ATTACHMENT A

7 Relative Merits of the Project as a Whole

The Commission is charged with locating transmission lines in a manner that is "compatible with environmental preservation and the efficient use of resources" and that minimizes "adverse human and environmental impact(s)" while ensuring electric power reliability (Minn. Statute 216E.02). Minn. Statute 216E.03, subdivision 7(b) identifies considerations that the Commission must consider when designating transmission lines routes.

Minn. Rule 7850.4100 lists 14 factors for the Commission to consider in its route permitting decisions, including impacts on human settlements, land-based economies, and the natural environment (see Factors Considered by the Commission for Transmission Line Route Permits sidebar). Through an analysis of the routing factors, this chapter presents the merits of the applicant's proposed route and other example, full route options.

Many of the project impacts relative to the applicable routing factors are anticipated to be avoided or minimized by the (1) route selection, (2) general and special conditions in the Commission's route permit, (3) prudent transmission structure placement and placement of the alignment within the permitted route, and (4) the requirements of "downstream" permits such as the construction stormwater permit.

The discussion here focuses on the first 12 routing factors (See Minn. Rule 7850.4100, factors A through L). Routing factors M and N— the unavoidable and irreversible impacts of the project—are discussed at the end of this chapter.

Routing factor G ("mitigate adverse environmental impacts") has several parts and speaks generally to environmental impacts. For purposes of discussion here, and with respect to routing factor G, it is assumed that all routing alternatives are equal with regard to maximizing energy efficiencies and accommodating expansion of transmission capacity. With respect to environmental impacts, the examination of such impacts suggested by routing factor G is included in the discussion of other routing factors and elements that more specifically address an environmental impact (e.g., effects on vegetation and wildlife, routing factor E).

Routing factor I, the use of existing large electric power generating plant sites, is not relevant to this project and is not discussed further.

Finally, routing factors H and J address similar issues, the use or paralleling of existing rights-of-way. Routing factor H relates to the use or paralleling of existing rights-of-way, but also includes items

Factors Considered by the Commission for Transmission Line Route Permits

To determine whether to issue a route permit for a high-voltage transmission line, the Commission shall consider the following factors of Minnesota Rules, part 7850.4100:

A. Effects on human settlement, including, but not limited to, displacement, noise, aesthetics, cultural values, recreation, and public services.

B. Effects on public health and safety.

C. Effects on land-based economies, including, but not limited to, agriculture, forestry, tourism, and mining.

D. Effects on archaeological and historic resources.

E. Effects on the natural environment, including effects on air and water quality resources and flora and fauna.

F. Effects on rare and unique natural resources.

G. Application of design options that maximize energy efficiencies, mitigate adverse environmental effects, and could accommodate expansion of transmission or generating capacity.

H. Use or paralleling of existing rights-of-way, survey lines, natural division lines, and agricultural field boundaries.

I. Use of existing large electric power generating plant sites.

J. Use of existing transportation, pipeline, and electrical transmission systems or rights-of-way.

K. Electrical system reliability.

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

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

N. Irreversible and irretrievable commitments of resources.

that do not have a ROW, such as survey lines, natural division lines, and agricultural field boundaries. Routing factor J relates to the use of existing transportation, pipeline, and electrical transmission rights-of-way. Within this chapter, these factors are considered similarly—the use or paralleling of existing rights-of-way, where there is infrastructure that has a ROW. However, the discussion here emphasizes existing transmission line ROW usage as opposed to other infrastructure ROW.

7.1 Applicants' Proposed Routes and Example Full Route Options

Seven full route options (i.e., end-to-end routes from the Iron Range Substation to the Sherco and Big Oaks Substations) are discussed here. These full route options are:

- **The applicants' proposed route**. This is the route proposed by the applicants in their CN and route permit application.
- **The applicants' proposed route with modifications**. This route includes modifications proposed by the applicants in response to public comments and includes routing alternatives that would further consolidate the proposed new double-circuit 345 kV transmission line with existing transmission lines, particularly in the Cole Lake-Riverton Region. This route includes alignment alternative AA3 and route alternative E1 (Map 7-1).
- **Example Route Option 1**. This route includes portions of the applicants' proposed route, including some modifications proposed by the applicants, and routing alternatives proposed during the EA scoping comment period. This route includes route alternatives B, E1, H1 and alignment alternatives AA3 and AA16 (Table 7-1; Map 7-2).
- **Example Route Option 2**. Similar to Route 1, this route includes portions of the applicants' proposed route, including some modifications proposed by the applicants, and routing alternatives proposed during the EA scoping comment period. This route includes route alternatives A2, B, C, E1, H1, J1 and alignment alternatives AA3 and AA16 (Table 7-1; Map 7-3).
- **Example Route Option 3**. This route includes modifications proposed by the applicants in response to public comments. This route includes alignment alternatives AA3 and AA9 (Table 7-1; Map 7-4).
- **Example Route Option 4**. This route includes portions of the applicants' proposed route, including some modifications proposed by the applicants, and routing alternatives proposed during the EA scoping comment period. This route includes route alternatives A2, B, C, E1, K, and J2 and alignment alternatives AA3 and AA16 ~~and AA3~~ (Table 7-1; Map 7-5).
- **Example Route Option 5**. This route includes portions of the applicants' proposed route, including some modifications proposed by the applicants, and routing alternatives proposed during the EA scoping comment period. This route includes route alternatives A2, B, C, E1, H1, J1 and J3, and alignment alternatives AA3 and AA16 (Table 7-1; Map 7-6).

These full route options are not meant to represent the only Northland Reliability Project routing possibilities. Rather, they are examples of route options that could be assembled for the project. They are meant to illustrate how various routing alternatives could be selected to build a full project route. Analyzing these seven full route options against each other provides the opportunity to understand what impacts might look like if one of these full routes, or a similar route, were selected by the Commission for the project.

The full route options were compiled by selecting route alternatives or alignment alternatives within each region that could be feasibly connected to each another to create a full transmission line route between the existing Iron Range Substation, a new Cuyuna Series Compensation Substation, the existing Benton County Substation, the existing Sherco Substation, and the new Big Oaks Substation (Map Book 7A).

These full route options are simply examples for comparison; other full routes may be developed by combining route alternatives and alignment alternatives that could create a full transmission line route connecting the relevant features noted above. No option is meant to represent a “best case scenario” or to be “least impactful overall.” Instead, the example routing options are meant to help the reader understand how the impacts of one routing option compares to another for the entirety of the line.

Placeholder for:

Map 7-1 Applicants' Proposed Route with Modifications

Placeholder for:

Map 7-2 Example Route Option 1

Placeholder for:

Map 7-3 Example Route Option 2

Placeholder for:

Map 7-4 Example Route Option 3

Placeholder for:

Map 7-5 Example Route Option 4

Placeholder for:

Map 7-6 Example Route Option 5

Table 7-1 Example Full Route Option Features

Region and Route Alternative Choices	Example Route Option 1	Example Route Option 1 Features	Example Route Option 2	Example Route Option 2 Features	Example Route Option 3	Example Route Option 3 Features	Example Route Option 4	Example Route Option 4 Features	Example Route Option 5	Example Route Option 5 Features
Iron Range Substation Region – A1, A2, A3, A4, and applicants' equivalent	Applicants' Equivalent	• Maximizes the paralleling of existing transmission line ROW; • Minimizes impacts to residences and non-residential structures; • Avoids impacts to cultural resources; and • Balances impacts to natural environment (not the highest or lowest for impacts to agriculture, wetlands, or forested land cover).	A2	• Route alternatives A1 and A2 are comparable options in that they both maximize use of paralleling existing transmission line and road rights-of-way and minimize impacts to the natural environment. However, route alternative A2 minimizes impacts to residences more than route alternative A1. • Route alternative A3 would place a residence between two transmission lines, within 200 feet of each line. • Route alternative A4 is the longest and while minimizing impacts to residences, it would have the most impact on the natural environment and does not make use of any existing transmission line ROW.	Applicants' Equivalent	• Maximizes the paralleling of existing transmission line ROW; • Minimizes impacts to residences and non-residential structures; • Avoids impacts to cultural resources; and • Balances impacts to natural environment (not the highest or lowest for impacts to agriculture, wetlands, or forested land cover).	A2	• Route alternatives A1 and A2 are comparable options in that they both maximize use of paralleling existing transmission line and road rights-of-way and minimize impacts to the natural environment. However, route alternative A2 minimizes impacts to residences more than route alternative A1. • Route alternative A3 would place a residence between two transmission lines, within 200 feet of each line. • Route alternative A4 is the longest and while minimizing impacts to residences, it would have the most impact on the natural environment and does not make use of any existing transmission line ROW.	A2	• Route alternatives A1 and A2 are comparable options in that they both maximize use of paralleling existing transmission line and road rights-of-way and minimize impacts to the natural environment. However, route alternative A2 minimizes impacts to residences more than route alternative A1. • Route alternative A3 would place a residence between two transmission lines, within 200 feet of each line. • Route alternative A4 is the longest and while minimizing impacts to residences, it would have the most impact on the natural environment and does not make use of any existing transmission line ROW.
Iron Range Substation Region – AA15 and applicants' equivalent	Applicants' Equivalent	• These two routing alternatives are similar with respect to the routing factors. However, alignment alternative AA15 would require two perpendicular crossings of an existing transmission line, which raises constructability and reliability concerns and costs. In contrast. the applicants' equivalent would parallel an existing transmission line for its entire length.	Applicants' Equivalent	• These two routing alternatives are similar with respect to the routing factors. However, alignment alternative AA15 would require two perpendicular crossings of an existing transmission line, which raises constructability and reliability concerns. In contrast. the applicants' equivalent would parallel an existing transmission line for its entire length.	Applicants' Equivalent	• These two routing alternatives are similar with respect to the routing factors. However, alignment alternative AA15 would require two perpendicular crossings of an existing transmission line, which raises constructability and reliability concerns. In contrast. the applicants' equivalent would parallel an existing transmission line for its entire length.	Applicants' Equivalent	• These two routing alternatives are similar with respect to the routing factors. However, alignment alternative AA15 would require two perpendicular crossings of an existing transmission line, which raises constructability and reliability concerns. In contrast. the applicants' equivalent would parallel an existing transmission line for its entire length.	Applicants' Equivalent	• These two routing alternatives are similar with respect to the routing factors. However, alignment alternative AA15 would require two perpendicular crossings of an existing transmission line, which raises constructability and reliability concerns. In contrast. the applicants' equivalent would parallel an existing transmission line for its entire length.

