluth Loop voltage stability threshold until the outage is restored. Therefore, the generation or non-wire alternative must be located at or near the Duluth Loop substations and must be available at the necessary time, with the necessary response, and for the necessary duration to address the Duluth Loop voltage stability issues. This generation must be available for dispatch, able to ramp up quickly, capable of matching the system load, and operate for the appropriate duration based on the restoration time of the transmission line outage.

It was noted in Section 3.3.1.2 (Voltage Stability Limit Calculation) that the Duluth Loop voltage stability threshold with none of the North Shore Loop generators online is 54 MW, increasing to 65.7 MW if the peaking units at the Laskin Energy Center are online. Therefore, a minimum generation or non-wire solution must be able to produce enough power to offset any Duluth Loop load above this threshold during peak-hour loading. The historical peak load for the area in the 2019 data set examined in Section 3.3 was 139.7 MW. Based solely on the historical peak load, therefore, a generation or non-wire alternative must be able to offset a minimum of 74 MW of Duluth Loop load, as shown in the equation below.

139.7 MW (Historical Peak) – 65.7 MW (Voltage Stability Threshold) = 74 MW

This is the absolute minimum as it assumes Laskin generation may be must-run for reliability during prior outages in the Duluth Loop and leaves no room for load additions beyond the 2019 historical winter peak level. A more appropriate minimum generation or non-wire alternative would include some margin for load growth or unforeseen system

conditions, likely pushing the actual need well above 100 MW. However, for the purpose of the following discussion of generation and non-wire alternatives, the minimum 74 MW requirement was used.

4.2.1 Peaking Generation

Minnesota Power considered peaking generation as an alternative to the Project. Peaking generation, in this context, means dispatchable generation that is interconnected to the transmission system and is able to run continuously when called upon, most likely using natural gas as the fuel source. Minnesota Power considered two general configurations for peaking generation. One peaking generation option is to install a bank of several relatively small natural gas reciprocating internal combustion engine (RICE) generators. Given the 74 MW minimum generation requirement for resolving the voltage stability issues, a RICE solution would likely require between 8-12 individual units.

A second peaking generation option is to install a relatively large natural gas combustion turbine in the Duluth area. For either of these solutions, the optimal point of interconnection for resolving voltage stability and transmission line loading concerns is at or near the Colbyville Substation. In addition to concerns with siting a new fossil-fueled generation station in a primarily residential area of Duluth, there are also concerns about the cost-effectiveness of such a solution and this option is not a more reasonable and prudent alternative to the Project.

4.2.2 Distributed Generation

Minnesota Power considered distributed generation in the Duluth Loop as an alternative to the Project. Distributed generation, in this context, means dispatchable generation that is connected to the local distribution system and is able to run continuously when called upon, most likely on natural gas. Renewable distributed generation and battery energy storage are also discussed in subsequent sections. While Minnesota Power considered various configurations of distributed generation and dynamic reactive support for the Duluth Loop and the North Shore, fossil-fueled distributed generation has the same fundamental concerns as transmission-connected peaking generation – and likely at a greater cost if consisting of a number of smaller generators in diverse locations. Therefore, the addition of new fossil-fueled distributed generators is not a more reasonable and prudent alternative to the Project.

4.2.3 Renewable Generation

Minnesota Power considered renewable generation as an alternative to the Project. Renewable generation, in this context, means either solar or wind generation. The renewable generation may be interconnected at a single location on the transmission system or at multiple locations on the transmission or distribution system. As discussed in Section 3.3 and at the beginning of Section 4.2, in order to adequately address voltage stability concerns in the Duluth Loop, a system solution is needed that will provide a significant amount of reliable power (a minimum of 74 MW, but potentially over 100 MW)

to the Duluth Loop and North Shore during an outage of either Arrowhead – Colbyville 115 kV or Arrowhead – Haines Road 115 kV.

This power also needs to be available when called upon in the amount required to mitigate the risk of a voltage collapse. Because renewable generation is dependent on natural events, such as sunlight or wind speed, and cannot be dispatched if those conditions are not met, neither wind generation nor solar generation alone is a viable alternative to the Project. Energy from these resources is not necessarily available at the times when it would be most necessary to support reliability in the Duluth Loop. For example, evaluating 2019 historical data, the Winter peak for the Duluth Loop area occurred on January 29, 2019 at 6:00 P.M., when a minimum of 74 MW of generation is needed to mitigate the risk of voltage collapse. As the sunsets at around 5 P.M. in January, solar energy output at 6 P.M. is generally non-existent. Wind energy output is unpredictable, sometimes decreasing during the evening hours of the day. Therefore, the addition of new renewable generation, by itself, is not a more reasonable and prudent alternative to the Project. The combination of renewable generation with energy storage is discussed below.

4.2.4 Energy Storage

Minnesota Power considered energy storage, both by itself and combined with new renewable generation, as an alternative to the Project. Energy storage, in this context, means a battery or some other energy storage technology capable of being charged and discharged when called upon to do so as long as there is sufficient energy available. As discussed in Section 3.3 and earlier in Section 4.2, in order to adequately address voltage stability concerns in the Duluth Loop, a system solution is needed that will provide a significant amount of power (a minimum of 74 MW on peak, but potentially over 100 MW) to the Duluth Loop and North Shore for an extended duration during an outage of either Arrowhead – Colbyville 115 kV or Arrowhead – Haines Road 115 kV. Given the nature of the transmission reliability concerns, the generation should also be able to run continuously for at least 7 days to allow adequate time for restoration in the event of a catastrophic transmission failure. Within that 7 days, there may be little or no opportunity to recharge an energy storage solution from the transmission system due to high Duluth Loop area load levels relative to the Duluth Loop voltage stability threshold. The duration of 7 days as a restoration time was selected for study purposes. Actual transmission line restoration times can vary significantly by severity, location and other factors. Minnesota Power follows best utility practice to prioritize and expedite restoration of transmission failures as soon as possible. Many unplanned transmission outages and failures can be corrected in less than 7 days; however, several restorations of Minnesota Power's transmission facilities resulting from severe weather within the last two years have exceeded this 7-day duration by a factor of 2 or more.

Evaluating 2019 historical load data, the maximum daily average over 7 days for Duluth Loop load was 1238.3 MWh above the stability threshold and occurred between January 25, 2019 and February 1, 2019. During this 7 day period, the minimum load level was 96.9 MW, which is well above the 65.7 MW stability threshold with Laskin generation online. Therefore, an energy storage solution would have had to discharge continuously

from a minimum of 31.2 MW to a maximum of 74 MW during this 7 day duration and would not have been able to recharge from the transmission system. For an energy storage solution by itself, a minimum rating of 8,668 MWh would be necessary to adequately and reliably support the transmission system during a 7 day transmission outage of both Arrowhead – Colbyville 115 kV and Arrowhead – Haines Road 115 kV. An energy storage solution of this magnitude – as of August 2021, over 5 times larger than the largest in the world[6] – is not a reasonable alternative to the Project.

Given that there is no or limited opportunity to recharge an energy storage solution from the transmission system, Minnesota Power also examined 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. Evaluating 2019 historical data, a 24 hour peak of 1370.7 MWh of energy was needed above the stability threshold in the Duluth Loop area. This occurred beginning at sunrise on January 29, 2019, the day when peak loading occurred in the Duluth Loop, and there was approximately 9.5 hours of possible daylight between sunrise and sunset. In the most idealized and optimistic scenario, 144.3 MW of solar generation paired with a 852.4 MWh rated energy storage solution would be the minimum alternative to mitigate the risk of voltage collapse in the Duluth Loop. The solar generation would support the daytime battery charging load of 89.7 MW. This also assumes that peaking generation at the Laskin Energy Center is running throughout the 7 day outage. If Laskin was not running or became unavailable, then the Duluth Loop voltage stability threshold would diminish and additional solar and storage capacity would be required. The numbers above also do not provide any room for load growth above the historical 2019 peak, or for periods of reduced solar output due to weather.

Minnesota Power utilized the MISO MTEP21 Transmission Cost Estimation Guide to estimate the cost of the 852.4 MWh energy storage solution. Excluding the cost of the 144.3 MW solar generation facility, the estimated cost of an energy storage solution with a rated instantaneous charge/discharge of 89.7 MW and an energy rating of 852.4 MWh is $276.4 million[7] based on the MISO assumptions for lithium ion energy storage "grid supporting devices."

As shown from the numbers discussed above, any combination of energy storage and solar generation meeting the minimum requirements for resolving the voltage stability concerns in the Duluth Loop would be very substantial in both size and cost. In addition to the economics of such a solution, siting, operational complexity, and the long-term effectiveness for the solution would all be significant concerns. Therefore, the addition of new energy storage in the Duluth Loop, whether by itself or in combination with new renewable generation, is not a more reasonable and prudent alternative to the Project.

[6] https://www.powermag.com/vistra-energizes-massive-1-2-gwh-battery-system-at-california-gas-plant/

[7] https://cdn.misoenergy.org/Transmission%20Cost%20Estimation%20Guide%20for%20MTEP21337433.pdf

4.2.5 Demand Side Management and Conservation

Minnesota Power considered demand side management and conservation as alternatives to the Project. In this context, demand side management and conservation are assumed to encompass all forms of peak shaving programs, such as interruptible loads and dual fuel programs, as well as more general energy conservation programs, such as energy-efficiency rebates. As noted in the previous section on energy storage, total Duluth Loop area load during the most demanding 7-day period in 2019 would have needed to be reduced by 31.2 – 74 MW in order to mitigate the risk of voltage collapse following unplanned outages during that period of time. This represents approximately 22 – 53 percent of the 139.7 MW historical peak demand for the Project area. Although conservation programs will continue to be implemented in Project area to encourage efficient use of electricity, these programs are insufficient to reach these significant levels of load reduction in the Duluth Loop. For these reasons, solutions involving demand side management and conservation are not a viable alternative to the Project.

4.2.6 Reactive Power Additions

As a final non-wire alternative, Minnesota Power considered implementing additional reactive power additions to support the area and prevent voltage collapse. Reactive power additions, in this context, mean transmission technology capable of providing reactive power and voltage support to the system through the use of traditional electromechanical devices such as switched capacitor banks and reactors, flexible AC transmission system (FACTS) devices such as static VAR compensators (SVCs) or static synchronous compensators (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 offsetting Duluth Loop load as discussed for previous generation and non-wire alternatives. While a reactive power addition alone may contribute to resolving or reducing the severity of the Duluth Loop voltage stability issues, reactive power additions alone cannot satisfy any of the needs of the Project. Reactive power additions would not reduce overloads on the Hilltop 230/115 kV transformer or increase the ratings of transmission lines in the Duluth Loop or the North Shore Loop, meaning that the existing system upgrades described in Section 4.4 would also be required. For these reasons, solutions involving only reactive power additions are not a viable alternative to the Project.

4.3 Alternative Voltages

4.3.1 Lower Voltage Alternatives

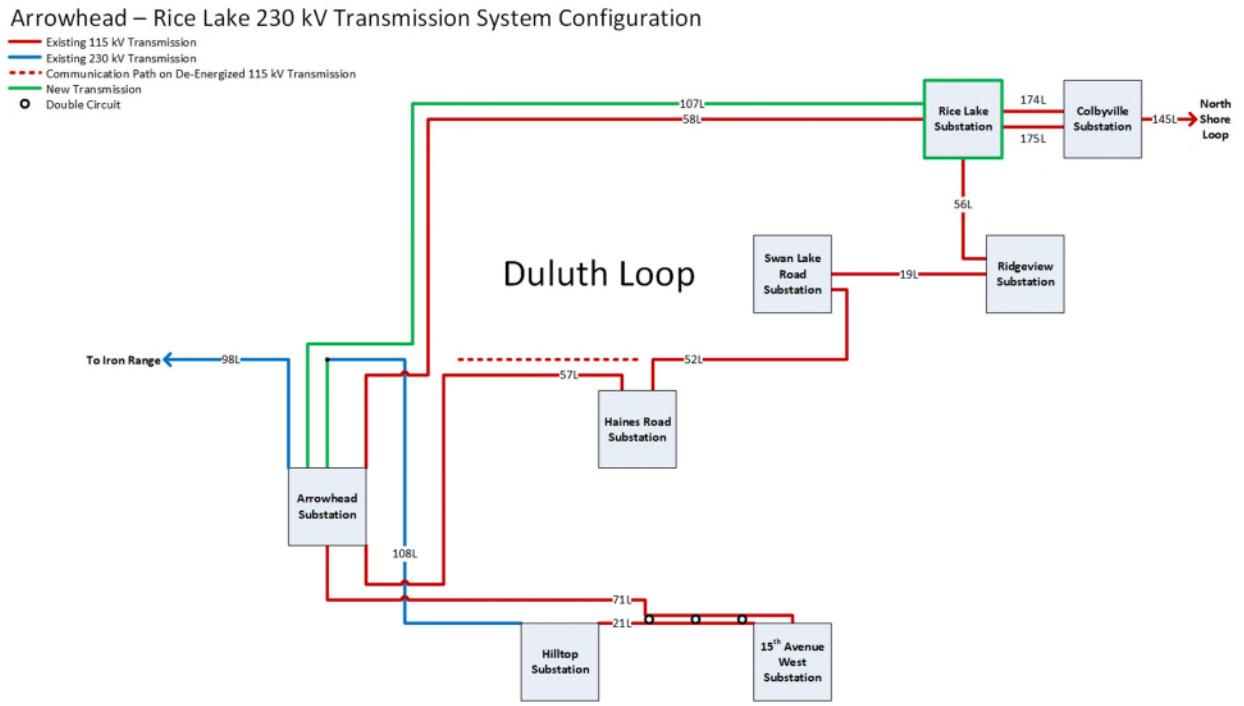
Minnesota Power considered lower voltage solutions involving improvements to the local 14 kV or 34 kV distribution system as an alternative to the Project. Minnesota Power does not have any existing 69 kV assets in the area, 69 kV was not considered as an alternative to the Project.

As described previously, a minimum of 74 MW of load would need to be offset in the Duluth Loop to mitigate the risk of voltage collapse during peak hours. In the case of lower-voltage alternatives involving the local distribution system, this means that 74 MW of load would need to be shifted out of the Duluth Loop onto distribution substations served from other parts of the transmission system. The Haines Road, Swan Lake Road, Ridgeview, and Colbyville substations in the Duluth Loop have distribution tie points that are generally designed to shift load from one Duluth Loop substation to another. A relatively small amount of load can be shifted onto some substations outside of the Duluth Loop, including onto the 15th Ave West Substation and the Four Corners Substation. A typical full-capacity distribution system tie point in the Duluth Area will have a capacity of between 15-30 MW. It is likely that several new 14 kV or 34 kV ties would be required to shift 74 MW of load out of the Duluth Loop onto adjacent distribution substations. This would involve new distribution feeders, significant distribution feeder and substation upgrades, and potentially new substations as substation capacity outside the Duluth Loop may not be sufficient. Shifting load out of the Duluth Loop onto other nearby Duluth-area substations also does nothing to improve the reliability or capacity of the existing Duluth Area 230/115 kV transformers, which is one of the three main need drivers for the Project. For these reasons, lower-voltage solutions are not a more reasonable and prudent alternative to the Project.

4.3.2 Higher Voltage Alternatives

Minnesota Power considered higher voltage solutions involving new 230 kV transmission as an alternative to the Project. Existing 230 kV transmission at the Arrowhead and Hilltop substations is the only higher voltage available in the Duluth area which is common to Minnesota Power's transmission system. Adding a different higher voltage would require new transformers. Any new 230 kV transmission line would have to connect to the Duluth Loop via a new 230/115 kV transformer. Space constraints at existing 115 kV substations in the Duluth Loop would likely require a new substation to be built to accommodate a new 230 kV Duluth Loop transmission connection. A new 230/115 kV Rice Lake Substation sited near the end of the common corridor located west of the Colbyville Substation would allow the two existing Duluth Loop 115 kV transmission paths to be connected to the new 230 kV line. The Arrowhead – Rice Lake 230 kV Alternative is shown in **Figure 4-1** below.

Figure 4-1. Arrowhead – Rice Lake 230 kV Alternative



While the Arrowhead – Rice Lake 230 kV alternative provides a reasonable technical alternative to the proposed Duluth Loop Project, it was rejected for the following reasons:

1. Establishment of a large new 230/115 kV substation on a greenfield site in the Rice Lake area would have significant human and environmental impacts compared to expanding the existing Ridgeview and Hilltop substations as proposed in the Project.

2. Construction of a new Arrowhead – Rice Lake 230 kV transmission line would involve the establishment of approximately 12 miles of new 230 kV transmission right-of-way located adjacent to existing Duluth Loop 115 kV lines. Double circuiting this 230 kV line with Duluth Loop 115 kV lines is not acceptable. The Project as proposed involves approximately 8 miles of entirely new 115 kV transmission right-of-way. Approximately 6 miles of the Project is being double circuited with an existing 115 kV line or overtaking an existing de-energized transmission line that is presently only carrying critical communications infrastructure. A new 230 kV line would require a wider right-of-way compared to a new 115 kV line. Therefore, the amount of new right-of-way required for the 230 kV alternative would greatly exceed what is needed for the Project as proposed and therefore would have greater human and environmental impacts.

For these reasons, the 230 kV alternative was rejected in favor of the Project.

4.4 Upgrade of Existing Facilities

Minnesota Power considered upgrading existing transmission facilities as an alternative to the Project.

To resolve the Duluth Loop voltage stability issues and thermal overloads in the Duluth Loop and North Shore Loop utilizing existing facilities, significant improvements would be needed on existing transmission lines in the Duluth Loop and North Shore Loop. Starting at the north end of the North Shore Loop, 61.2 miles of existing double circuit transmission line on lattice towers between the Mesaba Junction Switching Station and the Taconite Harbor Substation would need to be completely rebuilt with a significantly larger conductor to achieve sufficient capacity to support load in the Duluth Loop and the North Shore Loop under contingency conditions. In addition, another 30 miles of existing transmission line between the North Shore Switching Station and the Big Rock Substation would also have to be rebuilt with a larger conductor for the same reason.

In the Duluth Loop, Arrowhead – Colbyville 115 kV (19.2 miles), Arrowhead – Haines Road 115 kV (7.4 miles), Haines Road – Swan Lake Road 115 kV (1.3 miles), and Swan Lake Road – Ridgeview 115 kV (2.9 miles) would also need to be rebuilt with larger conductor. Completing a total rebuild and installation of a larger conductor on 183.2 total circuit miles of transmission lines could provide transmission line capacity necessary for serving the Duluth Loop and the North Shore Loop while also significantly reducing the impedance of the long distance from the Duluth Loop to the Hoyt Lakes area. The reduced system impedance would also improve the voltage stability threshold for serving the Duluth Loop under the contingencies described in Section 3.3. If larger conductor alone is not sufficient, a series compensation station or dynamic reactive support may be needed in the Duluth Loop and/or North Shore Loop to fully mitigate the risk of voltage collapse.

Rebuilding over 183 miles of existing lines and adding series compensation or dynamic reactive support in the North Shore Loop would be significantly more expensive than the Duluth Loop Project as proposed, would require significant outage durations during which time customers in the Duluth Loop and the North Shore Loop would be fed radially from either the Duluth area or from the Hoyt Lakes area. In addition, completing these upgrades would do nothing to improve the capacity or reliability of existing 230/115 kV transformers in the Duluth area, and therefore the proposed upgrades at the Hilltop and Arrowhead substations would also still be required. For these reasons, upgrading the existing system is not a reasonable alternative to the Project.

4.5 Alternative 115 kV Endpoints

Minnesota Power considered alternative endpoints for the 115 kV portion of the Project. The endpoints of the proposed Project were ultimately selected because they efficiently addressed many existing system needs in the Duluth Loop and North Shore Loop effectively and simultaneously, including replacing electric service reliability formerly provided to the Duluth Loop and North Shore Loop by retired or idled coal-fired baseload generators located along the North Shore. However, Minnesota Power also considered

alternative 115 kV endpoints. A discussion of these alternative endpoints and why they were deemed inferior to the endpoints selected for the 115 kV portion of the proposed Project is provided below.

4.5.1 Colbyville Substation

Constructing a new 115 kV transmission line from Hilltop Substation to the Colbyville Substation was considered. The Colbyville Substation would need to be rebuilt and reconfigured to accommodate a modern ring bus design as proposed for the Project. There are also transmission corridor constraints along the existing lines west of the Colbyville Substation. These constraints would make it challenging to construct a third 115 kV transmission line into the Colbyville Substation without either displacing a number of existing homeowners or double circuiting two Duluth Loop 115 kV lines. For reasons described in Section 4.6, double circuiting two Duluth Loop 115 kV lines would not meet the need for the Project. For these reasons, the Colbyville Substation alternative endpoint alone is not a viable alternative to the Project.

A future consideration including the Colbyville Substation that is enabled by the Project as proposed would involve relocating the termination of the existing Big Rock – Colbyville 115 kV Line from the Colbyville Substation to the Ridgeview Substation. The Duluth Loop Project would then proceed as proposed from the Ridgeview Substation to Hilltop Substation. Because the transmission line to Big Rock serves a fundamentally different purpose than the Duluth Loop transmission lines, providing the connection into the North Shore Loop rather than directly supporting the Duluth Loop, the additional extension from Colbyville to Ridgeview could be constructed on double circuit structures with existing Ridgeview – Colbyville 115 kV. This line extension would serve to eliminate the possibility of serving the Colbyville Substation load from the North Shore Loop. As discussed in Section 3.3.1.3 (Voltage Stability Limit and Historical Data Analysis), historical load levels at Colbyville and in the North Shore Loop do not indicate a present risk of voltage collapse for this condition, and future risk could likely be managed by running Laskin generation during an outage of either Arrowhead – Colbyville 115 kV or Ridgeview – Colbyville 115 kV. If at some point in the future this voltage collapse issue can no longer be managed with Laskin generation, the extension of Big Rock – Colbyville 115 kV to the Ridgeview Substation will be re-evaluated. For the present time, there is not a justifiable need to include this additional transmission extension in the Duluth Loop Project.

4.5.2 Swan Lake Road Substation

The Swan Lake Road Substation site is very constrained and is not designed for expansion to accommodate an additional 115 kV transmission line. Selecting the Project transmission at the Swan Lake Road Substation as an endpoint for the 115 kV transmission line also leaves all the Ridgeview Substation load exposed to potentially being served from the North Shore Loop. As shown in Section 3.3.1.3 (Voltage Stability Limit and Historical Data Analysis), this would result in a considerable number of hours at risk of voltage collapse. The Swan Lake Road Substation is less than three miles from the Ridgeview Substation, with the ability to route a new line along existing transmission corridor the entire distance. The Ridgeview Substation is a better endpoint for the Project

because it more effectively addresses the long-term needs for the Duluth Loop and maximizes the use of existing transmission corridor and an existing substation site that is suitable for expansion. The Ridgeview Substation endpoint also enables a future extension of the Big Rock – Colbyville 115 kV Line to Ridgeview, as described in Section 4.5.1. For these reasons, the Swan Lake Road Substation alternative endpoint is not a viable alternative to the Project.

4.5.3 Arrowhead 230/115 kV Substation

Both existing Duluth Loop transmission paths originate at the Arrowhead Substation. The configuration of the Arrowhead 115 kV bus is of an older design where there are two 115 kV buses separated by a single bus tie breaker. With the two 115 kV main buses at this substation, one connects to Arrowhead – Colbyville 115 kV and one connects to Arrowhead – Haines Road 115 kV, ensuring that a single bus outage does not result in loss of both Duluth Loop 115 kV lines. In 2017, a redundant bus-tie breaker was added to further improve reliability by ensuring that a single breaker failure does not result in loss of the entire Arrowhead 115 kV substation – and therefore both Duluth Loop lines. Further improvements at Arrowhead would be difficult to implement due to the configuration of the substation, because it would be very difficult to create a new 115 kV bus for a third Duluth Loop transmission path that does not result in two Duluth Loop transmission lines sharing a common bus or breaker. Voltage collapse concerns will remain if a third transmission path into the Duluth Loop shares a bus connection or a common breaker with one of the existing Duluth 115 kV transmission lines at the Arrowhead Substation. For these reasons, Minnesota Power decided that a third 115 kV transmission path into the Duluth Loop should not originate at the Arrowhead Substation. The following transmission lines and substations were also ruled out as a starting point for a new 115 kV transmission path into the Duluth Loop because they connect to the Arrowhead Substation:

- Arrowhead – Four Corners 115 kV: This transmission line and the Four Corners Substation are radially fed from the Arrowhead Substation, connected to the same 115 kV bus as Arrowhead – Haines Road 115 kV.

- Arrowhead – ETCO – Virginia 115 kV: This transmission line is approximately 58 miles in length and most of the line is relatively small 4/0 conductor which would need to be rebuilt and reconductored. The ETCO and Virginia substations are both more than 47 miles from the Arrowhead Substation, a long distance to serve significant Duluth Loop load in the event that a bus fault or breaker failure event resulted in loss of the Arrowhead source.

4.5.4 15th Avenue West Substation

The 15th Ave West Substation near downtown Duluth is very constrained for an expansion to accommodate an additional 115 kV transmission line. The transmission corridor into 15th Avenue West substation is also very constrained, and a new and heavily constrained transmission line corridor through dense residential and commercial areas of Duluth would likely be necessary to interconnect to the Ridgeview Substation. For these

reasons, the 15th Avenue West alternative endpoint is not a viable alternative to the Project.

4.6 Double Circuiting

Minnesota Power considered double circuiting the new 115 kV line with existing transmission lines. Double circuiting is the construction of two separate transmission circuits (three phases per circuit) on the same structures. Placing two transmission circuits on common structures generally reduces right-of-way requirements, which potentially reduces human and environmental impacts.

On the other hand, double circuit construction typically comes with a higher cost compared to single circuit and, in some cases, may result in reduced reliability or operational flexibility. For the Duluth Loop Project, as discussed below, the reliability concerns resulting from the double circuiting of certain segments would undermine the Project's effectiveness for addressing the Duluth Loop voltage stability concerns described in Section 3.3.

A primary need for establishing a third transmission path into the Duluth Loop is to ensure the Duluth Loop remains connected to either the Arrowhead Substation or Hilltop Substation at all times. Without local baseload generation online in the North Shore Loop, the Duluth Loop cannot be served radially from Silver Bay under most conditions without causing a voltage collapse. These voltage stability concerns are documented in detail in Section 3.3. After completion of the Project, the following transmission lines make up the Duluth Loop transmission paths:

- Arrowhead – Colbyville 115 kV Line
- Arrowhead – Swan Lake Road 115 kV Line
- Hilltop – Haines Road 115 kV Line
- Haines Road – Ridgeview 115 kV Line
- Swan Lake Road – Ridgeview 115 kV Line
- Ridgeview – Colbyville 115 kV Line

All of these transmission lines serve a common purpose of completing the connection from the Arrowhead or Hilltop 230/115 kV transmission sources to the Duluth Loop and the North Shore Loop. For the following reasons, double circuiting any two of these Duluth Loop transmission paths would not meet the need for the Project because:

- During maintenance on a single circuit Duluth Loop transmission line, a failure of a double circuit structure involving two Duluth Loop transmission lines would lead to the voltage collapse that is one of the fundamental need drivers the Project is intended to resolve.

- To perform maintenance on a double circuited segment of line, there will be times when both circuits need to be taken out of service. During maintenance on the double circuited Duluth Loop transmission lines, an outage of a single circuit Duluth Loop transmission line would lead to the voltage collapse that is one of the fundamental need drivers the Project is intended to resolve.

It is acceptable and consistent with the need for the Project to double circuit a Duluth Loop transmission line with other transmission lines not associated with the Duluth Loop. In fact, Minnesota Power has proposed that the new 115 kV transmission line exiting the Hilltop Substation will be double circuited with the existing Arrowhead – 15th Avenue West 115 kV Line for approximately 3.5 miles, that represents about 25 percent of the proposed 115 kV Project line length.

4.7 Alternative Number, Size, and Type of Conductor

All lines on the Minnesota Power transmission system for circuits at 230 kV and below utilize one wire per phase. The use of an increased number of conductors or bundled conductor systems has some benefits in terms of corona performance and cost effectiveness, particularly at extra high voltages of 345 kV and above. There is no significant technical benefit for the Project to utilize a bundled conductor system on 115 kV or 230 kV lines. Given the cost and complexity of adding a bundled system at 115 kV or 230 kV, without significant benefit at these voltages, there is no justification to pursue an increased number of conductors (bundled conductors) on this Project.

