In this section, the natural, cultural, human and socioeconomic resources in the general project area are discussed. The potential impacts that are generally associated with construction and operation of a high-voltage transmission line (HVTL) are also described for each resource, along with possible means of mitigating those impacts.

Section 7 provides the reader with a broad overview perspective of resources and impacts associated with the project. It discusses each resource topic in terms that are applicable to all or most of the route alternatives. For example, discussions of wetland functions or property values, which are subjects common to all route alternatives, are provided in Section 7 rather than being repeated for each of the 62 route alternatives.

The Section 7 general discussion of the affected environment and potential impacts associated with the project is followed by specific detailed information in Section 8. In Section 8, quantified details are provided on resources and potential impacts specific to each of the 62 route alternatives.

7.1 Public Health and Safety

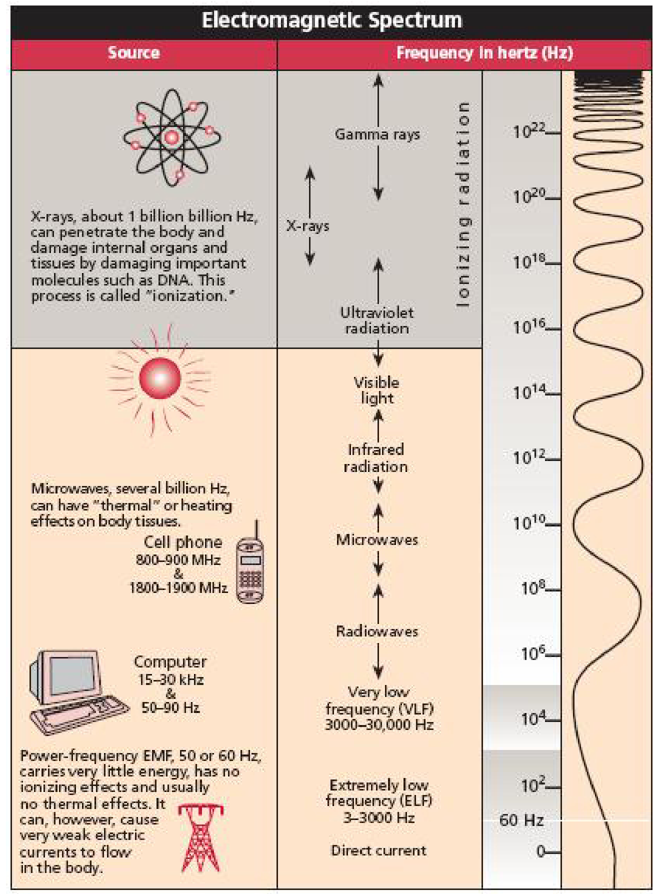
This section summarizes the potential impacts of the proposed transmission line on health and safety, including:

- Electric and Magnetic Fields (EMFs);
- Implantable Medical Devices;
- Induced Currents and Shock Hazards;
- Stray Voltage;
- Construction Activities and Equipment;
- Environmental Contamination;
- Security; and
- Severe Weather.

7.1.1 Electric and Magnetic Fields (EMF)

Electric and Magnetic Fields (EMFs) are invisible regions of force resulting from the presence of electricity. Naturally occurring EMFs are caused by the earth's weather and geomagnetic field. Man-made EMFs are caused from any electrical device and found wherever people use electricity. EMFs are characterized and distinguished by their frequencies, which is measured by the rate at which the fields change direction each second. A table displaying the wide spectrum of EMFs is shown in Figure 7.1.1 1.

Figure 7.1.1-1 Electromagnetic spectrum



The wavy line at the right illustrates the concept that the higher the frequency, the more rapidly the field varies. The fields do not vary at 0 Hz (direct current) and vary trillions of times per second near the top of the spectrum. Note that 10^4 means 10 x 10 x 10 x 10 or 10,000 Hz. 1 kilohertz (kHz) = 1,000 Hz. 1 megahertz (MHz) = 1,000,000 Hz.

Source: (NIH 2002)

As indicated in Figure 7.1.1 1, all power lines within the United States have a frequency equivalent to 60 cycles per second, defined as 60 Hertz (Hz). EMFs at this frequency level and within the range of 3 to 3,000 Hz are considered to be Extremely Low Frequency (ELF) EMFs (ELF-EMFs).

The term "EMF" usually, and for the purpose of this project, refers to separate electric and magnetic fields at ELF. However, the term can sometimes refer to "electromagnetic fields" and be used in a much broader sense to encompass both low and high frequency fields. It is important to differentiate between the two, as electric and magnetic fields in the ELF range are not coupled or interrelated in the same way that they are at higher frequencies (NIEHS 2002). ELF-EMFs also exhibit non-ionizing radiation and non-thermal characteristics, as opposed to high frequency fields (e.g., gamma rays and x-rays) that can exhibit ionizing radiation, capable of breaking through molecular bonds, and/or thermal characteristics. For the frequencies associated with power lines, it is useful to discuss separately electric and magnetic fields, which arise from the voltage of a power line and the flow of electricity, respectively.

What is the difference between electric and magnetic fields?

- Electric fields are measured in kilovolts per meter (kV/m).
- Magnetic fields—or flux density—is measured in mG or microTesla (μT).
- Electric field intensity is proportional to the voltage of the transmission line.
- Magnetic field intensity is proportional to the current flow.
- Electric fields are easily shielded or weakened by objects such as trees or walls.
- Magnetic fields are difficult to shield and, thus, more easily penetrate objects.

7.1.1.1 Electric Field

Electric fields are created by the electric charge (i.e., voltage) on a conductor (e.g., a transmission line). Electric fields are solely dependent upon the voltage of a conductor, not the actual flow of electricity (i.e., current). Electric field strength is measured in kilovolts per meter (kV/m). The strength of an electric field decreases rapidly as the distance from the source increases. Electric fields are easily shielded or weakened by most objects and material, such as trees, buildings, and even human skin.

Although there are no federal regulations regarding allowable electric fields, the Minnesota Public Utilities Commission has set a standard of 8 kV/m for the maximum electric field associated with a transmission line (measured at centerline and at 1 meter above ground). Six other states, including California, Florida, Montana, New Jersey, New York, and Oregon have comparable standards.

The proposed 345 kV transmission line would operate at a power frequency of 60 cycles per second (60 Hz). Variations in topography and other siting constraints along the proposed 81-89-mile-long transmission line route will require different structure types and configurations. This variation in structures would have an effect on the electric field strength emitted from the transmission line in certain areas.

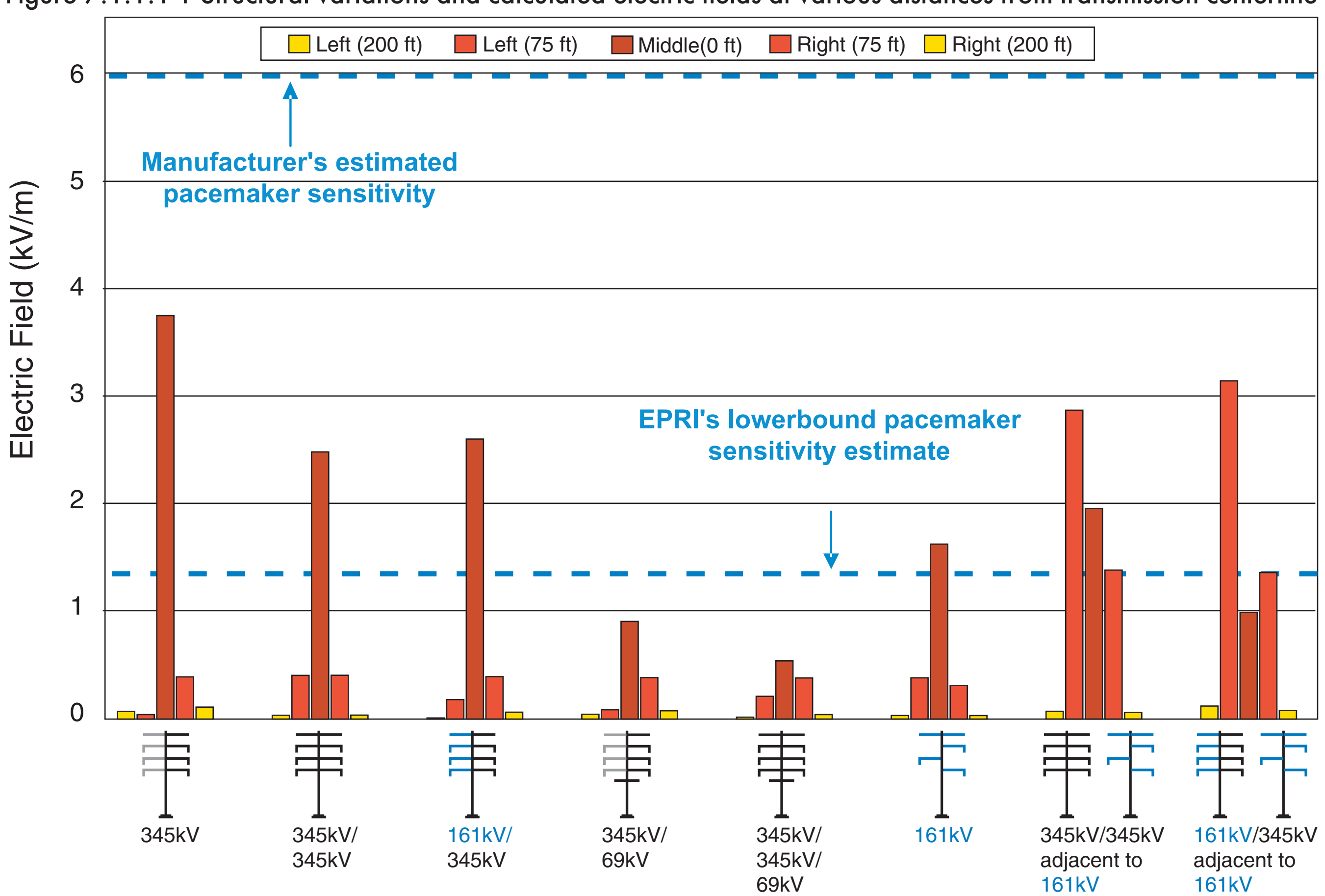
As described in previous sections (Section 4.0) the structure type and the number of circuits carried would vary depending on the area in question. As indicated by the applicant in the route permit application, the majority of the project would be constructed using single-pole double-circuit capable davit arm structures. In some areas both circuits would be utilized and may carry one active 345 kV line and one 345 kV line operated at 161 kV. In other locations the double circuit structure may carry a double-circuit 345kV/345kV with only one 345 kV circuit active. In addition, there may be some locations where the structure would include a 69 kV underbuild. The North Rochester Substation to Northern Hills Substation Segment would be constructed using single-pole davit arm structures carrying a 161 kV single-circuit. During the scoping process an additional configuration was suggested that would involve sharing right-of-way (ROW) between the North Rochester Substation to Mississippi River 345 kV double-circuit line and the North Rochester Substation to Northern Hills Substation 161 kV single circuit lines where possible creating a parallel alignment.