Region and Route Alternative Choices	Example Route Option 1	Example Route Option 1 Features	Example Route Option 2	Example Route Option 2 Features	Example Route Option 3	Example Route Option 3 Features	Example Route Option 4	Example Route Option 4 Features	Example Route Option 5	Example Route Option 5 Features
Hill City to Little Pine Region – B and applicants' equivalent	B	• Maximizes paralleling existing transmission line ROW more than the applicants' equivalent; • Minimizes impacts to residences within 250 feet; • Is located within 1,300 feet of the runway of the Hill City/Quadna Mountain Airport; however, parallels an existing transmission line in this location; • Minimizes impacts to cultural resources; and • While route alternative B would impact more forested vegetation native plant communities and candidate old growth, the applicants' equivalent would impact more Sites of Biodiversity Significance and native plant communities, as well as traverse a Wildlife Management Area.	B	• Maximizes paralleling existing transmission line ROW more than the applicants' equivalent; • Minimizes impacts to residences within 250 feet; • Is located within 1,300 feet of the runway of the Hill City/Quadna Mountain Airport; however, parallels an existing transmission line in this location; • Minimizes impacts to cultural resources; and • While route alternative B would impact more forested vegetation native plant communities and candidate old growth, the applicants' equivalent would impact more Sites of Biodiversity Significance and native plant communities, as well as traverse a Wildlife Management Area.	Applicants' Equivalent	• Fewer residences within 1,000 feet than route alternative B; • Located outside of the zones of concern for the Hill City/Quadna Mountain Airport; • Impacts less forested vegetation, native plant communities, and candidate old growth than route alternative B; however, impacts more Sites of Biodiversity Significance and native plant communities, and traverses a Wildlife Management Area	B	• Maximizes paralleling existing transmission line ROW more than the applicants' equivalent; • Minimizes impacts to residences within 250 feet; • Is located within 1,300 feet of the runway of the Hill City/Quadna Mountain Airport; however, parallels an existing transmission line in this location; • Minimizes impacts to cultural resources; and • While route alternative B would impact more forested vegetation native plant communities and candidate old growth, the applicants' equivalent would impact more Sites of Biodiversity Significance and native plant communities, as well as traverse a Wildlife Management Area.	B	• Maximizes paralleling existing transmission line ROW more than the applicants' equivalent; • Minimizes impacts to residences within 250 feet; • Is located within 1,300 feet of the runway of the Hill City/Quadna Mountain Airport; however, parallels an existing transmission line in this location; • Minimizes impacts to cultural resources; and • While route alternative B would impact more forested vegetation native plant communities and candidate old growth, the applicants' equivalent would impact more Sites of Biodiversity Significance and native plant communities, as well as traverse a Wildlife Management Area.
Hill City to Little Pine Region – C and applicants' equivalent	Applicants' Equivalent	• Is 1.5 miles shorter and maximizes the paralleling of existing transmission line ROW; • Avoids residences and non-residential structures in the ROW; and • Minimizes impacts to forested vegetation but would impact slightly more wetlands, Sites of Biodiversity Significance, and native plant communities. It would also have a few more stream crossings; however, it would traverse all of these resources while paralleling an existing transmission line ROW.	C	• Minimizes impacts to wetlands, Sites of Biodiversity Significance, and native plant communities but would impact more forested vegetation; and • Minimizes stream crossings; however, the crossings that would occur, would be new crossings, as they would occur where an existing transmission line ROW is not currently present.	Applicants' Equivalent	• Is 1.5 miles shorter and maximizes the paralleling of existing transmission line ROW; • Avoids residences and non-residential structures in the ROW; and • Minimizes impacts to forested vegetation but would impact slightly more wetlands, Sites of Biodiversity Significance, and native plant communities. It would also have a few more stream crossings; however, it would traverse all of these resources while paralleling an existing transmission line ROW.	C	• Minimizes impacts to wetlands, Sites of Biodiversity Significance, and native plant communities but would impact more forested vegetation; and • Minimizes stream crossings; however, the crossings that would occur, would be new crossings, as they would occur where an existing transmission line ROW is not currently present.	C	• Minimizes impacts to wetlands, Sites of Biodiversity Significance, and native plant communities but would impact more forested vegetation; and • Minimizes stream crossings; however, the crossings that would occur, would be new crossings, as they would occur where an existing transmission line ROW is not currently present.

Region and Route Alternative Choices	Example Route Option 1	Example Route Option 1 Features	Example Route Option 2	Example Route Option 2 Features	Example Route Option 3	Example Route Option 3 Features	Example Route Option 4	Example Route Option 4 Features	Example Route Option 5	Example Route Option 5 Features
Hill City to Little Pine Region – AA1, AA2, and applicants' equivalent	Applicants' Equivalent	• These three routing alternatives are similar with respect to the routing factors. However, alignment alternatives AA1 and AA2 would require perpendicular crossings of an existing transmission line, which raises constructability and reliability concerns. In contrast. the applicants' equivalent would parallel an existing transmission line for its entire length.	Applicants' Equivalent	• These three routing alternatives are similar with respect to the routing factors. However, alignment alternatives AA1 and AA2 would require perpendicular crossings of an existing transmission line, which raises constructability and reliability concerns. In contrast. the applicants' equivalent would parallel an existing transmission line for its entire length.	Applicants' Equivalent	• These three routing alternatives are similar with respect to the routing factors. However, alignment alternatives AA1 and AA2 would require perpendicular crossings of an existing transmission line, which raises constructability and reliability concerns. In contrast. the applicants' equivalent would parallel an existing transmission line for its entire length.	Applicants' Equivalent	• These three routing alternatives are similar with respect to the routing factors. However, alignment alternatives AA1 and AA2 would require perpendicular crossings of an existing transmission line, which raises constructability and reliability concerns. In contrast. the applicants' equivalent would parallel an existing transmission line for its entire length.	Applicants' Equivalent	• These three routing alternatives are similar with respect to the routing factors. However, alignment alternatives AA1 and AA2 would require perpendicular crossings of an existing transmission line, which raises constructability and reliability concerns. In contrast. the applicants' equivalent would parallel an existing transmission line for its entire length.
Hill City to Little Pine Region – AA16 and applicants' equivalent	AA16	• Minimizes impacts by reconfiguring an existing transmission line to use that line's ROW; and • Minimizes impacts to residences and the natural environment by constructing in an existing, previously disturbed ROW.	AA16	• Minimizes impacts by reconfiguring an existing transmission line to use that line's ROW; and • Minimizes impacts to residences and the natural environment by constructing in an existing, previously disturbed ROW.	Applicants' Equivalent	• Impacts minimized by paralleling existing transmission line for the entire length; and • Costs less than route alternative AA16.	AA16	• Minimizes impacts by reconfiguring an existing transmission line to use that line's ROW; and • Minimizes impacts to residences and the natural environment by constructing in an existing, previously disturbed ROW.	AA16	• Minimizes impacts by reconfiguring an existing transmission line to use that line's ROW; and • Minimizes impacts to residences and the natural environment by constructing in an existing, previously disturbed ROW.
Cole Lake-Riverton Region – AA3 and applicants' equivalent	AA3[1]	• Minimizes impacts by reconfiguring an existing transmission line to use that line's ROW; and • Minimizes impacts to residences and the natural environment by constructing in an existing, previously disturbed ROW.	AA3[1]	• Minimizes impacts by reconfiguring an existing transmission line to use that line's ROW; and • Minimizes impacts to residences and the natural environment by constructing in an existing, previously disturbed ROW.	AA3[1]	• Minimizes impacts by reconfiguring an existing transmission line to use that line's ROW; and • Minimizes impacts to residences and the natural environment by constructing in an existing, previously disturbed ROW.	AA3[1]	• Minimizes impacts by reconfiguring an existing transmission line to use that line's ROW; and • Minimizes impacts to residences and the natural environment by constructing in an existing, previously disturbed ROW.	AA3[1]	• Minimizes impacts by reconfiguring an existing transmission line to use that line's ROW; and • Minimizes impacts to residences and the natural environment by constructing in an existing, previously disturbed ROW.
Cole Lake-Riverton Region – E1, E2, E3, #4, E5, and applicants' equivalent	E1[2]	• Maximizes the paralleling of existing transmission line ROW and is the only route alternative to parallel one for its entire length; • Minimizes impacts to residences and non-residential structures; • Minimizes impacts to wetlands, forested vegetation, and Sites of Biodiversity Significance. It would traverse the edge of a Lake of Biological Significance but would do so while paralleling an existing transmission line ROW.	E1[2]	• Maximizes the paralleling of existing transmission line ROW and is the only route alternative to parallel one for its entire length; • Minimizes impacts to residences and non-residential structures; • Minimizes impacts to wetlands, forested vegetation, and Sites of Biodiversity Significance. It would traverse the edge of a Lake of Biological Significance but would do so while paralleling an existing transmission line ROW.	Applicants' Equivalent	• Least impact to residences and non-residential structures; and • Costs less than any of the proposed alternatives.	E1[2]	• Maximizes the paralleling of existing transmission line ROW and is the only route alternative to parallel one for its entire length; • Minimizes impacts to residences and non-residential structures; • Minimizes impacts to wetlands, forested vegetation, and Sites of Biodiversity Significance. It would traverse the edge of a Lake of Biological Significance but would do so while paralleling an existing transmission line ROW.	E1[2]	• Maximizes the paralleling of existing transmission line ROW and is the only route alternative to parallel one for its entire length; • Minimizes impacts to residences and non-residential structures; • Minimizes impacts to wetlands, forested vegetation, and Sites of Biodiversity Significance. It would traverse the edge of a Lake of Biological Significance but would do so while paralleling an existing transmission line ROW.

Region and Route Alternative Choices	Example Route Option 1	Example Route Option 1 Features	Example Route Option 2	Example Route Option 2 Features	Example Route Option 3	Example Route Option 3 Features	Example Route Option 4	Example Route Option 4 Features	Example Route Option 5	Example Route Option 5 Features
Cole Lake-Riverton Region – AA8, AA9 and applicants' equivalent	Not Applicable	• Alignment alternatives AA8 and AA9 are mutually exclusive of route alternative E1. Because route alternative E1 was selected in this area, alignment alternatives AA8 and AA9 cannot be selected.	Not Applicable	• Alignment alternatives AA8 and AA9 are mutually exclusive of route alternative E1. Because route alternative E1 was selected in this area, alignment alternatives AA8 and AA9 cannot be selected.	AA9[3]	• Minimizes impacts by following an existing road corridor for approximately 90 percent of its length; and • No residences within 75-250 feet (alignment alternative AA8 and the applicants' equivalent both have 1 residence within 75-200 feet).	Not Applicable	• Alignment alternatives AA8 and AA9 are mutually exclusive of route alternative E1. Because route alternative E1 was selected in this area, alignment alternatives AA8 and AA9 are automatically excluded.	Not Applicable	• Alignment alternatives AA8 and AA9 are mutually exclusive of route alternative E1. Because route alternative E1 was selected in this area, alignment alternatives AA8 and AA9 cannot be selected.
Cole Lake-Riverton Region – G and applicants' equivalent	Applicants' Equivalent	• Minimizes length by being almost 2 miles shorter than route alternative G; • Although it has two more residences within 250-500 feet, it does not have a non-residential structure in the ROW like route alternative G and • Minimizes impacts to agricultural and forested vegetation.	Applicants' Equivalent	• Minimizes length by being almost 2 miles shorter than route alternative G; • Although it has two more residences within 250-500 feet, it does not have a non-residential structure in the ROW like route alternative G; and • Minimizes impacts to agricultural and forested vegetation.	Applicants' Equivalent	• Minimizes length by being almost 2 miles shorter than route alternative G; • Although it has two more residences within 250-500 feet, it does not have a non-residential structure in the ROW like route alternative G and • Minimizes impacts to agricultural and forested vegetation.	Applicants' Equivalent	• Minimizes length by being almost 2 miles shorter than route alternative G; • Although it has two more residences within 250-500 feet, it does not have a non-residential structure in the ROW like route alternative G and • Minimizes impacts to agricultural and forested vegetation.	Applicants' Equivalent	• Minimizes length by being almost 2 miles shorter than route alternative G; • Although it has two more residences within 250-500 feet, it does not have a non-residential structure in the ROW like route alternative G and • Minimizes impacts to agricultural and forested vegetation.
Long Lake Region – H1, H2, H3, H4, H5, H6, H7, and applicants' equivalent	H1[4]	• More paralleling of existing transmission line ROW than the other routing alternatives; and • Minimizes impacts to wetlands, forested vegetation, Sites of Biodiversity Significance, and Grassland Bird Conservation Areas.	H1[4]	• More paralleling of existing transmission line ROW than the other routing alternatives; and • Minimizes impacts to wetlands, forested vegetation, Sites of Biodiversity Significance, and Grassland Bird Conservation Areas.	Applicants' Equivalent	• Minimizes impacts to residences;	Applicants' Equivalent	• Minimizes impacts to residences;	H1[4]	• More paralleling of existing transmission line ROW than the other routing alternatives; and • Minimizes impacts to wetlands, forested vegetation, Sites of Biodiversity Significance, and Grassland Bird Conservation Areas.
Long Lake Region – K and applicants' equivalent	Applicants' Equivalent	• Minimizes impacts to residences and non-residential structures in the ROW and total residences within 1,000 feet; • Minimizes impacts to agricultural vegetation; and • Minimizes impacts to cultural resources.	Applicants' Equivalent	• Minimizes impacts to residences and non-residential structures in the ROW and total residences within 1,000 feet; • Minimizes impacts to agricultural vegetation; and • Minimizes impacts to cultural resources.	Applicants' Equivalent	• Minimizes impacts to residences and non-residential structures in the ROW and total residences within 1,000 feet; • Minimizes impacts to agricultural vegetation; and • Minimizes impacts to cultural resources.	K	• Would parallel an existing transmission line corridor for its entire length; • A number of residences and non-residential structures are located within 75 feet of this route alternative; and • Would impact more Grassland Bird Conservation Areas and a Lake of Biological Significance but would do so while paralleling an existing transmission line.	Applicants' Equivalent	• Minimizes impacts to residences and non-residential structures in the ROW and total residences within 1,000 feet; • Minimizes impacts to agricultural vegetation; and • Minimizes impacts to cultural resources.