Utilizing larger wire can reduce transmission losses; however, this long term savings must exceed the initial cost increase to be considered as a viable alternative. Beyond the wire cost alone, larger wires translate to increased structural loading which results in higher structure costs. For longer transmission lines and extra high voltage lines, it is often worthwhile to perform a conductor optimization study in order to evaluate the economics of selecting different conductor sizes and configurations in view of long-term losses and initial capital costs. In the case of the shorter 115 kV or 230 kV lines included in the Project, localized transmission capacity needs and consistency with adjacent facilities of the same voltage class are more significant considerations than negligible economic savings from reduced losses. Based on projected future loading for the Duluth Loop Project, there will not be a benefit in using significantly larger conductors beyond those selected for the Project.

ACSR is the most common conductor type used on transmission lines. The existing 115 kV lines in the Duluth Loop are currently conductored with 636 kcmil ACSR and the 230 kV Line is conductored with 954 kcmil ACSR. (kcmil is 1000 circular mils which is a measure of cross-sectional area). Minnesota Power also uses Aluminum Conductor Steel Supported (ACSS) wire on some facilities. ACSS is referred to as a high temperature conductor as it is capable of higher thermal operation at reduced sag compared to ACSR. ACSS generally has a higher initial installation cost compared to a similarly sized ACSR wire; however, this cost can sometimes be justified based on loading needs and operational costs.

Additional high temperature conductor types and other alternate wires exist such as special alloy or composite core conductors; however, these conductor types are best suited for special loading and operational considerations and have much higher initial costs beyond that of ACSR or ACSS. Beyond initial costs, another important consideration of wire selection is consistency with existing lines and standards. The addition of a new conductor type or system outside of Minnesota Power's current standards would require new installation training and new inventory to be carried for maintenance and critical spares resulting in increased costs and/or a reduction in inventory levels of other items, which then results in diminished maintenance and emergency restoration responsiveness and effectiveness. These types of wire are not part of Minnesota Power's standard and are not being considered for use on the Duluth Loop Project as there is no special loading or operational need that would justify the cost and complexity.

For the Duluth Loop Project, 954 kcmil ACSR has been selected for the new 230 kV lines, and 666 kcmil ACSS has been selected for most of the new and reconstructed 115 kV lines; however, in some cases (for instance where connections are made to some existing lines) 636 kcmil ACSR will be used. These conductor selections are consistent with Minnesota Power standards and are anticipated to meet the needs of the Duluth Area and the North Shore Loop for the foreseeable future. More specifically, 666 ACSS was selected over 636 ACSR for the new and reconstructed 115 kV lines because it is an existing standard conductor in Minnesota Power's system and during normal anticipated line loading, its losses would be similar to 636 ACSR. The increased cost for the 666 ACSS is justified due to its higher thermal capacity which will allow for infrequent post contingent loading beyond that of 636 ACSR and consistent with the 1200 Amp rating of much of the existing substation equipment in the Duluth Loop. 954 ACSR was selected for the 230 kV line because it is within Minnesota Power's standard and is consistent with the existing line.

As discussed in Section 4.4, reconductoring or rebuilding existing lines with additional, larger, or alternate types of conductor as an alternative to building the new 115 kV line will not meet the Project need of adding a new 115 kV source to the Duluth Loop and is therefore not a viable alternative.

The initial installation costs, operational costs, and complexities that accompany the introduction of a new alternate number, size, or type of conductor on the Duluth Loop Project without significant benefit do not warrant the use of additional, larger, or alternate types of conductor beyond the 636 ACSR, 954 ACSR, and 666 ACSS selected for the Project.

4.8 Direct Current Alternative

High voltage direct current ("HVDC") lines are typically proposed for transmitting large amounts of electricity over long distances because line losses are significantly less over long distances on a HVDC line than an AC line. A HVDC line is not a reasonable alternative to the proposed Project. The Project is being proposed for local transmission system reliability purposes. HVDC lines are typically proposed for large regional

transmission projects that involve hundreds of miles of new transmission line. The Project must be readily tapped and tied in with the existing AC transmission system now and in the future to serve customers in the project area. HVDC lines require expensive conversion stations at each delivery point because the DC power must be converted to AC power before it can be used by customers. Such conversion stations would add significantly to the cost of the Project. As a result, there is no justification – in terms of reliability, economy, performance, or otherwise – for a HVDC line in this case.

4.9 Underground Alternative

Undergrounding is an alternative that is seldom used for high voltage transmission lines like those being proposed for the Project. One of the primary reasons underground high voltage transmission lines are seldom used is that they are significantly more expensive than overhead lines. The cost range depends on the design voltage, the type of underground cable required, the extent of underground obstructions like rock formations, the thermal capability of the soil, the number of river crossings, and other factors, but the construction cost of locating the entire length of the Project's proposed transmission underground is estimated to be as much as 8 to 10 times greater per mile than if it were to be constructed overhead as proposed. This cost does not include the large reactors that would likely be required at each substation to counteract the large line charging currents present on underground high voltage lines. In addition, there are increased line losses and additional maintenance expenses incurred throughout the useful life of an underground high voltage line that further increase the total additional cost of building an underground line instead of an overhead line.

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

A common argument in favor of implementing underground lines is that they will minimize the human and environmental impacts above ground. However, there are still human and environmental impacts both during and after construction of an underground transmission line. The predominant environmental impact from the construction, operation, and maintenance of underground transmission lines arises from the need to obtain and maintain a completely cleared rights-of-way above the underground transmission line. While construction activities for overhead transmission lines are typically concentrated around the line's structures, leaving areas between structures relatively undisturbed apart from some vegetation removal, construction of underground transmission lines requires the entire right-of-way to be completely cleared and utilized for construction activities. This results in increased impact to wetland areas due to the likely need to install an access road capable of supporting heavy construction equipment, trenching activities, and cable installation. After construction, the right-of-way needs to

be maintained free of woody vegetation to reduce soil moisture loss, since high voltage underground conductors make use of soil moisture for conductor cooling. A permanent road must also be maintained along the right-of-way for maintenance and repair.

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

Due to the construction, maintenance, reliability, and cost drawbacks of high voltage underground transmission lines, undergrounding is not a viable alternative for any segment of the proposed Duluth Loop Project.

4.10 No-Build Alternative/Consequence of Delay

Since the idling and retirement of the North Shore generators, an existing operational guide has been increasingly relied upon during necessary maintenance and upgrades in the Duluth Loop transmission lines and substations. This operational guide places load in the North Shore Loop on a radial feed from the Hoyt Lakes area and load in the Duluth Loop on a radial feed from the Arrowhead Substation. Customers on either side of the open point are exposed to outages anywhere along radial transmission system. In the case of the North Shore Loop, there is approximately 140 line-miles of outage exposure. While the total line-miles of exposure is much less in the Duluth Loop, the substations in the Duluth Loop serve some of the most densely-populated urban areas on Minnesota Power's entire system. Due to the configuration of the system and the risk involved with taking outages to perform routine construction and maintenance, it is becoming more and more challenging to schedule necessary outages of sufficient duration in the Duluth Loop and North Shore Loop. With these constraints, only critical or emergency maintenance is likely to be performed, resulting in deferred routine maintenance. At some point, outages will become unavoidable due to component failures or imminent concerns about safety and reliability. At that time, there will be even greater risk of a high-impact unplanned outage affecting the Duluth area or the North Shore due to deferred maintenance. Depending on load growth, the load-serving capability could be even further degraded, increasing the likelihood of a voltage collapse even more. Long-term use of the operational guide resulting in the minimization of routine construction and

maintenance on the transmission system results in unacceptable long-term reliability risks for the Duluth area and the North Shore, and therefore, the Duluth Loop Project must be constructed as proposed.

5.1 Summary of Route Selection Process and Guiding Factors

5.1.1 Route Development Process Summary

The Duluth Loop Project used a multi-stage, interactive routing process to identify route options for the proposed 115 kV line and the 230 kV line. The iterative process is designed to narrow the initial Study Area into Study Corridors, then into Route Alternatives, and finally into a Proposed Route. Throughout this process, Minnesota Power requested feedback from both stakeholders and the public through two public meetings, landowner mailings, stakeholder specific meetings, print and social media engagement and a project website. Taking into account this information, as well as the applicable Minnesota Statutes and Rules, potential state, federal, and local permits or approvals necessary for the Project, and the purpose and need for the Project, Minnesota Power identified a Proposed Route for consideration by the Commission. The route development process leading to the identification of the Proposed Route is discussed in detail below.

The term “Proposed Route” includes both the 115 kV route and the 230 kV route as well as the required substation expansion and work areas. The term “Proposed 115 kV Route” is a single route for the proposed 115 kV transmission line from the Ridgeview Substation to the Hilltop Substation. The term “Proposed 230 kV Route” is a single route for the proposed 230 kV transmission line from the Arrowhead Substation to the tie-in point with the existing 98 Line.

5.1.2 Routing Factors

The factors for route development are set forth in Minnesota Statutes § 216E.03, subdivision 7 and Minnesota Rule 7850.4100 and these factors directed Minnesota Power’s route development process.

Minnesota Statutes § 216E.03, subdivision 7(a) provides that the Commission’s route permit determinations “must be guided by the state’s goals to conserve resources, minimize environmental impacts, minimize human settlement and other land use conflicts, and ensure the state’s electric energy security through efficient, cost-effective power supply and electric transmission infrastructure.” Subdivision 7(e) of the same section requires the Commission to “make specific filings that it has considered locating a route for a high-voltage transmission line on an existing high-voltage transmission route and the use of parallel existing highway right-of-way and, to the extent those are not used for the route, the Commission must state the reasons.”

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

A. effects on human settlement, including, but not limited to, displacement, noise, aesthetics, cultural values, recreation, and public services;
B. effects on public health and safety;
C. effects on land-based economies, including, but not limited to, agriculture, forestry, tourism, and mining;
D. effects on archaeological and historic resources;
E. effects on the natural environment, including effects on air and water quality resources and flora and fauna;
F. effects on rare and unique natural resources;
G. application of design options that maximize energy efficiencies, mitigate adverse environmental effects, and could accommodate expansion of transmission or generating capacity;
H. use or paralleling of existing rights-of-way, survey lines, natural division lines, and agricultural field boundaries;
I. use of existing large electric power generating plant sites;
J. use of existing transportation, pipeline, and electrical transmission systems or rights-of-way;
K. electrical system reliability;
L. costs of constructing, operating, and maintaining the facility which are dependent on design and route;
M. adverse human and natural environmental effects which cannot be avoided; and
N. irreversible and irretrievable commitments of resources.

Minnesota Power utilized these statutory and rule routing criteria, routing experience, engineering considerations, and stakeholder feedback to develop the Proposed Route for the Project. To minimize impacts to humans and the environment, Minnesota Power first identified routing opportunities and constraints.

Opportunities are resources or conditions that create a potential for transmission line development. They include pre-existing linear infrastructure or other features (e.g., roads, transmission lines, and public land survey divisions of land) along which Project development would be particularly compatible. Opportunities also facilitate Project development by reducing impacts on constraints. Furthermore, Minnesota Rule 7850.4100 requires the Commission to consider when issuing a route permit the use or paralleling of existing rights-of-way (e.g., transportation corridors, pipelines, and electrical transmission lines), survey lines, natural division lines, and agricultural field boundaries, where practicable.

Constraints are resources or conditions that could limit or prevent transmission line development. Avoiding those resources or conditions is a goal, but not necessarily a requirement, of the routing process. Constraints might include areas restricted by regulations, or areas where impacts to resources would be difficult to mitigate. Constraints can include, for example: existing land uses such as homes, religious facilities, and schools; federal, state, and locally designated environmental protection areas; sensitive habitats or areas; cultural resources such as national landmarks and archaeological sites; and public infrastructure such as airports and aeronautical and

commercial telecom structures. It is important for the routing process to account for the fact that Project development may affect constraints differently.

In addition, technical guidelines will affect the routing process. These are specific engineering requirements, standards, and objectives associated with the construction of the Project. For example, engineering objectives included as part of the technical guidelines do not support double-circuiting of specific lines or segments as outlined in Chapter 3 and maintaining suitable separation between corridor centerlines when paralleling other electric transmission lines. Other engineering objectives may include line entrance into the substations, minimizing the overall line length, good access for construction and inspections, minimize the number of angles, minimize "special" structures needed to avoid/minimize impacts, and large spans. These technical guidelines are specific to the Project and provide the technical limitations related to the design, right-of-way requirements, and reliability concerns. They may apply to the entire Project or they may be specific to a particular segment.

Minnesota Power developed a list of potential routing opportunities, constraints, and technical guidelines for the Project (**Table 5-1** and **Table 5-2** and **Table 5-3**). It is important to note that not all of the items in **Table 5-1** to **Table 5-3** are present in the Study Area, and that these lists evolved during the routing process.

Routing opportunities were reviewed for the Project and considered in conjunction with potential routing constraints. In some areas, existing linear infrastructure offered corridors along which a transmission line might be located with less disruption to the natural and human environment. In other areas, there were no opportunities to parallel existing right-of-way in the direction desired; existing rights-of-way were too narrow or irregular in width and direction; or had constraints, such as homes or commercial buildings.

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

1. State statute and rule routing factors;

2. Technical expertise of engineers and planning staff responsible for the reliable and economic construction, operation, and maintenance of the Project, and other electric system facilities;

3. North American Electric Reliability Corporation ("NERC") reliability standards; and

4. Industry best practices.

Table 5-1. Routing Opportunities

Opportunities
Existing Transmission Lines
Roadways/Trails
Railroads
Public Land Survey System (e.g., section lines, half section lines, etc.)

Property Lines (legal divisions of land)
Natural division lines; field boundaries
Pipelines

Table 5-2. Routing Constraints

Constraints
Federal/State/County Resources
National Wildlife (and Fisheries) Refuges
State Natural Resource Areas
State or National Parks (Minnesota Rules 7850.4300)
State and National Historic Sites and Landmarks
National Historic Districts
State or National Wilderness Areas (Minnesota Rules 7850.4300)
National Monuments
State Scientific and Natural Areas (Minnesota Rules 7850.4300)
State wild, scenic, and recreational rivers and their land use districts
County or City Parks
Nature Preserves
Prairie Restoration Areas
National and State Forests
Wild and Scenic Rivers
State Wildlife Refuges/Birding Areas/Management Areas
Military Lands and Operations
Resource Easement Lands
Non-Government Organization (NGO) Lands
Conservation Areas (The Nature Conservancy, Sierra Club, etc.)
Important Bird Areas (The Audubon Society)
NGO Resource Easement Lands
Special Status Species/Habitat
Designated Critical Habitat
Bald eagle wintering/breeding habitat (“BGEPA”)
Threatened, Endangered & Protected Species (known occurrence areas and habitat)
Cultural Resources
Historic and Cultural Resources
National Register of Historic Places (Listed or eligible sites)
Historic Landscapes/Trails/Markers
National Natural Landmarks
Burial Areas (prehistoric or historic)
Cemeteries

Cultural Values (Traditional Communities)
Century/Sesquicentennial Farms
Special Jurisdictions
Native American Reservations
Native American Owned Lands
Visual Resources
Scenic Highways or Corridors
Scenic Overlooks
Geological Markers
Public Infrastructure
Airports
VOR (Aeronautic Navigation Equipment- Clear Zone)
Doppler Radar Systems
Telecom (Communication towers, antenna structures, etc.)
Housing/Homes (consider Environmental Justice)
Land Use
Planned Development (City/County Plans)
Commercial/Industrial Development
Daycares/Schools/Hospitals
Other Structures (billboards, barns, sheds)
Religious Facilities
Safety Regulations (gas stations, electrically sensitive areas, etc.)
Center Pivot/Lateral Move Irrigation
Organic Agriculture Land
Orchards
Forest
Aggregate Mine/Quarries
Trails (local, snowmobile, bike, horse)
Recreation Areas (Parks, golf courses, OHV trails)
Contaminated Areas (Superfund, Brownfields, etc.)
Natural Resources/Geomorphology
Flood Control Areas (Floodplain)
Lakes/Ponds/Reservoirs
Rivers/Streams (Impaired/PWI)
Trout Streams
Wetlands/Peatlands/Calcareous Fens
Native Prairie
Wooded Areas/Lands
Significant Geomorphology or Geologically Unstable Areas

Table 5-3. Technical Guidelines

Technical Guidelines
Terrain/Soil Conditions
Project length and endpoints
Roadway Access to the construction areas and completed Route (ease of inspecting and accessing areas of the Route)
Number of specialty structures needed to avoid/minimize impacts to environmental features
Number of angle structures
Size and type of foundation
Inductive Currents/Interference
Tree-trimming/Vegetation Management

5.2 Route Development Process

5.2.1 Project Study Area

5.2.1.1 Study Area Identification

Minnesota Power identified a Study Area that would help guide the corridor development process. The Study Area was initially developed based on the defined Project endpoints – Ridgeview Substation, Hilltop Substation and Arrowhead Substation. Within this general area major physiographic features, jurisdictional boundaries, sensitive land uses and ownerships, and existing utility corridors were defined to help refine the Study Area boundaries, representing the limits of reasonable or feasible transmission line corridors for the Project. The Project Study Area is shown in **Map 5-1** in **Maps tab**.

The Study Area was designed to encompass potential study corridors and feasible route alternatives that follow existing opportunities and minimize impacts to known resources. There are areas within the Study Area that are not suitable for transmission line development (e.g., dense residential development in the southeast portion, commercial development in Hermantown, Proctor railyard, parks, and the Duluth International Airport). In subsequent routing process steps, these constraint areas were reviewed and removed from further study as study corridors and route alternatives were developed. The following sections describe the Study Area boundaries.

5.2.1.1.1 Northern Boundary

The northern boundary is approximately 1,000 feet north and east of the intersection of Minnesota Power's existing 115 kV 56 Line and 57 Line. Where the 57 Line turns south, the Study Area continues in a southwesterly direction to Great River Energy's (GRE) existing Four Corners Substation. This boundary was developed to include opportunities to parallel existing transmission lines and pipeline, while providing ample space to route around the Duluth International Airport and avoid glide slope constraints.

5.2.1.1.2 Western Boundary

The western boundary is approximately 600 feet west of GRE's existing transmission line that generally runs north-south along Solway Road from GRE's Four Corners Substation to Minnesota Power's Arrowhead Substation. When the GRE line turns southeast, the boundary continues south to encompass the west side of the Arrowhead Substation. This boundary was developed to include opportunities to parallel Minnesota Power's existing 230 kV 90 Line and 98 Line for routing the proposed 230 kV transmission line extension to the Arrowhead Substation.

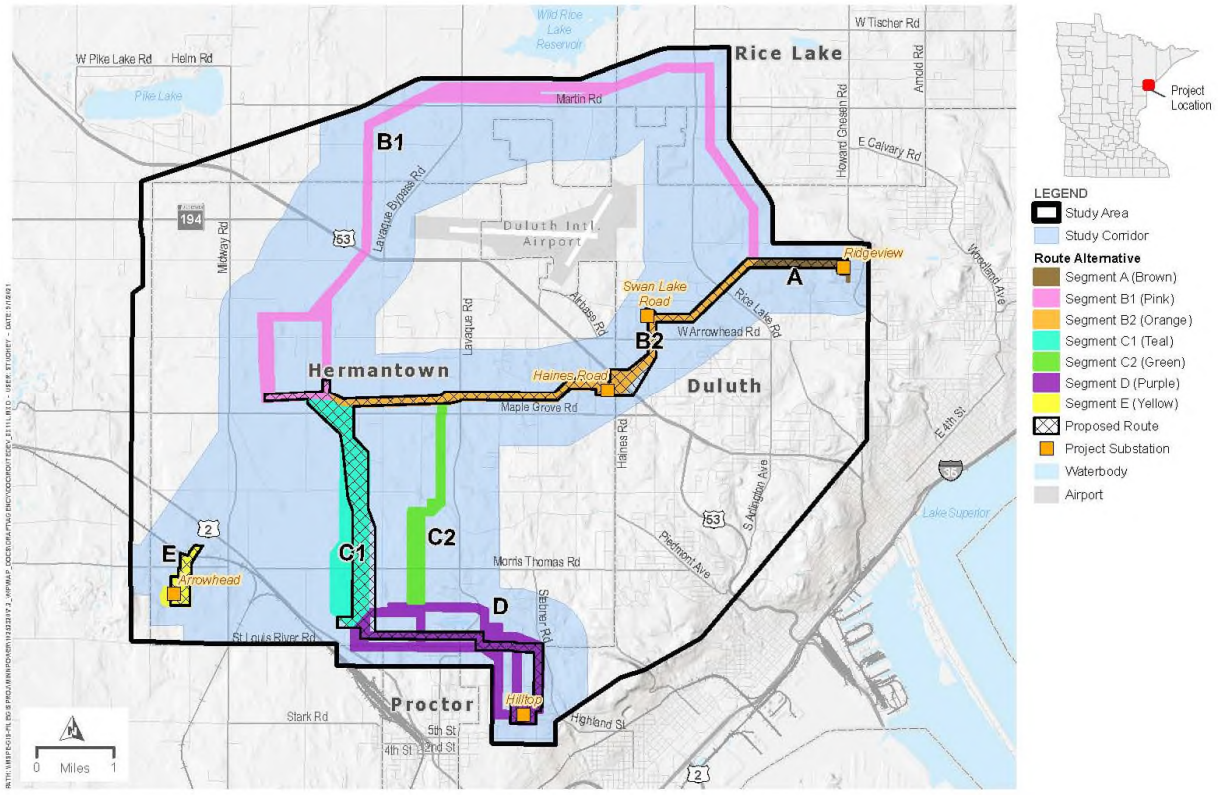
5.2.1.1.3 Southern Boundary

The southern boundary is approximately 600 feet south of Minnesota Power's existing 71 Line that runs from the Arrowhead Substation east to the Hilltop Substation. Where the existing 71 Line crosses Minnesota Power's existing 98 Line, the Study Area is expanded south by an approximate 300-foot buffer of the existing 98 Line towards the Hilltop Substation. The area around the Hilltop Substation is expanded to the south and west to allow for additional transmission line configurations entering and existing the substation as the area has transmission line congestion and residential areas. This boundary was developed to include opportunities to parallel existing transmission lines, while avoiding dense residential areas around Proctor and the railyard.

5.2.1.1.4 Eastern Boundary

The eastern boundary of the Study Area is approximately 600 feet southeast of Minnesota Power's existing 21 Line and 71 Line. At the point where the existing 21 Line and 71 Line turn east to the 15th Avenue Substation, the Study Area boundary continues northeast towards the intersection of Rice Lake Road (Highway 4) and Highway 194. The boundary then turns north towards the Ridgeview Substation. The boundary was developed to allow for possible corridor sharing with the existing 21 Line and 71 Line northeast from the Hilltop Substation and utilizing an existing distribution line running south from the Ridgeview Substation. Areas to the east are not included due to terrain and urban areas of Duluth.

Figure 5-1. Project Study Area



5.2.2 Project Study Corridor

5.2.2.1 Study Corridor Identification

Minnesota Power developed the Study Corridor by reviewing collected data, meeting with stakeholders, and performing broad environmental and engineering analyses on the Study Area.

In general, the Study Corridor was developed by considering the following:

- Parallel existing rights-of-way (transmission lines, pipelines, railway, or roads), survey lines, and natural division lines;
- Avoid densely populated areas;
- Avoid major environmental natural features (parks and wooded areas);
- Cross streams at areas where there is an existing disturbance (i.e. transmission line, road, other clearing) and minimal wetland fringe;
- Avoid known public and private airports;

- Maximize transmission system reliability; and
- Minimize length.

The Study Corridor is generally 1.25-mile-wide (buffer of 0.625 mile on each side) and is centered on the existing transmission lines and pipelines in the Study Area. The Study Corridor is shown in **Map 5-1** in **Maps tab**. The Study Corridor provides a buffer distance that would capture practical routing opportunities and allow for flexibility to avoid constraints in the vicinity of the existing transmission or pipeline systems. The Study Corridor avoided constraints such as densely populated areas, parks, Duluth International Airport, and large lakes.

The Study Corridor was presented to the public at open house meetings in January 2021 and to individual agencies during the winter 2020/2021. These meetings provided information about the Project to the public and agencies and allowed them to provide comments that would be used in the next step of the routing process. See **Chapter 8** for a summary of public and agency comments.

5.2.3 Routing Opportunities and Constraints

5.2.3.1 Route Alternatives Identification

5.2.3.1.1 Existing Linear Corridors

Minnesota Rules 7850.4100 and Minnesota Statue § 216E.03, subd. 7(e) provides preference for routes that parallel existing transportation, pipeline, and electrical transmission systems or rights-of-way. Minnesota Power identified this paralleling as a key factor in selecting the Proposed 115 kV Route and the Proposed 230 kV Route. The Proposed 115 kV Route and the Proposed 230 kV Route maximize existing rights-of-way by paralleling existing 115 kV transmission lines and existing 230 kV transmission lines.

5.2.3.1.2 Route Segment Network Development

Minnesota Power began Route Alternative development by creating an extensive network of route segments by which potential routes could be compared and evaluated. This process involved careful consideration of the Commission's routing factors and the identification of roads, transmission lines, railroads, and general property boundaries within the Study Corridor. In general, the route segments were developed by considering the following:

- Parallel existing transmission lines and pipelines;
- Double-circuiting opportunities of existing transmission lines that do not make up the existing Duluth Loop transmission paths;
- Parallel existing roadways and property lines;
- Avoid populated areas and homes; and

- Maximize distance from existing homes in areas without existing routing opportunities.

Route segments were located adjacent to existing transmission lines, transmission line double-circuiting opportunities, existing pipelines, and property/parcel lines that maximized distance from homes.

In locations along these existing opportunities where routing constraints were present, the route segments were located to avoid or minimize those constraints. Priority was placed on following existing property lines and maximizing distance from existing development. Where route segments intersected, a node was established. The portion of a route between each node was called a "route segment."

To minimize impacts to people and their residences, Minnesota Power identified homes and structures (e.g., barns, garages, sheds, businesses, etc.) within the Study Corridor. These two constraints are widely distributed and common throughout most of the Study Corridor, and thus were difficult to avoid on a corridor scale.

Homes and structures were initially identified through GIS raster data, aerial image interpretation, and public comments. After the identification process was completed, Minnesota Power calculated the distance to homes and structures for each Route Segment and categorized the route segments by that distance.

Using this information, Minnesota Power prioritized contiguous route segments that maximized the distance from homes and other structures, as well as existing infrastructure, while seeking to minimize the length and number of turns requiring angle structures. Minnesota Power also prioritized siting the Project along property lines or field lines, which helps minimize impacts on existing land uses. Minnesota Power continued this process of identifying contiguous segments until a route segment network was identified that provided routing possibilities within the Study Corridor.

5.2.3.1.3 Route Segment Comparison

Once the route segment network was developed, Minnesota Power reviewed the potential impacts associated with the route segments. The first step was to compare groups of smaller routes (contiguous route segments) that had common start and end points.

The route segments that most effectively consider and satisfy the routing factors set forth in Minnesota Statute and Rule were carried forward for further consideration. The proposed route segments selected generally follow existing transmission line corridors, as these segments most effectively minimize other impacts compared to other routes. While route segments were developed that paralleled road rights-of-way, these segments were not carried forward given the higher density of residences and business and associated increased level of impacts located along roadways when compared to available corridors paralleling existing transmission lines.

5.2.4 Project Route Alternatives

5.2.4.1 Creation of Route Alternatives

Minnesota Power used the developed route segments to create Route Alternatives. These Route Alternatives were generally 500-feet-wide and centered on route segments. Route Alternatives wider than 500 feet were created to allow for flexibility when more than one route segment was feasible, or where Minnesota Power recognized the need for additional flexibility for engineering reasons or to minimize impacts on known sensitivities or constraints. Segments A, B1, B2, C1, C2 and D provide routing options for the proposed 115 kV line. Segment E was developed for the proposed 230 kV line. These segments are shown in **Map 5-1** in **Maps tab**.

- Segment A – About 500-feet wide, extending from the Ridgeview Substation west for approximately 1.25 miles along the existing 56 Line and 19 Line.

- Segment B1 – Approximately 500-feet wide, extending north then west then south around the Duluth International Airport. This segment generally follows the existing 56 Line and 57 Line. The segment is wider along Martin Road to include Minnesota Power owned property that is located north of Martin Road, but south of Wild Rice Lake Reservoir. The segment also has an option near Arrowhead Road to parallel an existing pipeline.

- Segment B2 – This segment varies from approximately 500 feet to 1,800 feet wide, extending west and southwest generally following the existing 19 Line, 52 Line , and 58 Line past the Swan Lake Road and Haines Road Substations. The segment is wider where it crosses Highway 53 (Miller Trunk Highway) near the Haines Road Substation to provide flexibility in crossing Miller Trunk Highway, Miller Creek, existing utilities, and adjacent development.