Figure 7.1.1.1-1 identifies the different structure configurations proposed along with the calculated electric fields at various distances from the transmission centerline. Figure 7.1.1.1-1 also shows, as discussed in Section 7.1.1.4, potential impacts to implantable medical devices from electric fields associated with the structures for the project.

The maximum calculated electric field on the entire length of project would be in the areas where the transmission line would be configured as a single-pole davit arm 345/345 kV double-circuit with one 345 kV circuit in service. The maximum electric field for this configuration directly beneath the transmission centerline is estimated at 3.76 kV/m. This value falls below all state and international electric field guidelines as identified in Tables 7.1.1.1-1 and 7.1.1.1-2. Electric field values for all structure configurations up to 300 feet from the ROW centerline are provided in Table 7.1.1.1-3

The highest electric field calculated by the applicant at the edge of the transmission line ROW would be in the area where the 345 kV double-circuit and 161 kV single-circuit Parallel Alignment was suggested. In both configurations, single-pole davit arm 345/161 kV double-circuit adjacent to a single-pole davit arm 161 kV or single-pole davit arm 345/345 kV double-circuit adjacent to a single-pole davit arm 161 kV, the electric field at the edge of the ROW is estimated at 1.00 kV/m. This value is at or below all state guidelines for electric fields at transmission ROW edge as indicated in Tables 7.1.1.1-2. For the proposed project the highest calculated electric fields at 300 feet from transmission centerline would be 0.07 kV/m. These electric field strengths are well within the range of electric fields generated by other common household and business sources. No adverse health effects from electric fields are anticipated for persons living or working at locations along or near the proposed project.

Figure 7.1.1.1-1 Structural variations and calculated electric fields at various distances from transmission centerline



Source: Barr 2010

Table 7.1.1.1-1 International electric field guidelines

Organization	Electric Field (kV/m)	
	General Public	Occupational
IEEE (2002)	5	20
ICNIRP (2010)	4.2	8.3
ACGIH (2000)	---	25
NRPB (2004)	4.2	---
EU (1999)	4.2	---

IEEE - Institute of Electrical and Electronic Engineers
ICNIRP - International Commission on Non-Ionizing Radiation Protection
ACGIH - American Conference of Governmental Industrial Hygienists
NRPB - National Radiological Protection Board
EU - European Union

Table 7.1.1.1-2 State electric field regulations or guidelines

State	Electric Field	
	On ROW	Edge ROW
Florida	8 kV/m[a]	2 kV/m
	10 kV/m[b]	
Minnesota	8 kV/m	
Montana	7 kV/m	1 kV/m[d]
New Jersey		3 kV/m
New York	11.8 kV/m	1.6 kV/m
	11 kV/m[e]	
	7 kV/m[c]	
Oregon	9 kV/m	

a - For lines of 69-230 kV
b - For 500 kV lines
c - Maximum for highway crossings
d - May be waived by the landowner
e - Maximum for private road crossings

Table 7.1.1.1-3 Calculated electric fields (kV/m) for proposed transmission line designs (3.28 feet aboveground)

	Distance to Proposed Centerline in Feet (Electric field in kV/m)										
Structure Type	**-300**	**-200**	**-100**	**-75**	**-50**	**0**	**50**	**75**	**100**	**200**	**300**
Single-Pole, Davit Arm, 345/345 kv Double-Circuit with **One** 345 kV Circuit in Service	0.04	0.08	0.11	0.05	0.22	3.76	1.58	0.40	0.18	0.12	0.06
Single-Pole, Davit Arm, 345/345 kv Double-Circuit with **Both** 345 kV Circuit in Service	0.02	0.05	0.15	0.42	1.41	2.48	1.41	0.42	0.15	0.05	0.02
Single-Pole, Davit Arm, 345/345 kv Double-Circuit with **One** 345 kV active and one operated at 161 kV	0.01	0.02	0.09	0.20	0.56	2.62	1.50	0.41	0.16	0.08	0.04
Single-Pole, Davit Arm, 345/345/69 kv Triple-Circuit with **One** 345 and 69 kV Circuit in Service	0.04	0.06	0.03	0.10	0.43	0.92	1.10	0.40	0.10	0.09	0.06
Single-Pole, Davit Arm, 345/345/69 kv Triple-Circuit with **Both** 345 kV and 69 kV Circuits in Service	0.00	0.01	0.01	0.22	0.41	0.55	0.98	0.39	0.13	0.05	0.03
Single Pole Davit Arm 161 kV Single-Circuit	0.02	0.04	0.21	0.39	0.80	1.64	0.76	0.32	0.18	0.04	0.02
Single-Pole, Davit Arm, 345/345 kV Double-Circuit Adjacent to Single Pole Davit Arm 161 kV	0.04	0.08	1.00	2.88	2.87	1.97	1.52	1.40	0.53	0.07	0.03
Single-Pole, Davit Arm, 345/161 kv Double-Circuit Adjacent to Single Pole Davit Arm 161 kV	0.07	0.13	1.00	3.16	3.53	1.00	1.56	1.38	0.54	0.09	0.04

7.1.1.2 Magnetic Fields

Magnetic fields are created by and are solely dependent upon the electrical current in a conductor. Magnetic field strength is measured in milliGauss (mG). Similar to electric fields, the strength of a magnetic field decreases rapidly as the distance from the source increases. However, unlike electric fields, magnetic fields are not easily shielded or weakened by objects or materials.

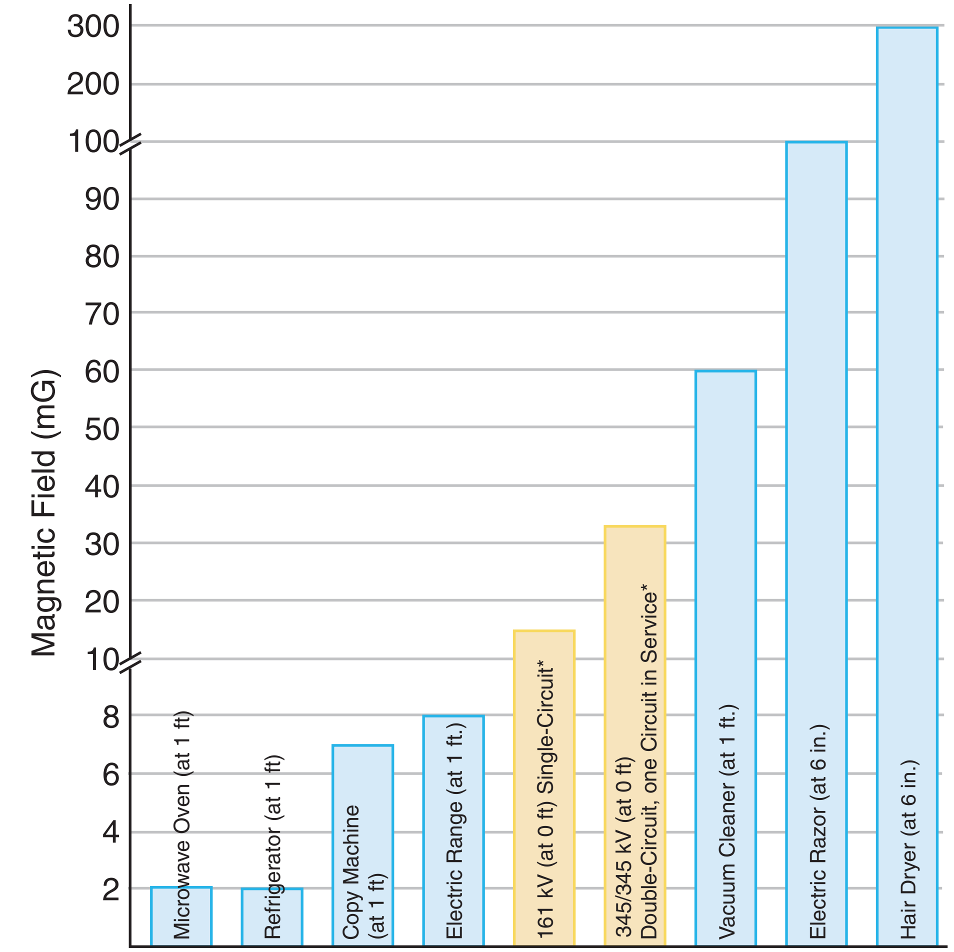
We encounter magnetic fields from every-day things such as radar and microwave towers, television and computer screens, motors, fluorescent lights, microwave ovens, cell phones, electric blankets, house wiring, and hundreds of other common electrical devices. The general wiring and appliances located in a typical home can produce an average background magnetic field of 0.5 mG to 4 mG (National Cancer Institute 2009). Magnetic fields of common household appliances are shown in Figure 7.1.1.2-1.

For example, the electrical wiring in a house, TVs, hairdryers, refrigerators, coffeepots, computers, toasters, lamps, and all other electrical appliances contribute to the EMF within a home.

There are no federal or Minnesota state regulations for the permitted strength of a magnetic field related to a transmission line; however, Florida, Massachusetts, and New York have adopted standards ranging from 150 to 250 mG (Table 7.1.1.2-3).

Because magnetic field strength is directly related to the electrical current or amps in the conductor, the magnetic field varies based on the flow of electricity and experiences peaks and valleys throughout the day.