Region and Route Alternative Choices	Example Route Option 1	Example Route Option 1 Features	Example Route Option 2	Example Route Option 2 Features	Example Route Option 3	Example Route Option 3 Features	Example Route Option 4	Example Route Option 4 Features	Example Route Option 5	Example Route Option 5 Features
Long Lake Region – AA17 and applicants' equivalent	Applicants' Equivalent	• Maximizes the paralleling of existing transmission line ROW; and • Alignment alternative AA17 would require two perpendicular crossings of an existing transmission line, which raises constructability and reliability concerns.	Applicants' Equivalent	• Maximizes the paralleling of existing transmission line ROW; and • Alignment alternative AA17 would require two perpendicular crossings of an existing transmission line, which raises constructability and reliability concerns.	Applicants' Equivalent	• Maximizes the paralleling of existing transmission line ROW; and • Alignment alternative AA17 would require two perpendicular crossings of an existing transmission line, which raises constructability and reliability concerns.	Applicants' Equivalent	• Maximizes the paralleling of existing transmission line ROW; and • Alignment alternative AA17 would require two perpendicular crossings of an existing transmission line, which raises constructability and reliability concerns.	Applicants' Equivalent	• Maximizes the paralleling of existing transmission line ROW; and • Alignment alternative AA17 would require two perpendicular crossings of an existing transmission line, which raises constructability and reliability concerns.
Benton County Elk River Region – J1, J2, J3, and applicants' equivalent	Applicants' Equivalent	• Maximizes the paralleling of existing transmission line ROW; • Minimizes impacts to residences; • Minimizes impacts to agricultural land; and • Minimizes impacts to Grassland Bird Conservation Area.	J1	• Avoids multiple crossings of the Elk River in the northern part of this region; and • Minimizes impacts to forested vegetation.	Applicants' Equivalent	• Maximizes the paralleling of existing transmission line ROW; • Minimizes impacts to residences; • Minimizes impacts to agricultural land; and • Minimizes impacts to Grassland Bird Conservation Area.	J2	• Has the most residences within 75-250 feet as well as the most residences within 1,000 feet; • Avoids multiples crossings of the Elk River; and • Avoids impacts to cultural resources	J1 and J3	• Maximizes the paralleling of existing transmission line ROW; • Avoids multiple crossings of the Elk River; • Minimizes impacts to forested vegetation; and • Minimizes impacts to a Grassland Bird Conservation area.

1 Because AA3 was selected here, route alternatives D3, AA4, AA6, and the applicants' equivalent are not viable options; these are alternatives to the applicants' proposed route in this area. The applicants' proposed route would be used just north of where AA3 ends.
2 Because E1 was selected here, route alternative F and alignment alternatives AA7, AA8, AA9, and AA10 are not viable options; these are alternatives to the applicants' proposed route in this area.
3 Because AA9 was selected here, route alternative E1 and alignment alternative AA8 are not viable options; these are alternatives to the applicants' proposed route in this area.
4 Because H1 was selected here, route alternative K and alignment alternatives AA12, AA13, and AA14 are not viable options; these are alternatives to the applicants' proposed route in this area.

7.2 Applicants' Proposed Routes and Example Full Route Option Impacts

Potential impacts of the applicants' proposed routes and full route options are summarized in Table 7-2 and described further in Chapters 7.2.1 through 7.2.5.

Table 7-2 Human and Environmental Impacts for the Applicants' Proposed Routes and Example Full Route Options

Resource	Element	Applicants' Proposed Route	Applicants' Proposed Route with Modifications	Example Route Option 1	Example Route Option 2	Example Route Option 3	Example Route Option 4	Example Route Option 5
Length (miles)		~~182.3~~176.3	~~180.5~~175.2	~~177.6~~174.1	~~179.6~~176.7	~~184.3~~176	~~177~~174.1	~~180.2~~177.4
Human Settlement	Residences within 0-75 feet (count)	3	2	2	3	3	5	4
	Residences within 75-250 feet (count)	102	111	109	117	104	126	125
	Residences within 250-500 feet (count)	164	172	194	209	161	210	212
	Residences within 500-1,000 feet (count)	380	377	385	396	386	410	402
Environmental Justice Concerns (EJC)	Communities of EJ concern crossed by the 150-ft ROW (count)	6	5	7	7	7	7	7
Land-Based Economies	Agricultural land in 150-ft ROW (acres)	1,260	1,302	1,298	1,325	1.280	1.346	1.337
Archaeology and Historic Architecture	Archaeological sites and historic architectural resources in 1,000-foot route width (count)	43	43	41	44	43	47	46
Water Resources	NHD stream crossings (count)	151	150	150	134	151	120	127
	PWI stream crossings (count)	82	79	78	59	82	52	52
	Impaired stream crossings (count)	46	46	46	28	46	18	21
	NHD lake crossings (count)	20	15	18	21	20	19	20
	Impaired lake crossings (count)	0	1	1	1	0	2	1
	PWI basin crossings (count)	9	7	9	9	10	10	9
	PWI wetland crossings (count)	10	7	7	6	7	6	6
	Floodplain crossings greater than 1,000 feet (count)	10	8	8	4	10	4	3
	Total wetlands in 150-foot ROW (acres)	986	957	968	926	977	887	913
	Forested wetlands in 150-ft ROW (acres)	235	223	233	218	235	211	211
	Wetland crossings greater than 1,000 feet (count)	84	80	77	71	82	68	70
Vegetation	Forested landcover in 150-foot ROW (acres)	1,240	1,157	1,093	1,102	1,242	1,047	1,092
Wildlife	Wildlife Management Areas in 150-foot ROW (acres)	14	18	5	5	14	5	5
	Grassland Bird Conservation Areas in 150-foot ROW (acres)	1,241	1,241	1,241	1,252	1,241	1,287	1,265
	Shallow Wildlife Lake in 150-foot ROW (acres)	6	6	6	6	6	6	6
Rare and Unique Natural Resources	Sites of Biodiversity in 150-foot ROW (ranked moderate, high, or outstanding; acres)	954	914	743	735	985	692	735
	Native plant communities in 150-foot ROW (acres)	293	275	276	271	299	271	271
	High Conservation Value Forest in 150-foot ROW (acres)	124	124	33	33	124	33	33

Resource	Element	Applicants' Proposed Route	Applicants' Proposed Route with Modifications	Example Route Option 1	Example Route Option 2	Example Route Option 3	Example Route Option 4	Example Route Option 5
	Lake of Biological Significance in 150-foot ROW (acres)	2	5	5	5	2	6	5
	Federal- or state-protected species documented in 150-foot ROW (count)	3	3	3	3	3	3	3
ROW Sharing and Paralleling	Transmission line (miles, percent)	159.3 (87)	166.7 (92)	167.8 (95)	160.0 (89)	162.7 (88)	159.0 (90)	158.5 (88)
	Roadway (miles, percent)	4.0 (2)	4.0 (2)	3.9 (2)	13.3 (7)	5.4 (3)	15.3 (9)	15.9 (9)
	Field, parcel, or section lines (miles, percent)	55.0 (30)	48.1 (27)	44.4 (25)	52.7 (29)	56.5 (31)	51.9 (29)	54.8 (30)
	Total ROW sharing and paralleling (miles, percent)	176.4 (97)	177.0 (98)	174.2 (98)	175.0 (98)	179.5 (97)	173.2 (98)	175.6 (97)
Estimated Cost[1]	Total estimated mid-range cost (2022 dollars in millions)	$9371,182	$1,063292	$1,107332	$1,131352	$9661,211	$1,118389	$1,138358

1 The estimated costs included in this table represent a general estimate for each full transmission line route based upon an approximate cost-per-mile calculation. Please see Table 3-2 for additional costs applicable to the project regardless of the route that is selected.

Formatted: Table Footnote, Right: 2.5"

7.2.1 Human Settlements

Potential impacts on human settlements are assessed through an evaluation of several elements (see Chapter 7, Factors Considered by the Commission for Transmission Line Route Permits sidebar). For some of the human settlement elements, project impacts are anticipated to be minimal and independent of the route selected and are therefore not analyzed or discussed here. Analysis of impacts to human settlements here focuses on those elements that vary with the route selected – aesthetics, displacement, and communities of EJ concern.

7.2.1.1 Aesthetics

Aesthetic impacts differ only slightly among the full route options; impacts can be minimized by placing the transmission line away from residences and by following existing infrastructure and ROW. Proximity of residences to the applicants' proposed routes and full route options are shown in Table 7-3 and depicted graphically in Figure 7-1, while ROW paralleling and sharing are shown in Table 7-4 and depicted graphically in Figure 7-2.

Each of the seven full routes would have similar aesthetic impacts based on the project's proximity to residences. The applicants' proposed route is near the fewest number of residences within 1,000 feet; example route option 4 is near the greatest number of residences (Table 7-3; Figure 7-1). Each of the full route options minimizes aesthetic impacts by paralleling and/or sharing existing ROW for between 97 and 98 percent of the route (Table 7-4; Figure 7-2). However, when considering the amount that each route would follow existing transmission lines, example route option 1 best minimizes aesthetic impacts with 95 percent of this route following existing transmission line ROW.