- Segment C1 – This segment extends south from Segments B1 and B2 generally along the existing 57 Line for approximately three miles. This segment ranges from 1,200 to 2,600 feet wide to provide flexibility in minimizing impacts to homes, wetlands, Hermantown Cemetery, and the Midway River (Minnesota Department of Natural Resources designated trout stream).

- Segment C2 – This segment varies from about 500 to 1,100 feet wide that runs south from Segment B1 along property lines and Birch Road.

- Segment D – Segment D extends east then south from Segments C1 and C2 to the Hilltop Substation. This segment includes several different sections that are generally 500 feet wide. Two east/west sections follow existing 71 Line and 98 Line, while a third section follows property lines. Extending south to the Hilltop Substation are three sections where two sections follow property lines and one follows the existing 71 Line and 98 Line.

- Segment E – This segment ranges from 500 to over 1,300 feet wide between the existing 98 Line and the Arrowhead Substation. The segment optimizes tie-in points to the existing 98 Line and the Arrowhead Substation, complicated crossings of existing transmission lines, and crossing the Canadian National Railroad.

These route alternatives were presented to the public and government agencies in March 2021 through agency specific meetings and virtual public open houses. These opportunities for Minnesota Power to interact with various stakeholders provided the public and government agencies with updated information and facilitated the collection of comments to develop the Proposed Route. See **Chapter 8** a summary of public and government agency comments.

5.2.5 Local Government and Agency Outreach

Minnesota Power conducted outreach with multiple local units of government, state agencies, and federal agencies in developing the Route Alternatives and this Application. The local government, state agency, and federal agency outreach taken to date is discussed in more detail in Chapter 8.

5.2.6 Public Outreach

Public outreach during the Route Alternatives development process occurred in several different stages and through different methods. Public outreach undertaken by Minnesota Power in developing the information provided in this Application is discussed in more detail in Chapter 8.

5.3 Route Refinement and Analysis

5.3.1 Proposed Route Refinement

Based on feedback from stakeholders and the public on the various route segments and Route Alternatives, as well as further analysis of the routing factors and more detailed engineering review, Minnesota Power identified a single Proposed 115 kV Route generally following existing transmission lines with several exceptions at existing constraints, such as the areas surrounding the Midway River, Miller Trunk Highway crossing, and the Wild Rose Trail Subdivision. These three areas are discussed below. A single Proposed 230 kV Route was also developed that is generally located on Minnesota Power property and follows existing transmission lines.

The existing 57 Line follows the Midway River, a waterway designated by the Minnesota Department of Natural Resources (“MnDNR”) as a trout stream. In comments, the MnDNR recommended minimizing impacts to the trout stream and suggested routing the proposed 115 kV line away from the stream. Minnesota Power then reviewed several different routing options within the Route Alternative C1 that would move the proposed and existing lines away from the Midway River and minimize possible impacts to the trout stream. Minnesota Power determined that locating the Proposed 115 kV Route about 400 to 900 feet west of the Midway River, on new right-of-way would best minimize

impacts to the stream and allow for better operations and maintenance access. The existing 57 Line would also be located to this new right-of-way and the existing 57 Line structures would be removed from the current right-of-way near the Midway River.

The crossing of Miller Trunk Highway is complicated due to the long span of the Minnesota Department of Transportation ("MnDOT") right-of-way, frontage and auxiliary roads, Miller Creek (a MnDNR designated trout stream) and surrounding wetlands, existing underground utilities, and developed business parcels. A wider route width is proposed in this area that allows for engineering design to work with the constraints.

To maximize distance from residential properties, the new 115 kV line is proposed to be double-circuited with the existing 71 Line and the existing 71 Line through the Wild Rose Trail subdivision is proposed to be removed. The existing 98 Line would be rebuilt from the location where it shifts south into the Hilltop Substation.

5.3.2 Proposed Route Identification

5.3.2.1 Proposed 115 kV Route

The Proposed 115 kV Route between the Ridgeview, Haines Road, and Hilltop Substations follows existing transmission lines for most of its length, utilizing existing transmission corridors where practicable (approximately 88 percent) to minimize environmental impacts (**Map 2-1, Map 2-2,** and **Appendix J-1 and Appendix J-2**.

The Proposed 115 kV Route from north to south begins at the existing Ridgeview Substation and follows the existing 19 Line and 56 Line, within an east-west corridor, going west for about 1.2 miles from the Ridgeview Substation. Within this corridor, the proposed 115 kV transmission line will be located between the existing 19 and 56 Lines. This new line will become designated as 19 Line and the existing 19 Line in this corridor will be reconstructed and be redesignated as part of the new 52 Line. At the point where the existing 56 Line turns north and the existing 19 Line turns southwest, the Proposed 115 kV Route shifts to the south side of the existing 19 Line to continue south and west for approximately 2.7 miles to enter the Haines Road Substation on the west side of Miller Trunk Highway as the new 52 Line. Throughout this segment, the existing conductor and structures will be replaced as needed on the existing 19 Line and 52 Line.

From the Haines Road Substation, the Proposed 115 kV Route (which will be referred to as the new 176 Line at this point) continues west generally along the existing 58 Line corridor. This corridor contains the currently energized 58 Line and a parallel deenergized line, known as 58D, which is currently supporting fiber optic communications. Both existing 58 Line and 58D will be rebuilt new conductor and structures as necessary for approximately 3.5 miles to a point about 0.3 miles east of the intersection of the existing 58 and 57 Lines. The existing 58 Line and 58D will be redesignated as 57 Line and the new 176 Line. At this point, the Proposed 115 kV Route (including the new 176 Line and rebuilt 57 Line) turns south in a new alignment for about 1.5 miles crossing Maple Grove Road and Hermantown Road to the existing 57 Line corridor located south of the Midway River. The Proposed 115 kV Route continues south following the existing 57 Line corridor

for about 1.4 miles to the existing 71 Line. The conductor and structures will be replaced as needed on the existing 57 Line.

Next, from the intersection with the existing 71 Line, 71 Line and the new 115 kV line (the new 176 Line) will be reconstructed as a 115 kV/115 kV double circuit line, going south for about 0.1 miles then east for 1.5 miles on the existing 71 Line corridor. At a point about 0.25 miles east of Lavaque Road, the proposed 71 Line/176 Line 115 kV/115 kV double circuit line would turn south for about 0.1 mile, then east for about 0.75 miles, then south for approximately 0.75 miles, and west for about 0.25 miles to enter the Hilltop Substation. Several segments of the existing 98 Line (newly designated 108 Line) will be shifted and rebuilt at the end of this alignment to facilitate the changes. Once the Project is constructed, the line configurations and designations will change based upon the bulleted list included in Section 2.1.5.1.

5.3.2.2 Proposed 230 kV Route

The Proposed 230 kV Route begins at the Arrowhead Substation and goes north for about 0.1 miles, then northeast for approximately 0.1 miles, then north for about 0.1 miles, then east for about 0.1 miles, then north and east for about 0.3 miles to a connection with the existing 98 Line (**Map 2-3**) which would then be redesignated 108 Line. The Proposed 230 kV Route is located mostly on Minnesota Power property with the exception of the northernmost 0.15 miles that spans the Canadian National Railroad and private property. The Proposed 230 kV Route is parallel to existing 115 kV transmission lines. Approximately 0.5 miles of the existing 98 Line would be removed from the corner of the existing 90 Line and 98 Line to the new 108 Line tie-in, including the span over a GRE transmission line and Canadian National Railroad.

5.4 Rejected Route Alternatives

5.4.1 Alternatives Considered but Rejected

Under Minnesota Rules 7850.3100, Minnesota Power must identify all rejected route alternatives in the application with an explanation of the reasons for rejecting them. Minnesota Power considered and presented route alternatives to the public and stakeholders in March 2021. The Proposed Route was developed from this set of alternatives. The Route Alternatives that were not selected are discussed below.

5.4.1.1 Route Alternative Segment B1

Route Alternative Segment B1 deviated from the Proposed 115 kV Route where the existing 56 Line turns north, about 1.2 miles west of the Ridgeview Substation (**Map 5-1** in **Maps tab**). It followed the existing 56 Line north on the east side of the Duluth International Airport, then followed the existing 57 Line west then south on the north and west sides of the Duluth International Airport. The alternative was rejected because it was significantly longer, routing restrictions associated with the airport and the airport's proposed zoning ordinances, would impact more wetlands, and would impact biodiversity significance areas.

5.4.1.2 Route Alternative Segment C2

Route Alternative Segment C2 deviates from the Proposed 115 kV Route approximately 0.25 miles west of Lavaque Road (**Map 5-1** in **Maps tab**). Route Alternative Segment C2 proceeds south along property lines for approximately 1.3 mile then turns west for approximately 0.5 miles then south again for 1.2 miles to connect with Route Alternative Segment D. This alternative was rejected because it spans a MnDNR fisheries conservation easement, it crosses a landowner's plated and permitted development, its close proximity to residences, and would have diagonal spans of Maple Grove Road and Hermantown Road where perpendicular spans are preferred.

5.4.1.3 Route Alternative Segment D

Through engineering review and study, it was determined that Minnesota Power could double-circuit the new 115 kV line with the existing 71 Line (**Map 5-1** in **Maps tab**). The double-circuit opportunity would utilize the existing 71 Line right-of-way thereby minimizing impacts to landowners and natural resources. Minnesota Power decided to optimize this opportunity and reject the other Route Alternative D segments that would create new right-of-way requirements at the edge of rural residential properties due to not double circuiting, have additional tree clearing, and would impact more wetlands.

5.4.1.4 Route Alternatives 230 kV line

Given the short length of the Proposed 230 kV Route, no other specific route segment alternatives were identified and rejected by Minnesota Power (**Map 5-1** in **Maps tab**). The Proposed 230 kV Route is the most direct route between the Arrowhead Substation and the existing 98 Line and is located mostly on Minnesota Power property.

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

6.1 Right-of-Way Requirements and Acquisition

6.1.1 Transmission Line Right-of-Way Width and Acquisition

For new 115 kV transmission lines, Minnesota Power typically acquires a minimum right-of-way of up to 100 feet wide (50 feet on each side of the transmission line centerline). For new 230 kV transmission lines, Minnesota Power typically acquires a minimum right-of-way of up to 130 feet wide (65 feet on each side of the transmission line centerline). It is sometimes necessary to secure extra permanent right-of-way at angles to accommodate guy anchors if used. Narrower right-of-way widths at specific and isolated routing constraint points may or may not be possible and will need to be evaluated on a case-by-case basis. **Table 6-1** provides the right-of-way requirements for the Project.

Table 6-1. Right-of-Way Requirements

Transmission Voltage	Right-of-Way Width (feet)
115 kV	100
230 kV	130

As a result of largely following existing transmission lines, Minnesota Power has existing easements for the existing lines (**Maps 1-1**, **2-1**, and **2-3**). To accommodate the new construction and proposed rebuilds and reconfigurations, Minnesota Power intends to either secure new easements, as needed, or to amend existing easements.

In locations where new easements are needed, Minnesota Power will work with landowners to negotiate the terms of an easement that will be acceptable to both parties. Most right-of-way discussions will begin during the detailed design phase of the project, after a final route has been selected by the Commission; however, some discussions may begin earlier. The land evaluation and acquisition process will include a title search, contact with the landowner, survey, real estate document preparation, negotiation, and completion of an easement agreement.

As part of the easement acquisition process, Minnesota Power's right-of-way agents will discuss the construction schedule and construction requirements with the owner of each parcel. Special considerations may be discussed, such as temporary or permanent gates, fencing, and access accommodations. Minnesota Power's experience with easement negotiations is that, in nearly all cases, the utility company is able to work with landowners to address their concerns and an agreement is reached for the purchase of the easement.

In rare instances where a negotiated settlement agreement cannot be reached, the landowner may choose to have an independent third-party determine the value of the

easement. This valuation is made through the utility's exercise of the right of eminent domain per Minnesota Statutes Chapter 117. This process is known as condemnation. Before commencing a condemnation proceeding, a utility must obtain at least one appraisal and provide a copy to the property owner. The property owner may also obtain another property appraisal and the utility must reimburse the property owner for the cost of the appraisal according to the limits set forth in Minnesota Statutes section 117.036, subdivision 2(b). To start the formal condemnation process, a utility files a petition in the district court where the property is located and serves that petition on all owners of the property.

If the court grants the petition, the court then appoints a three-person condemnation commission that will determine the compensation for the easement. The three people must be knowledgeable of applicable real estate issues. The commissioners schedule a viewing of the property and then schedule a valuation hearing where the utility and landowners can testify as to the fair market value of the easement or fee. The Commission then makes an award as to the value of the property acquired and files it with the court. Each party has 40 days from the filing of the award to appeal to the district court for a jury trial. In the event of an appeal, the jury hears land value evidence and renders a verdict. At any point in this process, the case can be dismissed if the parties reach a settlement.

There may be instances where a landowner elects to require Minnesota Power to purchase their entire property rather than acquiring only an easement for the transmission facilities. The property owner is granted this right under Minnesota Statutes section 216E.12, subdivision 4, which is sometimes referred to as the "Buy-the-Farm Statute." The Buy-the-Farm Statute applies only to transmission facilities that are 200 kV or more; thus, the Buy-the-Farm Statute may apply to parcels crossed by the proposed 230 kV transmission line.

6.1.2 Substations

The existing Hilltop Substation will be expanded on property currently owned by Minnesota Power. The existing Ridgeview Substation will also be expanded on property currently owned by Minnesota Power. The modifications necessary at the existing Haines Road Substation are not anticipated to require a physical expansion of the fenced substation. All system accommodations necessary at the Arrowhead Substation are anticipated to be completed within the existing fenced boundary of the substation. No new substations will be constructed as part of the Project.

6.1.3 Communication Infrastructure Modifications

Modifications to communications infrastructure in the Project area will be completed as part of the Duluth Loop Project to improve overall communication capabilities of the transmission system. To accommodate reconfigurations, some sections of existing OPGW to an adjacent splice box will be replaced due to age and condition. Communications infrastructure modifications are anticipated to occur in the following areas and are shown on **Map 2-5**:

- Replace aging OPGW on existing 230 kV tap to Hilltop (98 Line Tap) and continue this communications path on new 108 Line into the Arrowhead Substation;
- Replace aging OPGW on existing 115 kV Hilltop – Hibbard Line No. 7 (7 Line) and route this communications path into the Hilltop Substation;
- Replace aging OPGW on existing 71 Line near the Hilltop Substation and route this communications path into the Hilltop Substation;
- Replace aging OPGW on existing 19, 52, 57, and 58 Lines; and
- Construct an underground fiber communications path in the existing transmission corridor between reconfigured 57 Line and 58 Line.

While these modifications to communication infrastructure do not independently require a Certificate of Need or Route Permit from the Commission, these are identified in this application to ensure transparency in the overall work being completed in the Project area.

6.2 Construction Procedures

6.2.1 Transmission Lines

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

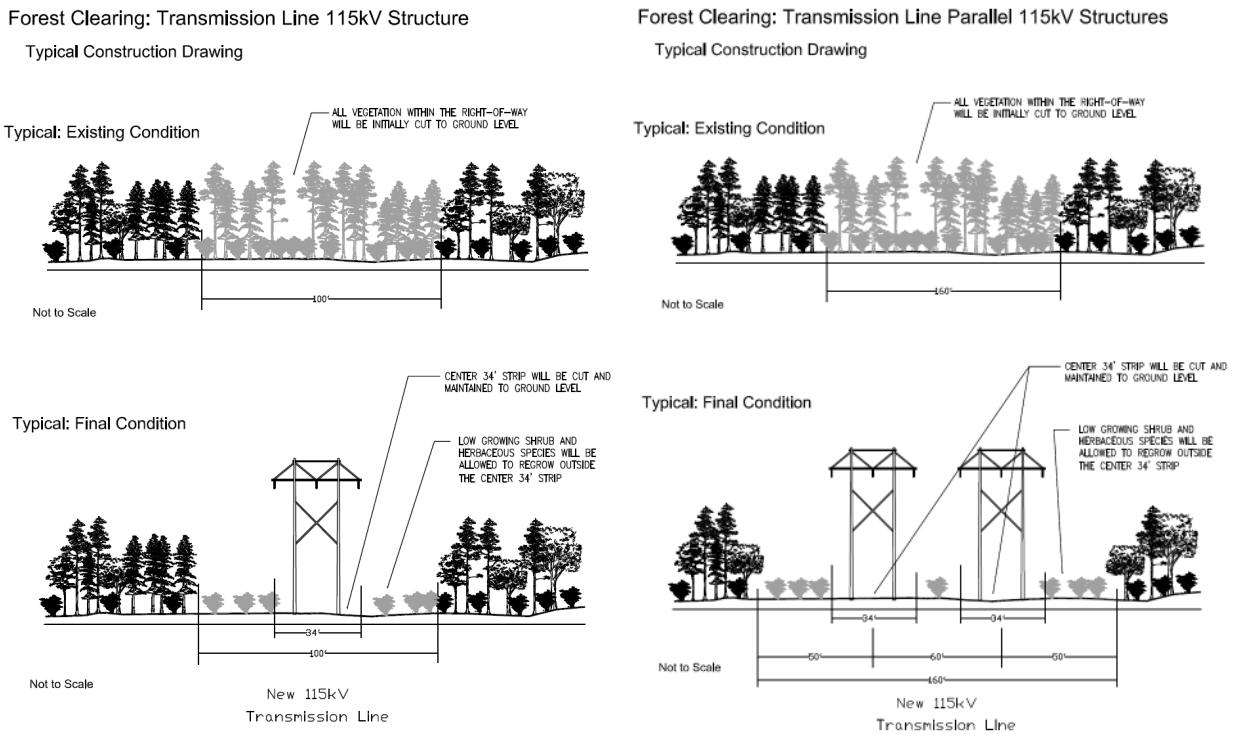
The first phase of construction activities will involve survey staking of the transmission line centerline and/or pole locations, then removal of trees and other vegetation from the full width of the right-of-way. As a general practice, low-growing brush will be allowed to reestablish at the outer limits of the easement area. Tree species that endanger safe and reliable operation of the transmission facility will be removed.

The NESC states that “vegetation that may damage ungrounded supply conductors should be pruned or removed.” Trees beyond the easement area that are in danger of falling into the energized transmission line (“danger trees”) will be removed or trimmed to eliminate the hazard as shown in **Figure 6-1**, as allowed by the terms in the given acquired easement. Danger trees generally are those that are dead, weak or leaning towards the energized conductors.

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

The final survey staking of pole locations may occur after the vegetation has been removed and just prior to the structure installation.

Figure 6-1. Standard Vegetation Management Practices[8]



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

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

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

Minnesota Power will employ standard construction practices that were developed from experiences with past projects in addition to industry-specific Best Management Practices ("BMPs"). BMPs address right-of-way clearance, erecting transmission line structures,

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

and stringing transmission lines. BMPs for the Project will be based on the specific construction design, prohibitions, maintenance guidelines, inspection procedures, and other activities involved in constructing the line. In some instances, these activities, such as schedules, are modified to incorporate a BMP for construction that will assist with minimizing impacts on sensitive environments. For example, in areas where construction occurs within a wetland, BMPs such as matting or winter construction may be used to minimize impacts.

Line construction will be staged in phases to effectively execute the work while maintaining service.

The existing transmission lines that will be removed as part of this Project are identified in **Map 1-1** and **Appendix J-3, pages 7, 8, 10, and 11 to 17**.

New wood pole structures will be installed directly into the ground (referred to as “direct embed”), by augering or excavating a hole typically 8 to 14 feet deep and 3 to 4 feet in diameter for each pole. Any excess soil from the excavation will be spread and leveled near the structure or removed from the site, if requested by the property owner or regulatory agency. The new wood poles will then be set and the augered holes back-filled with the excavated material, native soil, or crushed rock. In poor soil conditions, a galvanized steel culvert is sometimes installed vertically with the structure set inside, or in some case a wood framed ‘bog shoe’ is used to help support the poles

Steel pole structures are expected to be foundation supported with the drilled concrete pier foundations being the predominate foundation type. Concrete pier foundations are expected to vary from 4 feet to 6 feet in diameter.

After a number of structures have been erected, Minnesota Power will begin to install the wiring by establishing stringing setup areas. These stringing setup areas are usually located every two miles along a project route, or as needed, and occupy approximately 100-foot by 500-foot area. Conductor stringing operations require brief access to each structure to secure the conductor wire to the insulators and to install shield wire clamps once final sag is established. Temporary guard or clearance structures are installed, as needed, over existing distribution or communication lines, streets, roads, highways, railways or other obstructions after any necessary notifications are made or permits obtained. This ensures that conductors will not obstruct traffic or contact existing energized conductors or other cables. This also protects the conductors from damage.

Crossing of rivers, streams and wetlands will require particular attention during construction. Section 7.5 describes potential public water inventory and wetland crossings anticipated for the Project. In areas where construction occurs close to waterways, BMPs help prevent soil erosion and ensure that equipment fueling and lubricating occur at a distance from waterways.

6.2.2 Substations

Details regarding the modifications necessary at the Arrowhead, Haines Road, Ridgeview, and Hilltop substations are provided in Section 2.1.5.2.

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

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

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

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

6.2.3 Workforce Required

The workforce required for construction of the Project's facilities is estimated to be about 25 to 75 construction workers, depending on the construction sequencing and time of the year. This includes vegetation maintenance crews, transmission line and substation construction workers, safety supervisors, environmental support, and other on- and off-site support staff. Minnesota Power will work with local governments in the Project area to meet any specific local employment obligations.

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

6.3 Restoration Procedures

6.3.1 Transmission Lines

During construction, limited ground disturbances at the structure sites may occur. Staging areas for temporary storage of materials and equipment are established under agreements with the property owner or agency. Preferably, a previously-disturbed or developed area is used, and includes sufficient space to lay down material and pre-

assemble certain structural components or hardware and store construction equipment. Parts of the right-of-way or property immediately adjacent to the right-of-way may be used for structure laydown and framing prior to structure installation. Additionally, stringing setup areas are used to store conductors and equipment necessary for stringing operations. Disturbed areas will be restored to their original condition to the maximum extent practicable, or as negotiated with the landowner.

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

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

6.3.2 Substations

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

6.4 Operation and Maintenance

6.4.1 Transmission Lines

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

Access to the right-of-way of a completed transmission line is required periodically to conduct inspections, perform maintenance, and repair damage. Regular maintenance and inspections will be performed during the life of the transmission line to ensure its continued integrity. Generally, Minnesota Power will inspect the transmission lines annually. These inspections will be limited to the right-of-way and to areas where obstructions or terrain may require off-right-of-way access. If problems are identified

during inspection, repairs will be performed and damage restoration will occur or the landowner will be provided reasonable compensation for any damage to the property.

The right-of-way will be managed to remove vegetation that interferes with the operation and maintenance of the transmission line. Native shrubs that will not interfere with the safe operation and maintenance of the transmission line will be allowed to reestablish in the outer edge the right-of-way. Minnesota Power's practices provide for the inspection of 115 kV and 230 kV transmission lines annually. Right-of-way clearing practices include a combination of mechanical and hand clearing, with herbicide application where allowed, to remove or control vegetation growth. Noxious weed control with herbicides will be conducted as needed around structures and anchors.

6.4.2 Substations

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

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

6.4.3 Workforce Required

The workforce necessary to perform the transmission line and substation operation and maintenance will consist of two to four workers are required to perform inspections, maintain equipment, and repair any damaged facilities. Regular maintenance and inspections will be performed over the life of the facility to ensure a reliable system. Annual inspections will be performed on foot, by motorized vehicle, or by aerial means.

6.5 Electric and Magnetic Fields

Electric and magnetic fields (EMF) are invisible lines of force that are present anywhere electricity is produced or used, including around electric appliances and any wire that is conducting electricity. The term "EMF" is typically used to refer to electric and magnetic fields that are coupled together; however, for the lower frequencies associated with power lines, electric and magnetic fields are relatively decoupled and should be described separately. Electric fields are the result of electric charge, or voltage, on a conductor. The intensity of an electric field is related to the magnitude of the voltage on the conductor and is typically described in terms of kilovolts per meter (kV/m). Magnetic fields are the result of the flow of electricity, or current, traveling through a conductor. The intensity of a magnetic field is related to the magnitude of the current flow through the conductor and is typically described in units of magnetic flux density expressed as Gauss ("G") or

milliGauss ("mG"). Electric and magnetic fields are found anywhere there are energized, current-carrying conductors, such as near transmission lines, local distribution lines, substation transformers, household electrical wiring, and common household appliances.

6.5.1 Electric Fields

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

When an electric field reaches a nearby conductive object, such as a vehicle or a metal fence, it induces a voltage on the object. The magnitude of the induced voltage is dependent on many factors, including the object's capacitance, shape, size, orientation, location, resistance with respect to ground, and the weather conditions. If the object is insulated or semi-insulated from the ground and a person touches it, a small current would pass through the person's body to the ground. This might be accompanied by a spark discharge and mild shock, similar to what can occur when a person walks across a carpet and touches a grounded object, like a doorknob, or another person.

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

There is no federal standard for transmission line electric fields. The Commission, however, has historically imposed a maximum electric field limit of 8 kV/m measured at one meter above ground for new transmission projects.[9] As demonstrated below, the electric field associated with the Project will be well within the Commission's 8 kV/m limit.

The predicted intensity of electric fields associated with the various structure configurations of the Project are given in **Table 6-2** for the edge of right-of-way and at the location where the maximum electric field will be experienced. Where the Project parallels existing transmission lines, the presence of another energized line nearby will impact the electric field profile around the parallel lines. Therefore, the predicted intensity of electric fields associated with the various corridor scenarios where the Project's new

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

115 kV or 230 kV line parallels existing transmission lines are also given in **Table 6-2**. Because electric fields are particularly dependent on the voltage of the transmission line, the values in **Table 6-2** were calculated at the lines' maximum continuous operating voltage. Maximum continuous operating voltage is defined for the Project as the nominal voltage plus 10 percent, in this case either 126.5 kV (for nominally 115 kV lines) or 253 kV (for nominally 230 kV lines). Values were calculated assuming minimum conductor-to-ground clearance (that is, at mid-span) and a height of one meter above ground. The maximum calculated electric field among all possible configurations is 1.28 kV/m, which is well within the Commission's 8 kV/m limit. Plots of the lateral profile of electric field for each corridor configuration in **Table 6-2** are provided in **Appendix H**.

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

Corridor Configuration	Line Voltage	Edge of ROW	Maximum Overall		
		Intensity (kV/m)	Intensity (kV/m)	Distance from ROW Centerline (feet)	ROW Width (feet)
Project: 115 kV H-Frame Existing: 115 kV H-Frame Existing 115 kV H-Frame	126.5 kV 126.5 kV 126.5 kV	0.76	1.56	99.0	240.0
Project: 115 kV H-Frame Existing: 115 kV H-Frame	126.5 kV 126.5 kV	0.39	1.91	9.0	160.0
Project: 115 kV Monopole Existing: 115 kV Monopole	126.5 kV 126.5 kV	0.47	1.38	37.0	130.0
Project + Existing: 115 kV Double Circuit Monopole	126.5 kV 126.5 kV	0.08	1.07	10.0	100.0
Project + Existing: 115 kV Double Circuit Monopole Existing: 230 kV Monopole	126.5 kV 126.5 kV 253.0 kV	0.49	3.14	58.0	215.0
Project: 230 kV Monopole Existing: 115 kV H-Frame Existing: 115 kV H-Frame	253.0 kV 126.5 kV 126.5 kV	1.28	3.12	75.0	200.0
Project: 230 kV Monopole Existing: 115 kV H-Frame Existing: 115 kV H-Frame Existing: 115 kV Single Pole	253.0 kV 126.5 kV 126.5 kV 126.5 kV	1.28	3.12	125.0	300.0
Project: 230 kV Monopole Existing: 230 kV H-Frame Existing: 230 kV H-Frame	253.0 kV 253.0 kV 253.0 kV	0.88	4.54	26.0	260.0

6.5.2 Magnetic Fields

Current passing through any conductive material, including a wire, produces a magnetic field in the area around the material. The current flowing through the conductors of a transmission line produces a magnetic field that extends from the energized conductors to other nearby objects. The intensity of the magnetic field associated with a transmission line is proportional to the amount of current flowing through the line's conductors, and rapidly decreases with the distance from the conductors. Unlike electric fields, magnetic fields are not significantly impacted by the presence of trees, buildings, or other solid

structures nearby. Because the actual power flow on a transmission line could potentially vary widely throughout the day depending on electrical system conditions, the actual magnetic field level in the vicinity of the transmission line could also vary widely from hour to hour.

There are currently no Minnesota regulations pertaining to magnetic field exposure. The Commission has acknowledged that Florida, Massachusetts, and New York have established standards for magnetic field exposure.[10] To provide context for the calculated magnetic field levels associated with the Project, magnetic field levels associated with some common household electric appliances are provided in **Table 6-3**.