Figure 7.1.1.2-1 Magnetic field of common appliances



- Magnetic field levels predicted for proposed transmission line structures (single pole, davit arm structures) 3.28 feet above ground at a point directly under the transmission line and where the conductor is closest to the ground. Values shown were calculated for the 10 years after the planned in-service of the final component (2025) under normal system intact conditions and for average flows. Values for single-pole davit arm 345/345 kV double-circuit with one circuit in service shown for North Rochester to Alma segment (332 amps).

Source: Barr figure 2010 based on NIH 2002

As with electric fields, magnetic fields decrease in strength as one moves farther from the source. Magnetic fields also vary in intensity depending on the type of structure and the amount of current flowing through the transmission line in a given area. Figure 7.1.1.2-2 shows the calculated magnetic field strengths at various distances from the transmission centerline and for a variety of structure types.

Magnetic field values are provided in Table 7.1.1.2-1 for each line configuration of the project at two system conditions: the expected summer peak and average current flows projected for the planned in-service of the final component (2015) and 10 years following (2025) under normal system intact conditions.

Additional calculations were made using potential flows on the 345 kV line facilities that could occur under the highest anticipated loading conditions at some point in the future. High line loading conditions could occur during off-peak demand periods (periods of low electrical use/demand) if significant generation were to be located in the area and if there were an unplanned outage of a major Twin Cities 345 kV transmission source such as the Byron—Prairie Island transmission line or King—Eau Claire transmission line. These off-peak demand periods could occur for about six hours per day, for as long as the outage occurs and load levels are low. Based on this scenario, the highest flow that could occur on the facilities would be on the North Rochester Substation to Mississippi River Segment. This portion of the project could potentially experience flow of approximately 600 megavolt-amperes (MVA) for short periods of time. Magnetic field values for an assumed 600 MVA loading are provided in Table 7.1.1.2-2.

The maximum calculated magnetic field at the centerline of the project for expected normal conditions would be in areas where the transmission line would be configured as a single-pole davit arm 345/345/69 kV triple-circuit with one 345 and one 69 kV circuit in service (2025, peak). The magnetic field for this configuration directly beneath the transmission centerline is estimated at 71.85 mG. This value falls below all international magnetic field guidelines as identified in Table 7.1.1.2-3.

The maximum calculated magnetic field at the centerline of the project, under the highest anticipated loading conditions at some point in the future (assumed 600 MVA loading) would be in the areas where the transmission line would be configured as a single-pole davit arm 345/345kV double-circuit with both circuits in service (peak). The magnetic field for this configuration directly beneath the transmission centerline is estimated at is 260.78 mG. This value falls below all international magnetic field guidelines as identified in Table 7.1.1.2-3. No adverse health effects from magnetic fields are anticipated for persons living or working at locations along or near the proposed project. This said, potential health impacts related to magnetic fields, though well researched, contain some degree of uncertainty, see Section 7.1.1.3.

The maximum calculated magnetic field at the edge of the ROW for expected normal conditions would be in the areas where the transmission line would be configured as a single-pole davit arm 345/345 kV double-circuit with one 345 kV

Figure 7.1.1.2-2 Structural variations and calculated magnetic fields at various distances from transmission centerline (2025 peak flows)

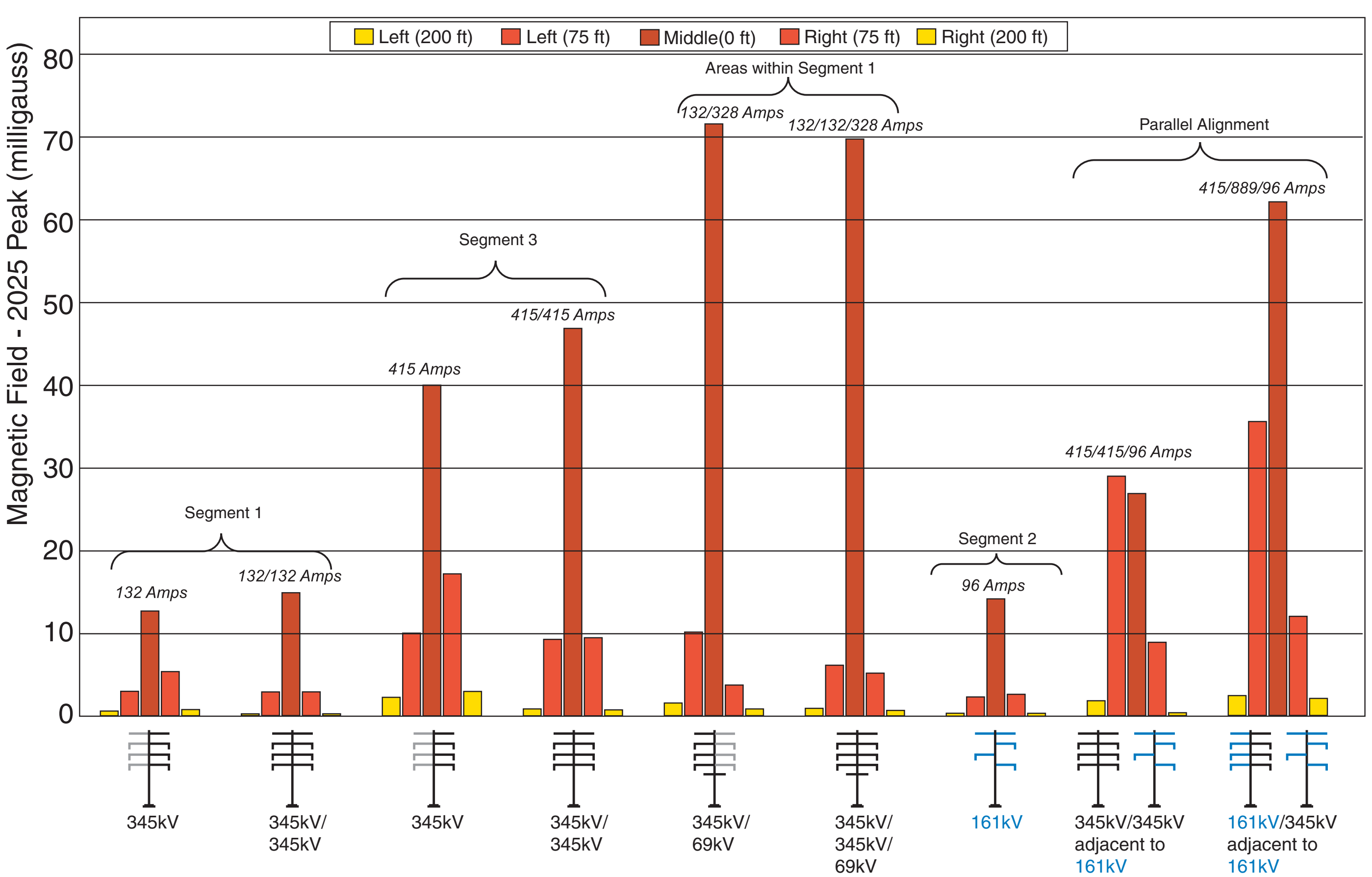


Table 7.1.1.2-1 Calculated magnetic fields (mG) for proposed transmission line designs (3.28 feet aboveground)