Table 7-3 Proximity of Residences to Applicants' Proposed Routes and Example Full Route Options

Residences, Distance from Anticipated Alignment	Applicants' Proposed Route	Applicants' Proposed Route with Modifications	Example Route Option 1	Example Route Option 2	Example Route Option 3	Example Route Option 4	Example Route Option 5
Residences within 0-75 feet	3	2	2	3	3	5	4
Residences within 75-250 feet	102	111	109	117	104	126	125
Residences within 250-500 feet	164	172	194	209	161	210	212
Residences within 500-1,000 feet	380	377	385	396	386	410	402
Total Residences within 1,000 feet	649	662	690	725	654	751	743

Figure 7-1 **Proximity of Residences to the Applicants' Proposed Routes and Example Full Route Options**

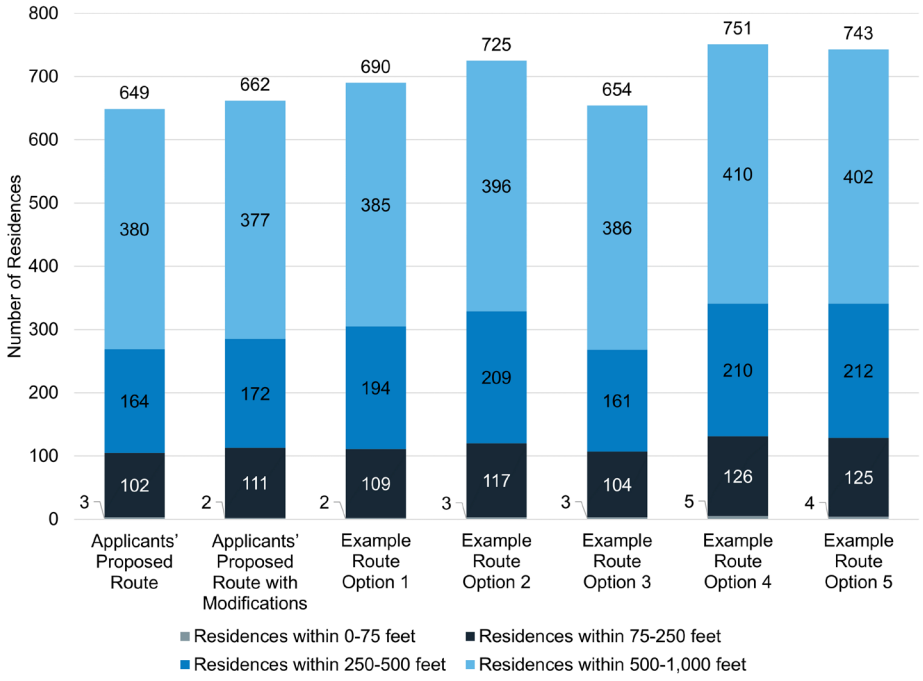
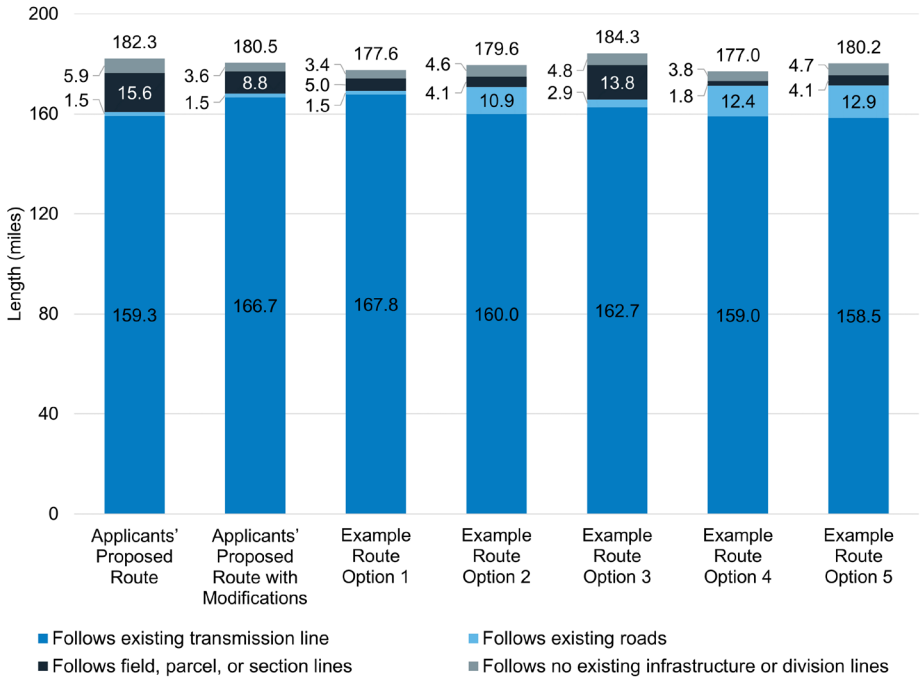


Table 7-4 ROW Paralleling and Sharing of Applicants' Proposed Routes and Example Full Route Options

Infrastructure	Applicants' Proposed Route miles (percent)	Applicants' Proposed Route with Modifications miles (percent)	Example Route Option 1 miles (percent)	Example Route Option 2 miles (percent)	Example Route Option 3 miles (percent)	Example Route Option 4 miles (percent)	Example Route Option 5 miles (percent)
Follows Existing Railroad	1.0 (1)	1.0 (1)	1.0 (1)	1.0 (1)	1.0 (1)	1.0 (1)	1.0 (1)
Follows Existing Roads	4.0 (2)	4.0 (2)	3.9 (2)	13.3 (7)	5.4 (3)	15.3 (9)	15.9 (9)
Follows Existing Transmission Line	159.3 (87)	166.7 (92)	167.8 (95)	160.0 (89)	162.7 (88)	159.0 (90)	158.5 (88)
Total – Follows Transmission Line, Road, or Railroad	160.8 (88)	168.2 (93)	169.2 (95)	170.9 (95)	165.7 (90)	171.4 (97)	171.4 (95)
Follows Field, Parcel, or Section Lines	55.0 (30)	48.1 (27)	44.4 (25)	52.7 (29)	56.5 (31)	51.9 (29)	54.8 (30)
Total – ROW Paralleling and Sharing	176.4 (97)	177.0 (98)	174.2 (98)	175.0 (98)	179.5 (97)	173.2 (98)	175.6 (97)
Total Length of Route Alternative	182.3	180.5	177.6	179.6	184.3	177.0	180.2

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

Figure 7-2 ROW Sharing and Paralleling - Applicants' Proposed Routes and Example Full Route Options



7.2.1.2 Displacement

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

Example route option 4 may result in the potential displacement of 5 residences, the most of any of the example routes considered. The applicants' proposed route, proposed route with modifications, and example route options 2 and 3 may each result in the potential displacement of three residences, while example route option 1 may result in the potential displacement of two residences. Example route option 5 may result in the potential displacement of 4 residences. In addition, each of these full routes could result in the displacement of several non-residential buildings located within the 150-foot ROW (Table 7-5).

Table 7-5 Proximity of Residences and Non-Residences to Applicants' Proposed Routes and Example Full Route Options

Residences and Non-Residences, Distance from Anticipated Alignment	Applicants' Proposed Route	Applicants' Proposed Route with Modifications	Example Route Option 1	Example Route Option 2	Example Route Option 3	Example Route Option 4	Example Route Option 5
Residences within 0-75 feet	3	2	2	3	3	5	4
Non-Residences within 0-75 feet	14	13	11	14	14	15	13
Total Residences and Non-Residences within 0-75 feet	17	16	13	17	17	20	17

Residential and non-residential buildings within the 150-foot ROW may or may not be displaced as a result of the project. Though buildings are generally not allowed within the ROW of a transmission line, there are instances where the activities taking place in these buildings are compatible with the safe operation of the line. For each of the buildings in the ROW, the applicants would need to conduct a site-specific analysis to determine if the building would need to be removed or relocated.

7.2.1.3 Environmental Justice

As indicated in Chapter 5.3.9, utility infrastructure can adversely impact low-income, minority, or tribal populations (communities of environmental justice concern, EJC). Each of the full route options analyzed in this chapter would cross several communities of EJC. The applicants' proposed route would cross six communities of EJC, the applicants' proposed route with modifications would cross five communities of EJC, and example route options 1 through 5 would each cross seven communities of EJC (Table 7-2).

However, no adverse or permanent impacts to the identified environmental justice communities are anticipated. While each of the full routes included in this analysis intersect environmental justice communities, they are not anticipated to experience disproportionately adverse impacts as a result of the project, particularly because the transmission line will parallel and/or share existing ROW for the majority of these route options (97 to 98 percent).

7.2.2 Land-Based Economies

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

7.2.2.1 Agriculture

Impacts to agricultural land in the 150-foot ROW of the full route options would be relatively similar (Table 7-2). The applicants' proposed route has the least amount of agricultural land within the ROW, totaling 1,260 acres (38 percent) (Table 7-2). In contrast, example route option 4 has the most agricultural land within the ROW, with 1,346 acres (42 percent), representing a difference of approximately 86 acres (Table 7-2).

7.2.2.2 Forestry

Impacts to designated forestry resources in the 150-foot ROW of the full route options would be relatively similar (Table 7-2). Forestry land within the ROWs of these options ranges between 1,047 acres (full route option 4) to 1,240 acres (applicants' proposed route).

There are designated forestry resources in the form of DNR state forest, Minnesota School Trust Land, Forests for the Future land, and SFIA land within the ROW of the full route options (Table 7-6). The ROW of full route options 2, 4, and 5 contain the fewest designated forestry resources (385 to 386 acres), while the applicants' proposed route with modifications contains the most (460 acres).

Table 7-6 Designated Forestry Resources Within the 150-foot ROW of Applicants' Proposed Routes and Example Full Route Options

Forestry Acreage	Applicants' Proposed Route	Applicants' Proposed Route with Modifications	Example Route Option 1	Example Route Option 2	Example Route Option 3	Example Route Option 4	Example Route Option 5
Acres of DNR state forest within 150-foot ROW	258	264	206	188	253	187	188
Acres of Minnesota School Trust Land[1] within 150-foot ROW	137	144	123	104	133	104	104
Acres of Forests for the Future[2] land within 150-foot ROW	19	19	32	36	19	36	36
Acres of Sustainable Forest Incentive Act[3] land within 150-foot ROW	33	33	56	58	33	58	58
Total Acreage	447	460	417	386	438	385	386

In some cases, multiple state land classifications are located within the same section. Therefore, features may be duplicated and the analysis results may over-represent potential impacts.
Data Sources: references (3); (4)
1 Minnesota School Trust Lands are DNR-administered lands that are set aside to provide a continual source of funding for public education (reference (4).
2 Minnesota's Forests for the Future Program is a conservation program administered by the DNR to encourage the protection of privately-owned forest lands through conservation easements or land purchases (reference (5)).
3 Minnesota's Sustainable Forest Incentive Act is a conservation program administered by the DNR that provides annual incentive payments to encourage private landowners to keep their wooded areas undeveloped (reference (109)).

New transmission line construction through forested lands would be required for all full route options; however, example route option 4 likely minimizes forestry impacts by having the least amount of forested lands in its ROW (Table 7-2). Route option 4 also shares the most ROW with existing roadway and transmission line infrastructure (99 percent) (Table 7-2, Table 7-4). In areas of ROW paralleling and sharing, impacts to forestry resource lands have already occurred. Placement of transmission

infrastructure in these locations may increase areas of forestry impact but would not introduce new impacts to an otherwise undisturbed forested setting.

7.2.2.3 Mining

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

There are no mining resources in the vicinity of the applicants' proposed route or the applicants' proposed route with modifications; as such, these route alternatives best minimize potential impacts to mining resources. Route options 1 through 4 each have the same two aggregate mines located in their ROW, though both routes would follow an existing transmission line ROW through one of these aggregate mines, minimizing introduction of new impacts (see Chapter 6.3.4.2.3).