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

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

The predicted intensity of magnetic fields associated with the various structure configurations of the Project are given **Table 6-4** and **Table 6-5** for the edge of right-of-way and at the location where the maximum magnetic field will be experienced. Where the Project parallels existing transmission lines, the presence of another energized line nearby will impact the magnetic field profile around the parallel lines. Therefore, the predicted intensity of magnetic fields associated with the various corridor scenarios where the Project's new 115 kV or 230 kV line parallels existing transmission lines are also given in **Table 6-4** and **Table 6-5**. Because magnetic fields are particularly dependent on the current flowing on the transmission line, magnetic field information is provided for two conditions: the maximum continuous rating of the Project and adjacent facilities, shown in **Table 6-4**, and the projected peak loading of the Project and adjacent facilities when placed into service, shown in **Table 6-5**. Maximum continuous rating is defined for the Project and adjacent facilities as the maximum allowable current flow based on the most limiting series element of the transmission facility as determined by Minnesota Power's Facility Ratings Methodology. Projected peak loading for the Project and adjacent facilities was derived from power system modeling of the Project under system normal conditions in a 2023 winter peak power flow case. Values were calculated assuming minimum conductor-to-ground clearance (that is, at mid-span) and a height of one meter

[10] *In the Matter of the Route Permit Application for the North Rochester to Chester 116 kV Transmission Line Project*, Docket No. E-002/TL-11-800, Order at 20 (Sept. 12, 2012).

above ground. Plots of the lateral profile of electric field for each corridor configuration in **Table 6-4** and **Table 6-5** are provided in **Appendix H**.

Out of all the possible transmission line configurations, the maximum possible magnetic field is 378.70 mG with the maximum possible magnetic field at the edge of the right-of-way calculated at 99.93 mG. However, the actual loading of the transmission line will be far below the thermal limit of the line, resulting in a maximum magnetic field under expected normal system conditions of 16.44 mG at the edge of the right-of-way, which is well below the magnetic field levels associated with most of the household electric appliances shown in **Table 6-3**.

Table 6-4. Calculated Magnetic Fields (mG) for Proposed Project Corridors (Maximum Continuous Rating)

Corridor Configuration	Line Current (Amps)	Edge of ROW	Maximum Overall		
		Intensity (mG)	Intensity (mG)	Distance from ROW Centerline (feet)	ROW Width (feet)
Project: 115 kV H-Frame Existing: 115 kV H-Frame Existing 115 kV H-Frame	1443.0	99.93	293.70	33.0	240.0
Project: 115 kV H-Frame Existing: 115 kV H-Frame	1443.0	51.25	370.60	26.0	160.0
Project: 115 kV Monopole Existing: 115 kV Monopole	1443.0	56.07	227.31	19.0	130.0
Project + Existing: 115 kV Double Circuit Monopole	1443.0	24.67	181.40	0.0	100
Project + Existing: 115 kV Double Circuit Monopole Existing: 230 kV Monopole	1443.0	41.01	237.89	47.0	215.0
Project: 230 kV Monopole Existing: 115 kV H-Frame Existing: 115 kV H-Frame	1384.0	87.81	273.07	8.0	200.0
Project: 230 kV Monopole Existing: 115 kV H-Frame Existing: 115 kV H-Frame Existing: 115 kV Single Pole	1384.0	87.39	271.60	58.0	300.0
Project: 230 kV Monopole Existing: 230 kV H-Frame Existing: 230 kV H-Frame	1475.0	88.26	378.70	17.0	260.0

Table 6-5. Calculated Magnetic Fields (mG) for Proposed Project Corridors (Projected Peak Loading)

Corridor Configuration	Line Current (Amps)	Edge of ROW	Maximum Overall		
		Intensity (mG)	Intensity (mG)	Distance from ROW Centerline (feet)	ROW Width (feet)
Project: 115 kV H-Frame Existing: 115 kV H-Frame Existing 115 kV H-Frame	187.26	15.54	37.32	88.0	240.0
Project: 115 kV H-Frame Existing: 115 kV H-Frame	264.07	9.94	65.62	27.0	160.0
Project: 115 kV Monopole Existing: 115 kV Monopole	264.07	10.38	41.37	20.0	130.0
Project + Existing: 115 kV Double Circuit Monopole	198.81	5.65	23.72	5.0	100.0
Project + Existing: 115 kV Double Circuit Monopole Existing: 230 kV Monopole	259.81	7.73	44.91	47.0	215.0
Project: 230 kV Monopole Existing: 115 kV H-Frame Existing: 115 kV H-Frame	276.63	16.44	69.21	4.0	200.0
Project: 230 kV Monopole Existing: 115 kV H-Frame Existing: 115 kV H-Frame Existing: 115 kV Single Pole	276.63	16.42	69.08	54.0	300.0
Project: 230 kV Monopole Existing: 230 kV H-Frame Existing: 230 kV H-Frame	389.33	16.36	84.04	7.0	260.0

6.5.3 EMF and Health Effects

Significant research has been performed since the 1970s to determine whether exposure to power frequency magnetic fields causes biological responses and health effects. Reviews of this research by public health agencies such as the U.S. National Cancer Institute, the U.S. National Institute of Environmental Health Sciences, and the World Health Organization ("WHO") do not show that exposure to electric power EMF causes or contributes to adverse health effects. For instance, in 2016, the U.S. National Cancer Institute concluded that:

> Numerous epidemiologic studies and comprehensive reviews of the scientific literature have evaluated possible associations between exposure to non-ionizing EMFs and risk of cancer in children (12–14). (Magnetic fields are the component of non-ionizing EMFs that are usually studied in relation to their possible health effects.) Most of the research has focused on leukemia and brain tumors, the two most common cancers in children. Studies have examined associations of these cancers with living near power lines, with magnetic fields in the home, and with exposure of parents to high

> levels of magnetic fields in the workplace. No consistent evidence for an association between any source of non-ionizing EMF and cancer has been found.[11]

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

> Research on the health effects of EMF has been carried out since the 1970s. Epidemiological studies have mixed results – some have shown no statistically significant association between exposure to EMF and health effects, some have shown a weak association. More recently, laboratory studies have failed to show such an association, or to establish a biological mechanism for how magnetic fields may cause cancer. A number of scientific panels convened by national and international health agencies and the United States Congress have reviewed the research carried out to date. Most concluded that there is insufficient evidence to prove an association between EMF and health effects; however, many of them also concluded that there is insufficient evidence to prove that EMF exposure is safe.[12]

Based on findings like the Working Group and U.S. National Cancer Institute, the Minnesota Public Utilities Commission has consistently found that "there is insufficient evidence to demonstrate a causal relationship between EMF exposure and any adverse human health effects."[13]

The potential impacts of electric fields include interference with the operation of pacemakers and Implantable Cardioverter/Defibrillators ("ICDs"). Interference with

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[11] NAT'L CANCER INSTITUTE, *Electromagnetic Fields and Cancer* (updated Jan. 3, 2019), available at https://www.cancer.gov/about-cancer/causes-prevention/risk/radiation/electromagnetic-fields-fact-sheet.

[12] Minnesota Department of Health, 2002. *A White Paper on Electric and Magnetic Field (EMF) Policy and Mitigation Options*.

[13] *In the Matter of the Application for a HVTL Route Permit for the Tower Transmission Line Project*, Docket No. ET-2, E015/TL-06-1624, Findings of Fact, Conclusions of Law and Order Issuing a Route Permit to Minnesota Power and Great River Energy for the Tower Transmission Line Project and Associated Facilities (August 1, 2007); *see also In the Matter of the Route Permit Application by Great River Energy and Xcel Energy for a 345 kV Transmission Line from Brookings County, South Dakota to Hampton, Minnesota*, Docket No. ET-2/TL-08-1474, ALJ Findings of Fact, Conclusions and Recommendation at Finding 216 (April 22, 2010 and amended April 30, 2010) ("there is no demonstrated impact on human health and safety that is not adequately addressed by the existing State standards for exposure") (adopted by the Commission on July 15, 2010); *In the Matter of the Application of Xcel Energy for a Route Permit for the Lake Yankton to Marshall Transmission Line Project in Lyon County*, Docket No. E002/TL-07-1407, Findings of Fact, Conclusions of Law and Order Issuing a Route Permit to Xcel Energy for the Lake Yankton to Marshall Transmission Project at 7-8 (Aug. 29, 2008).

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

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

6.6 Stray Voltage

"Stray voltage" is a condition that can occur on the electric service entrances to structures from distribution lines – not transmission lines. More precisely, stray voltage is a voltage that exists between the neutral wire of the service entrance and grounded objects in buildings such as barns and milking parlors.

Transmission lines do not, by themselves, create stray voltage because they do not connect to businesses or residences. Transmission lines can, however, induce stray voltage on a distribution circuit that is parallel and immediately under the transmission line. Appropriate measures will be taken to prevent stray voltage problems when the proposed Project parallels or crosses distribution lines.

6.7 Corona-Induced Ozone and Nitrogen Oxide Emissions

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

to corona discharges is approximately one-fourth of the production of ozone due to corona discharges (Jeffers, 1999).

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

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

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

6.8 Radio and Television Interference

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

Gap discharge interference is the most commonly noticed form of power line interference with radio and television signals, and also typically the most easily fixed. Gap discharges are usually caused by hardware defects or abnormalities on a transmission or distribution line causing small gaps to develop between mechanically connected metal parts. As sparks discharge across a gap, they create the potential for electrical noise, which can cause interference with radio and television signals in addition to audible noise. The degree of interference depends on the quality and strength of the transmitted communication signal, the quality of the receiving antenna system, and the distance between the receiver and the power line. Gap discharges are usually a maintenance issue, since they tend to occur in areas where gaps have formed due to broken or ill-fitted hardware (clamps, insulators, brackets). Because gap discharges are a hardware issue, they can be repaired relatively quickly once the issue has been identified. Corona from transmission line conductors can also generate electromagnetic noise at the same frequencies that radio and television signals are transmitted. The air ionization caused by corona generates audible noise, radio noise, light, heat, and small amounts of ozone as noted in Section 6.7. The potential for radio and television signal interference due to corona discharge relates to the magnitude of the transmission line-induced radio frequency noise compared to the strength of the broadcast signals. Because radio

frequency noise, like electric and magnetic fields, becomes significantly weaker with distance from the transmission line conductors, very few practical interference problems related to corona-induced radio noise occur with transmission lines. In most cases, the strength of the radio or television broadcast signal within a broadcaster's primary coverage area is great enough to prevent interference.

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

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

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

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

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

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

distant signal, creating a shadow effect. In the rare situation where the Project may cause interference within a station's primary coverage area, the problem can usually be corrected with the addition of an outside antenna.

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

6.9 Audible Noise

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

7.1 Environmental Setting

The proposed Project is located in St. Louis County, Minnesota within the North Shore Highlands Subsection of the Laurentian Mixed Forest Province (Province) as defined by the Minnesota Department of Natural Resource Ecological Classification System (Department of Natural Resources 2000). The North Shore Highlands Subsection parallels the shoreline of Lake Superior and follows the Highland Moraine along the lake. Bedrock outcrops and shallow glacial till soil are common in this Province. Presettlement vegetation consisted of pine, spruce and birch forest. Presently, the Province main activities include recreation, forestry, and tourism.

The environmental setting of the proposed Project's Study Area consists of open space, deciduous forest, and hydrologic features such as lakes, streams, rivers and wetlands. The physiographic features (topography, soils, geology and vegetation) of this Study Area vary from flat to rolling hills with steep ravines along streams and rivers. The Study Area is defined in Chapter 5.2.1.1 as the area initially reviewed for route development based on the defined Project endpoints of Ridgeview Substation, Hilltop Substation, and Arrowhead Substation. Within this Study Area major physiographic features, jurisdictional boundaries, and environmental resources are described within this chapter.

Typical land use within the Study Area and along the Proposed Route consists of low density and rural residential, open and public lands, and commercial property. Hermantown, Proctor and Duluth are the closest cities to and within the proposed Project.

Existing right-of-way associated with transmission lines, distribution lines and roads are prevalent within the proposed Project (**Map 1-1**). The term "Proposed Route" includes both the 115 kV route and the 230 kV route as well as the required substation expansion and work areas. The term "Proposed 115 kV Route" is a single route for the proposed 115 kV transmission line from the Ridgeview Substation to the Hilltop Substation. The term "Proposed 230 kV Route" is a single route for the proposed 230 kV transmission line from the Arrowhead Substation to the tie-in point with the existing 98 Line.

7.2 Human Settlement

The proposed Project is located in southeast corner of St. Louis County, Minnesota within the Arrowhead Region of the State (**Map 1-1**). The Proposed Route crosses into the cities of Duluth and Hermantown, whereas the city of Proctor is beyond the Proposed Route but very close. Thermal upgrades to the 98 Line would be located within the city of Proctor and Midway Township. Duluth is a port city on the west shore of Lake Superior. Hermantown is a suburb of Duluth and currently hosts a significant amount of the region's commercial and residential growth. Proctor is the smaller city of the three and is intersected by United States Highway 2. The commercial properties are centered on Miller Trunk Highway and Highway 2, such as Miller Hill Mall.

7.2.1 Proximity to Residences

Residences and business are located along most of the roads within the proposed Project. Residences are typically low density and rural residential with a house and non-residential structure. Avoidance of residences was a priority when identifying viable proposed 230 kV and 115 kV routes. Based upon current GIS data and aerial photographs, the front deck of one residence appears to be located within the anticipated right-of-way for the proposed 115 kV transmission line. This structure appears to be currently within the right-of-way of the existing 71 Line (**Appendix J-3, page 18**). The anticipated right-of-way for the proposed 115 kV transmission line contains three non-residential structures (**Table 7-1** and **Appendix J-3, pages 14, 17, and 19**). Two of the three non-residential structures have encroached on the existing right-of-way of the 71 Line (**Appendix J-3, pages 17 and 19**). One of the three non-residential structures would be located within new right-of-way of the proposed 57 Line and 176 Line (**Appendix J-3, page 14**). A non-residential structure is a structure in which one cannot reside (ex. garage, barn, shed, out-building, etc.).

Based upon current GIS data and aerial photographs, an anticipated right-of-way for the proposed 115 kV transmission line may contain five businesses along Mall Drive, Market Street, and Lightning Drive (**Table 7-2** and **Appendix J-3, pages 6 and 7**). One of the five businesses, the bank building, located at the intersection of Mall Drive and Haines Road would be a new business building that may be within the expanded right-of-way for the proposed Project (**Appendix J-3, page 6**). Four of the five businesses have encroached on the existing right-of-ways of the 58 Line and 58D and 52 Line.

No residences or businesses are located within the anticipated right-of-way for the proposed 230 kV transmission line (**Table 7-1** and **Table 7-2** and **Appendix J-3, pages 22 and 23**).

Table 7-1. Proximity of Residences and Non-Residential Structures to the Proposed Project Right-of-Way

Feature	Proposed 230 kV Transmission Line Right-of-Way		Proposed 115 kV Transmission Line Right-of-Way	
	Residences	Non-Residential Structures	Residences	Non-Residential Structures
Number within Project ROW	0	0	1[1]	3
Number within 0 to 75 feet from Project ROW*	0	1	11[2,3]	2
Number within 76 to 150 feet from Project ROW*	0	0	18	8

Number within 151 to 300 feet from Project ROW*	1	4	23	28
Number within 301 to 500 feet from Project ROW*	2	3	55[4]	56
Total Number within 500 feet of Project ROW*	3	8	108	97

* Project Right-of-Way (ROW) is an approximate existing and proposed right-of-way. Final right-of-way will be determined in final design.

1. This number includes a residence that is currently within the ROW of the existing 71 Line. The proposed 115 kV line will use the existing ROW of the 71 Line and will not increase the current ROW.
2. Deerfield Townhouses are located at Stebner Road and Tamarack Lane is a higher density rental townhouse complex with buildings within about 25 feet of the existing 58 Line right-of-way. This townhouse complex is counted as one residence.
3. This number does not include the residences within the Wild Rose Trail Subdivision where the existing 71 Line is proposed to be removed.
4. Miller Creek Townhouse are located at Sundby Road and Miller Creek Drive is a higher density rental townhouse complex with a building about 380 feet from the existing 52 Line right-of-way. This townhouse complex is counted as one residence.

Table 7-2. Proximity of Businesses to the Proposed Project Right-of-Way

Feature	Proposed 230 kV Transmission Line Right-of-Way	Proposed 115 kV Transmission Line Right-of-Way
Number of Businesses within Project ROW	0	5
Number of Businesses 0 to 75 feet from Project ROW*	0	4
Number of Businesses 76 to 150 feet from Project ROW*	0	3
Number of Businesses 151 to 300 feet from Project ROW*	0	15
Number of Businesses 301 to 500 feet from Project ROW*	0	10
Total Number of Businesses within 500 feet of Project ROW*	0	37

* Project Right-of-Way (ROW) is an approximate existing and proposed right-of-way. Final right-of-way will be determined in final design.

7.2.1.1 Impacts and Mitigation

No residences or businesses are anticipated to be displaced by the proposed Project. The deck of the residence and two of the three non-residential structures have encroached on the existing 71 Line right-of-way (**Appendix J-3, pages 17, 18, and 19**). The proposed 115 kV transmission line (176 Line) would be double circuited with the existing 71 Line on new structures on the existing 71 Line right-of-way. The double-circuit segment will have a structure change to steel monopole from wood H-frame and therefore there may be an increase in the number of structures and structure heights. Minnesota Power proposes to use their existing right-of-way and will work with the landowners regarding structure encroachment during construction and operations and maintenance.

The Project proposes to reroute a portion of the existing 71 Line that currently crosses the Wild Rose Trail Subdivision (**Appendix J-3, page 20**). The reroute consolidates the transmission corridor (71 Line, proposed 176 Line and realigned 108 Line) and will result in a reduction of transmission line impacts to the yards of residences within the Wild Rose Trail Subdivision (**Appendix J-3, page 20**). Also, the Project proposes several other areas of realignment, such as along Market Street and Lightning Drive, to address existing right-of-way encroachments and to better accommodate recent developments. The proposed realignment along Market Street and Lightning Drive will move the existing 115 kV transmission line further south and north (respectively) to increase the separation of the proposed 115 kV transmission line from the businesses (**Appendix J-3, pages 6 and 7**). Minnesota Power will work with the bank building owner should the building be located within the expanded right-of-way. In addition, the proposed realignment along Lightning Drive would increase the separation from the Deerfield Townhouses located at Stebner Road and Tamarack Lane (**Appendix J-3, page 7**).

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

7.2.2 Public Health and Safety

Public safety will be a priority during construction and operation of the proposed Project. Safety concerns may include slow movement of construction equipment on public roads, construction equipment crossing public roads, wire pulling across public roads and near public areas, and clearing operations.

Proper safeguards would be implemented for construction and operation of the proposed 115 kV and 230 kV transmission lines. The proposed Project will be designed in compliance with state, NESC, and Minnesota Power standards regarding clearance to ground, clearance to crossing utilities, clearance to buildings, strength of materials, and right-of-way widths. Construction crews and/or contract crews will comply with state and NESC standards regarding installation of facilities and standard construction practices.

Minnesota Power's established safety procedures, as well as industry safety procedures, will be followed during and after installation of the transmission line, including clear signage during all construction activities.

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

Please refer to Section 6.5 for a discussion of electric and magnetic fields.

7.2.2.1 Impacts and Mitigation

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

Minnesota Power will ensure that safety requirements are met during construction and operation of the facilities. During active construction, measures will be made to ensure the safety of local residents which will include, but is not limited to, signage where active construction is occurring, flaggers at road and railroad crossings, and barriers around active construction zones. Additionally, when crossing roads or railroads during stringing operations, guard structures will be utilized to eliminate traffic delays and provide safeguards for the public. With implementation of these safeguards and protective measures, no additional mitigation is proposed.

7.2.3 Audible Noise

Noise is defined as unwanted sound. It may be comprised of a variety of sounds of different intensities across the entire frequency spectrum. Noise is measured in units of decibels (dB) on a logarithmic scale. Because human hearing is not equally sensitive to all frequencies of sound, the most noticeable frequencies of sound are given more "weight" in most measurement schemes. The A-weighted decibel ("dBA") scale corresponds to the sensitivity range for human hearing. A noise level change of 3 dBA is barely perceptible to human hearing. A 5-dBA change in noise level, however, is clearly noticeable. A 10-dBA change in noise level is perceived as a doubling (or halving) of noise loudness. For reference, **Table 7-3** shows noise levels associated with common, everyday sources, providing context for the transmission line and substation noise levels discussed later in this section.

Table 7-3. 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	Gas lawnmower at 1 meter
80	Food blender at 1 meter
70	Vacuum cleaner at 3 meters
60	Normal speech at 1 meter
50	Dishwasher in the next room
40	Library
30	Bedroom
20	Quiet rural nighttime

Source: MPCA (2015)

The Minnesota Pollution Control Agency ("MPCA") established daytime and nighttime noise standards by Noise Area Classifications are provided in **Table 7-4**. MPCA noise standards are expressed using the L50 and L10 statistical descriptors, which represent the range of permissible dBA within a one hour period. The L50 noise level represents the level exceeded 50 percent of the time, or for 30 minutes in an hour. The L10 noise level represents the level exceeded 10 percent of the time, or for 6 minutes in an hour. Noise Area Classifications (NAC) are categorized by the type of land use activities at a location and the sensitivity of those activities to noise. Residential-type activities including homes, churches, camping and picnicking areas, and hotels are included in NAC-1. Commercial-type land use activities such as transit terminals, retail and business services are included in NAC-2. Industrial-type land use activities are included in NAC-3. Most of the Project area would be categorized as NAC-1 or NAC-2. Practically, this means that during the one-hour period of monitoring, daytime noise levels in a residential-type (NAC-1) land use area of the Project cannot exceed 65 dBA for more than 10 percent of the time or 60 dBA more than 50 percent of the time.

Table 7-4. MPCA Noise Limits by Noise Area Classification (dBA)

Noise Area Classification	DAYTIME		NIGHTTIME	
	L_{10}	L_{50}	L_{10}	L_{50}
1 Residential-type Land Use Activities	65	60	55	50
2 Retail-type Land Use Activities	70	65	70	65
3 Manufacturing-type Land Use Activities	80	75	80	75

Source: MPCA (2015)

Audible noise will occur as part of the construction and operation phases of the Project. Noise-sensitive land uses within the vicinity of the proposed Project route primarily include residential homes and neighborhoods, cross-country ski and walking trails, trout streams, Hermantown Cemetery, churches, office buildings, restaurants, retail/shopping stores, and city parks.

7.2.3.1 Noise Related to Construction

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

7.2.3.2 Noise Related to Substations

Construction during the Project-related upgrades to the Ridgeview, Hilltop, Haines Road, and Arrowhead substations, including expansion of the Ridgeview and Hilltop substations and reconfiguring existing transmission lines at the Hilltop Substation is anticipated to occur primarily during daytime hours. During normal operations, noise from substations primarily comes from the transformers. Noise from a transformer is present whenever the transformer is energized and is nearly constant, with only a slight variation associated with the operating of cooling fans or pumps. Noise levels associated with power transformers are highly dependent upon the size and voltage level of the transformers. No additional transformers will be added at any of the Project substations. An aging 115/14 kV transformer at the Ridgeview Substation will be replaced which is expected to reduce transformer-related noise at the substation. The existing 230/115 kV transformer at the Hilltop Substation will be replaced with a higher-capacity transformer, which is expected to have a negligible impact on transformer-related noise at the substation. Therefore, the Project is not anticipated to result in any significant new audible noise impacts related to substations.

7.2.3.3 Noise Related to Transmission Lines

Transmission line conductors produce noise under certain conditions. The level of noise depends on conductor conditions, voltage level, and weather conditions. Operational noise levels produced by a 115 kV transmission line are generally less than outdoor background levels and are therefore not usually perceivable. Proper design and construction of the transmission line in accordance with industry standards will help to ensure that noise impacts are minimized. Noise associated with operation of the transmission line is discussed further below.

Noise emissions from transmission line conductors generally occur during heavy rain and wet conductor conditions. In foggy, damp or rainy weather, transmission lines can create a crackling sound due to corona discharges – the small amount of electricity ionizing the moist air near the conductors. During heavy rain the background noise level of the rain is usually greater than the noise from the transmission line. As a result, people do not normally hear noise from a transmission line during heavy rain. During light rain, dense fog, snow and other times where there is moisture in the air, transmission lines will

produce audible noise equal to approximately household background levels. During dry weather, audible noise from transmission lines is barely perceptible. Several other factors, including conductor voltage, shape and diameter, and surface irregularities such as scratches, nicks, dust, or water drops can affect a conductor's electrical surface gradient and therefore its corona and noise performance. As shown in the calculated values for the Project, the electric field strength of a 115 kV transmission line is not typically high enough to produce significant corona discharges and the associated audible noise.

7.2.3.4 Impacts and Mitigation

Construction noise will be temporary and primarily limited to daytime hours. Instances such as outages, operational limitations, customer schedules or other factors may cause construction to occur outside of daytime hours or on weekends. Heavy equipment will also be equipped with sound attenuation devices such as mufflers to minimize the daytime noise levels.

The predicted L50 audible noise levels associated with the various structure configurations of the Project are given in **Table 7-5** for the edge of right-of-way. Where the Project parallels existing transmission lines, the presence of another energized line nearby will impact the audible noise profile around the parallel lines. Therefore, the predicted audible noise associated with the various corridor scenarios where the Project's new 115 kV or 230 kV line parallels existing transmission lines are also given in **Table 7-5**. Because transmission line audible noise is primarily related to the electric field, and electric fields are particularly dependent on the voltage of the transmission line, the values in **Table 7-5** were calculated at the lines' maximum continuous operating voltage. Maximum continuous operating voltage is defined for the Project as the nominal voltage plus 10 percent, in this case either 126.5 kV (for nominally 115 kV lines) or 253 kV (for nominally 230 kV lines). Values were calculated assuming minimum conductor-to-ground clearance (that is, at mid-span) and a height of one meter above ground.

As indicated in **Table 7-4** above, 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. The calculated L50 values at the edge of right-of-way for the Project presented in **Table 7-5** below demonstrate that the audible noise associated with the Project will be within the most stringent MPCA limitations in all scenarios, and no mitigation is necessary. Plots of the lateral profile of L50 audible noise for each corridor configuration in **Table 7-5** are provided in **Appendix H**.

Table 7-5. Calculated L50 Audible Noise (dBA) for Proposed Project

Corridor Configuration	Line Voltage	Edge of ROW L50 Noise (dBA)
Project: 115 kV H-Frame Existing: 115 kV H-Frame Existing 115 kV H-Frame	126.5 kV 126.5 kV 126.5 kV	24.09
Project: 115 kV H-Frame	126.5 kV	22.66

Existing: 115 kV H-Frame	126.5 kV	
Project: 115 kV Monopole Existing: 115 kV Monopole	126.5 kV 126.5 kV	22.86
Project + Existing: 115 kV Double Circuit Monopole	126.5 kV 126.5 kV	20.37
Project + Existing: 115 kV Double Circuit Monopole Existing: 230 kV Monopole	126.5 kV 126.5 kV 253.0 kV	47.15
Project: 230 kV Monopole Existing: 115 kV H-Frame Existing: 115 kV H-Frame	253.0 kV 126.5 kV 126.5 kV	49.16
Project: 230 kV Monopole Existing: 115 kV H-Frame Existing: 115 kV H-Frame Existing: 115 kV Single Pole	253.0 kV 126.5 kV 126.5 kV 126.5 kV	49.16
Project: 230 kV Monopole Existing: 230 kV H-Frame Existing: 230 kV H-Frame	253.0 kV 253.0 kV 253.0 kV	49.37

7.2.4 Aesthetics

Most of the Proposed Route is located parallel to existing transmission lines. The current land use along the Proposed Route consists of low density and rural residential, open and public lands, and commercial areas. Right-of-way tree clearing and construction activities will be visible throughout the Proposed Route. The new transmission lines and substation expansions will be new features visible in the general area of the proposed Project.

Both 115 kV and 230 kV structure types will be wood or steel pole H-frame structures or steel monopole structures. The Proposed Route will have different visual impacts from 115 kV transmission lines to 230 kV transmission lines due to structure height difference (Minnesota Power 2021).

The proposed 115 kV structure height ranges from 50-110 feet. The new right-of-way and associated clearing will be visible where the approximately 1.5-mile-long segment of the new 115 kV transmission line proceeds south across Maple Grove Road and Hermantown Road through a densely wooded area, west of the Midway River. Otherwise, approximately 88 percent of the 115 kV transmission line is proposed to be parallel or rebuilt with existing transmission lines. This segment is shown on **Appendix J-3, pages 10 and 13 to 15**.