Structure Type	Route Segment	Timeframe	Current (Amps)	Distance to Proposed Centerline in Feet (Magnetic field in mG)										
				-300	-200	-100	-75	-50	0	50	75	100	200	300
Single-Pole, Davit Arm, 345/345 kV Double-Circuit with **One** 345 kV Circuit in Service	Hampton to North Rochester Substation Segment	2015 Peak	140	0.38	0.79	2.35	3.41	5.24	13.58	9.64	5.88	3.77	1.04	0.46
		2015 Average	112	0.30	0.63	1.88	2.73	4.19	10.87	7.71	4.71	3.01	0.83	0.37
		2025 Peak	132	0.36	0.74	2.22	3.22	4.94	12.81	9.09	5.55	3.55	0.98	0.43
		2025 Average	106	0.29	0.60	1.78	2.58	3.97	10.29	7.30	4.45	2.85	0.79	0.35
Single-Pole, Davit Arm, 345/345 kV Double-Circuit with **Both** 345 kV Circuit in Service	Hampton to North Rochester Substation Segment	2015 Peak	140/140	0.10	0.31	1.76	3.22	6.34	15.92	6.42	3.27	1.80	0.31	0.10
		2015 Average	112/112	0.08	0.24	1.41	2.58	5.07	12.74	5.13	2.62	1.44	0.25	0.08
		2025 Peak	132/132	0.10	0.29	1.66	3.04	5.98	15.01	6.05	3.09	1.69	0.30	0.10
		2025 Average	106/106	0.08	0.23	1.33	2.44	4.80	12.06	4.86	2.48	1.36	0.24	0.08
Single-Pole, Davit Arm, 345/345 kV Double-Circuit with **One** 345 kV Circuit in Service	North Rochester Substation to Mississippi River Segment	2015 Peak	403	1.12	2.33	6.97	10.11	15.54	40.27	28.58	17.44	11.17	3.09	1.35
		2015 Average	322	0.87	1.81	5.41	7.85	12.06	31.24	22.17	13.53	8.67	2.40	1.05
		2025 Peak	415	1.12	2.33	6.97	10.11	15.54	40.27	28.58	17.44	11.17	3.09	1.35
		2025 Average	332	0.90	1.87	5.57	8.09	12.43	32.21	22.86	13.95	8.94	2.47	1.08
Single-Pole, Davit Arm, 345/345 kV Double-Circuit with **Both** 345 kV Circuit in Service	North Rochester Substation to Mississippi River Segment	2015 Peak	403/403	0.29	0.88	5.07	9.27	18.26	45.84	18.48	9.43	5.17	0.91	0.30
		2015 Average	322/322	0.23	0.70	4.05	7.41	14.59	36.63	14.76	7.53	4.13	0.72	0.24
		2025 Peak	415/415	0.30	0.91	5.22	9.55	18.80	47.21	19.03	9.71	5.32	0.93	0.31
		2025 Average	332/332	0.24	0.73	4.18	7.64	15.04	37.76	15.22	7.76	4.26	0.75	0.24
Single-Pole, Davit Arm, 345/345/69 kV Triple-Circuit with **One** 345 kV Circuit in Service	Areas within Hampton to North Rochester Substation Segment	2015 Peak	140/325	0.74	1.65	6.20	10.42	20.73	70.89	8.50	3.77	2.51	1.01	0.52
		2015 Average	112/260	0.59	1.32	4.96	8.33	16.58	56.71	6.80	3.02	2.01	0.81	0.41
		2025 Peak	132/328	0.73	1.62	6.14	10.36	20.71	71.85	5.89	3.92	2.54	0.99	0.50
		2025 Average	106/262	0.58	1.30	4.91	8.28	16.55	57.37	7.09	3.12	2.03	0.79	0.40
Single-Pole, Davit Arm, 345/345/69 kV Triple-Circuit with **Both** 345 kV Circuit in Service	Areas within Hampton to North Rochester Substation Segment	2015 Peak	140/140/325	0.47	1.00	3.51	6.16	14.19	68.88	11.45	5.18	3.00	0.93	0.46
		2015 Average	112/112/260	0.37	0.80	2.81	4.93	11.35	55.11	9.16	4.14	2.40	0.75	0.37
		2025 Peak	132/132/328	0.47	1.02	3.61	6.35	14.55	69.98	11.70	5.33	3.09	0.95	0.47
		2025 Average	106/106/262	0.38	0.82	2.88	5.06	11.61	55.87	9.34	4.25	2.47	0.76	0.37
Single Pole Davit Arm 161 kV Single-Circuit	North Rochester Substation to Northern Hills Substation Segment	2015 Peak	95	0.20	0.43	1.50	2.42	4.39	14.29	5.41	2.79	1.65	0.42	0.18
		2015 Average	76	0.16	0.34	1.20	1.94	3.51	11.43	4.33	2.23	1.32	0.33	0.14
		2025 Peak	96	0.20	0.43	1.52	2.45	4.43	14.44	5.47	2.82	1.66	0.42	0.18
		2025 Average	77	0.16	0.34	1.22	1.96	3.56	11.58	4.38	2.26	1.33	0.34	0.15
Single-Pole, Davit Arm, 345/345 kV Double-Circuit Adjacent to Single Pole Davit Arm 161 kV	Portions of the line that have a Parallel Alignment	2015 Peak	403/403/96	0.62	1.95	14.60	28.35	43.38	26.50	18.36	9.19	3.71	0.52	0.19
		2015 Average	322/322/77	0.50	1.56	11.67	22.65	34.65	21.19	14.72	7.38	2.98	0.42	0.16
		2025 Peak	415/415/96	0.63	2.00	15.04	29.22	44.71	27.15	18.41	9.12	3.66	0.51	0.19
		2025 Average	332/332/77	0.51	1.60	12.03	23.37	35.76	21.73	14.76	7.32	2.94	0.41	0.15
Single-Pole, Davit Arm, 345/161 kV Double-Circuit Adjacent to Single Pole Davit Arm 161 kV	Portions of the line that have a Parallel Alignment	2015 Peak	403/861/96	1.19	2.52	14.91	34.68	70.69	60.52	28.55	12.02	5.75	2.29	1.15
		2015 Average	322/689/77	0.96	2.02	11.93	27.74	56.56	48.45	22.88	9.64	4.60	1.83	0.92
		2025 Peak	415/889/96	1.24	2.62	15.41	35.82	73.00	62.39	29.07	12.27	5.97	2.38	1.19
		2025 Average	332/711/77	0.99	2.09	12.32	28.65	58.38	49.91	23.28	9.82	4.77	1.90	0.95

Table 7.1.1.2-2 Calculated magnetic fields (mG) for proposed transmission line designs (3.28 feet aboveground Assumed 600 MVA Loading)

Structure Type	Route Segment	Timeframe	Current (Amps)	Distance to Proposed Centerline in Feet (Magnetic field in mG)										
				-300	-200	-100	-75	-50	0	50	75	100	200	300
Single-Pole, Davit Arm, 345/345 kV Double-Circuit with **One** 345 kV Circuit in Service	North Rochester Substation to Mississippi River Segment	Peak	1004	1.38	2.90	9.13	13.71	22.17	66.54	46.84	26.57	16.08	4.11	1.80
		Average	803	1.10	2.32	7.30	10.96	17.73	53.22	37.47	21.25	12.86	3.28	1.44
Single-Pole, Davit Arm, 345/345 kV Double-Circuit with **Both** 345 kV Circuit in Service	North Rochester Substation to Mississippi River Segment	Peak	502/502	3.07	6.93	27.35	47.73	102.72	260.78	102.72	47.73	27.35	6.93	3.07
		Average	402/402	2.46	5.55	21.90	38.22	82.26	208.83	82.26	38.22	21.90	5.55	2.46
Single-Pole, Davit Arm, 345/345/69 kV Triple-Circuit with **One** 345 kV Circuit in Service	Areas within Hampton to North Rochester Substation Segment	Peak	1004/328	2.94	6.12	18.63	27.57	44.35	60.98	36.78	28.16	20.42	6.83	3.20
		Average	803/262	2.35	4.89	14.80	22.04	35.45	48.71	29.42	22.53	16.33	5.46	2.56
Single-Pole, Davit Arm, 345/345/69 kV Triple-Circuit with **Both** 345 kV Circuit in Service	Areas within Hampton to North Rochester Substation Segment	Peak	502/502/328	0.45	0.98	2.81	4.05	8.32	52.76	11.10	5.06	2.86	0.93	0.49
		Average	402/402/262	0.36	0.78	2.25	3.24	6.64	42.10	8.88	4.05	2.29	0.74	0.39
Single-Pole, Davit Arm, 345/345 kV Double-Circuit Adjacent to Single Pole Davit Arm 161 kV	Portions of the line that have a Parallel Alignment	Peak	502/502/96	0.73	2.36	18.24	35.55	54.35	31.88	18.81	8.70	3.27	0.46	0.17
		Average	402/402/77	0.58	1.89	14.60	28.47	43.52	25.54	15.08	6.98	2.63	0.37	0.14
Single-Pole, Davit Arm, 345/161 kV Double-Circuit Adjacent to Single Pole Davit Arm 161 kV	Portions of the line that have a Parallel Alignment	Peak	213/176/96	0.53	1.44	8.35	14.96	21.09	14.39	17.39	10.51	4.95	0.79	0.30
		Average	170/141/77	0.42	1.15	6.65	11.93	16.84	11.54	13.96	8.43	3.97	0.63	0.24

circuit in service (2015, peak; 2025 peak). The magnetic field for this configuration, on the edge or the ROW, is estimated at is 17.44 mG. This value is below all state established guidelines for magnetic fields at the edge of transmission ROW as indicated in Table 7.1.1.2-4.

The maximum calculated magnetic field at the edge of the ROW under the highest anticipated loading conditions at some point in the future (assumed 600 MVA loading) would be in the areas where the transmission line would be configured as a single-pole davit arm 345/345kV double-circuit with both circuits in service (peak). The magnetic field for this configuration, on the edge or the ROW, is estimated at is 47.43 mG. This value is below all state established guidelines for magnetic fields at the edge of transmission ROW as indicated in Table 7.1.1.2-4. No adverse health effects from magnetic fields are anticipated for persons living or working at locations along or near the proposed project. This said, potential health impacts related to magnetic fields, though well researched, contain some degree of uncertainty, see Section 7.1.1.3

Table 7.1.1.2-3 International magnetic field guidelines

Organization	Magnetic Field	
	General Public	Occupational
IEEE (2002)	9,040	27,100
ICNIRP (2010)	2,000	10,000
ACGIH (2000)	---	10,000/1000*
NRPB (2004)	830	4,200
EU (1999)	830	---

* For persons with cardiac pacemakers or other medical electronic devices
IEEE - Institute of Electrical and Electronic Engineers
ICNIRP - International Commission on Non-Ionizing Radiation Protection
ACGIH - American Conference of Governmental Industrial Hygienists
NRPB - National Radiological Protection Board
EU - European Union

Table 7.1.1.2-4 State magnetic field regulations or guidelines

State	Magnetic Field at Edge of ROW
Florida	150 mG[a] (max load)
	200 mG[b] (max load)
	250 mG[c] (max load)
Massachusetts	85 mG
New York	200 mG (max load)

a - For lines of 69-230 kV
b - For 500 kV lines
c - For 500 kV lines in certain existing ROW

7.1.1.3 Health Studies

A common concern related to EMFs is the potential of adverse health effects that exposure to EMFs may have on children, elderly, and pregnant women. The suggestion that these demographics are more susceptible to adverse health effects from EMF exposure is consistent with a large body of information showing that these demographics are more vulnerable than average adults to other exposures, such as to chemicals, diseases, and ionizing radiation.

Numerous panels of experts have convened to review research data relevant to whether or not EMFs are associated with adverse health effects. These reviews have been conducted by the National Institute of Environmental Health Sciences (NIEHS), the U.S. Environmental Protection Agency (USEPA), the World Health Organization (WHO), and the Minnesota State Interagency Working Group (MSIWG) on EMF Issues.