7.2.2.4 Recreation and Tourism

Recreation and tourism opportunities in the project area primarily consist of scenic byways, state forests, WMAs, off-road vehicle trails, snowmobile trails, and water trails. The applicants' proposed route, applicants' proposed route with modifications, and all of the example full route options each cross the same number of scenic byways and water trails. There are small variations in the number of state forests, WMAs, off-road vehicle trails, and snowmobile trails that would be crossed by the applicants' proposed route, applicants' proposed route with modifications, and example full route options.

Overall, example route option 4 crosses the fewest number of state forests, WMAs, off-road vehicle trails, and snowmobile trails. The applicants' proposed route with modifications would cross one more WMA than the other routes, while example routes 1, 2, and 5 would cross the greatest number of snowmobile trails. More state forest crossings would be needed for the applicants' proposed route, applicants' proposed route with modifications, and example route option 3 (Table 7-7).

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

Route	Applicants' Proposed Route	Applicants' Proposed Route with Modifications	Example Route Option 1	Example Route Option 2	Example Route Option 3	Example Route Option 4	Example Route Option 5
Scenic byways (count)	2	2	2	2	2	2	2
State forest crossings (count)	6	6	4	4	6	4	4
WMA crossings (count)	2	3	2	2	2	2	2
Off-road vehicle trails (count)	9	9	8	8	9	8	8
Snowmobile trails (count)	10	10	11	11	10	10	11
Water trails (count)	2	2	2	2	2	2	2

Example route options 1 through 5 as well as the applicants' proposed route with modifications would each cross through a portion of the Cuyuna Country State Recreation Area. However, the applicants' proposed route with modifications as well as example route options 1, 2, 4, and 5 would cross this recreation area within existing transmission line ROW in an area of double-circuiting. An additional 80 feet of ROW from within the Cuyuna Country State Recreation Area would be needed to accommodate the double-circuiting and placement of the route through this area. As a result, minimal impacts to the Cuyuna Country State Recreation Area are anticipated. Example route option 3 would cross this recreation area parallel to existing road ROW at the far eastern edge of the recreation area and outside of the area used for recreation (Photo 7-1).

Photo 7-1 View of Example Route Option 3 in the Vicinity of the Cuyuna Country State Recreation Area

Photograph looking south, Cuyuna Country State Recreation Area is located on the right side of the photo

Because transmission line construction and operation generally has minimal permanent and temporary impacts to trails and introduction of new impacts would be minimized to the extent possible by ROW sharing and paralleling, recreation and tourism impacts as a result of the project are expected to be minimal. Overall, each of the example route options, including the applicants' proposed route and applicants' proposed route with modifications, would have similar impacts to recreation and tourism in the project area.

7.2.3 Archaeological and Historic Resources

Between 41 and 47 archaeological and historic resources are located within the 1,000-foot route width of the full route options (Table 7-2). These resources are further classified in Table 7-8. Most of these cultural resources have been previously determined not eligible for the NRHP and therefore no additional work related to these cultural resources would be required for the project to proceed, regardless of which route is selected. However, the project has the potential to adversely affect those cultural resources that have not been evaluated for the NRHP, or which are listed on or have been determined eligible for listing on the NRHP (i.e., significant cultural resources).

Table 7-8 Summary of Archaeological and Historic Architectural Resources within the 1,000-foot Route Width of Applicants' Proposed Route and Example Full Route Options

	Applicants' Proposed Route	Applicants' Proposed Route with Modifications	Example Route Option 1	Example Route Option 2	Example Route Option 3	Example Route Option 4	Example Route Option 5
Count of NRHP-listed or -eligible Resources	6	7	7	8	6	8	8
Count of Unevaluated Cultural Resources	17	16	13	15	17	15	15
Count of Resources Previously Determined Not Eligible for NRHP	20	20	21	21	20	24	23
Total	43	43	41	44	43	47	46

Although the overall counts of cultural resource types are similar among the full route options, example route option 1 is least impactful to cultural resources overall, while example route option 4 is most impactful. However, when looking only at cultural resources that are listed or eligible for the NRHP, both the applicants' proposed route and example route option 3 are least impactful, while example route options 4 and 5 are most impactful.

Of the significant cultural resources located within the route width of the applicants' proposed route and the applicants' proposed route with modifications, three NRHP-listed/-eligible historic architectural resources (XX-RRD-NPR007/ XX-RRD-NPR021, and CW-XXX-00001) have the potential to be impacted by the project. The applicants' proposed route would cross each of these resources in a brand-new location, which may alter these resource's setting, feeling, appearance, and/or association. However, where example route options 1, 2, 4, and 5 cross these resources, the crossing occurs where an existing transmission line is present. Due to paralleling an existing transmission line, route options 1, 2, 4, and 5 do not have the potential to introduce new impacts to the resources' setting, feeling, appearance, and/or association.

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

Archaeological sites that are not evaluated or are listed in or eligible for the NRHP may also be impacted by the project if any of these sites are present within the footprint of ground disturbance. Ground disturbing activities have the potential to impact these resources if they cannot be avoided by the project.

The primary means to minimize impacts to archaeological and historic architectural resources is prudent routing or structure placement (i.e., avoiding known archaeological and historic resources). If they cannot be avoided, impacts to these resources could be mitigated by measures developed in consultation with SHPO prior to construction.

7.2.4 Natural Environment

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

7.2.4.1 Water Resources

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

Watercourses and Waterbodies

Each of the full route options would cross streams and waterbodies, as summarized in Table 7-2. Route options 4 and 5 minimize stream crossings, including NHD streams, impaired streams, and PWI streams. The difference in stream crossings between route options 4 and 5 and the other five full route options stems from the J2 route alternative in the Benton County Elk River region (which is part of route option 4) and the combined J1/J3 route alternative (which is part of route option 5). Both of these route alternatives are primarily located in a new transmission line ROW west of the Elk River, while the other five full routes would use route alternatives that parallel an existing transmission line ROW while crossing the Elk River multiple times.

The applicants' equivalent in the Benton County Elk River region, which is used for the applicants' proposed route, the applicant's proposed route with modifications, and route option 3 would cross the Elk River 26 times, as shown in the Map Book 5G; this count is relatively high due to the meandering nature of the Elk River. Waterbody crossings would be relatively comparable across each of the full route options. However, the applicants' proposed route with modifications would have fewer NHD lake crossings and PWI basin crossings than the other six routes. The applicant's proposed route would have the most PWI wetland crossings.

All of the full route options would traverse areas mapped as 100-year floodplain. Although floodplains would be spanned to the extent possible, each of the full route options would cross floodplain areas wider than 1,000 feet, which may require one or more structures to be placed in a floodplain (Table 7-2). Route options 2, 4, and 5 have fewer floodplain crossings greater than 1,000 feet than the other four full route options.

Wetlands

Wetlands within the rights-of-way of the full route options consist of emergent wetlands, forested wetlands, and shrub-dominated wetlands. The applicants' proposed route has the most acres of wetland (986 acres) and route option 4 would have the least (887 acres). The applicants' proposed route and route option 3 would have the most forested wetland (235 acres) within their 150-foot ROW, while route options 4 and 5 would have the least acres of forested wetland (211 acres) (Table 7-2). Although

wetlands would be spanned to the extent possible, each of the full route options would cross between 68 (route option 4) and 84 (applicants' proposed route) wetland areas wider than 1,000 feet, which may require one or more structures to be placed in a wetland (Table 7-2).

7.2.4.2 Vegetation

Each of the full route options would impact forested vegetation within their 150-foot ROW, with route option 4 impacting the least (1,047 acres) and route option 3 impacting the most (1,242 acres) (Table 7-2). Each of the full route options would minimize impacts associated with forest fragmentation by following existing transmission line and/or road ROW for the majority of their length (Table 7-2).

7.2.4.3 Wildlife

Impacts to wildlife habitat would be relatively comparable for the full route options in that they would all cross WMAs, GBCA, and a DNR-identified shallow wildlife lake. The applicants' proposed route, the applicants' proposed route with modifications, and route option 3 would cross the edge of the Birchdale and Moose Willow WMAs, while route options 1, 2, 4, and 5 would cross solely the edge of the Birchdale WMA. Route options 2, 4, and 5 would cross slightly more acres of GBCA than the other routes (Table 7-2). Each of the full route options would minimize impacts associated with habitat fragmentation by following existing transmission line and/or road ROW for the majority of their length (Table 7-2).

7.2.5 Rare and Unique Natural Resources

Using the NHIS database, it was determined there are no differences among the full route options with respect to documented federal- or state-protected species. Each of the full route options have one documented federally protected species (the northern long eared bat) and the same 15 state protected species documented within 1 mile of them; these are summarized in Appendix N. In addition, three of the 15 state protected species, including the loggerhead shrike, Blanding's turtle, and rock sandwort, have also been documented within the 150-foot ROW of each full route option. As discussed in Chapter 5.11.1.3, potential impacts to these species can be mitigated by incorporating species-specific BMPs.

Each of the full route options would intersect several DNR SBS, with route options 1, 2, 4, and 5 intersecting approximately 200 acres less than the applicants' proposed route, the applicants' proposed route with modifications, and route option 3 (Table 7-2). Each of the full route options would intersect native plant communities, with the applicants' proposed route and route option 3 intersecting slightly more than the other five routes (Table 7-2). Each of the full route options would also intersect High Conservation Value Forest, with routes options 1, 2, 4, and 5 intersecting approximately 90 fewer acres than the other 3 routes. All seven full route options would intersect Lakes of Biological Significance while paralleling an existing transmission line ROW. The applicants' proposed route and route option 3 would traverse approximately 2 acres of one Lake of Biological Significance, while the other five routes would traverse between 5 and 6 acres of two Lakes of Biological Significance (Table 7-2; Map Book 5I).

7.3 Relative Merits Summary

The discussion here uses text and a color graphic to describe the relative merits of the full route options (Table 7-9). The color graphic and related notes for a specific routing factor or element are not meant to be indicative of the best route for the project, but are provided as a relative comparison to be evaluated together with all other routing factors. For example, routes that are "red" for a particular factor or element are not meant to indicate a fatal flaw with a specific full route option.

For routing factors where impacts are anticipated to vary with the full route options, the graphic represents the magnitude of anticipated difference between these anticipated impacts and compares them across the seven full route options. For routing factors that express the state of Minnesota's interest in the efficient use of resources (e.g., the use and paralleling of existing rights-of-way), the graphic represents the consistency of the full route options with these interests and compares them to each other.

Table 7-9 Guide to Relative Merits of the Applicants' Proposed Routes and Example Full Route Options

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

7.3.1 Routing Factors for Which Impacts Are Not Anticipated to Vary Among Applicants' Proposed Routes and Example Full Route Options

Potential impacts are anticipated to be minimal and not vary significantly among the full route options for the following routing factors and elements:

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

7.3.2 Routing Factors for Which Impacts Are Anticipated to Vary among Applicants' Proposed Routes and Example Full Route Options

Potential impacts are anticipated to vary among the full route options for the following routing factors and elements:

- Impacts on human settlements (factor A)—aesthetics, displacement, and environmental justice communities.

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

Relative merits of the full route options for all routing factors / elements for which impacts are anticipated to vary among route options are shown and discussed in Table 7-10.