The proposed 230 kV structure height ranges from 65-110 feet. Due to the increased height of these structures, these structures may be easier to see from the surrounding roadways, specifically where the approximately one-mile extension of an existing 230 kV transmission connects to the Arrowhead Substation. The proposed 230 kV transmission

line is parallel to existing transmission lines with existing rights-of-ways. This segment is shown on **Appendix J-3, page 22**.

The Ridgeview and Hilltop substation expansions will occur at existing substations and on property owned by Minnesota Power. The sight lines to both substation expansions would be obscured by existing stands of trees. Also, there is already considerable utility infrastructure in the area (existing transmission and distribution lines are prevalent throughout the Project). The Hilltop Substation expansion is shown on **Appendix J-1** and Ridgeview Substation expansion is shown on **Appendix J-2**.

7.2.4.1 Impacts and Mitigation

Right-of-way clearing will be the most obvious visual impact in areas close to roads, residential areas, businesses, trails, and city-owned property such as cemeteries or parks. The Proposed 115 kV Route crosses the Hermantown Central Park (Fichtner Field) on the existing right-of-way for the 58 Line and 58D. Currently, there are two transmission lines (58 Line and 58D) that cross the park and these two crossings will remain with the Proposed 115 kV Route and there will be no significant change in the visual characteristics (**Appendix J-3, page 10**). Many of the snowmobile trails are located along or within the existing transmission line rights-of-way, the trail users may notice a wider right-of-way, but should not anticipate a different aesthetic quality while using the trail.

The right-of-way will be maintained for the existing 115 kV transmission lines, but additional tree clearing outside of the right-of-way may be necessary during construction for pull and tension sites. Minnesota Power identified the Proposed Route that follows significant, existing right-of-way. The transmission lines that already exist in the vicinity of the Proposed Route will limit the extent to which the new infrastructure is viewed as a disruption to the area's scenic integrity. Since the majority of the Proposed Route runs parallel with existing transmission lines or are rebuild segments, the visual impacts are minimized.

The Project proposes to reroute a portion of the existing 71 Line that currently crosses the Wild Rose Trail Subdivision. The reroute consolidates the transmission corridor (71 Line, proposed 176 Line and realigned 108 Line) and will result in a reduction of transmission line visual impacts to the front yards of residences within the Wild Rose Trail Subdivision (**Appendix J-3, page 21**). The reconstruction of the existing and proposed 115 kV transmission lines along Market Street will improve the visual characteristics of this segment by moving the lines closer to Market Street and having greater separation from the business and using steel monopole structures that will use less space in the parking lots than the current H-Frame structures.

7.2.5 Socioeconomic

The Project is located in St. Louis County in northeast Minnesota.

The socioeconomic setting of the Proposed Route was evaluated on a regional level comparing data from the cities of Duluth, Hermantown, and Proctor, St. Louis County, and the state of Minnesota. Data gathered from the 2010 and 2020 U.S. Census are summarized in **Table 7-6**.

Table 7-6. Socioeconomic Characteristics within the Project Area

Location	Population 2010	Population 2020	Change (%)	Median Household Income	Population below poverty level (%)
State of Minnesota	5,303,925	5,639,632	0.93 %	$74,593	9.0%
St. Louis County	200,226	199,070	-0.99%	$60,434	12.8%
City of Duluth	86,230	85,915	-0.99%	$52,463	18.2%
City of Hermantown	9,414	9,604	0.98%	$73,865	4.0%
City of Proctor	3,057	3,040	-0.99%	$57,794	5.1%

7.2.5.1 Impacts and Mitigation

Impacts to socioeconomics at a local and regional level would be minor due to the short-term timeframe of construction of the proposed Project. During construction, revenue increase may occur in local businesses from purchases made by utility personnel and contractors.

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

Since socioeconomic impacts are anticipated to be short-term and beneficial to the local communities, no mitigation is proposed.

7.2.6 Cultural Values

Cultural values are based off principles that form the foundation for community unity. Historic demographics of St. Louis County include Bois Forte Band of Chippewa and Fond du Lac Band of Lake Superior Chippewa and German, Norwegian, Swedish and Irish heritage.

St. Louis County is known for its abundant access to natural resources and recreational areas such as Lake Superior, the Boundary Waters Canoe Area, Voyagers National Park, and the Superior National Forest. Parts of the federally recognized Bois Forte Band of Chippewa and Fond du Lac Band of Lake Superior Chippewa reservations are located within St. Louis County. Consultation with Jill Hoppe, Tribal Historic Preservation Officer ("THPO") with the Fond du Lac Band of the Lake Superior Chippewa, informed the Applicant of two comments regarding cultural resources near to the Route Alternatives (**Appendix M, April 9, 2021 meeting**). One area is Mogie Lake, a wild rice lake, that is about 400 feet north of the Proposed Route (**Appendix R-1 and Appendix J-3, pages**

18-19). The second area is a historic trail called the *Rice Lake Trail* that led from Lake Superior, through Chief Buffalo's Tract, and northward to Wild Rice Lake (**Appendix R-1 and Appendix J-3, page 2**). The Proposed Route crosses this historic trail near the existing Line 19 and Line 56 intersect (**Appendix R-1 and Appendix J-3, page 2**). The City of Duluth is the largest city within the county and the Port of Duluth is the farthest inland port accessible by oceangoing ships in the world (Duluth Seaway Port Authority 2021). Popular attractions and events in St. Louis County include Skyline Parkway, Grandmas Marathon, Duluth's Aerial Lift Bridge and Canal Park, the Duluth Air Show, the John Beargrease Sled Dog Marathon, the Bayfront Blues Festival, and the International Wolf Center. The major industries of St. Louis County include mining, wood and paper products, shipping, aviation, higher education, health care, and tourism.

The present day cultural values are centered around the celebration of national and local holidays and the appreciation of the natural features of the region instead of values based on heritage.

7.2.6.1 Impacts and Mitigation

Construction of the Proposed Route is not anticipated to impact local cultural values; therefore, no mitigation is needed. Fond du Lac Band of the Lake Superior Chippewa THPO stated that the *Rice Lake Trail* is most likely not present, however if construction identifies a historic trail in this area then the Applicant is to notify the THPO (**Appendix M, April 9, 2021 meeting**).

7.2.7 Recreation

There are several public trails, parks, such as Brewer Park, rivers and lakes, and the Skyline Parkway within a few miles of the Project. As shown in **Map 7-1** in **Maps tab**, Hermantown Central Park (Fichtner Field) lies within the Proposed Route as well as snowmobile trails, walking and biking trails, Snowflake Nordic Ski Center, Chester Creek, Miller Creek, Rocky Run Creek, Midway River, and Kingsbury Creek. Common recreational activities within St. Louis County include hunting, biking, hiking, snowmobiling, cross-county skiing, fishing, and camping.

Snowflake Nordic Ski Center is located on Tischer Creek Duluth Building Co. Land. The trails are open to cross-country skiing and hiking. Camping is also available.

Chester Creek Aquatic Management Area (AMA) (MnDNRa 2018) is made up of four subunits that were acquired in 2010. Subunit 1 and 2 are located approximately 0.3 miles from the northwest boundary of the Proposed Route. Subunit 1 is a 1.54-acre area directly adjacent to the south side of Norton Road. Subunit 2 is a 2.83-acre area located approximately 415 feet south of Norton Road. Angling is the only allowable use in Chester Creek AMA and Chester Creek is a MnDNR designated Trout Stream (MnDNRb 2021).

Miller Creek AMA is made up of 7 subunits, but only subunit 1 is located near the Proposed Route. Subunit 1 is a 10.75-acre area located approximately 0.4 miles west of the Swan Lake Road Substation. Miller Creek AMA was acquired in 1966 and the only

allowable use is angling (**Map 7-1** in **Maps tab**). Miller Creek is a MnDNR designated Trout Stream.

Midway River AMA is made up of six subunits, but only subunit 1 is near the Proposed Route. Subunit 1 is a 9.96-acre area located approximately 0.25 miles from west boundary of the Proposed Route and 0.40 miles south of Hermantown Road. Midway River AMA was acquired in 1966 and the only allowable use is angling (**Map 7-1** in **Maps tab**). Midway River is a MnDNR designated Trout Stream.

7.2.7.1 Impacts and Mitigation

Construction activities such as tree clearing, lighting and noise from heavy construction equipment may temporarily disturb nearby wildlife and habitat. Permanent disturbance is anticipated to be minimal and concentrated to areas of new construction where tree clearing will be most prominent. Overall, disturbance should not affect local hunting and wildlife observation.

Construction of the Proposed Route should not disrupt nearby recreational activities. Through the Hermantown Central Park (Fichtner Field) and Snowflake Nordic Ski Center the new transmission line will be parallel to the existing transmission line, thereby reducing the overall right-of-way width needed for two separate lines and minimizing the visual impacts from park users (**Map 7-1** in **Maps tab**). Park and Ski Center users will have temporary restricted access during construction. Minnesota Power and their construction contractor will use signs informing the public of construction in the area and the restricted access during construction. Aside from agency coordination discussed below, no mitigation is proposed.

The Applicant will coordinate with the MnDNR, USFWS, Hermantown Parks and Recreation Department, and Duluth Parks and Recreation Department to ensure construction of the Proposed Route will not cause any significant impacts to nearby natural resources and trout streams.

7.2.8 Public Services and Transportation

The Proposed Route is located in an area where usual public services are available such as waste and recycling services, electricity, city sewer and water systems, fire protection, police, and natural gas. A discussion of existing public services and impacts and mitigation is discussed below.

7.2.8.1 Utilities

Existing distribution line rights-of-ways are located within the Proposed Route as well as a natural gas pipeline owned by Northern Natural Gas Company that crosses the Proposed Route approximately 0.25 miles west of Ugstad Road and about 0.25 miles north of Morris Thomas Road (**Map 1-1** and **Appendix J-3, page 15** in **Appendix J**).

7.2.8.1.1 Impacts and Mitigation

The design and operating process of transmission lines require specific standards and mitigation outlined in NERC, Federal Energy Regulatory Commission (FERC) and NESC which aid in the compatibility of new construction with existing utilities. Existing transmission lines and substations will be temporarily taken out of service during construction of the transmission rebuilds and substation tie-ins. This construction work will be coordinated to avoid electric service outages. All existing utilities will be identified and marked prior to construction with help from the Gopher State One Call utility locate service.

7.2.8.2 Transportation

Existing interstate, state, county and city owned rights-of-ways are located within the Proposed Route. Roadways include but are not limited to County Highway 48, County Road 284, County Highway 56, County Highway 6, County Road 898, United States Highway 53, Trunk Highway 194, County Highway 91, County Highway 32, County Highway 4, Rice Lake Road, West Arrowhead Road, Maple Grove Road, Lavaque Road, Morris Thomas Road, Ugstad Road, and Stebner Road (**Map 1-1**).

7.2.8.2.1 Impacts and Mitigation

Minnesota Power will coordinate with MN Department of Transportation to confirm that construction of the Proposed Route will not interfere with routine roadway maintenance. Based on the location of other existing utilities and site improvements that are identified during survey activities, the transmission line will be designed to meet or exceed required clearances. Temporary localized traffic delays may occur when heavy equipment enters and exits roadway rights-of-ways along the transmission corridor and for stringing operations at roadway crossings.

7.2.8.3 Airport

Duluth International Airport is located approximately 1-mile northwest of Swan Lake Road Substation (**Map 1-1**). The Route Alternative around the airport was eliminated from consideration.

7.2.8.3.1 Impacts and Mitigation

Minnesota Power will coordinate with the Duluth International Airport and the Joint Airport Zoning Board on the status of their zoning ordinance revisions. The Proposed Project is anticipated to be parallel to existing transmission lines and not closer to the airport than the existing transmission lines, however some transmission line structures might be taller than the existing transmission line structures. Minnesota Power will coordinate with the Duluth International Airport to avoid affects to the airport and therefore affects are not anticipated.

7.3 Land-Based Economics

7.3.1 Agriculture

The United States Department of Agriculture (USDA) 2017 Census of Agriculture for St. Louis County states 779 farms in the county with an average size of 178 acres per farm. Approximately 138,753 acres of farmland exist in the county. Over $16 million was generated from crop and livestock sales in 2017 (USDA 2017).

The Proposed Route crosses minimal land currently used for agricultural purposes (**Map 7-2** in **Maps tab**). No impacts to agricultural land are anticipated, therefore no mitigation is proposed.

7.3.2 Forestry

Although one of the major industries in St. Louis County is paper products and timber, there are no commercial forestry activities within the Proposed Route. Much of St. Louis County is made up of densely forested land. Forested areas within the Proposed Route are shown in **Map 7-2** in **Maps tab**. Approximately 750 acres of forested land is within the Proposed Route (**Table 7-14**). Forested land within the Proposed Route has traditionally been used for timber in sawmills and for personal use as a heating source.

Because there are no known commercial forestry operations in the vicinity of the proposed Route, there are no anticipated impacts to commercial forestry operations and therefore no mitigation is proposed.

7.3.3 Tourism

Within the Proposed 115 kV Route, the Hermantown Missing Link and MnDNR designated snowmobile trails (**Appendix J-3, pages 11-14 and 17-21**), Rocky Run Trail (**Appendix J-3, page 9**), Hermantown Central Park (Fichtner Field) (**Appendix J-3, page 10**), and Snowflake Nordic Ski Center (**Appendix J-3, page 2**) are the main recreation and tourist attractions (**Map 7-1** in **Maps tab**). No tourism attractions are located within the Proposed 230 kV Route and no impacts are anticipated.

7.3.3.1 Impacts and Mitigation

The Proposed 115 kV Route is in proximity or crosses over the areas listed above, but the proposed Project will not permanently interfere with the use of the recreational areas, therefore no mitigation is proposed. Signage and temporary closures may be necessary during construction. Users of the recreational areas will hear temporary construction noise if they are using the recreation areas while construction is occurring.

7.3.4 Mining

There are no known active gravel pits or other mining activity in the vicinity of the Project. As no impacts on mining are anticipated, no mitigation is proposed.

7.4 Archaeological and Historic Resources

A Phase Ia Cultural Resources Literature Search was completed for the proposed Project to learn about known cultural and architectural resources within a 1-mile buffer of the Proposed Route (**Appendix R**). Information was sourced at the Minnesota State Historic Preservation Office ("SHPO") located in St. Paul, Minnesota, as well as the National Register of Historic Places ("NRHP") online map, various public and private databases, and online sources, to perform an assessment of cultural resources within a 1-mile buffer of the Proposed Route. In addition to formal site records, General Land Office maps, Trygg maps, and historic aerial maps where available, were accessed in February 2021 to identify potential historic-period cultural features within a 1-mile buffer of the Proposed Route. In April 2021, the Fond du Lac Band of Lake Superior Chippewa THPO also provided comments regarding cultural resources within and adjacent to the Proposed Route (**Chapter 7.4.2**). **Table 7-7** provides a summary of cultural resources within a 1-mile buffer of the Proposed Route.

Table 7-7. Summary of Previously Recorded Archaeological and Historic Architectural Resources

Cultural Resources Types	Total Within 1 mile of Proposed Route	Number that Overlap or in Vicinity of Proposed Route	Total NRHP-Eligible or Listed
Archaeological Sites	6	1 (vicinity)	0
Historic Cemeteries	1	2 (overlaps)	0
Ethnographic Study Place Names	1	0	0
Fond du Lac THPO-Identified Resources	2	2 (1 vicinity, 1 overlaps),	0
Historic Architectural Resources	70	1 (overlaps)	1 (does not overlap)

7.4.1 Previously Recorded Archaeological Sites

The Phase Ia Literature Search identified six previously recorded archaeological sites and two historic cemeteries (unrecorded) within a 1-mile buffer of the Proposed Route (**Appendix R-1**). Only one of the archaeological sites, the Getchell Homestead, is in the vicinity (approximately 160 feet east) of the Proposed Route (**Appendix R-1**). Additionally, the recorded historic boundaries of the Sunrise Memorial Cemetery and Hermantown Cemetery overlap the Proposed Route. None of the archaeological sites or cemeteries have been formally evaluated for the NRHP.

7.4.2 Fond du Lac THPO-Identified Resources

Consultation with Jill Hoppe, THPO with the Fond du Lac Band of the Lake Superior Chippewa, informed the Applicant of two comments regarding cultural resources near to the Route Alternatives (**Appendix M, April 9, 2021 meeting**). One area is Mogie Lake, considered a wild rice lake by the THPO, that is about 400 feet north the Proposed Route

(**Appendix R-1 and Appendix J-3, pages 18-19**). The second area is a historic trail called the *Rice Lake Trail* that led from Lake Superior, through Chief Buffalo's Tract, and northward to Wild Rice Lake (**Appendix R-1 and Appendix J-3, page 2**). The Proposed Route crosses this historic trail near the existing Line 19 and Line 56 intersect (**Appendix R-1 and Appendix J-3, page 2**).

7.4.3 Historic Architectural Resources

The Phase Ia Literature Search identified 35 historic architectural resources (SHPO-inventoried properties), 32 Works Progress Administration ("WPA") era homes that have not been formally inventoried, and three linear resources (Trunk Highway 53; Trunk Highway 61 - West Duluth bypassed segment; and Skyline Parkway District's *Western Extension Segment*) within a 1-mile buffer of the Proposed Route (**Appendix R-1**). Only the Trunk Highway 53 intersects the Proposed Route (**Appendix R-1**). The Skyline Parkway District's *Western Extension Segment* is listed in the NRHP and four of the historic architectural resources associated with the district have been determined non-contributing resources. Additionally, one other historic architectural resource has been determined not eligible for the NRHP. None of the other 30 historic architectural or two linear resources have been formally evaluated for the NRHP.

7.4.4 Impacts and Mitigation

The Proposed Route was developed to avoid or minimize potential affects to previously recorded archaeological and historic architectural resources. The Proposed Route crosses the historic boundaries of the Sunrise Memorial Cemetery and the Hermantown Cemetery (**Appendix R-1**). The Proposed Route crosses the current boundary of the Hermantown Cemetery (**Appendix R-1 and Appendix J-3, page 16**). However, the current boundary of the Sunrise Memorial Cemetery is located beyond the Proposed Route. The proposed 115 kV transmission line will avoid the Hermantown Cemetery and is parallel to an existing transmission line that is located east of the Hermantown Cemetery. The Proposed Route will span Trunk Highway 53 (Miller Trunk Highway) that is listed as a historic linear feature, parallel to an existing transmission line (**Appendix R-1**). The archaeological site, Getchell Homestead, is located beyond the Proposed Route (**Appendix R-1**).

Fond du Lac Band of the Lake Superior Chippewa THPO stated that the Rice Lake Trail is most likely not present, however if construction identifies a historic trail in this area then the Applicant is to notify the THPO (**Appendix M, April 9, 2021 meeting**). No affects to Mogie Lake is anticipated as the new line is proposed to be double-circuited with the existing 71 Line and construction is planned to remain on the existing 71 Line right-of-way.

Minnesota Power will consult with SHPO to develop a field review strategy of the Proposed Route to survey for potential archaeological and historic properties that the Project could adversely affect, either directly or indirectly, within the Area of Potential Effects (APE), unless they can be shown to have been adequately reviewed under previous surveys. Any historic property identified within the APE should be evaluated by

looking at it within historic contexts as defined, described and developed by the SHPO. Appropriate prehistoric contexts should be used for any precontact archaeological site. For historic-era properties, some contexts might include, among others: Minnesota's Iron Ore Industry, 1880s-1945; Northern Minnesota Lumbering, 1870-1930s; Railroads and Agricultural Development, 1870-1945; Shipping, 1870-1940; The Fur Trade Around Western Lake Superior, 1650-1840; Early Settlement, pre-1870; Industry and Commerce, 1870-1940; Community Institutions, 1870-1940; Neighborhoods, 1870-1940; and Minnesota Farms 1820-1960. Other contexts could be developed as needed, particularly when addressing the WPA-era homes along West Arrowhead Road, or linear properties. When dealing with historic cemeteries, National Register Bulletin Number 41, "Guidelines for Evaluating and Registering Cemeteries and Burial Places" (Potter and Boland 1992), should be consulted. Additional investigations to identify archaeological sites, and to verify NRHP-eligible architectural properties is recommended. Consultation with SHPO and other state and federal agencies, tribes and historic organizations is recommended to define an appropriate APE for the project.

7.5 Natural Environment

7.5.1 Air Quality

Emissions from fossil fuel combustion in the heavy equipment during construction of the Proposed Project, as well as fugitive dust emissions from the vehicles traveling on- and off-road, will contribute a negligible amount of air emissions. The only potential air emissions from a transmission line or conductors within the substation result from corona, which may produce ozone and oxides of nitrogen. Please refer to Section 6.7 for a discussion of ozone and nitrogen oxide emissions.

7.5.1.1 Impacts and Mitigation

Temporary and localized air quality impacts caused by construction vehicle emissions and fugitive dust from right-of-way clearing and construction activities are expected to occur. Exhaust emissions from diesel equipment will vary during construction but will be minimal and temporary. The magnitude of emissions is influenced heavily by weather conditions and the specific construction activity taking place. Appropriate dust control measures, including the use of wetting unpaved roads and right-of-way access points will be implemented to mitigate impacts.

No impacts to air quality are anticipated due to the operation of the substation or transmission line.

7.5.2 Water Resources

Hydrologic features located within the Proposed Route, include wetlands, lakes, rivers and floodplains perform several important functions within a landscape, including flood attenuation, groundwater recharge, water quality protection and wildlife habitat production (**Map 7-3** in **Maps tab**). The proposed Project lies within the St. Louis River watershed, in the southern portion of the Great Lakes Basin.

7.5.2.1 Ground Water

MnDNR divides Minnesota into six groundwater provinces. The Proposed Project is located within both the Arrowhead/Shallow Bedrock Province and the Central Province. The Arrowhead/Shallow Bedrock Province is described as exposed or shallow Precambrian bedrock with limited groundwater. The Central Province is described as sand aquifers in generally thick sandy and clayey glacial drift overlying Precambrian and Cretaceous bedrock (MnDNR 2000). A review of the Minnesota County Well Index identified seven private wells occur within the Proposed Route (**Map 7-3** in **Maps tab**). No municipal water supply wells are located within the Proposed Route. No Minnesota Department of Health wellhead protection areas occur within the Proposed Route. No Environmental Protection Agency sole source aquifers occur within the Proposed Route.

7.5.2.1.1 Impacts and Mitigation

The Applicant does not anticipate impacts to groundwater in the Project area. Structure foundations will generally range from 25 feet to 60 feet in depth. All foundation materials would be non-hazardous materials. Any effects on water tables would be localized and short term and would not affect hydrologic resources. The Applicant will conduct geotechnical investigations to help identify shallow depth to groundwater resource areas, which may require special foundation designs. The Applicant will continue to work with landowners to identify springs and wells near the proposed Project.

7.5.2.2 Floodplains

A floodplain is flat, or nearly flat, land adjacent to a river or stream that experiences occasional or periodic flooding. It includes the floodway, which consists of the stream channel and adjacent areas that carry flood flows, and the flood fringe, which includes areas covered by the flood but which do not experience strong current. Floodplains function to prevent damage by detaining debris, sediment, water, and ice. The Federal Emergency Management Agency (FEMA) delineates floodplains and determines flood risks in areas susceptible to flooding. FEMA designates floodplain areas based on the percent chance of a flood occurring in that area every year. These areas include the 100-year floodplain, which has a one percent chance of flooding each year and the 500-year floodplain, which has a 0.2 percent chance of flooding each year.

At the state level, the MnDNR oversees the administration of the state floodplain management program by promoting and ensuring sound land use development in areas to promote the health and safety of the public, minimize loss of life, and reduce economic losses caused by flood damages. The MnDNR also oversees the national flood insurance program for the state of Minnesota. Floodplains are also regulated at the local level by each county. Associated ordinances allow for utility transmission lines as a conditional use for floodway and floodplain districts.

The Proposed Route crosses both FEMA-designated 100-year and 500-year floodplains areas in locations associated primarily with waterbodies such as the Midway River, Miller Creek, Chester Creek, and Kingsbury Creek. A total of about 292 acres of 100-year

floodplain and 0.28 acre of 500-year FEMA-designated floodplains occur within the Proposed 115 kV Route (**Map 7-3** in **Maps tab**). A total of 6.3 acres of 100-year floodplain and no 500-year FEMA-designated floodplains occur within a proposed right-of-way for the 115 kV transmission line. No FEMA-designated floodplains within the Proposed 230 kV Route, Ridgeview Substation, and Hilltop Substation.

7.5.2.2.1 Impacts and Mitigation

The Project may require up to five (5) new transmission line structures to be placed within FEMA designated 100-year floodplain areas for a less than 0.1 acre impact. The temporary impacts during construction are estimated to be about 16 acres from access routes, structures work areas, and wire pull sites. The placement of transmission line structures in floodplains is not anticipated to alter the flood storage capacity of the floodplain based on the minimal size of individual transmission line structures. The Project will work with local floodplain authorities to permit any structures in floodplains.

7.5.2.3 Impaired Waters

The MPCA is charged with classifying waterbodies in Minnesota. Consistent with the requirements of the Clean Water Act (CWA), the MPCA has established water quality standards, including the identification of beneficial uses of the state's waters, numeric standards and narrative criteria, and non-degradation protections for high-quality or unique waters. Minnesota advances the CWA's presumption that a waterbody should attain healthy aquatic life and recreation uses, and groups the waters of the state into one or more of the following seven designated use classifications per Minn. R. Ch. 7050.0140:

- Class 1 waters, domestic consumption
- Class 2 waters, aquatic life and recreation
- Class 3 waters, industrial consumption
- Class 4 waters, agriculture and wildlife
- Class 5 waters, aesthetic enjoyment and navigation
- Class 6 waters, other uses and protection of border waters
- Class 7 waters, limited resource value waters

Section 303(D) of the CWA requires states to publish every two years a list of streams and lakes that are not meeting their designated uses, because of excess pollutants (impaired waters). The list, known as the 303(d) list, is based on violations of water quality standards. In Minnesota, the MPCA has jurisdiction over determining 303(d) waters. These waters are described as "impaired". The Proposed 115 kV Route crosses two impaired streams, Miller Creek and Kingsbury Creek (**Map 7-3** in **Maps tab**). No impaired streams within the Proposed 230 kV Route. Both streams are listed as having an impaired designated use of aquatic life and recreation (MPCAa 2020).

7.5.2.3.1 Impacts and Mitigation

Mitigation measures will be implemented to prevent or minimize surface water impacts that could affect water quality. The MPCA, through the NPDES and under the CWA and

the State Disposal System ("SDS"), regulates construction activities that may impact stormwater runoff. The Project will apply for authorization to discharge stormwater associated with construction activity under the MPCA NPDES/SDS Construction Stormwater General permit (MNR100001). The Project will develop a Storm Water Pollution Prevention Plan ("SWPPP") that will identify BMPs to be implemented during construction to minimize erosion and sedimentation impacts to surface waters. Erosion and sedimentation abatement measures, for example, would be employed to mitigate impacts to water resources within the Proposed Route. No fueling or maintenance of vehicles or application of herbicides would occur within 100 feet of streams, ditches, and waterways to protect against introduction of these materials into surface or groundwater systems. Materials such as fuels, lubricants, paints, and solvents required for construction would be stored away from surface water resources according to appropriate regulatory standards. Any spills or leaks would be cleaned up immediately and leaking equipment removed from the area for proper maintenance. In the area of impaired waters, the Project will implement BMPs in accordance with section 23.1 of MNR100001 which defines additional requirements for discharges to special (Prohibited, Restricted, Other) and impaired waters.

7.5.2.4 Lakes

Mogie Lake is the only lake located near the Proposed Route, approximately 400 feet north of the Proposed Route and about 800 feet north of the proposed 71 Line / 176 Line double-circuit 115 kV transmission line, near the intersection of Lavaque Road and Youngdahl Road (**Map 7-3** in **Maps tab and Appendix J-3, pages 18-19)**. Mogie Lake is also a MnDNR Public Water Basin. The MnDNR does not list Mogie Lake as a wild rice lake, however the Fond du Lac Band of the Lake Superior Chippewa THPO considers it a wild rice lake. Because the Proposed Route does not span a lake, there are no anticipated impacts to lakes. Aside from construction stormwater discharge BMPs, no additional mitigation is proposed.

7.5.2.5 Rivers and Streams

No streams are located within the Proposed 230 kV Route (**Map 7-3** in **Maps tab**). The proposed 115 kV transmission line crosses a total of eight river and stream features, with some features being crossed multiple times for a total of 31 crossings, 12 of the crossings would be new crossings (**Table 7-8**) and 19 of the crossings would occur at existing crossing locations along either rebuilt or double circuit segments of the Project (**Table 7-9)**, shown in **Map 7-3** in **Maps tab**. Six existing crossings of the Midway River and four crossings of other unnamed stream features would be removed as a result of the Project. The Project would also result in three existing crossings of Rocky Run and one existing crossing of an unnamed stream being buried as part of other upgrades associated with the Project.