In 1992, the U.S. Congress authorized the Electric and Magnetic Fields Research and Public Information Dissemination Program (EMF-RAPID Program) in the Energy Policy Act. The Congress instructed NIEHS, National Institutes of Health, and the U.S. Department of Energy (USDOE) to direct and manage a program of research and analysis aimed at providing scientific evidence to clarify the potential for health risks from exposure to ELF-EMFs (NIEHS 1999). The EMF-Rapid Program provided the following conclusions to Congress on May 4, 1999:

- *"The scientific evidence suggesting that ELF-EMF exposures pose any health risk is weak."*

- *"Epidemiological studies have serious limitations in their ability to demonstrate a cause and effect relationship whereas laboratory studies, by design, can clearly show that cause and effect are possible. Virtually all of the laboratory evidence in animals and humans and most of the mechanistic work done in cells fail to support a causal relationship between exposure to ELF-EMF at environmental levels and changes in biological function or disease status. The lack of consistent positive findings in animal or mechanistic studies weakens the belief that this association is actually due to ELF-EMFs, but it cannot completely discount the epidemiological findings."*

- *"The NIEHS concludes that ELF-EMF exposure cannot be recognized as entirely safe because of weak scientific evidence that exposure may pose a leukemia hazard. In our opinion, this finding is insufficient to warrant aggressive regulatory concern. However, because virtually everyone in the United States uses electricity and therefore is routinely exposed to ELF-EMF, passive regulatory action is warranted such as a continued emphasis on educating both the public and the regulated community on means aimed at reducing exposures. The NIEHS does not believe that other cancers or non-cancer health outcomes provide sufficient evidence of a risk to currently warrant concern (NIEHS, 1999)."*

Currently, the USEPA states the following viewpoint of the associated health effects of EMFs on its website (USEPA: Electric and Magnetic Fields (EMF) Radiation from Power Lines 2009):

> *"Much of the research about power lines and potential health effects is inconclusive. Despite more than two decades of research to determine whether elevated EMF exposure, principally due to magnetic fields, is related to an increased risk of childhood leukemia, there is still no definitive answer. The general scientific consensus is that, thus far, the evidence available is weak and is not sufficient to establish a definitive cause-effect relationship" (USEPA: Electric and Magnetic Fields (EMF) Radiation from Power Lines 2009).*

Currently, the WHO states the following viewpoint of the associate health effects of EMFs on its website (WHO 2009):

> *"Extensive research has been conducted into possible health effects of exposure to many parts of the frequency spectrum. All reviews conducted so far have indicated that exposures below the limits recommended in the INNIRP (1998) EMF guidelines, covering the full frequency range from 0-300 GHz, do not produce any known adverse health effect. However, there are gaps in knowledge still needing to be filled before better health risk assessments can be made" (WHO 2009).*

In September of 2002, the MSIWG on EMF Issues, published "A White Paper on Electric and Magnetic Field (EMF) Policy and Mitigation Options," referred to as the "White Paper." The MSIWG was formed to examine the potential health impacts of EMFs and to provide useful, science-based information to policy makers in Minnesota. Work Group members included representatives from the Department of Commerce, the Department of Health, the Pollution Control Agency (PCA), the Public Utilities Commission (Commission), and the Environmental Quality Board (EQB) (MSIWG, 2002). The White Paper concluded the following:

- *"Some epidemiological results do show a weak but consistent association between childhood leukemia and increasing exposure to EMF (see the conclusion of IARC and NIEHS). However, epidemiological studies alone are considered insufficient for concluding that a cause and effect relationship exists, and the association must be supported by data from laboratory studies. Existing laboratory studies have not substantiated this relationship (see NTP 1999; Takebe et al. 2001), nor have scientists been able to understand the biological mechanism of how EMF could cause adverse effects. In addition, epidemiological studies of various other diseases, in both children and adults, have failed to show any consistent pattern of harm from EMF."*

- *"The Minnesota Department of Health concludes that the current body of evidence is insufficient to establish a cause and effect relationship between EMF and adverse health effects. However, as with many other environmental health issues, the possibility of a health risk from EMF cannot be dismissed. Construction of new generation and transmission facilities to meet increasing electrical needs in the State is likely to increase exposure to EMF and public concern regarding potential adverse health effects."*

- *"Based upon its review, the Work Group believes the most appropriate public health policy is to take a prudent avoidance approach to regulating EMF. Based upon this approach, policy recommendations of the Work Group include:*
  - *Apply low-cost EMF mitigation options in electric infrastructure construction projects;*
  - *Encourage conservation;*
  - *Encourage distributed generation;*
  - *Continue to monitor EMF research;*
  - *Encourage utilities to work with customers on household EMF issues; and*
  - *Provide public education on EMF issues" (MSIWG 2002).*

Researchers have not been able to establish a cause and effect relationship between exposure to EMFs and adverse health effects. Accordingly, there is not a magnetic field exposure-response calculation that can be performed to estimate possible adverse health impacts.

During public hearing proceedings for the proposed 345 kV transmission line from Brookings County, South Dakota to Hampton, Minnesota, Dr. Peter Valberg provided pre-filed direct testimony regarding his findings on health effects associated with EMF. Dr. Valberg holds graduate degrees both in physics and human physiology. He is the author of more than 80 peer-reviewed articles on environmental health and cell biology and has directed health risk assessments for municipal health departments, utilities, regulatory agencies, and industry on evaluation of potential health effects from exposure to EMF and RF. In his direct testimony Dr. Valberg noted that scientist have not been able to establish a laboratory or other model that reliably demonstrates adverse biological changes in response to typical electric-power MF fields. In fact a large number of studies with laboratory animals exposed, over their lifetimes, to MF levels a thousand-fold higher that near power lines yielded no effect. Furthermore, laboratory research with isolated cells and biophysical analyses have not identified plausible mechanisms by which MF at level encountered near transmission lines can lead to the creation or stimulation of tumor cells.

Continued Research

It is important to note that although expert panels and agencies, such as the ones discussed above, have not identified a cause and effect relationship between exposure to EMFs and adverse health effects, hypotheses continue to be researched and guidelines proposed. These include, but are not limited to, Dr. David Carpenter's proposed guidance on EMF levels and public health and the Melatonin and Henshaw Effect hypotheses formed by Professor Denis Henshaw.

Dr. Carpenter, during the recent public hearings for the proposed 345 kV transmission line from Brookings County, South Dakota to Hampton, Minnesota, provided testimony regarding his findings on health effects associated with EMF. Dr. Carpenter is a public health physician and Director of the Institute for Health and the Environment at the University of Albany, SUNY. He researched and co-wrote an article titled, *Setting Prudent Public Health Policy for Electromagnetic Field Exposures*. Dr. Carpenter concludes "there is strong scientific evidence that exposure to magnetic fields from power lines greater than 4 mG is associated with an elevated risk of childhood leukemia." He suggests that prudent public health policy would reflect this association and limit EMF exposures to levels in the 2 – 4 mG range. He also suggests that EMF exposure may be associated with risk for disease other than childhood leukemia, including Alzheimer's disease and amyotrophic lateral sclerosis (ALS) (Carpenter 2008). Dr. Carpenter, in agreement with the "prudent avoidance" approach recommended by the MSIWG on EMF

Issues, proposes that regulatory bodies consider EMF levels in their decisions, independent of whether a cause and effect relationship can be shown between EMF exposure and adverse health impacts.

The Melatonin hypothesis proposed by Professor Denis Henshaw, associates exposure to elevated magnetic fields to a decrease in the natural production of melatonin in the human body, a known natural anti-cancer agent produced by the pineal gland. The Henshaw hypothesis, also proposed by Professor Henshaw, postulates that transmission lines increase the amount of air pollution the human body retains when it is inhaled, thus creating a greater likelihood of developing cancer and/or other adverse health effects. High voltages carried by transmission lines have the ability to separate electrons from individual air molecules (a process known as ionization). Ionization results in the creation of electrically charged particles, referred to as "corona ions." The Henshaw hypothesis proposes that the corona ions may be carried away from the immediate surrounding area by wind. The corona ions are considered to have a sticking ability to cling on to surfaces, similar to a dust particle, and are considered to stick to common air pollutants, such as vehicle exhaust pollution (air pollution associated with the project is further discussed in Section 7.13). The theory postulates that due to the stickiness of the corona ions, the particles also have a greater chance of becoming trapped in the human lung upon inhalation. The theory concludes that corona ions created by high voltages carried by transmission lines stick to air pollution particles and have a greater likelihood of sticking to the inside of the human lung upon inhalation, thus creating a greater chance of developing adverse health effects including cancer. There is currently not an exposure-response calculation that can be performed to estimate possible adverse health impacts through the Melatonin or Henshaw effect hypotheses. Such impacts, if any, are uncertain.

7.1.1.4 Implantable Medical Devices

Research has established that certain electric fields can potentially interfere with implantable medical devices, such as cardiac pacemakers, implantable cardioverter defibrillators (ICDs), neurostimulators, and insulin pumps. This interference, referred to as Electromagnetic Interference (EMI), can cause inappropriate triggering of a device or inhibit the device from responding appropriately (PSCW 2009).

Most of the research on electromagnetic interference and medical devices is related to pacemakers. According to a 2004 Electric Power Research Institute (EPRI) report, implantable cardiac devices are more sensitive to electric fields than to magnetic fields. The earliest interference from magnetic fields in pacemakers was observed at 1,000 mG, an exposure level far greater than the magnetic fields associated with high-voltage transmission lines (HVTLs).

Therefore, the focus of research has been on electric field impacts. Possible effects of electric fields on pacemakers are:

- Rate increase,
- Erratic pacing,
- Switch to asynchronous pacing or fixed-rate pacing,
- Single beat inhibition (i.e. a single beat is missed by the pacemaker), and
- Total inhibition.

The 2004 EPRI report states that sensitivity to electric fields was reported at levels ranging from 1.5 kV/m upwards, though some units are immune at 20 kV/m. Medtronic and Guidant, manufacturers of various implantable medical devices, have indicated that electric fields below 6 kV/m are unlikely to cause interactions affecting operation of most of their devices (Figure 7.1.1.1-1).

Although most modern cardiac devices are less susceptible to effects from EMFs due to engineering design, older designs can still be affected. In the event that a cardiac device is impacted, the effect is typically a temporary asynchronous pacing (i.e., fixed rate pacing) and the device would return to its normal operation when the person moves away from the source of EMFs (PSCW 2009). No adverse health impacts or permanent impacts on implantable medical devices are anticipated as a result of the project.

7.1.1.5 EMF Mitigation Strategies

There are several EMF mitigation strategies which could be employed to lower public EMF exposure levels. Three primary methods to reduce EMF levels are explained below.

Distance

Magnetic field exposure is directly related to distance from the transmission line. The strength of both the electric and magnetic fields from transmission lines is inversely proportional to the square of the distance from the source conductors. As indicated in the route permit application, the applicant has selected route options and designs in part to avoid residences to the greatest possible extent. Several of the factors described in Section 3.3.6 that guide the commission's route selection take into account impacts on residences and farmsteads. Additionally, within a permitted route, the proposed ROW and the structures can be designed to minimize EMF exposure.

Compaction

The configuration and distance between transmission line phases has an impact on EMF exposure. The amount of EMF exposure is reduced when the phases are compacted. The applicant could consider compacted structure designs where feasible.