Table 7-10 Relative Merits of Applicants' Proposed Routes and Example Full Route Options

Routing Factor/Resource	Applicants' Proposed Route	Applicants' Proposed Route with Modifications	Example Route Option 1	Example Route Option 2	Example Route Option 3	Example Route Option 4	Example Route Option 5	Summary
Human Settlement – Aesthetics								Each of the seven full routes would have similar aesthetic impacts based on proximity to residences. The applicants' proposed route is near the fewest number of residences; example route option 4 is near the greatest number of residences. Route option 1 uses the most existing transmission line ROW (95 percent), while the applicants' proposed route with modifications is second with 92 percent and route option 4 is third at 90 percent. Route options 2, 3, 5, and the applicants' proposed route each use less than 90 percent of existing transmission line ROW (between 87 and 89 percent).
Human Settlement – Displacement								Route option 1 has the fewest residences and non-residences within the 150-foot ROW (2 residences and 11 non-residences). The majority of the other route options (applicants' proposed route, route options 2 and 3) each have 3 residences 14 non-residences within the 150-foot ROW. Route options 4 and 5 have the most residences (5 and 4, respectively) and non-residential structures (15 and 13, respectively) within the 150-foot ROW.
Human Settlement – Environmental Justice								The applicants' proposed route with modifications would only cross five communities of EJ concern, where the other route options would cross six to seven communities of EJ concern. However, since these full route examples mostly follow existing transmission line ROW, these communities of EJ concern should not be adversely or disproportionately affected by the project and differences are marginal.
Land-Based Economies – Agriculture								There is only a difference of approximately 86 acres of agricultural land between each of the full route options. Impacts would be similar regardless of the route selected.
Land-Based Economies – Forestry								The ROW of full route options 2, 4, and 5 contain the fewest designated forestry resources (385 to 386 acres), while the applicants' proposed route with modifications contains the most (460 acres). Route option 4 minimizes forestry impacts by having the least amount of forested lands in its ROW and by sharing the most ROW with existing roadway and transmission line infrastructure (99 percent).
Land-Based Economies – Mining								Route options 1 through 4 have two aggregate mines within their rights-of-way; the applicants' proposed route and the applicants' proposed route with modifications do not. Impacts to the aggregate mines likely can be mitigated; thus, differences between the route options are marginal.
Land-Based Economies – Recreation and Tourism								The applicants' proposed route, applicants' proposed route with modifications, and all of the example full route options each cross the same number of scenic byways and water trails. There are small variations in the number of state forests, WMAs, off-road vehicle trails, and snowmobile trails that would be crossed by the applicants' proposed route, applicants' proposed route with modifications, and example full route options. Overall, example route option 4 crosses the fewest number of state forests, WMAs, off-road vehicle trails, and snowmobile trails. The applicants' proposed route with modifications would cross one more WMA than the other routes, while example routes 1, 2, and 5 would cross the greatest number of snowmobile trails. More state forests crossings would be needed for the applicants' proposed route, applicants' proposed route with modifications, and example route option 3.
Archaeological and Historic Architectural Resources								The applicants' proposed route, the applicants' proposed route with modifications, and route option 3 would both cross significant cultural resources in an area of new ROW, where route options 1, 2, 4, and 5would cross these same resources using existing transmission line ROW. Otherwise, counts of cultural resources are similar across each full route option.
Natural Environment – Watercourses and Waterbodies								Route options 2, 4, and 5 would have the least number of stream crossings and floodplain crossings great than 1,000 feet. The applicants' equivalent in the Benton County Elk River region, which is used for the applicants' proposed route, the applicant's proposed route with modifications, and route option 3 would cross the Elk River 26 times; this count is relatively high due to the meandering nature of the Elk River. Waterbody crossings would be relatively comparable across each of the full route options. However, the applicants' proposed route with modifications would have fewer NHD lake crossings and PWI basin crossings than the other six routes. The applicant's proposed route would have the most PWI wetland crossings.
Natural Environment – Wetlands								The ROW of route options 2, 4, and 5 have the least acres of wetland, including forested wetland. These route options would also cross fewer wetlands create than 1,000 feet wide.

Routing Factor/Resource	Applicants' Proposed Route	Applicants' Proposed Route with Modifications	Example Route Option 1	Example Route Option 2	Example Route Option 3	Example Route Option 4	Example Route Option 5	Summary
Natural Environment – Vegetation								Route options 1, 2, 4, and 5 would have less impact on forested vegetation. Route options 4 and 5 minimize impacts to forested vegetation along the Elk River.
Natural Environment – Wildlife								Route options 1, 2, 4, and 5 minimizes impact to wildlife and associated habitat by avoiding the Moose Lake WMA. Route options 4 and 5 minimize impacts to wildlife habitat along the Elk River.
Rare and Unique Natural Resources								Route options 1, 2, 4, and 5 minimize impacts to Sites of Biodiversity Significance and High Conservation Value Forests.
Use or Paralleling of Existing ROW								Total ROW paralleling and sharing is nearly equal across all route options. There is some variation in the paralleling of existing transmission line rights-of-way. Route option 1 uses the most existing transmission line ROW (95 percent), while the applicants' proposed route with modifications is second with 92 percent and route option 4 is third at 90 percent. Route options 2, 3, 5, and the applicants' proposed route each use less than 90 percent of existing transmission line ROW (between 87 and 89 percent).
Costs[1] Dependent on Design and Route (2022 dollars in millions)	$937~~$1,182~~	$1,063~~$1,292~~	$1,107~~$1,332~~	$1,131~~$1,352~~	$966~~$1,211~~	$1,118~~$1,389~~	$1,138~~$1,358~~	The applicants' proposed route is the least expensive, while example route option 4 is the most expensive. Major factors affecting cost include double-circuiting long sections of transmission line in route options 1, 2, 4, and 5 as well as specialty structures that would be required near the Hill City/Quadna Mountain airport for route options 1, 2, 4, and 5.

1 The estimated costs included in this table represent a general estimate for each full transmission line route based upon an approximate cost-per-mile calculation. Please see Table 3-2 for additional costs applicable to the project regardless of the route that is selected.

Formatted: Table Footnote, Right: 0.5"

1 The estimated costs included in this table represent a general estimate for each full transmission line route based upon an approximate cost-per-mile calculation. Please see Table 3-2 for additional costs applicable to the project regardless of the route that is selected.

Formatted: Table Footnote, Right: 0.5"

7.4 Unavoidable Impacts

Transmission lines are large infrastructure projects that can have adverse human and environmental impacts. Even with mitigation strategies, there are adverse project impacts that cannot be avoided. These impacts are anticipated to occur for all routing alternatives and to vary, if at all, as discussed above.

Aesthetic impacts cannot be avoided. The project would introduce new transmission line structures and conductors into project area viewsheds. These structures and conductors would be visible; therefore, they would have an adverse aesthetic impact. Temporary construction-related impacts also cannot be avoided. These include construction-related noise and dust generation and disruption of traffic near construction sites.

While the project would parallel existing transmission lines and other infrastructure to the extent practicable, impacts to agriculture cannot be completely avoided. The project requires the placement of concrete footings and the construction of transmission line structures in a project area that has sizeable areas of agricultural use. Potential impacts include loss of tillable acreage and constraints on the layout and management of field operations.

Finally, impacts to the natural environment cannot be avoided. Even if impacts can be limited to the transmission line's ROW, construction and operation of the transmission line would require tree removal and brush trimming, as well as clearing at structure sites. These are unavoidable impacts to vegetation. Unavoidable impacts to vegetation also include the removal or fragmentation of habitat and the creation of edge habitats. Transmission line conductors adversely affect avian species by creating opportunities for collisions with the conductors. These collisions could occur despite mitigation strategies such as the use of bird flight diverters.

7.5 Irreversible and Irretrievable Impacts

The commitment of a resource is irreversible when it is impossible or very difficult to redirect that resource for a different future use. An irretrievable commitment refers to the use or consumption of a resource such that it is not recoverable for later use by future generations. These types of commitments are anticipated to occur for all routing alternatives and not to vary significantly among alternatives.

The commitment of land for a transmission line ROW is likely an irreversible commitment. In general, lands in the rights-of-way for large infrastructure projects such as railroads, highways, and transmission lines remain committed to these projects for a relatively long period of time.

Even in instances where a ROW is abandoned, the land within the ROW is typically repurposed for a different infrastructure use, such as a rails-to-trails program, and is not returned to a previous land use. This said, transmission line rights-of-way can be returned to a previous use (e.g., row crop, pasture) by the removal of structures and structure foundations to a depth that supports this use, but this becomes more challenging in areas of ROW paralleling as it would rely on a commitment from more than one facility to return the land to previous use.

There are few commitments of resources associated with the project that are irretrievable. These commitments include the steel, concrete, and hydrocarbon resources committed to the project, though it is possible that the steel could be recycled at some point in the future. Labor and fiscal resources required for the project are also irretrievable commitments.

3.2.2 Structures

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

Figure 3-1 Example Double-Circuit, Monopole 345 kV Structures with V-String Insulators

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

There may be various locations along the route where existing transmission lines would need to be realigned, relocated, reconfigured, or replaced. The structure types to be used at these locations include, but are not limited to, typical wood or steel construction and typical monopole or H-frame structures. Structure designs would be driven by an effort to minimize human and environmental impacts, to the extent practicable.

The double-circuit 345 kV structures would range in height from 130 to 170 feet, with spans of 800 to 1,000 feet between structures. A monopole structure is typically installed on a concrete foundation, while

3.3.1 Route Width

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

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

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

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

- Iron Range Substation region, South of the Iron Range Substation – the applicants request a route width of one mile to allow for flexibility in entering and exiting the substation in Sections 19 and 20 of Trout Lake Township in Itasca County.
- Hill City to Little Pine region, Minnesota Power's high-voltage direct current (HVDC) line – where the route crosses Minnesota Power's existing ±250 kV HVDC line in Section 31 of Macville Township in Aitkin County, the applicants request a route width of 4,400 feet. An Enbridge pump station and associated 230 kV tap line owned by GRE are located east of the 92 Line, and the route would need to cross over both the HVDC line and tap line. The applicants are requesting a wider route width in this area to provide flexibility to cross the HVDC line at mid-span, thus minimizing the height of the structures and to avoid the existing infrastructure in the area.
- Hill City to Little Pine region, Swatara area – the applicants request an expanded route width of approximately 4,000 feet east-west by approximately 4,000 feet north-south where Minnesota Power's existing 92 Line turns from a northeast-southwest diagonal orientation to a north-south orientation, to provide additional flexibility to minimize impacts to residences.
- Cole Lake region, River Road in Wolford Township – South of the Mississippi River near River Road and Cole Lake Way, northwest of Crosby in Section 21 of Wolford Township in Crow Wing County, Minnesota Power's 13 Line joins the 11 Line and 92 Line from the east. The applicants are requesting a route width of up to one mile (expanding to the east) on the east side of the existing lines to provide flexibility to avoid impacts to existing residences.
- Cole Lake region and Riverton region, Cuyuna Series Compensation Station – to allow for the siting of the new Cuyuna Series Compensation Station and flexibility in routing the project transmission lines into and out of the new substation in Sections 5, 6, 7, and 8 of Irondale Township in Crow Wing County, the applicants request a route width of 1.25 miles.