Table 7-8. New River and Stream Crossings by the Proposed 115 kV Transmission Line

MnDNR Hydro ID Number	Feature Name	Number of Crossings	MnDNR PWI Water	Designated Trout Stream	Appendix J-3 Page Number
113455	Chester Creek East Branch	2	Yes	Yes	1
113446	Chester Creek	2	Yes	Yes	3
111728	Miller Creek	1	Yes	Yes	5
111740	Unnamed Stream	5	Yes	Yes	4 and 5
111906	Midway River	1	Yes	Yes	14
111972	Unnamed Stream	1	Yes	Yes	16

Table 7-9. Existing River and Stream Crossings to be Rebuilt or Double Circuited by the Proposed 115 kV Transmission Line

MnDNR Hydro ID Number	Feature Name	Number of Crossings	MnDNR PWI Water	Designated Trout Stream	Appendix J-3 Page Number
113455	Chester Creek East Branch	1	Yes	Yes	1
113446	Chester Creek	1	Yes	Yes	3
111728	Miller Creek	1	Yes	Yes	5
111740	Unnamed Stream	10	Yes	Yes	4 and 5
111978	Unnamed Stream	4	Yes	Yes	10
111763	Kingsbury Creek	1	Yes	Yes	17
111972	Unnamed Stream	1	Yes	Yes	16

7.5.2.5.1 Impacts and Mitigation

Since the streams within the Proposed Routes are MnDNR Public Waters, please reference Section 7.5.2.6 for a discussion of impacts and mitigation.

7.5.2.6 Public Waters

Public Waters are wetlands, water basins, and watercourses of significant recreational or natural resource value in Minnesota as defined in Minnesota Statutes Section 103G.005. The MnDNR has regulatory jurisdiction over these waters, which are identified on the MnDNR Public Waters Inventory (PWI) maps. In addition to Public Waters, certain surface waters in Minnesota are designated as trout streams or lakes by the State of Minnesota, according to Minn. Stat. § 6264.0050 which by definition are considered Public Waters and are regulated by the MnDNR.

The proposed transmission line crosses eight MnDNR public waterways all of the public waters crossed by the proposed transmission line are designated trout streams (**Map 7-3** in **Maps tab** and **Table 7-8** and **Table 7-9**). In addition to mapped designated trout streams, the MnDNR provided point locations of unmapped trout stream tributaries within the Proposed Route. One MnDNR Public Water Wetlands occurs within the Proposed Route (**Map 7-3** in **Maps tab**). It is an unnamed wetland, located north of Rice Lake Road. The southern end of this Public Water wetland is located within Minnesota Power's existing transmission line right-of-way, whereas the new transmission line is located

southeast of the wetland boundary and will not span the PWI wetland. Mogie Lake is a MnDNR Public Water Basin located near the Proposed Route, approximately 800 feet north of the proposed 71 Line / 176 Line double-circuit 115 kV transmission line, near the intersection of Lavaque Road and Youngdahl Road (**Map 7-3** in **Maps tab and Appendix J-3, pages 18 and 19**). The MnDNR does not list Mogie Lake as a wild rice lake, however the Fond du Lac Band of the Lake Superior Chippewa THPO considers it a wild rice lake. MnDNR Public Watercourses crossed by the proposed transmission line are listed in **Table 7-8** and **Table 7-9**.

7.5.2.6.1 Impacts and Mitigation

The proposed transmission line crosses eight trout streams (MnDNR public waterways) a total of 31 different times, due to the sinuous nature of the streams (**Table 7-8** and **Table 7-9**). The Midway River would be spanned at a new location in a more perpendicular orientation. Minnesota Power's existing 57 Line, which will be removed from the Midway River over a distance of about 0.4 miles (**Appendix J-3, pages 13 and 14**). The Proposed 115 kV Route span of the Midway River will result in improved condition for the river as the removed existing 57 Line right-of-way revegetates. The other proposed stream crossings are parallel, rebuild, or double-circuit to existing transmission lines. Additional clearing will be necessary for the parallel crossings, however the new line will be able to share right-of-way with the existing line therefore reducing the overall cleared right-of-way from two separate 100-foot-wide rights-of-ways (total of 200-feet-wide) to a combined 160-foot-wide right-of-way. Trout rely on cold water habitat, therefore clearing of trees along MnDNR designated trout streams and their tributaries may result in adverse warming of the stream water. Shade provided by trees and shrubs is important to minimize thermal impacts to trout streams. The Applicant will work with the MnDNR to obtain proper licenses and approvals for Public Water crossings by the proposed Project. Through the license approval process, the Applicant and the MnDNR will determine the appropriate mitigation measures for Public Water crossings, including trout streams. Mitigation measure may include work in water exclusion dates, which are September 15th - June 30th in the Project area. In addition, special clearing set-backs may be required when working near MnDNR designated trout streams. Where possible a 75 foot vegetated buffer will be maintained adjacent to trout streams, except for a 20-foot-wide travel path. In locations where clearing activities must take place within the 75 foot buffer, hand clearing techniques will be used to minimize impacts to soils and existing vegetation. Rootstock of woody vegetation will remain in place to avoid impacts to soils and allow existing vegetation to regrow quicker. Through the NPDES permitting process the Project will be required to comply with Section 23.1 of MNR100001 which includes designated trout streams within the definition of special waters. Best management practices such as redundant perimeter controls and the stabilization of exposed soils immediately upon completion of work within the 75 foot buffer would be implemented to minimize erosion near MnDNR designated trout streams.

On June 18, 2021, the Applicant was informed of a potential project to re-meander Miller Creek by the South St. Louis County Soil and Water Conservation District (SWCD). This Miller Creek re-meander project crosses Minnesota Power's existing 52 Line right-of-way

(**Appendix J-3, page 6**). The Applicant will continue to work with the SWCD on their proposed Miller Creek re-meander project and the Proposed Project.

7.5.2.7 Wetlands

Wetlands are important resources for flood abatement, wildlife habitat, and water quality. Wetlands that are hydrologically connected to the nation's navigable rivers are protected federally under Section 404 of the CWA and most wetlands in Minnesota are protected under the state Wetland Conservation Act ("WCA"). The Minnesota Wetland Inventory ("MWI") is a publicly available GIS database that provides information on the location and characteristics of wetlands in Minnesota. The inventory is an 2008 update of the USFWS National Wetlands Inventory ("NWI") that was completed for Minnesota in the 1980s. Wetlands listed on the MWI may be inconsistent with local wetland conditions; however, the MWI is the most accurate and readily available database of wetland resources within the Project area and were therefore used to identify wetlands in the Proposed Route.

Wetland types within the MWI are classified using the cowardin wetland habitat classification system (MnDNRc 2021). The cowardin classification system is hierarchical and defines wetland habitats based on vegetative and sediment class along with water regime. About two (2) acres wetlands are located within the Proposed 230 kV Route and no wetlands are located with the Proposed 230 kV right-of-way (**Map 7-3** in **Maps tab**). About 391.6 acres of wetlands occur within the Proposed 115 kV Route with approximately 50.6 acres of wetland within the Proposed 115 kV right-of-way (existing and new rights-of-ways) (**Table 7-10** and **Table 7-11** and **Map 7-3** in **Maps tab**). Eight wetland habitat types/type combinations are mapped as occurring within the Proposed Route: palustrine emergent ("PEM"), palustrine forested ("PFO"), palustrine scrub/shrub ("PSS"), palustrine unconsolidated bottom ("PUB"), and riverine (**Table 7-10**). PEM wetlands are habitats dominated by emergent herbaceous plant species. PFO wetlands are habitats dominated by woody tree species. PSS wetlands are habitats dominated by woody shrub species. PUB wetlands are associated with ponds, less than 20 acres in size and have less than 30 percent vegetative cover.

Table 7-10. MWI Wetlands within the Proposed Route

Wetland Type	Wetland within Proposed 230 kV Route (acres)	Wetland within Proposed 115 kV Route (acres)
Freshwater Emergent Wetland	1.7	101.7
Freshwater Forested Wetland	0	79.5
Freshwater Pond	0.1	2.3
Freshwater Shrub Wetland	0	129.4
Freshwater Forested/Emergent Wetland	0	12.4
Freshwater Forested/Shrub Wetland	0	34.8
Freshwater Shrub/Emergent Wetland	0.2	29.3
Riverine	0	1.6
Total	**2.0**	**391.6**

Table 7-11. MWI Wetlands within the Proposed 115 kV Transmission Line Right-of-Way

Wetland Type	Wetland within Proposed Right-of-Way (existing and new) (acres)	Wetland within Proposed Right-of-Way (New) (acres)
Freshwater Emergent Wetland	30.2	2.1
Freshwater Forested Wetland	4.8	1.8
Freshwater Pond	0.4	0.1
Freshwater Shrub Wetland	8.0	4.2
Freshwater Forested/Emergent Wetland	0.9	0
Freshwater Forested/Shrub Wetland	1.9	0
Freshwater Shrub/Emergent Wetland	4.4	1.2
Riverine	0.08	0.03
Total	**50.6**	**9.5**

7.5.2.8 Impacts and Mitigation

Both permanent and temporary impacts to wetlands would result from construction of the Project. Permanent fill impacts would constitute the placement of permanent fill material within the wetland area, such as the placement of a transmission line structure or grading work associated with the expansion of the Hilltop and Ridgeview substations. Permanent conversion impacts would constitute the clearing of forested wetlands within the right-of-way where these resources would not be allowed to revegetate to a forested wetland due to safety requirements but would be managed to be either emergent or shrub wetlands. It is estimated that 7.6 acres of permanent conversion impacts to forested, forested/emergent, and forested/shrub wetlands would be converted to either emergent or shrub wetlands within the existing and new right-of-way (**Table 7-12**). Temporary fill impacts to wetlands would occur in the form of the placement of temporary construction matting along access routes, transmission line structure work areas, and wire pull sites. No anticipated impacts from the Proposed 230 kV transmission line, since no MWI mapped wetland are located within the Proposed 230 kV Route. Approximately 0.55 acres of permanent fill would result from construction of the proposed 115 kV transmission line. Of this permanent fill, about 2,373 square feet (0.05 acres) is associated with the placement of transmission line structures within wetland areas, approximately 0.03 acres of permanent impacts of fill would occur as a result of expansion of the Hilltop Substation, and about 0.47 acres of permanent fill would occur as a result of expansion of Ridgeview Substation (**Table 7-12** and **Table 7-13**). A total of 26.6 acres of temporary impacts would occur as a result of the proposed 115 kV transmission line (**Table 7-12**).

Table 7-12. Proposed 115 kV Transmission Line Wetland Impacts

MWI Wetland Type	Permanent Fill Transmission Structure Placement[1]	Permanent Conversion Impacts[2]	Temporary Fill[3]
Freshwater Emergent Wetland	1,528 sq. ft.	0	14.5 acres
Freshwater Forested Wetland	331 sq. ft.	7.60 acres	3.4 acres
Freshwater Pond	0	0	0.1 acres
Freshwater Shrub Wetland	379 sq. ft.	0	4.9 acres
Freshwater Forested/ Emergent Wetland	0	0	0.3 acres
Freshwater Forested/Shrub Wetland	0	0	2.1 acres
Freshwater Shrub/Emergent Wetland	135 sq. ft.	0	1.2 acres
Riverine	0		0.07 acres
Total	**2,373 sq. ft.**	**7.60 acres**	**26.6 acres**

[1] Permanent structure placement includes both H-Frame structure placement (56.5 sq. ft. per structure) and Monopole Structure Placement (78.5 sq. ft. per structure)

[2] Permanent conversion impacts assumes that all forested, forested/emergent, and forested/shrub wetlands would be cleared and converted to either emergent or shrub wetlands within the existing and new right-of-way.

[3] Temporary fill impacts include access routes (30-foot-wide travel path along the proposed centerline of the project), structure work areas (100 foot by 100 foot per structure), and wire stringing areas (approximately 0.66 acres per location).

Table 7-13. Proposed Substation Expansion Wetland Impacts

Impact Type	MWI Wetland Type	Impact Amount
Ridgeview Substation Expansion Permanent Fill	Freshwater Emergent Wetland	0.47 acres
Hilltop Substation Expansion Permanent Fill	Freshwater Emergent Wetland	0.03 acres

Wetland impact avoidance measures that may be implemented during design and construction of the Project includes spacing and placing the transmission structures at variable distances to span and avoid wetlands, where practical. When it is not practical to span the wetland, several measures can be utilized to minimize impacts during construction:

- When possible, construction will be scheduled during frozen ground conditions.
- When construction during winter is not possible, construction mats (e.g., wooden mats and/or a composite matting system) will be used to protect wetlands.

Additionally, all-terrain construction vehicles may be used, which are designed to minimize impact to soils in damp areas.

- Construction crews will attempt to access the wetland with the least amount of physical impact to the wetlands.
- Utilizing the existing road system for access and material deliver to minimize travel through wetlands.

Initial coordination with the USACE regarding the proposed Project indicated that impacts associated with the proposed Project will likely meet conditions to be authorized under the USACE St. Paul Regulatory District Utility Regional General Permit. The Applicant will continue to coordinate with USACE and will apply for a permit once design details are available. Mitigation may be required by the USACE, typically in the form of wetland replacement credits, for permanent fill of wetland areas. A wetland permit from the appropriate Local Government Units ("LGUs") may be required in compliance with the Minnesota WCA. The Applicant will coordinate with the LGUs and apply for a permit if required once design details are available.

7.5.3 Flora and Fauna

7.5.3.1 Flora

Pre-settlement vegetation in the area consisted of mostly aspen-birch forest with white pine-red pine forest, mixed hardwood-pine forest, and conifer bogs and swamps. Vegetation communities in the area currently includes developed urban areas, woody wetland and deciduous forest (**Map 7-2** in **Maps tab**).

7.5.3.2 Fauna

Wildlife species in St. Louis County include bald eagles, woodcock, ruffed grouse, wild turkeys, songbirds, white-tailed deer, black bear, beaver, muskrat, river otter, grey wolf, rabbits, squirrels, red and gray fox, raccoon, migratory waterfowl (geese, ducks, trumpeter swans, herons, raptors), and various birds (meadowlarks, sparrows, thrushes, various woodpeckers, shore birds).

7.5.3.3 Impacts and Mitigation

Impacts to native vegetation are anticipated due to construction activities. The disturbance would be minimized by using the existing road system to the extent practical, traveling within the right-of-way as appropriate, and not building new roads unless necessary. Further, the transmission line may span sensitive resources, such as streams and wetlands to the extent practical. Last, the transmission line is mostly being constructed parallel to existing transmission lines, rebuilding existing transmissions, and double-circuiting an existing transmission line. Approximately 88 percent (about 12.2 of 13.9 miles) of the Proposed 115 kV Route would parallel or double-circuit existing transmission rights-of-ways, minimizing impacts to previously undisturbed vegetation in those areas.

Construction of the proposed Project could lead to the introduction or spread of invasive species and noxious weeds. Construction activities that could potentially lead to the introduction of invasive species include ground disturbance that leaves soils exposed for extended periods, introduction of topsoil contaminated with weed seeds, vehicles importing weed seed from a contaminated site to an uncontaminated site, and conversion of landscape type, particularly from forested to open settings.

Potential impacts due to invasive species and noxious weeds can be mitigated by:

- Revegetating disturbed areas using weed-free seed mixes and using weed-free straw and hay for erosion control.
- Removal of invasive species/noxious weeds via herbicide and manual means.
- Cleaning and inspecting construction vehicles to remove dirt, mud, plant, and debris from vehicles prior to arriving at and leaving construction sites.

There is minimal potential for the displacement of wildlife and loss of habitat from construction of the proposed Project. Wildlife that inhabit natural areas could be impacted in the short-term within the immediate area of construction. The distance that animals will be displaced will depend on the species. Additionally, these animals will be typical of those found in forested urban settings and should not incur population level effects due to construction.

Raptors, waterfowl and other bird species may be affected by the construction and placement of the transmission lines. Avian collisions (with or without electrocution) are a possibility after construction of the proposed Project. Waterfowl are typically more susceptible to transmission line collision, especially if the transmission line is placed between wetlands and fields that serve as feeding areas, or between wetlands and open water, which serve as resting areas. The Proposed Route minimizes potential impacts by predominantly paralleling existing transmission rights-of way.

In addition, where practical the Project will consider the Avian Powerline Interaction Committee (“APLIC”) recommendations to reduce electrocution and collisions. The Applicant proposes to use bird flight diverters to mark the section of proposed double-circuit transmission line that runs east-west about 600 feet south of Mogie Lake to reduce the likelihood of collisions (**Appendix J-3, pages 18 and 19**).

7.6 Zoning and Land Use

7.6.1 Zoning

The Proposed Route is split between the City of Duluth and the City of Hermantown zoning ordinances. The majority of the corridor is zoned as Low Density and Rural Residential with High Density Commercial zoning where the corridor crosses TH 194 at Hermantown Marketplace and small parcels of open space, public and industrial zoned areas. Zoning information for the Proposed Route is show in **Map 7-4** in **Maps tab**. The Proposed 115 kV Route is within the Natural Environment and General Development Shoreland Overlay district per the Hermantown Zoning Code Chapter 5 Section 555 (City

of Hermantown 2015). The northeastern portion of the Proposed 115 kV Route overlaps the Duluth International Airport Overlay Zone C (City of Duluth 2019) (**Map 7-4** in **Maps tab**). The Proposed 115 kV Route is located with the City of Duluth's Shoreland Management zones (overlay district) per Section 50-18.1 Natural Resources Overlay (NR-O).

7.6.2 Land Use

Current land use within the Proposed Route consists of mainly rural residential, open and public lands and commercial areas. Commercial and retail spaces are primarily located at Hermantown Marketplace near the Haines Road substation. Hermantown Central park and several recreational trails including snowmobile, cross-country skiing and walking trails intersect the Proposed Route.

7.6.3 Land Cover

The total acreage of each land cover type overlapped by the Proposed Route is provided in **Table 7-14** and shown on **Map 7-2** in **Maps tab**. Land cover of the proposed new right-of-way is provided in **Table 7-15** for both the 115 kV and 230 kV transmission lines. **Table 7-16** lists the land cover of the proposed Ridgeview and Hilltop substation expansions.

Table 7-14. Land Cover of the Proposed Route

	Proposed Route		Proposed 230 kV Route		Proposed 115 kV Route	
Land Cover Type	**Acres**	**Percent of Total**	**Acres**	**Percent of Total**	**Acres**	**Percent of Total**
Cultivated Crops	0.21	0.01%	0	0%	0.2	0%
Deciduous Forest	699.46	42.51%	44.2	45%	655.2	42%
Developed, High Intensity	31.32	1.90%	7.7	8%	23.6	2%
Developed, Medium Intensity	46.79	2.84%	8.8	9%	37.9	2%
Developed, Low Intensity	36.36	2.21%	1.6	2%	34.7	2%
Developed, Open Space	72.79	4.42%	1.4	1%	71.4	5%
Emergent Herbaceous Wetlands	34.99	2.13%	4.5	5%	30.5	2%
Evergreen Forest	0.86	0.05%	0	0%	0.8	0%
Hay/Pasture	29.89	1.82%	1.5	2%	28.4	2%
Herbaceous	12.92	0.79%	3.5	4%	9.4	1%
Mixed Forest	55.04	3.35%	6.4	6%	48.6	3%
Open Water	0.31	0.02%	0	0%	0.3	0%
Shrub/Scrub	22.16	1.35%	6.4	6%	15.7	1%
Woody Wetlands	602.30	36.61%	13.1	13%	589.2	38%
Total	1645.40	100%	99.1	100%	1545.9	100%

Table 7-15. Land Cover of the Proposed New Rights-of-Way

	Proposed New 230 kV Right-of-Way		Proposed New 115 kV Right-of-Way	
Land Cover Type	**Acres**	**Percent of Total**	**Acres**	**Percent of Total**
Cultivated Crops	0	0%	0	0%
Deciduous Forest	6.6	62%	46.5	59%
Developed, High Intensity	0	0%	<0.1	0%
Developed, Medium Intensity	0	0%	1.3	2%
Developed, Low Intensity	0	0%	1.9	2%
Developed, Open Space	0.2	2%	2.5	3%
Emergent Herbaceous Wetlands	1.3	12%	1.2	2%
Evergreen Forest	0	0%	0	0%
Hay/Pasture	0	0%	0.2	0%
Herbaceous	0.1	1%	0.5	1%
Mixed Forest	0.6	6%	4.0	5%
Open Water	0	0%	0	0%
Shrub/Scrub	0.1	1%	0.3	0%
Woody Wetlands	1.8	17%	20.3	26%
Total	**10.7**	**100%**	**78.8**	**100%**

Table 7-16. Land Cover of the Proposed Substation Expansions

Land Cover Type	Acres	Percent of Total
Deciduous Forest	2.30	62.34%
Developed, Low Intensity	0.12	3.37%
Developed, Open Space	0.01	0.16%
Herbaceuous	0.06	1.70%
Mixed Forest	0.43	11.73%
Shrub/Scrub	0.76	20.70%
Total	**3.68**	**100%**

7.6.4 Impacts and Mitigation

The Ridgeview and Hilltop substation parcels currently have approximately 2.3 acres in forested land use, 0.13 acres in developed land use and approximately 1 acre in herbaceous/scrub shrub land use (**Table 7-16**). The construction footprints of the substation expansions are minor and no mitigation is proposed. Hilltop Substation expansion is shown on **Appendix J-1 and Appendix J-3, page 3**. Ridgeview Substation expansion area is shown on **Appendix J-2 and Appendix J-3, page 1**.

The Proposed Route will overlap approximately 700 acres of forested land and 600 acres of woody wetlands, which are the two largest land use categories overlapped by the proposed right-of-way after developed land (**Table 7-14**). Impacts to forested land will be the most obvious impact to overall land cover within the Proposed Route (**Table 7-17**).

As stated in Chapter 7.2.4, the 1.5 mile segment of new 115 kV transmission line west of the Midway River, traverses through a densely wooded area (**Appendix J-3, pages 10 to 15**). This stretch of transmission line will require new right-of-way which will convert the existing forested land to open, cleared space. Much of the Proposed 115 kV Route is proposed to be parallel or double-circuit to existing transmission lines, which will reduce the amount of new right-of-way needed and clearing. Since the Ridgeview and Hilltop substation expansions will alter the existing land cover, the expansion areas will be an impact. Land cover impacts from the proposed substation expansions are stated in **Table 7-16**. Tree clearing along the entire right-of-way will occur per Minnesota Power standards.

Table 7-17. Land Cover Impacts from the Proposed 230 kV and 115 kV Routes

	Proposed 230 kV Transmission Line		**Proposed 115 kV Transmission Line**	
Land Cover Type	**Temporary Direct Impacts**[1]	**Permanent Direct Impacts**[2]	**Temporary Direct Impacts**[1]	**Permanent Direct Impacts**[2]
Cultivated Crops (acres)	0	0	0	0
Deciduous Forest (acres)	7.3	2.9	74.9	23.0
Developed, High Intensity (acres)	0	0	1.7	<0.1
Developed, Low Intensity (acres)	0	0	4.1	<0.1
Developed, Medium Intensity (acres)	0.1	0	3.9	<0.1
Developed, Open Space (acres)	0.2	0	6.8	<0.1
Emergent Herbaceous Wetlands (acres)	0.9	<0.1	2.4	<0.1
Evergreen Forest (acres)	0	0	0	0
Hay/Pasture (acres)	0	0	0.7	<0.1
Herbaceous (acres)	0.1	0	0.4	<0.1
Mixed Forest (acres)	1.4	0.2	5.0	1.8
Open Water (acres)	0	0	0	0
Shrub/Scrub (acres)	0.3	0	1.3	<0.1
Woody Wetlands (acres)	1.5	1	38.4	9.9
Total	**11.8**	**4.1**	**139.6**	**34.7**

[1] Temporary fill impacts include access routes (30-foot-wide travel path along the proposed centerline of the project), structure work areas (100 foot by 100 foot per structure), and wire stringing areas (approximately 0.66 acres per location).

[2] Permanent structure placement includes both H-Frame structure placement (56.5 sq. feet per structure) and Monopole Structure Placement (78.5 sq. feet per structure)

7.7 Rare and Unique Resources

7.7.1 Threatened and Endangered Species

The Project reviewed available data on threatened and endangered species and requested consultation from the MnDNR and USFWS. The Project reviewed the MnDNR Natural Heritage Inventory System ("NHIS"), under License Agreement #181559 (DNRd 2021), for documented occurrences of state-listed species within one mile of the Proposed Route. Although this review does not represent a comprehensive survey, it provides information on the potential presence of protected species and habitat within the vicinity of the Proposed Route. The USFWS Information, Planning, and Consultation system was used to identify federally threatened, endangered, and proposed candidate species, and designated critical habitat that may occur near and within the Proposed Route.

7.7.1.1 State Listed Species

Records provided by the MnDNR indicates that floating marsh marigold (*Caltha natans*), which is a state-listed endangered species, is known to occur within the Proposed Route (**Appendix R-2**). Floating marsh marigold is a circumboreal aquatic species with 2-6 small white flowers about 1 centimeter ("cm") across. The leaves are 2-5 cm along and wide with a rounded tip and a deeply notched base. Floating marsh marigold is typically associated with low-gradient riverine systems and has been known to occur in shallow, slow-moving water in streams, creeks, pools, ditches, sheltered lake margins, swamps, and beaver ponds (MnDNRd 2021).

The state-listed species of special concern, Northern goshawk (*Accipiter gentilis*) is also mapped as occurring within one mile of the Proposed Route (**Appendix R-2**). Northern goshawk is a large-bodied forest-dwelling hawk with broad wings and a long rounded tail. Northern goshawks are most commonly found in larger tracts of mature and older upland forest (DNRd 2021). Special status species, including species of special concern, do not have a legal or protected status but are tracked by the MnDNR.

Through early consultation with the MnDNR, they stated that the Blanding's turtle (*Emydoidea blandingii*) a state-listed threatened species may occur in the proposed Project area. However, it is not listed in the NHIS database for the proposed Project area. According to the MnDNR's website, "The Blanding's turtle averages 15-25 cm (5.9-9.8 in.) in length. Its most diagnostic characteristics are its domed upper shell (carapace) and its bright yellow chin and throat." Further the MnDNR's website characterizes the Blanding's turtle habitat as "calm, shallow waters, including wetlands associated with rivers and streams with rich aquatic vegetation are especially preferred. In Minnesota, this species appears fairly adaptable, utilizing a wide variety of wetland types and riverine habitats in different regions of the state."

The MnDNR was contacted requesting information on the possible effects of the proposed Project on threatened and endangered species. The MnDNR concurred with

the Applicant's assessment within the NHIS review request that there are no anticipated impacts to rare features.

7.7.1.2 Federally Listed Species

Canada lynx (*Lynx canadensis)* federally listed as threatened*,* northern long-eared bat (NLEB) (*Myotis septentrionalis*) federally listed as threatened, piping plover (*Charadrius melodus*) federally listed as endangered, and red knot (*Canutus rufa*) federally listed as endangered. Additionally, critical habitat for the Canada lynx occurs partially within the Proposed Route. An official species list from the USFWS is included in **Appendix R**.

The Canada lynx is a mid-sized boreal forest cat species that is approximately 30-35 inches long and weighs about 15-30 pounds. Canada lynx habitat is associated with moist, cool, boreal spruce-fir forests with high snowshoe hare (*Lepus americanus*) densities. The Proposed Route from Ridgeview Substation to Miller Trunk Highway is mapped as occurring within Canada lynx critical habitat. There is approximately 323 acres of Canada lynx critical habitat within the Proposed 115 kV Route (**Appendix R-2**).

The NLEB is a medium-sized bat that is 3.0 to 3.7 inches in length with a wingspan of 9 to 10 inches. The species' name is due to its relatively long ears compared to other members of the genus Myotis. In winter, NLEBs hibernate in mines and caves in areas with high humidity, constant temperatures, and no air currents. In summer, the species roosts alone or in colonies in live and dead trees under bark, in cavities, or in crevices. The MnDNR maintains a list of townships containing documented NLEB maternity roost trees and hibernacula entrances in Minnesota (MnDNRe 2021). A review of the MnDNR's township list shows that there are no NLEB hibernaculum within 0.25 mile of the Proposed Route nor are there any NLEB maternity roost trees located within the Proposed Route.

Piping plover is a small, stocky shorebird with a sand-colored upper body, a white underside, and orange legs. Piping plovers habitat consists of wide, flat, open, sandy beaches with very little grass or other vegetation. Due to the lack of available habitat, it is unlikely that piping plovers would occur within the Proposed Route.