Phase cancellation

Phase cancellation significantly reduces EMF from transmission lines. For the double-circuit lines, rearranging phase conductors may help to reduce magnetic field strength. The applicant could consider these options during the detailed project design phase.

7.1.2 Stray Voltage

Stray voltage is an extraneous voltage that appears on grounded surfaces in buildings, barns, and other structures. Stray voltage and its impact is normally an issue associated with electric distribution lines and is a condition that can exist between the neutral wire of a service entrance and grounded objects in buildings. The source of stray voltage is a voltage that is developed on the grounded neutral wiring network of a building and/or the electric power distribution system. Stray voltage can result from damaged, corroded, or poorly connected wiring or damaged insulation. Transmission lines do not, by themselves, create stray voltage because they do not connect to businesses or residences. The project would have no direct electrical connection to conductors originating in another system; it would not connect with the local distribution system. Transmission lines, however, can induce stray voltage on a distribution circuit that is parallel and immediately under the transmission line. Induced voltage between a transmission line and distribution circuit only occurs in the immediate vicinity of the distribution circuit and does not travel along the transmission or distribution line.

Stray voltage safety concerns are primarily associated with distribution lines. Stray voltage is not identified as a safety concern associated with the project; however, since transmission lines can induce stray voltage on distribution

What is Compaction?

Compaction is the placing of the three phases of a three phase AC power transmission line as close together as possible. Doing this creates greater field cancellation and the ground level electric field is reduced.

The resulting ground level electric field is the sum of the electric fields produced by the voltages of the three phases; and these three voltages ideally sum to zero (balanced conditions). Therefore, if it were physically possible to place all three conductors at the same point in space, there would be no electric field at ground level.

circuits that are parallel and immediately under a transmission line, mitigation measures may be necessary if the project transmission line parallels or crosses distribution lines. These appropriate measures are site specific and may include, but are not limited to:

- Cancellation: Arranging transmission line phase conductors in a configuration to minimize EMF levels, bonding distribution neutral and transmission shield wires together, and employing an under built transmission shield wire bonded to distribution neutral rather than a normal overhead shield wire.
- Separation: Increase the distance between transmission and distribution facilities by placing across the road and/or burying the distribution facilities, or providing greater vertical distance between the transmission line phase conductor and an under built distribution line.
- Enhanced Grounding: Employing bare buried counterpoises connected to the distribution neutral and/or transmission shield wire (Asah, Personal Communication, Additional Stray Voltage Information 2009).

7.1.3 Induced Currents and Shock Hazards

The electric field from a transmission line can couple with a conductive object, such as a vehicle or a metal fence, which is in close proximity to the transmission line. This coupling would induce a voltage on the object, which is dependent on many factors, including the weather, object shape, size, orientation, and location along the ROW. Additionally, alternating magnetic fields created by transmissions lines can induce currents on conductive objects. If these objects are insulated or semi-insulated from the ground and a person touches them, a small current would pass through the person's body to the ground. This might be accompanied by a spark discharge and mild shock, similar to what can occur when a person walks across a carpet and touches a grounded object or another person.

Current flow through a person to the ground is the main concern of induced voltage. Proper grounding of metal objects under the transmission line is the best method of avoiding these shocks. Most shocks from induced current are considered more of a nuisance than a danger. The Commission's electric field limit of eight kV/m was designed to prevent serious hazard from shocks due to induced voltage under transmission lines. The National Electric Safety Code (NESC) has set an induced current limit of five milliamps (mA) for objects under transmission lines.

Another issue that arises when operating vehicles near power lines is whether vehicles can be safely refueled. Although the possibility of fuel ignition under a power line is remote, it is not recommended to refuel vehicles directly under or within 100 feet of a 345 kV transmission line.

7.1.4 Construction Activities and Equipment

Construction workers are subject to typical construction related incidents including slips, trips, falls, wounds, and traumatic injuries. Additional safety issues relevant to this project may result from electrocution and/or the construction of tall structures.

7.1.5 Security

Towers and substations have the potential to be vandalized; they typically contain copper wire and other metals which may be targeted for theft. The addition of transmission line poles associated with overhead designs and walls surrounding the proposed substations would increase the area available for unauthorized graffiti in the project area. The presence of additional utility infrastructure in the project area could increase the local risk for terror attacks intended to damage civil infrastructure and disrupt the electrical power system.

7.1.6 Severe Weather

Severe weather, including high winds, ice and snow storms, and tornados, could create possible safety hazards in what is considered the "engineering (designed) fall distance" of an overhead transmission line. Snow and ice accumulation and high winds can increase a structure's weight, making it more susceptible to failure or collapse. While the term "fall distance" is not defined or utilized by the utility industry, by the applicant, or by federal statute or federal regulation (Xcel Energy, FHA 2009), the HUD Handbook 4150.2, states that "[f]or field analysis, the appraiser may use tower height as the fall distance" (Xcel Energy, FHA 2009). The fall distance, therefore is defined by a perimeter around the structure with a radius equal to the height of the tower.

7.1.7 Environmental Contamination

During construction of the project, the potential to encounter existing soil and groundwater contamination would be a potential safety and health concern. Exposing existing contaminated soils could create a health and safety risk to construction workers and the nearby public. Furthermore, existing contamination could be mobilized due to soil disturbances associated with construction activities and pose a further health and safety risk to the public and the environment.

The PCA's database of Leaking Underground Storage Tanks (LUST) and Master Entity System (MES) Locations shows no contaminated sites within 75 feet of any of the route alternatives. There are three MES Locations and 14 LUST sites within 500 feet of one or more of the route alternatives. These sites are listed in Appendices H, I and J and are shown on Maps 8.1-21, 8.2.17 and 8.3-34. Health and safety risks associated with contaminated sites can be minimized by avoiding them.

7.2 Property Values

Public input gathered during the scoping process for this project indicated that many people are concerned about the potential effect of high-voltage transmission lines (HVTLs) on the value of their property. This concern is understandably higher among residents living adjacent to the proposed routes. The relationship between property values and proximity to transmission lines has been researched for decades, using a variety of methodologies. Nevertheless, research has not identified a clear cause-and-effect relationship, in part because there is a difference between the perceived impact of transmission lines on property values and the actual observed effect of transmission lines on property sales. In this section, the research on the impact of transmission lines on property values is summarized, and the general consensus resulting from the research is discussed.

7.2.1 Property Value Concerns

Public concerns over the potential negative impact of nearby transmission lines on property values generally fall into one or more of the following three categories:

- **Concern over the potential health effects from electric and magnetic fields (EMF)**: There has been an ongoing discussion among researchers and the general public over potential health issues associated with exposure to EMF. The Minnesota State Interagency Working Group (MSIWG) examined available relevant data and concluded that "the current body of evidence is insufficient to establish a cause and effect relationship between EMF and adverse health effects" (MSIWG 2002). Similar separate evaluations by the National Institute of Environmental Health Sciences (NIEHS), World Health Organization (WHO), and the U.S. Environmental Protection Agency (USEPA) of the best available scientific evidence reached the same conclusion, that there is no established cause and effect relationship between EMF and public health risks. Nevertheless, public perception of the effects of EMF on health can influence decisions related to the purchase of property adjacent to a transmission line, and may exert an influence on property value.

See Section 7.1 for a detailed discussion of public health and safety, including potential EMF impacts on health.

- **Potential aesthetic impacts of transmission lines:** The visual profile of transmission line structures and wires may decrease the perceived aesthetic quality of adjacent property. Also, while the transmission lines would not generate noise above the state noise standards, the public perception may be that transmission lines generate unacceptable noise levels.
- **Potential interference with farming operations and/or foreclosure of present or future land uses:** Installation of a transmission line can remove arable land from production. It also has the potential to interfere with operation of equipment, create safety hazards, and foreclose the opportunity to consolidate farmlands or develop the land for another use.

Research on property values indicates that, in some instances, transmission lines have a positive impact on property. Positive impacts on nearby properties and their values can occur when:

- A cleared right-of-way (ROW) provides better access to interior lands or water.
- Urban or suburban residential lots on or adjacent to power line corridors are sized larger than neighboring lots but similarly priced, allowing residents to benefit from the added buffer and space the ROW provides.
- The open space of the utility corridor is integrated into a neighborhood and utilized by local residents.
- Increased local electrical reliability enhances opportunities for development of residential, commercial, or industrial development.
- A utility ROW may provide improved access for hunting, snowmobiling, or other recreational activities, especially in the vicinity of large wooded parcels in rural areas.
- Wildlife use forest openings for foraging and as travel corridors between habitats surrounded by developed areas.

7.2.2 Property Value Research

Attempts to correlate proximity to transmission lines with property values are complicated by the interaction of several relevant factors, including geographic region, land use, variability in perceptions over time, and limited sales data for similar properties before and after construction of transmission lines. Researchers have generally used both survey-based techniques and statistical analyses to make inferences and draw conclusions about the relationship between transmissions lines and property value. In general, surveys provide useful insights for estimating price effects based on public opinion, yielding what researchers refer to as "stated preferences." Statistical analyses, on the other hand, reflect the actual behavior of property buyers and sellers in terms of recorded sales prices, providing what researchers refer to as the "revealed preferences." In other words, there is often incongruity between what people think and how they actually behave. Measuring both perceptions and actual behaviors helps researchers understand the relationship between transmission lines and property values.

A recent literature review (Jackson and Pitts 2010) examined 17 studies on the relationship between transmission lines and property values to compare their results and to develop some general conclusions. The studies span the period from 1956 to 2009, and were placed into one of three categories designated by the review authors:

- Survey-based studies;
- Statistical sales-based analyses using multivariate analysis to isolate the impact of transmission lines by holding other variables statistically constant, and
- Sales-based analyses not using multivariate analysis, but utilizing factors such as sale/resale analysis, price per square foot comparisons, case studies and "paired sales" analysis, where the values of two homes that are similar in all respects except for proximity to transmission lines are compared.

Upon completion of their review of the studies, Jackson and Pitts (2010) concluded the following:

> "The studies reviewed…generally pointed to small or no effects on sales prices due to the presence of electric transmission lines. Some studies found an effect but this effect generally dissipated with time and distance. The effects that were found ranged from approximately 2% to 9%. Most studies found no effect, and in some cases a premium was observed."