Table 6-1 Human and Environmental Impacts – Route Alternative B, Hill City to Little Pine Region

Resource	Element	Route Alternative B	Applicants' Equivalent
Length (miles)		26.4	27.0
Human Settlement	Residences within 0-75 feet (count)	0	0
	Residences within 75-250 feet (count)	1	3
	Residences within 250-500 feet (count)	14	2
	Residences within 500–1,000 feet (count)	14	18
Transportation	Airports within 1 mile (count)	1	0
Land-Based Economies	Agricultural land in 150-foot ROW (acres)	7	29
Water Resources	Total wetlands in 150-foot ROW (acres)	190	150
	Forested wetlands in 150-foot ROW (acres)	104	56
Vegetation	Forested landcover in 150-foot ROW (acres)	376	349
Wildlife	Wildlife Management Area in 150-foot ROW (acres)	0	13
Sensitive Ecological Resources	Sites of Biodiversity Significance in 150-foot ROW (acres)	199	308
	Native Plant Communities in 150-foot ROW (acres)	145	139
	High Conservation Value Forest in 150-foot ROW (acres)	32	123
	Candidate Old Growth Stand in 150-foot ROW (acres)	9	0
	Federal- or state-protected species documented in 150-foot ROW (count)	0	0
ROW Sharing and Paralleling	Transmission line (miles, percent)	26.4 (100)	25.4 (94)
	Roadway (miles, percent)	0 (0)	0 (0)
	Field, parcel, or section lines (miles, percent)	0 (0)	0 (0)
	Total ROW sharing and paralleling (miles, percent)	26.4 (100)	25.4 (94)
Reliability	Crossing of existing transmission lines (count)	~~0~~2	0
Estimated Cost	Total estimated cost (2022 dollars in millions)	$150.4~~146.4~~[1]	$149.9

1 Specialty structures or other mitigation measures – e.g., moving the alignment of route alternative B, with or without moving the MP 11 line – would be required to avoid impacts to the Hill City-Quadna Airport. The costs of these mitigation measures are not represented in this table.~~Significant engineering would be needed to develop the specialty structures required near the Hill City-Quadna Airport to lower structure heights to less than 80 feet as well as the specific ROW needs to accommodate the lower structures. At this time there is no way to estimate these structure costs.~~

Table 6-2 Hill City to Little Pine Region ROW Sharing and Paralleling of Route Alternative B

Infrastructure	Route Alternative B miles (percent)	Applicants' Equivalent miles (percent)
Follows Existing Railroad	0.0. (0)	0.0. (0)
Follows Existing Roads	0.0. (0)	0.0. (0)
Follows Existing Transmission Line	26.4 (100)	25.4 (94)
Total – Follows Transmission Line, Road, or Railroad	26.4 (100)	25.4 (94)
Follows Field, Parcel, or Section Lines	0.0. (0)	0.0. (0)
Total – ROW Paralleling and Sharing	26.4 (100)	25.4 (94)
Total Length of Route Alternative	26.4	27.0

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

6.2.2.1.2 Socioeconomics and Environmental Justice

Socioeconomic factors provide an indication of how economic activity affects and is shaped by social processes. Socioeconomic measures indicate how societies progress, stagnate, or regress because of the actions and interactions within and between the local, regional, and global economic scale. Transmission line projects can contribute to growth and progress at the local level over time, but generally do not have a significant long-term socioeconomic impact.

The project would improve the socioeconomics of the region through the creation of jobs, generation of tax revenue, and providing more reliable electrical service to the surrounding communities. Route alternative B intersects with Macville Township, Beulah Township, Little Pine Township, and the city limits of Hill City; all of which have been identified as communities with EJCs. No adverse or permanent impacts to the identified communities with EJCs are anticipated. While route alternative B does intersect communities with EJCs, these communities are not anticipated to experience disproportionately adverse impacts from the project, particularly because the project would parallel existing transmission line ROW in these communities.

6.2.2.2 Transportation

Potential transportation impacts are assessed by looking at various elements of transportation and public services as outlined in Chapter 5.4. In general, impacts to transportation services are anticipated to be minimal and independent of the route selected.

6.2.2.1 Airports

One public airport is located within 1 mile of route alternative B. The northern end of the Hill City/Quadna Mountain Airport runway is approximately 1,300 feet southeast of route alternative B and is therefore located within safety zone C. However, in this area, route alternative B parallels an existing transmission

line that is also located within safety zone ~~A~~C. Route alternative B would need to be constructed with specialty structures ~~no more than 80 feet in height~~ or using other mitigation measures in the vicinity ~~(0.5 to 1 mile)~~ of the Hill City/Quadna Mountain Airport to meet the public airport clearance requirements. ~~It is assumed that structures placed in the vicinity of the airport would match the height of the structures located along the existing transmission line that is also adjacent to the airport.~~

of the High Conservation Value Forest that are designated candidate old growth stands, while the applicants' equivalent would not intersect any candidate old growth stands.

Table 6-3 Sensitive Ecological Resources in the ROW of Route Alternative B and the Applicants' Equivalent

Sensitive Ecological Resource	Area within ROW of Route Alternative B	Area within ROW of Applicants' Equivalent
Sites of Biodiversity Significance	199 total acres; 135 acres ranked high; 64 acres ranked moderate	308 total acres; 181 acres ranked high; 127 acres ranked moderate
Native Plant Communities	145 total acres; 10 acres have a conservation status of S1 or S2; conservation status of remaining acres is S3-S5	139 acres - conservation status S3-S5
High Conservation Value Forest	32 acres	123 acres
Candidate Old Growth Stand	9 acres	0 acres

As noted above, route alternative B would parallel an existing transmission line ROW for its entire length and the applicants' equivalent would parallel an existing transmission line ROW for 94 percent of its length. Except for a portion of one SBS ranked moderate, which the applicants' equivalent would traverse in a new ROW, both route alternatives would traverse sensitive ecological resources within or adjacent to areas that have been previously disturbed by transmission line rights-of-way, which would minimize impacts to these resources.

6.2.2.7 Reliability

When one transmission line crosses another, reliability risks increase because the failure of one line can unexpectedly de-energize the other. Additionally, there is increased risk that if one transmission line falls, it can bring down the other transmission line, resulting in two, rather than one, line failures. Furthermore, performing maintenance at the transmission line crossing creates a safety risk, as under normal operating conditions one line must remain energized while work is occurring on the other line. Therefore, where practical, new lines are typically designed to minimize transmission line crossings.

Route alternative B would require two transmission line crossings, thereby introducing an increased reliability concern. The applicants' equivalent would require no transmission line crossings. ~~No transmission line crossings are required for these route alternatives.~~

6.2.2.8 Cost

Costs of the route alternatives are generally proportional to length and take into account the need for specialty and heavy-angle structures, which are more expensive than standard and/or tangent structures (Table 6-22). Costs are similar between route alternative B ($146 million) and the applicants' equivalent ($149 million). Route alternative B may require additional engineering to develop the specialty structures needed to keep structure heights to less than 80 feet in proximity of the Hill City/Quadna Mountain.

Table 6-4 Human and Environmental Impacts – Alignment Alternative AA16, Hill City to Little Pine Region

Resource	Element	Alignment Alternative AA16	Applicants' Equivalent
Length (miles)		11.0	11.0 (345 kV) 1.7 (115 kV)
Human Settlement	Residences within 0-75 feet (count)	0	0
	Residences within 75-250 feet (count)	1	4
	Residences within 250-500 feet (count)	8	5
	Residences within 500–1,000 feet (count)	14	17
Land-Based Economies	Agricultural land in 150-foot ROW (acres)	26	20
Water Resources	Total wetlands in 150-foot ROW (acres)	94	87
	Forested wetlands in 150-foot ROW (acres)	43	8
Vegetation	Forested landcover in 150-foot ROW (acres)	70[1]	151
Sensitive Ecological Resources	Sites of Biodiversity Significance in 150-foot ROW (acres)	195	227
	Native Plant Communities in 150-foot ROW (acres)	2	9
	High Conservation Value Forest in 150-foot ROW (acres)	5	5
	Federal- or state-protected species documented in 150-foot ROW (count)	0	0
ROW Sharing and Paralleling	Transmission line (miles, percent)	11.0 (100)	12.7 (100)
	Roadway (miles, percent)	0 (0)	0 (0)
	Field, parcel, or section lines (miles, percent)	0 (0)	0 (0)
	Total ROW sharing and paralleling (miles, percent)	11.0 (100)	12.7 (100)
Reliability	Crossing of existing transmission lines (count)	0	0
Estimated Cost	Total estimated cost (2022 dollars in millions)	$106-$119[2]	$~~70.6~~64.9

1 The NLCD indicates forested vegetation is in the ROW; however, the ROW is an existing transmission line ROW that has been cleared and is routinely maintained.

2 Double-circuiting the existing transmission lines in order to place the proposed route within existing ROW would add between $45-$58 million to alignment alternative AA16 (base cost of $59.3 million)

Table 6-5 Human and Environmental Impacts – Route Alternatives D3, AA4, and AA6, Cole Lake-Riverton Region

Resource	Element	Route Alternative D3	Alignment Alternative AA4	Alignment Alternative AA6	Applicants' Equivalent
Length (miles)		3.3	2.4	2.6	2.8
Human Settlement	Residences within 0-75 feet (count)	0	0	0	0
	Residences within 75-250 feet (count)	0	2	1	0
	Residences within 250-500 feet (count)	0	1	3	3
	Residences within 500–1,000 feet (count)	0	2	4	3
Land-Based Economies	Agricultural land in 150-ft ROW	<1	7	2	2
Water Resources	Total wetlands in 150-foot ROW (acres)	21	3	3	6
	Forested wetlands in 150-ft ROW (acres)	6	0	0	<1
Vegetation	Forested landcover in 150-foot ROW (acres)	49	28[1]	36	39
Rare and Unique Natural Resources	Sites of Biodiversity Significance in 150-foot ROW (acres)	57	6	19	23
	Federal- or state-protected species documented in 150-foot ROW (count)	0	0	0	0
ROW Sharing and Paralleling	Transmission line (miles, percent)	0 (0)	2.4 (100)	1.7 (63)	1.7 (60)
	Roadway (miles, percent)	0 (0)	0 (0)	0.4 (17)	0 (0)
	Field, parcel, or section lines (miles, percent)	3.3 (100)	0.2 (8)	0.7 (25)	0.9 (31)
	Total ROW sharing and paralleling (miles, percent)	3.3 (100)	2.4 (100)	2.1 (80)	2.3 (84)
Reliability	Crossing of existing transmission lines (count)	0	0	0	0
Estimated Cost	Total estimated cost (2022 dollars in millions)	$18.4	~~$55.6 - 66.5~~29.2[2]	$14.7	$15.3

1 The NLCD indicates forested vegetation is in the ROW; however, the ROW is an existing transmission line ROW that has been cleared and is routinely maintained.

2 Mid-range cost provided. Cost is driven by the need to reconfigure three existing transmission lines with this alignment alternative (base cost of $13.5 million)

Table 6-6 Human and Environmental Impacts – Alignment Alternative AA3, Cole Lake-Riverton Region

Resource	Element	Alignment Alternative AA3	Applicants' Equivalent
Length (miles)		4.9	5.1
Human Settlement	Residences within 0-75 feet (count)	0	0
	Residences within 75-250 feet (count)	3	0
	Residences within 250-500 feet (count)	1	4
	Residences within 500–1,000 feet (count)	3	4
Land-Based Economies	Agricultural land in 150-ft ROW	22	3
Water Resources	Total wetlands in 150-foot ROW (acres)	7	13
	Forested wetlands in 150-ft ROW (acres)	<1	2
Vegetation	Forested landcover in 150-foot ROW (acres)	44[1]	79
Rare and Unique Natural Resources	Sites of Biodiversity Significance in 150-foot ROW (acres)	58	75
	Federal-or state-protected species documented in 150-foot ROW (count)	0	0
ROW Sharing and Paralleling	Transmission line (miles, percent)	4.9 (100)	4.0 (79)
	Roadway (miles, percent)	0 (0)	0 (0)
	Field, parcel, or section lines (miles, percent)	2.0 (41)	2.6 (51)
	Total ROW sharing and paralleling (miles, percent)	4.9 (100)	4.7 (92)
Reliability	Crossing of existing transmission lines (count)	0	0
Estimated Cost	Total estimated cost (2022 dollars in millions)	$~~55.9~~ ~~66.9~~57.7[2]	$28.5

1 The NLCD indicates forested vegetation is in the ROW; however, the ROW is an existing transmission line ROW that has been cleared and is routinely maintained.