Red knot is a small shore bird with mottled black and gray uppers and a cinnamon brown head. Underparts of some birds show traces of "red" in the fall, which is where the species name is derived from. In Minnesota they are found almost exclusively along the shore of Lake Superior. Due to the lack of available habitat, it is unlikely that red knots would occur within the Proposed Route.

7.7.1.3 Impacts and Mitigation

The Applicant will continue to coordinate with the MnDNR and USFWS to ensure that sensitive species near the proposed Project are not impacted by construction of the Project.

Stream crossings within the Proposed Route associated with the potential presence of floating marsh marigold, would be spanned by the transmission line. Additionally, these stream features fall under the jurisdiction of the MnDNR as both Public Waters and

designated trout streams where additional construction stormwater BMPs will be required such as work in water timing restrictions, restrictions on activities near the stream bank per the MnDNR's License to Cross Public Waters, maintaining vegetated buffers and redundant erosion control measures adjacent to the streams. Due to the avoidance of work activities within potential floating marsh marigold habitat it is unlikely that the proposed Project would have an adverse effect on floating marsh marigold.

According to the MnDNR, threats to the Blanding's turtle include mortality crossing roads to reach nesting sites, moving between wetlands, and habitat degradation and loss of upland and wetland habitats. Turtles may travel along streams and wetlands in the Project Area. The Applicant will work with the MnDNR to implement best management practices for areas inhabited by Blanding's turtles along the proposed Project (**Appendix R – DNR email dated July 9, 2021**). Minnesota Power will work with the MnDNR to develop a contractor training program for the proposed Project during construction.

Due to the transient nature of the Canada lynx within the Project Area and the development within the Project Area, it is unlikely that the Canada lynx would persist within the Proposed Route. There is about 19.4 acres of Canada lynx critical habitat within the Proposed 115 kV right-of-way with about 0.1 acres of impact from the structures and about 31.7 acres of temporary impact during construction. In addition, there is about 3.6 acres of permanent impact from the Ridgeview Substation expansion. Being that the portion of the Proposed Route located within Canada lynx critical habitat is located adjacent to existing transmission line right-of-way and the Ridgeview Substation property, it is unlikely that the Project would have an adverse effect on the Canada lynx critical habitat as this habitat has been previously disturbed (**Appendix R-2**).

There are no NLEB hibernacula within 0.25 mile of the Proposed Route, nor are there any known occupied NLEB roost trees located within 150 feet of the Proposed Route. The Project intends to comply with tree clearing timing restrictions as defined by the USFWS 4(d) Rule for the NLEB by performing clearing activities during the winter months (i.e. October 1 through March 31) when the NLEB would not be present within the Project Area. Therefore, it is unlikely that the proposed Project would have an adverse effect on the NLEB.

Once the permitted centerline is known and detailed design of the line is available, the Applicant will coordinate with the MnDNR and USFWS to ensure their concerns are addressed. As part of the CWA permit for the proposed Project, informal consultation between the USACE and the USFWS will be required regarding both the NLEB and Canada lynx.

7.7.2 Natural Resource Sites

There are no MnDNR Wildlife Management Areas and MnDNR Scientific and Natural Areas in the proposed Route. Additionally, there are no MnDNR Minnesota Biological Survey areas of Biological Significance located within the Proposed Route. The nearest MnDNR Minnesota Biological Survey areas of Biological Significance are Norton Road

Woods and Hartley Park located about 0.25 miles from the Ridgeview Substation (**Appendix R-2**).

7.8 Physiographic Features

7.8.1 Topography

The Proposed Route is located within the North Shore Highlands Subsection of the Laurentian Mixed Forest Province as defined by the MnDNR Ecological Classification System (MnDNR 2000).

The landscape of the Laurentian Mixed Forest Province ranges from poorly drained peatlands to rolling plains with deep glacial drift to rugged terrain with thin glacial deposits and exposed bedrock. The North Shore Highlands Subsection parallels the shoreline of Lake Superior and follows the Highland Moraine along the lake. About three (3) percent of the subsection is made up of lakes and several short streams run along the Highland Moraine, ending at Lake Superior.

Elevations along the Proposed Route vary from 1,400 feet above sea level ("ASL") to around 1,250 feet ASL from the Ridgeview Substation to the Hilltop Substation. Slopes of about 5-6 percent grade are present throughout the Proposed Route with more prominent slopes near waterbody and stream banks. The gradual rolling topography of the area is characteristic of the North Shore Highlands Subsection.

7.8.1.1 Impacts and Mitigation

Construction of the Proposed Route will have minimal to no impacts to the topography of the area; therefore, no mitigation is proposed.

7.8.2 Geology

Continental glacier activity is evident in the rugged shoreline along Lake Superior as well as exposed igneous intrusions of the Duluth Complex. Skyline Parkway, located approximately 0.3 miles east of the Hilltop Substation, follows one of the highest stretches of Lake Superior called the Glacial Lake Duluth level. Bedrock is composed of Upper Precambrian granite, sandstone, shale, basalt, gabbro, anorthosite, rhyolite and diabase. Exposed bedrock is common in this area due to thin glacial drift (MnDNR 2000). Geologic landforms found in the vicinity of the Proposed Route includes gabbro intrusions and outcrops of volcanic lava flows along streambeds.

7.8.2.1 Impacts and Mitigation

Construction of the Proposed Route will not alter the geology of the region; therefore, no mitigation is proposed.

7.8.3 Soils

USDA soils data was reviewed to determine soil type within the Proposed Route (**Table 7-18** and **Map 7-5** in **Maps tab**). There is no prime farmland within the Proposed Route and proposed substation expansions. There is about 60.3 acres and 576.5 acres of Farmland of Statewide Importance within the Proposed 230 kV Route and Proposed 115 kV Route, respectively. There is about eight (8) acres and 34.3 acres of Farmland of Statewide Importance within the Proposed 230 kV right-of-way and Proposed 115 kV right-of-way, respectively.

There is about 3.68 acres of Hermantown-Finland (s3672) soils within the proposed Ridgeview and Hilltop substation expansions. Approximately 3.3 acres of Farmland of Statewide Importance within the proposed Ridgeview and Hilltop substation expansions.

Table 7-18. Soils Within the Proposed Route

	Proposed Route		Proposed 230 kV Route		Proposed 115 kV Route	
Soil Type	**Acres**	**Percent of Total**	**Acres**	**Percent of Total**	**Acres**	**Percent of Total**
Hermantown-Ahmeek (s3676)	165.06	10.03%	44.4	45%	120.7	8%
Hermantown-Finland (s3672)	1425.53	86.64%	0	0%	1425.5	92%
Dusler-Duluth (s3677)	54.81	3.33%	54.8	55%	0	0%
Total	**1645.40**	**100%**	**99.1**	**100%**	**1546.2**	**100%**

7.8.3.1 Impacts and Mitigation

Construction of the Proposed Project will not have significant impacts on the overall soil profile of the area since no extensive grading or excavating activities are associated with construction. **Table 7-19** lists the anticipated soil impacts of the proposed 230 kV and 115 kV routes (**Map 7-5** in **Maps tab**).

Table 7-19. Soil Impacts from the Proposed 230 kV and 115 kV Routes

	Proposed 230 kV Transmission Line		Proposed 115 kV Transmission Line	
Soil Type	**Temporary Direct Impacts (acres)[1]**	**Permanent Direct Impacts (acres)[2]**	**Temporary Direct Impacts (acres)[1]**	**Permanent Direct Impacts (acres)[2]**
Hermantown-Ahmeek (s3676)	8.4	<0.1	3.6	0
Hermantown-Finland (s3672)	0	0	135.9	0.5
Dusler-Duluth (s3677)	3.5	<0.1	0	0
Total	**11.9**	**<0.1**	**139.6**	**0.5**

[1] Temporary direct impacts include access routes (30-foot-wide travel path along the proposed centerline of the project), structure work areas (100 foot by 100 foot per structure), and wire stringing areas (approximately 0.66 acres per location).

[2] Permanent structure placement includes both H-Frame structure placement (56.5 sq. ft. per structure) and Monopole Structure Placement (78.5 sq. ft. per structure)

There is about 9.8 acres and 48.9 acres of temporary impacts to Farmland of Statewide Importance within the Proposed 230 kV Route and Proposed 115 kV Route, respectively. There is about 0.1 acres and 0.2 acres of permanent impacts to Farmland of Statewide Importance within the Proposed 230 kV right-of-way and Proposed 115 kV right-of-way, respectively.

There is about 3.6 acres of permanent impacts to Hermantown-Finland (s3672) soils from the proposed Ridgeview and Hilltop substation expansions. There is approximately 3.3 acres of permanent impacts to Farmland of Statewide Importance within the proposed Ridgeview and Hilltop substation expansions.

7.9 Unavoidable Impacts

The design, construction, and operation of the Proposed Route will use the procedures and process described in this Application, to specifically mitigate potential impacts. Minimal impacts from construction activities are unavoidable and could include short-term traffic delays, soil compaction and erosion, vegetative clearing, wetland conversion, visual impacts, habitat loss, disturbance and displacement of wildlife, and loss of land use for other purposes. The nominal impacts include conversion of forested land to cleared right-of-way, wetland fill impacts, visual impacts and seasonal maintenance of tall growing vegetation.

The Project will require only minimal commitments of resources that are irreversible and irretrievable. Irreversible and irretrievable resource commitments are related to the use of nonrenewable resources and the effects that the use of these resources have on future generations. Irreversible commitments of resources are those that result from the use or destruction of a specific resource that cannot be replaced within a reasonable timeframe. Irretrievable resource commitments are those that result from the loss in value of a resource that cannot be restored after the action.

Those commitments that do exist are primarily related to construction. Construction resources include aggregate resources, concrete, steel, and hydrocarbon fuel. During construction, vehicles necessary for these activities would be deployed on site and would need to travel to and from the construction area, consuming hydrocarbon fuels. Other resources would be used in structure construction, structure placement, and other construction activities.

8.1 Agency and Tribal Outreach

The Applicant initiated outreach to federal, state, and local agencies and tribal representatives through project notification emails and online meetings. **Appendix M** provides copies of meeting notes from discussions with agencies representatives. This agency outreach effort tiered from the public outreach described in Chapter 8.2. The federal, state, and local agencies and tribal representatives remained on the proposed Project's stakeholder list and were mailed and emailed notifications of the two virtual open houses and virtual community meetings and could provide comments about the proposed Project.

In December 2020, the Applicant emailed Project introduction letter and maps of the Study Area and Study Corridor to federal, tribal, state, and local agencies with jurisdiction in the proposed Project Study Area. The letter introduced the Project and requested agency input into public and environmental resources that may be located within the Study Area and/or Study Corridor or resources that may be potentially affected by the proposed Project.

In January 2021, the Applicant hosted virtual meetings with agencies to provide preliminary project details and a timeline of major milestones. The Applicants also requested input from the agencies with respect to the resources under their jurisdiction as well as the identification of federal and state permits and/or approvals that may be potentially required for the Project. In addition, agency and tribal representatives were mailed the Engagement Phase 1 stakeholder letter and notifications of the virtual open house and community meetings (Chapter 8.2).

In March 2021, the Applicant hosted virtual meetings with agencies and Fond du Lac Band of Lake Superior Chippewa to review the proposed Project description and benefits and provided an update on the Project's route development. Also, the Project emailed tribal representatives with project updates and a map of the Route Alternatives. The Project developed Route Alternatives that were presented to the agencies, tribes, and public for their review and comment during Engagement Phase 2 (Chapter 8.3). The agencies and tribal representatives were mailed the Engagement Phase 2 stakeholder letter and notifications of the virtual open house and community meetings (Chapter 8.3). The Applicant requested input from the agencies and tribal representatives with respect to the resources under their jurisdiction that may be located within and near to the Route Alternatives.

In June 2021, the Applicant hosted virtual meetings with agencies and Fond du Lac Band of Lake Superior Chippewa to review the proposed Project, schedule, and discuss an anticipated Proposed Route for the Project.

A summary of meetings with federal and state agencies is included below. The Applicant will continue to meet with city and county officials as the Project moves forward and the

Applicant will seek any necessary local permits. **Table 8-1** identifies agencies that were contacted through meetings or a notification email outside of the Public Outreach outlined in Section 8.2 and the date that the consultation was conducted.

Table 8-1. Agency and Tribal Contacts

Name	Date of Meeting
U.S. Fish and Wildlife Service	12/18/2020
U.S. Army Corps of Engineer	12/18/2020, 1/21/2021, 3/4/2021, 6/11/2021
Bureau of Indian Affairs	12/22/2020
U.S. Department of Agriculture -Natural Resources Conservation Service	12/22/2020, 3/16/2021, 8/20/2021
U.S. Environmental Protection Agency	12/30/2020
Federal Highway Administration	12/30/2020
Air National Guard - 148th Fighter Wing	1/4/2021, 1/21/2021
Federal Aviation Administration	12/22/2020, 1/12/2021, 6/11/2021
Bois Forte Band of Chippewa	12/18/2020, 3/24/2021
Red Lake Nation	12/18/2020, 3/24/2021
White Earth Nation	12/18/2020, 3/24/2021
Mille Lacs Band of Ojibwe	12/18/2020, 3/24/2021
Leech Lake Band of Ojibwe	12/18/2020 and 1/14/2021, 3/24/2021
Fond du Lac Band of Lake Superior Chippewa	12/18/2020, 3/24/2021, 4/9/2021, 6/21/2021
Grand Portage Band of Lake Superior Chippewa	12/18/2020, 3/24/2021
MN Dept. of Natural Resources	12/18/2020, 1/14/2021, 3/19/2021, 6/18/2021, 7/1/2021
MN Dept. of Commerce – Energy Environmental Review and Analysis	12/18/2020, 1/13/2021, 3/2/2021, 6/16/2021
MN Public Utilities Commission	12/18/2020, 1/13/2021, 3/2/2021, 6/16/2021
MN State Historic Preservation Office	12/18/2020, 1/14/2021, 5/1/2021
MN Office of State Archaeologist	12/30/2020, 1/14/2021, 5/1/2021
MN Indian Affairs Council	12/30/2020, 1/14/2021, 5/1/2021
MN Board of Water and Soil Resources	12/22/2020, 1/21/2021, 3/4/2021, 6/11/2021
MN Dept. of Agriculture	12/22/2020
MN Pollution Control Agency	12/22/2020
MN Dept. of Transportation – Utility and Aviation	12/22/2020, 3/1/2021
MN Dept. of Health	12/30/2020
South St. Louis County Soil and Water Conservation District	12/18/2020, 6/22/2021, 7/1/2021

St. Louis County	12/18/2020, 3/31/2021, 6/16/2021
City of Duluth	12/21/2020, 1/6/2021, 3/4/2021, 6/14/2021
Duluth Airport Authority	1/12/2021, 6/11/2021
Joint Airport Zoning Board	1/15/2021, 6/11/2021
City of Hermantown	12/18/2020, 3/31/2021, 6/15/2021
City of Proctor	12/18/2020, 1/14/2021, 6/17/2021
City of Rice Lake	1/13/2021, 3/31/2021
Western Lake Superior Sanitary District	3/18/2021

8.1.1 Federal Agencies

8.1.1.1 U.S. Army Corps of Engineers

The Project met concurrently with the U.S. Army Corps of Engineers (USACE) and Board of Water and Soil Resources, who informed that the proposed Project would require authorization from the USACE for wetland impacts under Section 404 of the Clean Water Act and the Wetland Conservation Act. The Applicant discussed the Project with USACE Regulatory Project Manager who will manage the permitting process. These discussions included the following:

- USACE will coordinate with USFWS and SHPO on the Section 7 and Section 106 consultation, respectively;
- Trout streams and listed species will need to coordinate with the MnDNR;
- Field survey/delineation along the final route – delineation would follow the new transmission line and work proposed
    - Level 1 delineation (desktop with field review) is sufficient for the transmission line
    - Level 2 delineation (field delineation) at the substations to evaluate fill;
- Substation expansions might be covered under a Regional General Permit;
- City of Duluth is the LGU for the substation expansions; and
- Transmission line is covered under the Federal Approvals Exemption.

8.1.1.2 U.S. Fish and Wildlife Service

The U.S. Fish and Wildlife Service received the Project's request for technical assistance with an environmental review, specifically concerning threatened and endangered species under the Endangered Species Act of 1973, as amended (16 U.S.C. §1531-1544). The USFWS provides technical assistance through our Information for Planning and Consultation (IPaC) system.

8.1.1.3 U.S. Department of Agriculture, Natural Resources Conservation

The NRCS responded that form FPPA AD-1006 should be completed to determine whether the Farmland Protection Policy Act applies to the Project. The Applicant followed-up with the NRCS, who stated that the Project is excluded from the Farmland Protection Policy Act because no federal funding will be used for the Project. NRCS also provided a map of NRCS administered easements, which are not located in St. Louis County, MN.

8.1.1.4 Air National Guard - 148th Fighter Wing

The Applicant met with the Air National Guard who have no concerns with the proposed Project if Federal Aviation Administration guidance is followed.

8.1.1.5 Federal Aviation Administration

The FAA stated that there are transmission lines currently on the landscape near to the Duluth International Airport. If the proposed Project stays on the outside (beyond) the existing transmission lines and structure elevation is about the same, then there should be no issues at the airport. Further the airport is revising its Master Plan and they are glad to have knowledge of the proposed Project. The FAA would want to be informed of helicopter construction near to the airport. The FAA notifications forms 7460-1 and 7460-2 Obstruction Evaluation / Airport Airspace Analysis would be filed prior to construction.

8.1.2 Tribal Nations

8.1.2.1 Fond du Lac Band of Lake Superior Chippewa

The Applicant met with the Tribal Historic Preservation Office (THPO) who reviewed the proposed Project, including shapefiles. Consultation with Jill Hoppe, THPO with the Fond du Lac Band of the Lake Superior Chippewa, informed the Applicant of two comments regarding cultural resources near to the Route Alternatives (**Appendix M, April 9, 2021 meeting**). One area is Mogie Lake, a wild rice lake that is about 400 feet north of the Proposed Route (**Appendix R-1 and Appendix J-3, pages 18-19**). The second area is a historic trail called the *Rice Lake Trail* that led from Lake Superior, through Chief Buffalo's Tract, and northward to Wild Rice Lake (**Appendix R-1**). The Proposed Route crosses this historic trail near the existing Line 19 and Line 56 intersect (**Appendix R-1**). Fond du Lac Band of the Lake Superior Chippewa THPO stated that the *Rice Lake Trail* is most likely not present, however if construction identifies a historic trail in this area then the Applicant is to notify the THPO (**Appendix M, April 9, 2021 meeting**).

8.1.3 State Agencies

8.1.3.1 State Historic Preservation Office

The Applicant met concurrently with SHPO, Office of State Archaeologist ("OSA"), and Indian Affairs Commission who informed the Applicant to conduct a Phase 1a Literature

Review and in turn, consult with the Agencies about an archeological survey, if necessary, after a final route has been selected by the Commission. In addition, SHPO informed of a large historic area of WPA-era houses along West Arrowhead Road in Hermantown, MN. This historic area is not recorded in SHPO or OSA database. The agencies requested the Applicant meet with the Fond du Lac Band of Lake Superior Chippewa. The agencies discussed Project permitting and federal agency involvement. The SHPO reviewed and concurred with the Applicant's Phase 1a Literature Review on June 21, 2021.

8.1.3.2 Office of State Archaeologist

Please refer to the State Historic Preservation Office summary.

8.1.3.3 Indian Affairs Commission

Please refer to the State Historic Preservation Office summary.

8.1.3.4 Department of Natural Resources

The Applicant discussed the Project with MnDNR staff who will participate in the Commission review process, permitting, NHIS, and Public Water Inventory (PWI) crossings. These discussions included the following:

- An NHIS review request was submitted on March 16, 2021 with MnDNR concurrence received on July 9, 2021. The NHIS request reviewed impacts to rare features, including the floating marsh marigold, northern goshawk, and Blanding's turtle, in addition to PWI, trout stream, and wetland crossings. Surveys for the floating marsh marigold would not be required
- On April 2, 2021, the MnDNR provided information on a fisheries conservation easement and locations of unmapped tributaries to trout streams located within the Route Alternatives
- Most of the stream crossings within the Proposed Route are PWI waters and trout streams
- The Applicant will apply to the MnDNR for a License to Cross Public Waters and will continue to consult with the MnDNR on the PWI and trout stream crossings
- On June 18, 2021, the Applicant was informed of a project to re-meander Miller Creek by the South St Louis County Soil and Water Conservation District (SWCD)
- On June 22, 2021, the Applicant met with a representative of the SWCD. On July 1, 2021, the Applicant met with representatives of the SWCD and MnDNR. The meeting participants discussed Miller Creek proposed alignment being located close to the Applicant's existing transmission line structure. The Applicant informed the SWCD and MnDNR that they would need a 100 foot by 100-foot area between Miller Creek and Miller Trunk Highway to rebuild the existing structure and install a new structure.

8.1.3.5 Minnesota Department of Transportation

The Applicant met with MNDOT to discuss the proposed Project's span of Miller Trunk Highway (Trunk Highway 53). MNDOT staff informed the Applicant of their right-of-way limits and provided a Utility Accommodation Policy that will need to be followed during design of the transmission line span of Miller Trunk Highway. MNDOT staff also informed the Applicants that there are many other buried utilities along Miller Trunk Highway that will need to be located.

8.1.3.6 Minnesota Board of Water and Soil Resources

The Project met concurrently with USACE and Board of Water and Soil Resources, who informed that the proposed Project would require authorization from the USACE for wetland impacts under Section 404 of the Clean Water Act and the Wetland Conservation Act. Please refer to the USACE for a summary of the meetings.

8.1.4 Local Government Units

8.1.4.1 St. Louis County

The Applicant met with St. Louis County and discussed public outreach, land use planning, wetland LGU contact, and informed that the proposed Project will cross county roads requiring permitting. The Applicant may seek easements from the County for tax forfeit parcels.

8.1.4.2 South St. Louis County Soil and Water Conservation District

On June 22, 2021, the Applicant met with a representative of the SWCD who informed the Applicant of their project to re-meander Miller Creek. The SWCD wants to return Miller Creek to the natural low spot within the wetland.

On July 1, 2021, the Applicant met with representatives of the SWCD and MnDNR. The meeting participants discussed Miller Creek proposed alignment being located close to the Applicant's existing transmission line structure. The Applicant informed the SWCD and MnDNR that they would need a 100 foot by 100-foot area between Miller Creek and Miller Trunk Highway to rebuild the existing structure and install a new structure.

8.1.4.3 City of Duluth

The Applicant met with the City of Duluth Planning staff and discussed the following:

- The Duluth International Airport is in the process of revising their master plan. It will be important to meet with the Duluth Airport Authority and Joint Airport Zoning Board.
- The City has revised their Skyline Parkway overlay, which is a zoning code for public benefit.

- The City has about 30 boards and commissions that cover various resources and topics. It was recommended to add city contacts from the Parks and Recreation, Heritage Preservation, Indigenous Community, and Economic Planning boards to the stakeholder list. Citizen groups will be concerned with affects to trails – hiking, walking, and mountain biking.
- The Applicant discussed public outreach and virtual meetings.
- The Applicant discussed route development and overview.
- Duluth's wetland LGU contact information was provided who will need to be involved with the substation expansions impacts to wetlands.

- The Applicant may seek easements from the City for City-owned parcels.

8.1.4.4 City of Hermantown

The Applicant met with the City of Hermantown staff and discussed the following:

- The Applicant discussed public outreach and comments from the virtual meetings.
- The Applicant discussed route development and an overview of the Miller Creek and Miller Trunk Highway span, Lightning Drive/Mall Road, Midway River and Wild Rose Trail Subdivision areas.
- The Applicant may seek easements from the City for City-owned parcels
- Preference for the proposed Project is stay within or parallel existing rights-of-way.

8.1.4.5 City of Proctor

The Applicant met with the City of Proctor staff and discussed the following:

- The Applicant discussed public outreach and comments from the virtual meetings.
- Very little of the Proposed Route is located within Proctor. The Applicant is planning a thermal upgrade of the existing 98 line that is located within Proctor. This work would occur within the existing ROW and is permitted through Minnesota Power's existing Route Permit.
- Clarified that the Hilltop Substation is located within Duluth.
- The Applicants may need a permit for Proctor for crossing city road, Youngdahl Road.

8.1.4.6 City of Rice Lake

The Applicant met with the City of Rice Lake staff and discussed the following:

- The Applicant discussed public outreach and comments from the virtual meetings.
- Potential for developments near Martin Road and Rice Lake Road.

- Very little of the Proposed Route is located within Rice Lake.
- Rice Lake informed the Applicant that the Duluth International Airport was revising their Master Plan.

8.2 Public Outreach

8.2.1 Outreach Kickoff and Engagement Planning

The project team developed a Public Engagement Plan in October 2020 in anticipation for a January 2021 project launch. The plan included a comprehensive approach that consisted of two engagement phases: Study Corridor and Route Alternatives notifications. The first two phases consisted of several engagement methods including a project website, a virtual open house, virtual community meetings, live chats (only included in the first (Study Corridor) phase), project overview mailings, a dedicated email and hotline to field questions and comments, an interactive comment map, mailed project information packets, and detailed maps that could be downloaded and printed from the project website. See **Appendix N** for engagement materials.

8.2.2 Key Communication Channels

The following communication channels were made available throughout the project.

8.2.2.1 Project Website

The project website (www.duluthloop.com) launched on January 14, 2021 and remained open for the duration of the project. The website was used to provide an overview of the project, inform the public of the engagement opportunities, and allow stakeholders an opportunity to provide feedback and ask questions through an interactive comment map or general comment form. Recorded versions of the Virtual Community Meetings were also uploaded to the website for public viewing. The website was continuously updated throughout each phase of the project.

8.2.2.2 Project Email and Information Line

Connect@DuluthLoop.com and an information line (218-755-5512) were created to field public comments about the project. A local area code was chosen for the phone number so it would be familiar to project area stakeholders. These communication channels were made available on all materials and the project website. All comments were reviewed and responded to by the project team.

8.3 Engagement Phase 1: Study Corridor

Minnesota Power hosted the first virtual engagement from January 18 through February 5, 2021, to provide opportunities to learn about the project, provide input on the Study Corridor, and ask questions in a Question-and-Answer session.

8.3.1 Phase 1 Notifications

8.3.1.1 Stakeholder Letter and Email

A letter with attached overview handout was mailed and emailed to project stakeholders. The letter gave an overview of the project and detailed the virtual engagement opportunities. The distribution list included federal, state and local agencies, Tribal representatives, and non-government organizations. The letter was mailed in several batches to accommodate new stakeholders requesting to be added to the mailing list:

- Batch 1 mailing sent on January 14, 2021 to 135 stakeholders
- Batch 2 mailing sent on January 20, 2021 to 33 stakeholders
- Batch 3 mailing sent on January 22, 2021 to 14 stakeholders
- Batch 1 email sent on January 18, 2021 to 141 stakeholders
- Batch 2 email sent on January 21,2021 to 14 stakeholders

8.3.1.2 Postcard

A 5x7 postcard was mailed to 8,341 landowners within the Study Area on January 26, 2021. The mailing list was generated from St. Louis County parcel data records. The postcard included information about the project, virtual engagement opportunities, how to provide a comment, and contact information.

8.3.1.3 Paid Advertisements

Paid advertisements were placed in the Duluth News Tribune, Duluth News Tribune Digital, Hermantown Star, and Proctor Journal with distribution in the project area announcing the virtual engagement opportunities. The paid advertisements run dates are shown in **Table 8-2**.

Table 8-2. Paid Advertisement Run Dates

Paper Name	Run Date
Duluth News Tribune	January 20, 2021
DNT Digital	January 26, 2021
Hermantown Star	January 21, 2021
Hermantown Star	January 28, 2021
Proctor Journal	January 21, 2021

8.3.1.4 Social Media

Geo-Targeted Facebook advertisements ran in the project area during the first phase of engagement. The first advertisement promoting the virtual community meetings was a boosted event page that ran from January 18 – January 28, 2021. The second

advertisement was a boosted post promoting the live chat times on the virtual open house and ran from January 25 – January 29, 2021.

8.3.2 Phase 1 Engagement Events

8.3.2.1 Virtual Community Meetings

Two virtual community meetings were hosted on January 28, 2021 with one meeting at 12 p.m. and the second meeting at 7 p.m. Both meetings consisted of a presentation by the project team to provide stakeholders and community members with an opportunity to learn about the project, listen to subject matter experts discuss different elements of the project, see and provide input on the Study Corridor, and ask questions during the Question-and-Answer session.