Jackson and Pitts discussed the utility of both survey-based and statistically-based methods, quoting one of the research papers to note that statistical analyses "reflect what buyers and sellers actually do, opposed to what potential buyers say they might do, under specified hypothetical circumstances" (Kinnard and Dickey 1995). Selected findings from all seventeen studies reviewed by Jackson and Pitts are provided below, along with the year and type of study:

Survey-based studies

- Kinnard, 1967 – Questionnaires were sent to property owners intersected by or abutting transmission line ROW in 17 Connecticut subdivisions. Over 85 percent indicated they would purchase again in the same location. Kinnard concluded that property value is not significantly affected by proximity to transmission lines.
- Morgan et al., 1985 – A questionnaire asked participants to rank the risk from transmission lines, electric blankets and 14 other common hazards. Electric blankets and transmission lines were ranked as presenting the least risk. Participants were then provided with information on EMF and its potential health effects. Additional subsequent question responses indicated a change in perception and an increased concern about the risk of EMF.
- Solum, 1985 – Presented a questionnaire to 180 agricultural, recreational or residential property owners in northwest Wisconsin whose land was encumbered by transmission lines. All three types had some level of concern over the proximity of the lines, but for varying reasons. Further interviews indicated that all but one of the properties sold at a market price comparable to non-encumbered properties, and that none of the buyers had reduced their purchase offers due to the presence of the transmission line.
- Delaney and Timmons, 1992 – Survey results from 219 real estate appraisers found that 84% believed that transmission line proximity results in an average ten percent lower market value. Ten percent of respondents found no effect, and six percent thought transmission lines increased property value due to larger lots for similar price.
- Kung and Seagle, 1992 – Sent a questionnaire to homeowners in Memphis and Shelby Counties, TN. Half of the respondents considered the transmission line an eyesore; however, 72 percent of those who thought the lines were an eyesore also said the lines had no effect on the purchase price. Prices of homes adjacent to the transmission line are similar to prices of other homes in the same neighborhood.
- Priestly and Evans, 1996 – Conducted a survey of 445 homeowners living near transmission lines in the San Francisco area. Eighty-seven percent of the 267 respondents felt the transmission line was a negative element in their neighborhood.

Statistical Sales Price Analyses

- Brown, 1976 – Conducted regression analysis on sales of farm land in Sakatchewan, Canada, between 1965 and 1970, and found that the relationship of land value to the number of power line structures was not statistically significant, and that the lines did not negatively affect property value. Brown also found that the structures can be an impediment to farming operations.

- Colwell and Foley, 1979 – Examined 200 property sales over a ten-year period in Decatur, Illinois and found that sales price increases as distance from a transmission line increases. Property values were approximately six percent lower within 50 to 200 feet of the transmission line, but there was no difference in property value beyond 200 feet.
- Colwell, 1990 – Followed up the study above and confirmed that the selling price of residential property increases as distance from the transmission line increases. The rate of increase slows with distance and eventually disappears.
- Rigdon, 1991 – Evaluated 46 properties sold in Marquette County, Michigan over a five-year period, and found no statistically significant relationship between sales price and proximity to a transmission line easement.
- Hamilton and Schwann, 1995 – Reviewed previous literature and found that transmission lines can reduce adjacent property values, but that the reduction is generally less than five percent of property value, and that the reduction diminishes at 600 feet.
- Des Rosiers, 1998 – Reviewed property values of 507 homes in the Montreal area, and found an average drop in property value of 9.6 percent for homes immediately adjacent to the line. He also found an average increase of up to 9.2 percent in value for homes one to two lots away from the transmission line, and no effect beyond 500 feet.
- Wolverton and Bottemiller, 2003, and Cowger, Bottemiller, and Cahill, 1996 – Two studies, both conducted in Portland, Vancouver and Seattle, the 2003 work repeating the 1996 study with more rigorous analytical methods. Both applied statistical methods to paired-sales analysis, and found no price effect on residential property from proximity to transmission lines. The data also show no difference in appreciation rates between homes near a transmission line and homes further away.
- Chalmers and Voorvaart, 2009 – Studied residential properties sold in Connecticut and Massachusetts between 1999 and 2007, and found proximity to transmission lines to have an insignificant effect on sales prices.

Sales-based analyses

- Carll, 1956 – Compared property values and interviewed owners, buyers and brokers along a transmission line in Los Angeles, and found that residences adjoining the ROW had not sold at a discount, and that lenders did not adjust loan amounts for lots adjacent to the ROW.
- Bigras, 1964 – Reviewed over 1,900 deeds of sale and mortgages in Quebec and found that prices for vacant land adjacent to transmission lines were generally higher than the average price of all transactions. Land adjacent to transmission lines was sold faster and was developed to a higher degree than land away from the lines.

Jackson and Pitts (2010) concluded from these studies that proximity to transmission lines results in little or no effect on property value. In studies where transmission lines were found to have impacts to property values, the decrease in values typically ranged from approximately two percent to ten percent. In some instances, increases in property value were found. The following additional studies and reviews generally reach a similar conclusion.

Between 1978 and 1982, Jensen and Weber and the Jensen Management Company conducted three studies in west-central Minnesota. The studies in 1978 and 1982 are of particular interest since they consider effects to agricultural land. The 1978 study found that the landowners cited an inconvenience to the presence of the line, but had not paid less for their land (Electric Power Research Institute (EPRI), 1978). The 1982 study, however, found there was a broad range of effect from no effect to a 20 percent reduction, which depended on the amount of disruption to farm operations (EPRI 1982).

In the final EIS on the Arrowhead-Weston Electric Transmission Line Project, the Wisconsin Public Service Commission (PSC) addressed the issue of property value changes associated with high voltage transmission lines. This document summarized the findings of approximately 30 papers, articles, and court cases covering the period of 1987 through 1999. The Arrowhead-Weston EIS provides six general observations:

- The potential reduction in sale price for single family homes may range from zero to 14 percent.
- Adverse effects on the sale price of smaller properties could be greater than effects on the sale price of larger properties.
- Other amenities, such as proximity to school or jobs, lot size, square footage of a house and neighborhood characteristics, tend to have a much greater effect on sale price than the presence of a power line.
- The adverse effects appear to diminish over time.
- Effects on sale price are most often observed for properties crossed by or immediately adjacent to a power line, but effects have also been observed for properties farther away from the line.
- The value of agricultural property is likely to decrease if the power line poles are placed in an area that inhibits farm operations.

The Arrowhead-Weston Electric Transmission Line Project environmental impact statement (EIS) reported that in Midwest states such as Minnesota, Wisconsin, and the Upper Peninsula of Michigan, the average decrease appears to be between four and seven percent. The EIS noted that it is very difficult to make predictions about how a specific transmission line would affect the value of specific properties.

An additional potential adverse effect of transmission lines on adjacent properties is on the ability of homeowners and developers to obtain Federal Housing Administration (FHA) and/or Housing and Urban Development (HUD) loans. Section 2.2(J) of the HUD guidebook, "Valuation Analysis for Single Family One- to Four-Unit Dwellings" states that "no dwelling or related property improvement may be located within the engineering (designed) fall distance of any pole, tower or support structure of a high-voltage transmission line" (HUD 1999). If a home is located within the easement for a transmission line, HUD requires a letter from the utility assuring that the home is outside of the fall distance of any structures.

7.2.3 Mitigation

As noted in the discussion above, the actual impact of a transmission line on nearby property values cannot be reliably or consistently quantified. As a result, it is difficult to define mitigation measures in quantifiable terms. Therefore, the principal mitigation strategy is to avoid residences to the extent possible during route selection. The applicant has stated that once a route is selected, they would work with property owners during the development of the transmission line alignment to determine the maximum feasible distance between the transmission line and residences.

In areas where the proposed line has a voltage of 200 kilovolt (kV) or greater, landowners on the selected route may choose to sell their property to the utility per Minnesota Statute Section 216E.12, Subdivision 4, rather than live on the property with the transmission line. This is sometimes referred to as the "Buy the Farm" provision. Under this provision, owners of certain types of properties defined in the statute may sell the property to the utility for the fair market value of the parcel. However, property owners opting to sell under this provision must sell the entire property, not just the area crossed by the transmission line. This provision is discussed further in Section 7.3.

7.3 Human Settlement

This section summarizes visual impacts, noise, proximity to homes, wind breaks, and other impacts typically associated with human settlement. Methods to mitigate these impacts are also summarized. Related issues such as health and safety (Section 7.1), property values (Section 7.2), archaeological and historical resources (Section 7.10), and land based economies (Section 7.4) are addressed elsewhere in this document.

7.3.1 Visual and Aesthetic Impacts

Aesthetics refer to the natural and human modified landscape features or visual resources that contribute to the public's experience and appreciation of the environment. Examples of natural landscape features that define an area's visual character include wetlands, surface waters, landforms, forests, and vegetation patterns. Buildings, roads, bridges, and other structures reflect human modifications to the landscape. The visual character and quality of the project area and the potential impacts from the project have been assessed based on a qualitative review of the natural and manmade features of the environment within and adjacent to the project area.

The scenic value or visual importance of an area is a subjective matter and depends upon the perception and philosophical and/or psychological response of the viewer. Generally, landscapes that exhibit a high degree of variety and harmony among the basic elements of form, line, color and texture have the greatest potential for high visual and aesthetic quality. The level of impact to visual resources is also subjective and generally depends on the sensitivity and exposure of a particular viewer and can, therefore, vary greatly from one individual to the next.

The existing landscape character across the project area varies from towns and suburban developed areas to farmsteads and agricultural lands to forested lands and riparian and river environments. The landscape's topography varies from mostly flat to rolling agricultural land and from rolling forested areas to blufflands near the Mississippi River.