2 Mid-range cost provided. Cost is driven by the need to reconfigure three existing transmission lines with this alignment alternative (base cost of $~~26.9~~27.2 million)

Table 6-7 Human and Environmental Impacts – Route Alternatives E1 through E5, Cole Lake-Riverton Region

Resource	Element	Route Alternative E1	Route Alternative E2	Route Alternative E3	Route Alternative E4	Route Alternative E5	Applicants' Equivalent
Length (miles)		10.2	10.7	11.1	11.2	11.4	11.0
Human Settlement	Residences within 0-75 feet (count)	0	0	2	3	3	1
	Residences within 75-250 feet (count)	8	7	8	8	8	2
	Residences within 250-500 feet (count)	21	11	16	13	10	10
	Residences within 500–1,000 feet (count)	23	26	31	20	17	25
Land-Based Economies	Agricultural land in 150-ft ROW	33	6	20	12	13	9
Water Resources	Total wetlands in 150-foot ROW (acres)	53	71	52	63	54	76
	Forested wetlands in 150-ft ROW (acres)	3	10	5	8	7	13
Vegetation	Forested landcover in 150-foot ROW (acres)	88[1]	131	127[1]	127	137	136
Wildlife	Wildlife Management Area in 150-foot ROW (acres)	4	4	1	4	4	0
	Shallow Wildlife Lake in 150-foot ROW (acres)	0	0	0.2	0	0	0
Rare and Unique Natural Resources	Sites of Biodiversity Significance in 150-foot ROW (acres)	61	63	83	62	63	84
	Native Plant Communities in 150-foot ROW (acres)	0	0	18	0	0	18
	Lake of Biological Significance in 150-foot ROW (acres)	3	0	3	0	0	0
	Federal- or state-protected species documented in 150-foot ROW (count)	1	1	1	1	1	1
	Transmission line (miles, percent)	10.2 (100)	5.9 (55)	7.5 (68)	10.0 (89)	9.4 (83)	3.2 (29)

Resource	Element	Route Alternative E1	Route Alternative E2	Route Alternative E3	Route Alternative E4	Route Alternative E5	Applicants' Equivalent
ROW Sharing and Paralleling	Roadway (miles, percent)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
	Field, parcel, or section lines (miles, percent)	1.9 (19)	4.0 (37)	4.6 (41)	0 (0)	1.9 (17)	7.9 (71)
	Total ROW sharing and paralleling (miles, percent)	10.2 (100)	7.9 (74)	10.1 (92)	10.0 (89)	9.4 (83)	9.2 (83)
Reliability	Crossing of existing transmission lines (count)	0	0	0	6	6	0
Estimated Cost	Total estimated cost (2022 dollars in millions)	$~~118.7-145.7~~157.4[2]	$59.3	$~~118.5-145.5~~143.2[3]	$75.7[4]	$76.6[5]	$61.1[6]

1 The NLCD indicates forested vegetation is in the ROW; however, the ROW is an existing transmission line ROW that has been cleared and is routinely maintained.

2 Mid-range cost provided. Cost is driven by the need to reconfigure and remove up to thirteen existing transmission lines, underground three distribution lines, and retire and relocate one substation with this route alternative (base cost of $56.7 million)

3 Mid-range cost provided. Cost is driven by the need to reconfigure and remove up to thirteen existing transmission lines, underground three distribution lines, and retire and relocate one substation with this route alternative (base cost of $61.5 million). In addition, this route alternative may require residential displacement. There is no way to estimate the displacement cost at this time.

4 This route would require crossing six existing lines. Two heavy-angle structures would also be needed for an additional cost of approximately $740,000 per structure ($62.2 million base cost). In addition, this route alternative may require residential displacement. There is no way to estimate the displacement cost at this time.

5 This route would require crossing six existing lines. Two heavy-angle structures would also be needed for an additional cost of approximately $740,000 per structure ($63.1 million base cost). In addition, this route alternative may require residential displacement. There is no way to estimate the displacement cost at this time.

6 This route alternative may require residential displacement. There is no way to estimate the displacement cost at this time.

that do not have a ROW, such as survey lines, natural division lines, and agricultural field boundaries. Routing factor J relates to the use of existing transportation, pipeline, and electrical transmission rights-of-way. Within this chapter, these factors are considered similarly—the use or paralleling of existing rights-of-way, where there is infrastructure that has a ROW. However, the discussion here emphasizes existing transmission line ROW usage as opposed to other infrastructure ROW.

7.1 Applicants' Proposed Routes and Example Full Route Options

Four full route options (i.e., end-to-end routes from the Iron Range Substation to the Sherco and Big Oaks Substations) are discussed here. These full route options are:

- **The applicants' proposed route**. This is the route proposed by the applicants in their CN and route permit application.
- **The applicants' proposed route with modifications**. This route includes modifications proposed by the applicants in response to public comments and includes routing alternatives that would further consolidate the proposed new double-circuit 345 kV transmission line with existing transmission lines, particularly in the Cole Lake-Riverton Region. This route includes alignment alternative~~s~~ AA3~~, AA9~~, and route alternative E1.
- **Example Route Option 1**. This route includes portions of the applicants' proposed route, including some modifications proposed by the applicants, and routing alternatives proposed during the EA scoping comment period. This route includes route alternatives B, E1, H1 and alignment alternatives AA3 and AA16 (Table 7-1; Map 7-1).
- **Example Route Option 2**. Similar to Route 1, this route includes portions of the applicants' proposed route, including some modifications proposed by the applicants, and routing alternatives proposed during the EA scoping comment period. This route includes route alternatives A2, B, C, E1, H1, J1 and alignment alternatives AA3 and AA16 (Table 7-1; Map 7-2).

These full route options are not meant to represent the only Northland Reliability Project routing possibilities. Rather, they are examples of route options that could be assembled for the project. They are meant to illustrate how various routing alternatives could be selected to build a full project route. Analyzing these four full route options against each other provides the opportunity to understand what impacts might look like if one of these full routes, or a similar route, were selected by the Commission for the project.

The full route options were compiled by selecting route alternatives or alignment alternatives within each region that could be feasibly connected to each another to create a full transmission line route between the existing Iron Range Substation, a new Cuyuna Series Compensation Substation, the existing Benton County Substation, the existing Sherco Substation, and the new Big Oaks Substation (Map Book 7A).

These full route options are simply examples for comparison; other full routes may be developed by combining route alternatives and alignment alternatives that could create a full transmission line route connecting the relevant features noted above. No option is meant to represent a "best case scenario" or to be "least impactful overall." Instead, the example routing options are meant to help the reader understand how the impacts of one routing option compares to another for the entirety of the line.

Table S-1 Relative Merits of Applicants' Proposed Routes and Example Full Route Options

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

Routing Factor/Resource	Applicants' Proposed Route	Applicants' Proposed Route with Modifications	Example Route Option 1	Example Route Option 2	Summary
Land-Based Economies – Recreation and Tourism					The applicants' proposed route and applicants' proposed route with modifications have the following additional recreational resources in their rights-of-way compared to the route options 1 and 2: two scenic byways, two state forests, two Wildlife Management Areas (WMAs), eight off-road vehicle trails, one snowmobile trail, and one water trail. Example route options 1 and 2 would each require new ROW within the boundaries of the Cuyuna Country State Recreation Area.
Archaeological and Historic Architectural Resources					The applicants' proposed route and the applicants' proposed route with modifications would both cross significant cultural resources in an area of new ROW, where route options 1 and 2 would cross these same resources using existing transmission line ROW. Otherwise, counts of cultural resources are similar across each full route option.
Natural Environment – Watercourses and Waterbodies					Route option 2 would have the least number of stream crossings. However, it should be noted that the difference in stream crossings between route option 2 and the other three route options stems from the J1 route alternative in the Benton County Elk River region (which is part of example route option 2) being located in a new transmission line ROW west of the Elk River. In contrast, the other three full route options would use the applicants' equivalent to parallel an existing transmission line ROW while crossing a meandering section of the Elk River multiple times. The applicants' proposed route would avoid crossing an impaired lake and would have the least number of PWI basin crossings but would have the most PWI wetland crossings.
Natural Environment – Wetlands					The ROW of route option 2 has the least acres of wetland, including forested wetland.
Natural Environment – Vegetation					Route options 1 and 2 would have less impact on forested vegetation.
Natural Environment – Wildlife					Route option 1 minimizes impacts to wildlife and associated habitat by avoiding the Moose Lake WMA.
Rare and Unique Natural Resources					Route options 1 and 2 minimize impacts to Sites of Biodiversity Significance and High Conservation Value Forests.

Routing Factor/Resource	Applicants' Proposed Route	Applicants' Proposed Route with Modifications	Example Route Option 1	Example Route Option 2	Summary
Use or Paralleling of Existing ROW					Total ROW paralleling and sharing is nearly equal across all route options. There is some variation in the paralleling of existing transmission line rights-of-way. Route option 1 uses the most existing transmission line ROW (95 percent), while the applicants' proposed route with modifications is second with 92 percent. Route option 2 and the applicants' proposed route each use less than 90 percent of existing transmission line rights-of-way (89 percent and 87 percent, respectively).
Costs Dependent on Design and Route (2022 dollars in millions)	$1,182	$1,292	$1,332	$1,352	The applicants' proposed route is the least expensive, while example route option 2 is the most expensive. Factors affecting cost include double-circuiting long sections of transmission line in route options 1 and 2 as well as specialty structures that would be required near the Hill City/Quadna Mountain airport.

Commented [VP1]: Costs updated in response to applicants' comment letter

7.2.2.3 Mining

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

There are no mining resources in the vicinity of the applicants' proposed route or the applicants' proposed route with modifications; as such, these route alternatives best minimize potential impacts to mining resources. Route options 1 and 2 each have the same two aggregate mines located in their ROW, though both routes would follow an existing transmission line ROW through one of these aggregate mines, minimizing introduction of new impacts (see Chapter 6.3.4.2.3).

7.2.2.4 Recreation and Tourism

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

Table 7-1 Recreational Resources Crossed by the 150-foot ROW of Applicants' Proposed Routes and Example Full Route Options

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

Full route options 1 and 2 as well as the applicants' proposed route with modifications would each cross through a portion of the Cuyuna Country State Recreation Area. However, full route options 1 and 2 would cross this recreation area within existing transmission line ROW in an area of double-circuiting. An additional 80 feet of ROW from within the Cuyuna Country State Recreation Area would be needed to accommodate the double-circuiting and placement of the route through this area. As a result, minimal impacts to the Cuyuna Country State Recreation Area are anticipated. The applicants' proposed route with modifications would cross this recreation area parallel to existing road ROW at the far eastern edge of the recreation area and outside of the area used for recreation (Photo 7-1).