A total of 14 attendees joined the first virtual community meeting and a total of 10 attendees joined the second virtual community meeting (not including project team members or other Minnesota Power staff). A total of seven questions were asked during the Q&A portion of the first virtual community meeting and five questions asked at the second virtual community meeting. There were also five questions submitted before the presentation.

8.3.2.2 Live Chats

The project team hosted three live chat sessions during the virtual open house. The purpose of the live chat sessions was to provide an enhanced 1:1 engagement opportunity for community members to chat with project team members and ask questions during a time when in-person meetings are not possible. The live chats took place at the following times:

- Tuesday, January 26, 2021 at 12:00 – 1:00 p.m.
- Wednesday, January 27, 2021 at 4:30 – 6:00 p.m.
- Friday, January 29, 2021 at 7:30 – 9:00 a.m.

One attendee participated in the live chat on Wednesday, January 27, 2021.

8.3.3 Phase 1 Communication Tools

8.3.3.1 Virtual Open House

A virtual open house was made available to the public from January 18 – February 5, 2021. The virtual open house was an interactive website that provided on-demand access to the same content presented at the virtual community meeting. A link to the open house was available on the project website. Visitors could scroll through the slides at their own pace to review information about the project, timeline and routing process, provide questions and comments through a comment form, a multiple choice survey question or an interactive comment map, open detailed maps that zoomed into particular

areas, and learn about additional engagement opportunities and ways to interact with the project team.

8.3.3.2 Interactive Map

An online interactive map was made available to the public from January 18 – February 5, 2021 to collect comments and input on the Study Corridor and route sensitivities and opportunities. The maps were promoted on all notifications and the link was available from the project website and virtual open house. The team received six comments on the interactive map. The following bullet points summarize the comments:

- Facility in the Study Corridor near Martin Road should be added to the north side of the existing line.
- Not in support of the small wooded buffer that separates the current transmission line being removed.
- Property pin to show the location of an individuals' lot.
- Concerns over appearances of power lines from trails and homes facing the power line.
- Please confirm the construction of the existing 230 kV line is not the line that goes through my property.
- Request for information on why the area does not include the full mile stretch of Vaux Road and what financial impact the project will cause.

8.3.3.3 Information Packets

Packets of detailed project information were available on the project website and were also mailed or emailed to community members upon request. Sixty copies were dropped off at three city halls for community members to pick up: Hermantown, Rice Lake, and Duluth. The information packets included the same information that was provided during the Virtual Community Meeting and Virtual Open House. Packets included

A Project Overview Handout, Virtual Open House Materials, an 11.5" x 17" Study Corridors Map, a Comment Form and Survey and a prepaid return envelope for completed comment forms. A total of nine packets were mailed to requesting residents. The project team did not receive any completed comment forms.

8.3.3.4 Public Comments

Comments were collected through various communication channels including project email, information line, virtual open house, online comment map, and phone calls. **Table 8-3** lists the number of comments received through each communication line. **Table 8-4** identifies the comments by category. All comments were reviewed and responded to by the project team.

Table 8-3. Number of Comments Received
(Excludes virtual community meeting comments)

Method	Number of Comments Received (January 14, 2021 – February 7, 2021)
Information Line	11
Project Email	3
Web Comment	6
Total	**20**

Table 8-4. List of Comments by Category
(Excludes virtual community meeting comments)

Category	Number of Comments Received
Packet Request	9
Mailing/Email List Addition Request	4
Study Corridor and Property Impact Information	5
Easement	2

8.4 Engagement Phase 2: Route Alternatives

Minnesota Power hosted the second virtual engagement from March 15 to April 2, 2021 to provide opportunities to learn about the proposed Route Alternatives and to collect public comments.

8.4.1 Phase 2 Notifications

8.4.1.1 Stakeholder Letter and Email

A letter with an enclosed overview handout was mailed and emailed to project stakeholders on March 15, 2021. The letter provided a project overview, described the Route Alternatives, and detailed the virtual engagement opportunities. The stakeholder list used for this distribution was updated throughout the project.

8.4.1.2 Postcard

A 5x7 postcard was mailed to 5,532 landowners and residents within the Study Corridor on March 15, 2021. The mailing list was generated from St Louis County parcel data records. The postcard included information about the project, the Route Alternatives, virtual engagement opportunities, and ways to provide feedback and contact the project team.

8.4.1.3 Press Release

A press release was sent to the following media outlets on Monday, March 15, 2021:

- The Duluth News Tribune
- Hermantown Star
- Proctor Journal
- KDALl radio
- WDIO TV
- KBJR TV
- FOX TV
- KDLH-TV

The press release announced the upcoming engagement opportunities and included the Route Alternatives map.

8.4.1.4 Paid Advertisements

Paid advertisements were placed in the Duluth News Tribune, Duluth News Tribune Digital, Hermantown Star, and Proctor Journal with distribution in the project area announcing the Route Alternative virtual engagement opportunities. The paid advertisement run dates are shown in **Table 8-5**.

Table 8-5. Paid Advertisement Run Dates

Paper Name	Run Date
Duluth News Tribune	March 20, 2021
Duluth News Tribune Digital	March 22, 2021
Hermantown Star	March 18, 2021
Proctor Journal	March 18, 2021

8.4.1.5 Social Media

Minnesota Power ran an advertisement promoting the Virtual Open House and Interactive Comment Map from March 15 – April 2, 2021. The ad was instead ran as an organic post on Minnesota Power's Facebook page and not a geo-targeted Facebook advertisement. The second advertisement promoting the Virtual Community Meetings was a boosted event page that ran from March 16 – March 25, 2021.

8.4.2 Phase 2 Engagement Events

8.4.2.1 Virtual Community Meetings

Four virtual community meetings were hosted on March 23, 2021 and on March 25, 2021, on both days the first meeting was at 12:00 p.m. and the second meeting was at 6:00

p.m. Meetings consisted of a presentation by the project team and a facilitated Question and Answer session.

A total of 56 people participated in the virtual community meetings and submitted 90 questions to the project team. **Table 8-6** details the numbers of attendees at each meeting. These numbers do not include project team members.

Table 8-6. Virtual Community Meeting Attendance and Comments

Meeting	Attendance	Comments
Meeting #1	4	1
Meeting #2	20	38
Meeting #3	20	24
Meeting #4	12	27

8.4.3 Phase 2 Communication Tools

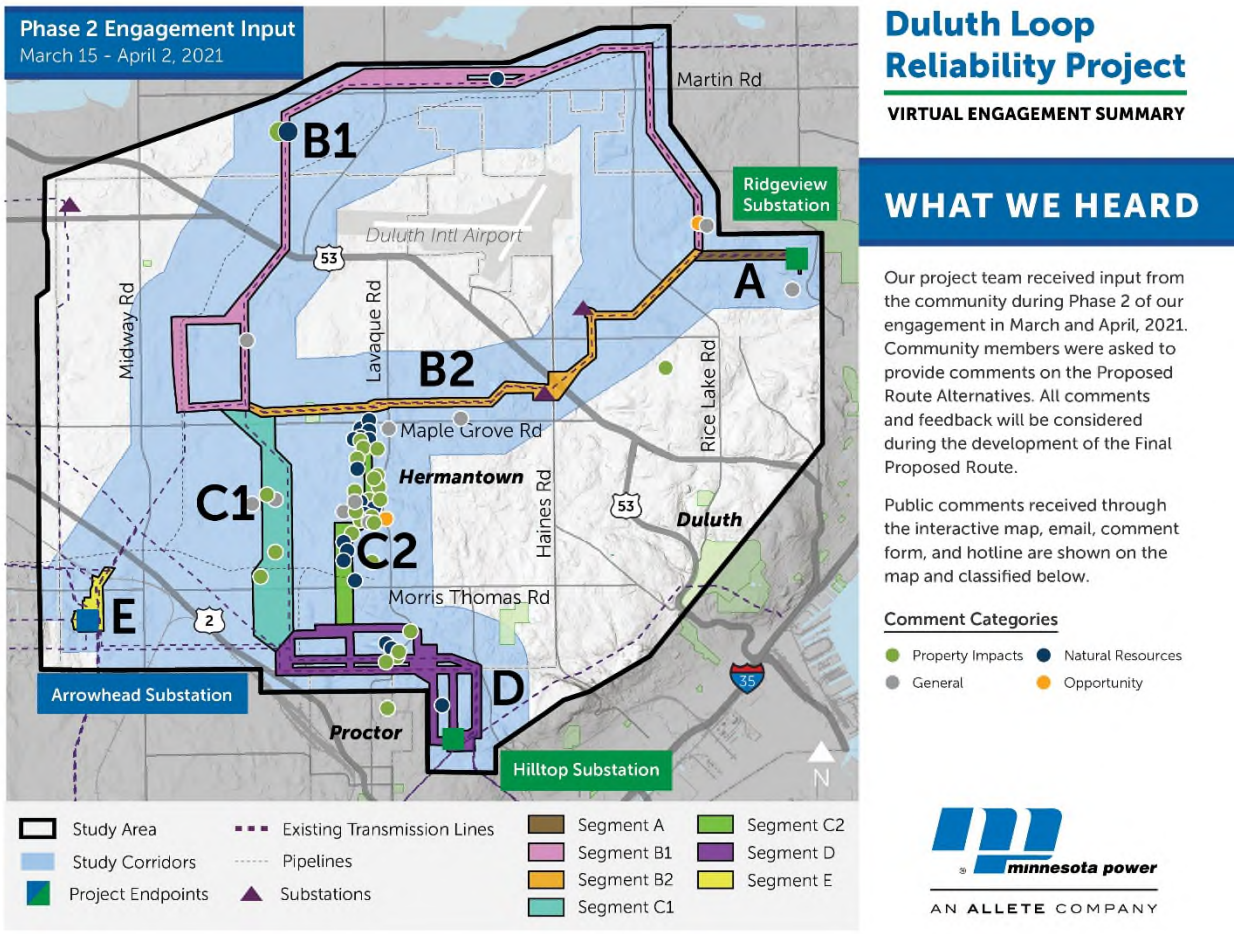
8.4.3.1 Virtual Open House

A virtual open house was made available to the public from March 15 – April 2, 2021. The virtual open house was an interactive website that provided on-demand access to the same content presented at the virtual community meeting. A link to the open house was available on the project website. Visitors could scroll through the slides at their own pace to review information about the project, timeline and routing process, provide questions and comments through a comment form or an interactive comment map, click into detailed maps that zoomed into particular areas, and learn about additional engagement opportunities and ways to interact with the project team.

8.4.3.2 Interactive Map

An online interactive map was made available to the public from March 15 – April 2, 2021 to collect comments and input on the Route Alternatives. The maps were promoted on all notifications and the link was available from the project website and virtual open house. The team received 33 comments on the interactive map. **Figure 8-1** below illustrates the locations of the comments received.

Figure 8-1. Locations of Comments Received



8.4.3.3 Detailed Maps

Detailed maps focused on different sections of the Route Alternatives were made available on the project website. These maps were downloaded 465 times by 234 unique users.

8.4.3.4 Information Packets

Packets of detailed project information were available on the project website and were also mailed or emailed to community members upon request. Forty-five copies were mailed to three city halls for community members to pick up: Hermantown, Rice Lake, and Proctor (15 each). Ten packets were also mailed to the City of Duluth for their City Commissioners. No packets were picked up at these city hall locations. The information packets included the same information that was provided during the virtual community meetings and virtual open house. A prepaid envelope was included for individuals to send their comment forms to the project team. One completed survey was returned to the team. A total of four packets were mailed to requesting residents during second phase of Engagement.

8.4.3.5 Email and Information Line

Comments were collected through various lines of communication including an information line, virtual open house, email, and interactive comment map. **Table 8-7** indicates the number of comments received through each communication line. **Table 8-8** identifies the comments by category.

Table 8-7. Number of Additional Comments Received (Excludes virtual community meeting comments)

Method	Number of Comments Received (March 15, 2021 – April 2, 2021)
Information Line	13
Project Email	17
Virtual Open House Web Form	19
Interactive Comment Map	33
Total	**82**

Table 8-8. List of Comments by Category (Excludes virtual community meeting comments)

Category	Number of Comments Received
Info Request	16
Property Impacts	39
Development	9
Environment & Wetlands	18

In addition to the Certificate of Need and Route Permit sought in this Application, several other permits will be required to construct the Project depending on the final route selected and the conditions encountered during construction. A list of the local, state and federal permits that may be required for this Project is provided in **Table 9-1**. Any required permits will be obtained by the Applicant in a timely manner.

Table 9-1. Permit or Approval List

Permit	Jurisdiction
Local Approvals	
Road Crossing/ROW Permits	St. Louis County; cities of Duluth, Proctor, and Hermantown
Lands Permit or Easement	St. Louis County; cities of Duluth, Proctor, and Hermantown
Overwidth Loads Permits	St. Louis County; cities of Duluth, Proctor, and Hermantown
Driveway/Access Permits	St. Louis County; cities of Duluth, Proctor, and Hermantown
Municipal Stormwater Permit	City of Duluth
Minnesota State Approvals	
Endangered Species Consultation	MnDNR – Ecological Services
Licenses to Cross Public Waters	MnDNR – Lands and Minerals
National Pollutant Discharge Elimination System (NPDES) Construction Stormwater Permit	Minnesota Pollution Control Agency (MPCA)
Section 401 Clean Water Act Water Quality Certification	MPCA
Spill Prevention, Control and Countermeasure Plan update	MPCA
Wetland Conservation Act (WCA)	Board of Water and Soil Resources, Soil and Water Conservation District, County, City,
Minn. Stat. Ch. 138 (Minnesota Field Archaeology Act and Minnesota Historic Sites Act)	SHPO, Office of State Archaeologist, and Minnesota Indian Affairs Council
Driveway/Access Permit	MnDOT
Utility Accommodation on Trunk Highway ROW	MnDOT
Oversize and/or Overweight Permit	MnDOT
Federal Approvals	
Section 404 Dredge and Fill Permit[5]	United States Army Corps of Engineers (USACE)
Endangered Species Consultation	United States Fish and Wildlife Service (USFWS)
Part 7460 Airport Obstruction Evaluation	Federal Aviation Administration /MnDOT
Other Approvals	
Crossing Permits/Agreements/Approvals	Other utilities such as pipelines, railroads

9.1 Local Approvals

After the Commission approves a route and any appropriate design engineering is completed, the Applicant will work with LGUs to obtain any of the following approvals if necessary.

9.1.1 Road Crossing/ROW Permits

These permits may be required to cross or occupy county or city road ROW.

9.1.2 Land Permit or Easements

These permits or easement may be required to cross or occupy county or city lands.

9.1.3 Oversize/Overweight Load Permits

These permits may be required to move over-width or heavy loads on county, township, or city roads.

9.1.4 Driveway/Access Permits

These permits may be required to construct access roads or driveways from county or city roadways.

9.1.5 Duluth Municipal Stormwater Permit

A stormwater permit may be required from the City of Duluth for stormwater discharges associated with construction activities disturbing one or more acres. A requirement of the permit is to develop and implement a SWPPP, which includes BMPs to minimize discharge of pollutants from the site.

Expansions of the Ridgeview and Hilltop substations will disturb more than one acre of land. The Applicant will coordinate the development of a comprehensive SWPPP for the Project and obtain any required permit(s) from the City of Duluth and MPCA once the Commission approves a route for the Project.

9.2 State Approvals

9.2.1 Endangered Species Consultation

The MnDNR Natural Heritage and Nongame Research Program collects, manages, and interprets information about nongame species. Consultation was requested from the MnDNR for the Project regarding rare and unique species. The Applicant will work with the MnDNR regarding Project-specific construction considerations after the Commission approves a route for the Project.

9.2.2 License to Cross Public Waters

The MnDNR Division of Lands and Minerals regulates utility crossings over, under, or across any state land or public water identified on the Public Waters and Wetlands Maps. A license to cross Public Waters is required under Minnesota Statutes Section 84.415 and Minnesota Rules Chapter 6135. The proposed 115 kV transmission line and underground fiber optic line would cross MnDNR Public Waters; therefore, licenses would be required. The Applicant will work with the MnDNR to obtain these licenses once a route is approved and sufficient engineering work is completed to support the MnDNR's application process.

9.2.3 Wetland Conservation Act

The Minnesota Board of Water and Soil Resources administers the state WCA, under Minnesota Rules Chapter 8420. The proposed Project would require a permit under these rules for anticipated permanent impacts to wetlands from transmission line structures, Ridgeview and Hilltop substation expansions, and construction. The Applicant will apply for these permits (which is a joint application with the Section 404 permit) or for an exemption if applicable once the Commission approves a route for the Project and more detailed transmission engineering is completed.

9.2.4 NPDES Permit

An NPDES permit from the MPCA is required for stormwater discharges associated with construction activities disturbing one or more acres. A requirement of the permit is to develop and implement a SWPPP, which includes BMPs to minimize discharge of pollutants from the site. Construction of the expanded Ridgeview and Hilltop substations will disturb more than one acre of land. Applicant will coordinate the development of a comprehensive SWPPP for the Project and obtain any required permit(s) from the MPCA once the Commission approves a route for the Project.

9.2.5 Section 401 Water Quality Certification

A Section 401 certification is necessary to obtain a federal permit for a project that could result in a discharge to navigable waters. A Section 401 certification is a part of the Section 404 process and would be obtained with the joint applications for WCA and the Section 404 permit.

9.2.6 Spill Prevention, Control and Countermeasure Plan

A Spill Prevention, Control and Countermeasure ("SPCC") plan update would be required for the Ridgeview and Hilltop substation expansions should there be new (added or changed) transformers to the facilities in order to contain and prevent discharge of oil or other petroleum products into waters of the United States.

9.2.7 Driveway/Access Permit

The Applicant and its contractors will work with MnDOT should access from a MnDOT road be required for construction once the Commission approves a route for the Project and more detailed transmission engineering is completed.

9.2.8 Utility Accommodation on Trunk Highway ROW

MnDOT requires the submission of an Application for Utility Accommodation on Trunk Highway Right of Way when utilities request permission to place, construct, and reconstruct utility facilities within Trunk Highway ROW, whether the utility facility runs longitudinally, skewed, or perpendicular to the centerline of the highway. The Applicant will work with MnDOT once the Commission approves a route for the Project and more detailed transmission engineering is completed.

9.2.9 Oversize and/or Overweight Permit

An Oversize and/or Overweight permit is required by MnDOT when a vehicle is transporting an oversize/overweight load on Minnesota trunk highways. If the Project requires the transport of oversize or overweight loads, the Applicant and its contractors will work with MnDOT to obtain any required permits.

9.3 Federal Approvals

9.3.1 Section 404 Permit

A Section 404 permit is required from the USACE for discharges of dredged or fill material into waters of the United States. Once the Commission approves a final route and a more detailed design of the two substation expansions and transmission line is completed, the Applicant will determine if impacts exceed the permitting threshold. If impacts exceed the permitting threshold, the Applicant will apply for any required permits.

9.3.2 Endangered Species Consultation

The Applicant requested USFWS review of the Project regarding federally-listed species and critical habitat. The Applicant will work with the USFWS to comply with the Bald and Golden Eagle Protection Act or Migratory Bird Treaty Act to identify any areas that may require marking transmission line shield wires and/or to use alternate structures to reduce the likelihood of avian collisions. The Applicant will work with the USFWS regarding Project-specific construction considerations after the Commission approves a route for the Project.

9.3.3 Part 7460 Airport Obstruction Evaluation

FAA notice and approval are required for structures 200 feet above ground level or those that may exceed an imaginary surface extending outward and upward at certain slopes defined in the Code of Federal Regulations Chapter 77.9. Form 7460-1 shall be submitted

to the FAA for notice of construction. Following construction completion, as-built information will be submitted using Form 7460-2.

9.4 Other Approvals

These approvals may be required to have a transmission line span an existing utility such as a pipeline, distribution line and/or a railway. Otherwise, an approval may be needed from the utility or railway for an access road or driveway that accesses the other utilities right-of-way or railway lands and will be obtained once a Route Permit has been issued by the Commission.

10.1 Certificate of Need Criteria

Pursuant to Minnesota Statute § 216B.243, the Commission has established criteria under Minnesota Rule 7849.0120 that it will apply to determine whether an applicant has established that a new proposed high voltage transmission line is needed and shall be granted a Certificate of Need. Minnesota Power has described in this application the reasons why the Commission should grant a Certificate of Need to build the Duluth Loop Project, which includes: (1) construction of about 14 miles of new 115 kV transmission line between the Ridgeview, Haines Road, and Hilltop Substations; (2) construction of a new one-mile extension connecting an existing 230 kV transmission line to the Arrowhead Substation; (3) upgrades to the Ridgeview, Hilltop, Haines Road, and Arrowhead substations; and (4) reconfiguration, rebuild, and upgrade to existing transmission lines and communications infrastructure in the Project area. Those reasons are summarized here.

10.1.1 Denial Would Adversely Affect the Energy Supply

Denial of a Certificate of Need for the Project would adversely affect the future adequacy, reliability, or efficiency of energy supply to Minnesota Power and its customers in the region, which includes a unique mix of industrial customers vital to Minnesota and the regional economy. The transmission system in the Duluth area has historically been supported by several coal-fired baseload generators located along Minnesota's North Shore. For decades, these local generators have contributed to the reliability of the transmission system by delivering power to the local area and by providing system support. As Minnesota Power and its customers have transitioned away from reliance on coal to increasingly lower-carbon sources of energy, the idling of generators on the North Shore has led to an increased reliance on the transmission system to deliver replacement power and system support to the Duluth area and the North Shore. In order to maintain a continuous supply of safe and reliable electricity, while replacing the support once provided by these local coal-fired generators, the Duluth-area transmission system must be upgraded.

The Duluth Loop Project includes the planning and construction of a new transmission line and associated system upgrades that will enhance reliability by building an additional transmission source to these communities in and around Duluth and along the North Shore. Many of the customers in the Duluth area are served from substations connected to the Duluth Loop, including Hermantown, the Miller Hill Mall, the Duluth International Airport, Duluth Heights, Kenwood, the universities, the downtown hospital district, Woodland, Lakeside, Hunter's Park, and Congdon, among others. In summary, the Duluth Loop Project will enhance reliability for communities in Duluth and the North Shore by adding additional transmission to the area and to replace grid strength and stability that was once provided by local coal-fired generation.

10.1.2 No Reasonable and Prudent Alternative

As discussed in **Chapter 4**, a more reasonable and prudent alternative was not demonstrated by the study work and analysis conducted by Minnesota Power. Minnesota Power evaluated multiple alternatives including: (1) size alternatives (different voltages or conductor arrays, alternative current ("AC")/direct current ("DC"), and double-circuit); (2) generation alternatives; and (3) no build alternatives. After evaluating these alternatives, Minnesota Power concluded that none of these alternatives is a more reasonable and prudent alternative to the proposed Project.

10.1.3 Project will Provide Benefits to Society in a Manner Compatible with Protecting the Environment

The Project is needed to provide transmission reliability and grid strength and stability solutions to accommodate a transition away from coal-fired baseload generation to increasingly lower-carbon and renewable sources of energy, which lowers emissions and benefits the environment. The Project will also benefit customers in the service area by addressing severe voltage stability concerns, relieving transmission line overloads, enhancing the reliability of Duluth-area transmission sources, and by ensuring an adequate power supply for years to come. In addition, consistent with the Commission's routing criteria, the proposed Project will be routed in a manner compatible with protecting the natural and socioeconomic environment.

10.1.4 Project will Comply with All Applicable Requirements

Minnesota Power has identified the other permits and approvals that may be required for the Project in **Chapter 9**. Minnesota Power has demonstrated that it will comply with all applicable requirements and obtain all necessary permits.

10.2 Route Permit Factors

According to Minn. Stat. § 216E.02, subd. 1, it is the policy of the state of Minnesota to locate high voltage transmission lines in an orderly manner that minimizes adverse human and environmental impacts and ensures continuing electric power system reliability and integrity. Under Minn. R. 7850.4000, the Commission's rules require that applicants for route permits meet applicable standards and factors under Minn. Stat. §§ 216E.03 and 216E.04, and under other Minnesota law and Commission rules. The Commission shall issue a route permit for a high voltage transmission line that is consistent with state goals to conserve resources, minimize environmental impacts and impacts to human settlement, minimize land use conflicts, and ensure the state's electric energy security through efficient, cost-effective transmission infrastructure.

The Proposed Route for the Project meets these factors by: utilizing existing transmission right-of-way to the extent feasible, double-circuiting with an existing line where this configuration is not contrary to the operational objectives of the Project, includes realignments of existing lines to reduce impacts to natural resources, address right-of-

way encroachments, and consolidates transmission corridors to reduce impacts to established residences, and upgrading existing transmission infrastructure.

10.3 Conclusion and Request for Commission Approval

For all the reasons set forth in this Application and as supported by the Appendices hereto, Minnesota Power respectfully requests that the Commission issue a Certificate of Need and Route Permit authorizing construction of the Duluth Loop Project.

City of Duluth. 2019. *Zoning Regulations – Overlay Districts; airport Overlay*. Retrieved June 18, 2021. https://duluthmn.gov/media/11026/50-18-ao.pdf.

City of Hermantown. 2015. *Zoning Regulations; Chapter 5. Land Use Regulations*. Retrieved June 18, 2021. https://hermantownmn.com/wp-content/uploads/2020/01/ZONING_CHAPTER_5_LAND_USE_REGULATIONS_2015-12-29.pdf.

Department of Natural Resources (MnDNR). September 2000. Ecological Classification System. Retrieved May 24, 2021. https://www.MnDNR.state.mn.us/ecs/index.html.

DNRa. 2018. Chester Creek AMA. Retrieved August 31, 2021. https://www.MnDNR.state.mn.us/amas/detail_report.html?id=AMA00539.

DNRb. 2021. Streamfinder; Chester Creek. Retrieved August 31, 2021. https://www.MnDNR.state.mn.us/streamfind/north-shore-stream.html?id=S-003.

DNRc. 2021. Ecological and Water Resources. Wetlands. Retrieved August 31, 2021. https://www.MnDNR.state.mn.us/wetlands/index.html.

DNRd. 2021. Natural Heritage Inventory System (NHIS); HDR License Agreement #181559. https://www.MnDNR.state.mn.us/nhnrp/nhis.html.

DNRe. June 7, 2021. Townships Containing Documented Northern Long-Eared Bat (NLEB) Maternity Roost Trees and/or Hibernacula Entrances in Minnesota. Retrieved August 31, 2021. https://files.MnDNR.state.mn.us/eco/ereview/minnesota_nleb_township_list_and_map.pdf

Duluth Seaway Port Authority. 2021. Port Operations and Facilities. Retrieved May 22, 2021. https://duluthport.com/business/port-operations-and-facilities/.

Jeffers. 1999. “Electric and Magnetic Fields and Ecology.” In Issues in Environmental Science and Technology, No. 11; Environmental Impact of Power Generation. The Royal Society of Chemistry.

Minnesota Pollution Control Agency (MPCA). November 2015. A Guide to Noise Control in Minnesota. Retrieved May 22, 2021. https://www.pca.state.mn.us/sites/default/files/p-gen6-01.pdf.

MPCAa. 2020. Minnesota’s Impaired Waters List. Retrieved August 31, 2021. https://www.pca.state.mn.us/water/minnesotas-impaired-waters-list.

Minnesota Power. 2021. Duluth Loop Reliability Project – Structures. Retrieved May 24, 2021. https://www.mnpower.com/DuluthLoop.

USDA. 2017. 2017 Census of Agriculture for St. Louis County. Retrieved May 22, 2021. https://www.nass.usda.gov/Publications/AgCensus/2017/Online_Resources/County_Profiles/Minnesota/cp27137.pdf.

Appendix A Certificate of Need Completeness Checklist

Appendix B Route Permit Completeness Checklist

Appendix C Applicant's Exemption Request

Appendix D Applicant's Notice Plan Petition

Appendix E Commission Order on Exemption Request and Notice Plan

Appendix F 90-day Pre-Application Letter to Local Units of Government and Affidavits of Mailing

Appendix G Notice of Intent to File a Route Permit Application under the Alternative Route Permit Process

Appendix H Electric and Magnetic Fields Calculations and Noise Calculations

Appendix I Duluth Transmission Study

Appendix J Detailed Route Maps and figures showing the Ridgeview Substation and Hilltop Substation expansions

Appendix K Technical Drawings of Proposed Structures

Appendix L Environmental Impact Tables

Appendix M Agency Correspondence

Appendix N Public Outreach Materials

Appendix O List of Landowners Along and Adjacent to Route Options

Appendix P Project Area Substation Load Data and Minnesota Power's July 2021 Annual Electric Utility Forecast Report

Appendix Q Applicant's Demand-Side Management and Conservation

Appendix R ***Confidential*** - Natural Heritage Information System, USFWS Species List, and Phase Ia Cultural Resources Literature Search