Visual impacts would result from new transmission line structures, conductors, and new or expanded right-of-way (ROW). The degree of these impacts depends upon the extent of corridor sharing, the degree of shielding by terrain and vegetation and the amount of existing human modification to the landscape. In agricultural areas transmission line structures would likely represent the tallest features of the landscape, and the power poles would be visible on clear days for up to four miles. 20/20 vision equates roughly one arcminute of resolution. Conservatively assuming the towers maintain a six foot-diameter for their full height, the maximum distance where this would be greater than one arcminute is just under four miles. Beyond that the poles should become harder to distinguish. At four miles, most of the tower is still above the horizon (except the bottom couple feet), so on a clear day they very likely would be visible at that distance. In forested areas and areas with more pronounced topography the visibility of poles and conductors may be more limited, however new or expanded ROW through forested areas, for example, would have additional impact on visual and aesthetic quality. The proposed transmission line and structures would add to the changing landscape of the area in more developed urban and semi-rural areas. There are areas where the transmission line structures would clearly be visible along roads and through private lands. There would however be opportunities to construct the transmission line in areas that lessen the potential visual impacts. Moreover, these areas are already characterized by a relatively high proportion of visible human-made landscape elements.

Potential Mitigation

There are several methods the applicant could use to reduce visual impacts, including:

- Select route alternatives that maximize ROW sharing with existing linear corridors (transmission lines, roadways, and railroads) to minimize the proliferation of visual impacts to open spaces and developed areas alike.
- Avoid routing through areas with high-quality, distinctive view sheds, including scenic highways, river crossings, and similar areas where feasible.
- Cross rivers and streams using the shortest distance possible (perpendicular to the water body).
- Use uniform structure types to the extent practical. The height of the structure may be reduced (including using the shorter H-frame structures) to minimize impacts within scenic areas.
- Construct the lines carefully so as to prevent any unnecessary destruction, scarring or defacing of the natural surroundings in the vicinity of the work.

7.3.2 Noise

Noise is generally defined as unwanted sound. Sound travels in mechanical wave motion and produces a sound pressure level. Sound pressure level is commonly measured in decibels (dB), representing the logarithmic increase in sound energy relative to a reference energy level. Sound measurement is further refined by using an A-weighted decibel scale (dBA) to emphasize the range of sound frequencies that are most audible to the human ear (i.e., between 1,000 and 8,000 cycles per second).

How is noise measured?

Noise is measured in Units of decibels (dB) on a logarithmic scale. Because human hearing is not equally sensitive to all frequencies of sound, certain frequencies are given more "weight." The A-weighted decibel (dBA) scale corresponds to the sensitivity range for human hearing.

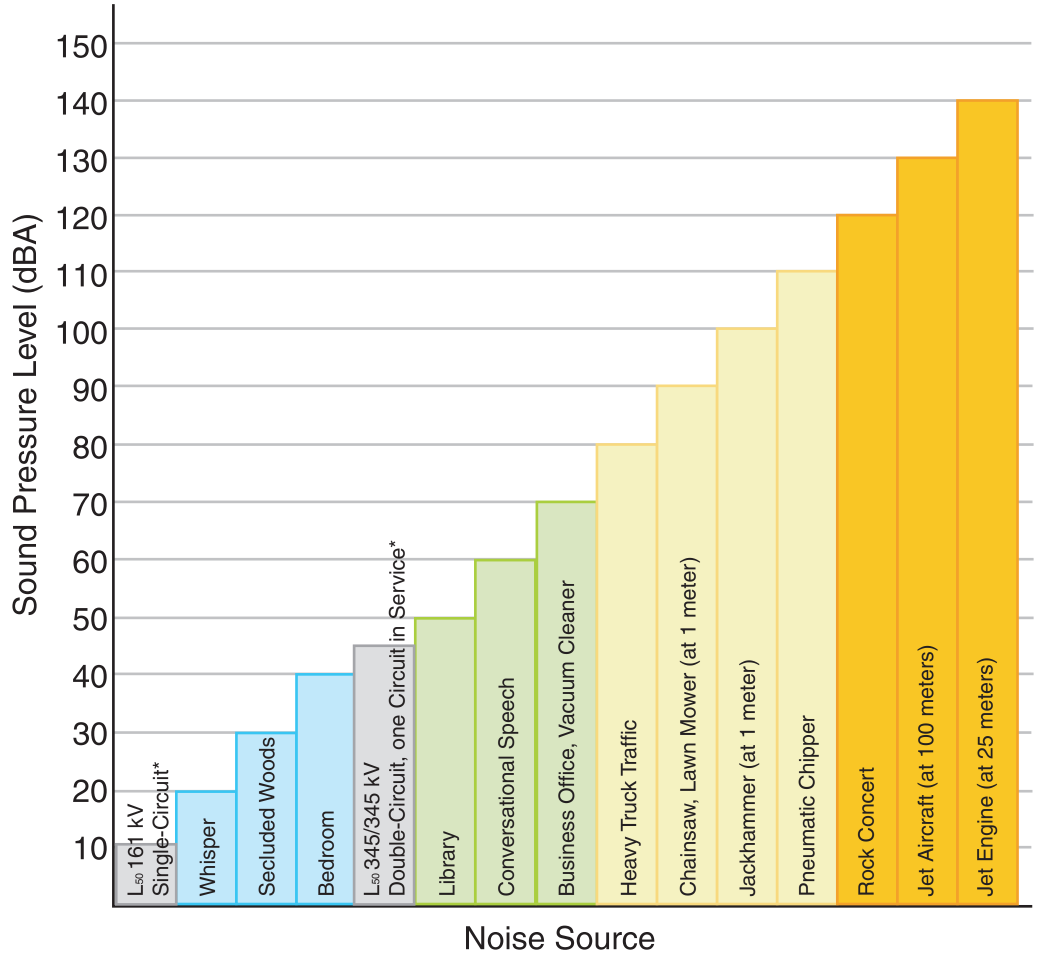
Cumulative noise increases occur on a logarithmic scale. A noise level change of 3 dBA is barely perceptible to average human hearing. A five dBA change in noise level, however, is clearly noticeable. A ten dBA change in noise levels is perceived as a doubling or halving of noise loudness, while a 20 dBA change is considered a dramatic change in loudness. For cumulative increases resulting from sources of different magnitudes, the rule of thumb is that if there is a difference of greater than ten dBA between noise sources, there will be no additive effect to the overall noise level (i.e., only the louder source would be heard and the quieter source would not contribute to noise levels). Figure 7.3.2-1 shows noise levels associated with common, everyday sources and places the magnitude of noise levels discussed here in context.

Transmission lines can produce noise under certain conditions. The level of noise depends on conductor conditions, voltage level, and weather conditions. In damp or rainy weather, transmission lines can create a crackling sound due to the small amount of electricity ionizing the moist air near the conductors.

During heavy rain the background noise level of the falling rain itself is usually greater than ten dBA louder than the noise from the transmission line. As a result, people do not normally hear noise from a transmission line during heavy rain. During light rain, dense fog, snow, and other times when there is moisture in the air, transmission lines would produce audible noise approximately equal to household background levels.

The Minnesota Pollution Control Agency (PCA) has established standards for the regulation of daytime and nighttime noise levels for areas of residential, commercial, and industrial land use. The primary noise-sensitive receptors in the project area are rural residences. Generally, activity-related noise levels during the operation and maintenance of transmission lines are minimal and do not exceed the PCA noise limits outside of the ROW. The applicant modeled worst-case scenario noise levels from the project using the Bonneville Power Administration CFI8X model. Modeled noise levels were below applicable state standards. Modeled noise levels for the structure types that would be used for the project are compared to PCA noise limits in Table 7.3.2-1.

Figure 7.3.2-1 Comparison of modeled project noise with noise levels associated with common, everyday noise sources



* L50 noise levels predicted at edge of ROW for proposed transmission line structures (all single pole, davit arm structure) and voltages for the project using Bonneville Power Administration CFI8X model. See Table 7.3.2-1.

Source (Minnesota Pollution Control Agency (PCA) 2008)

Table 7.3.2-1 Noise: comparison of modeled noise levels to state noise limits

		L_{50} (dBA)	L_{10} (dBA)
State noise limits by noise area classification (NAC)			
1 Residential	Daytime	60	65
	Nightime	50	55
2 Commercial	Daytime Nightime	65	70
3 Industrial	Daytime Nightime	75	80
Modeled noise level by structure type (edge of ROW)			
Single pole, davit arm, 345/345 kV double–circuit with one circuit in service		45.8	54.1*
Single pole, davit arm, 345/345 kV double–circuit with one circuit operating at 161 kV		46.6	50.1*
Single pole, davit arm, 161 kV single–circuit		10.7	14.2*
Single pole, davit arm, 345/345 kV double–circuit with 69 kV underbuild		45.6	53.7*

* L_5 noise levels were modeled instead of L_{10} noise levels. L_5 noise levels are used here as a conservative estimate of L_{10} noise levels and do not exceed PCA L_{10} limits outside of the ROW.

What is L_{10}?

L_{10} is the dBA that may be exceeded 10 percent (6 minutes) of the time within an hour.

What is L_{50}?

L_{50} is the dBA that may be exceeded 50 percent (30 minutes) of the time within an hour.

7.3.3 Proximity to Structures

Regulators and utilities try to select routes that avoid residences, outbuildings and other structures as much as possible. In rural areas, there is often a trade-off between routing the line down section-lines in farm fields (which helps avoid homes and other structures) or down roadways (which avoids impacts to agricultural lands but potentially increases proximity to farmsteads and other residences). In more developed areas, residences and businesses may be more difficult to avoid.

House Count Methodology

Section 8 of this draft environmental impact statement (EIS) includes detailed tables and maps showing the number and location of residences along the various route options. These data were developed by (1) reviewing the applicant's information (2) updating it using high-resolution aerial photographs, and (3) ground verification of the applicant's data including locations of houses and other human settlement features.

Mitigation

The primary way to reduce proximity to homes and buildings is through careful route selection. As stated in the route permit application, the applicant tried to avoid residences and buildings when selecting their proposed routes. Avoiding homes would also be an important criterion for final route selection. Section 8 of this draft EIS compares the impacts to residential and other structures on the various route options under consideration. In addition, the applicant has proposed route centerlines that run along the side of the street without homes or building conflicts when possible (see Appendix A).

Finally, while low-voltage residential distribution lines can be placed underground, it is generally not feasible to install the proposed high-voltage transmission line (HVTL) underground for more than a mile or two because of the state of technology, high-cost, and reliability concerns (See Section 4.6).

7.3.4 Displacement

For electrical safety code and maintenance reasons, utilities would not generally allow residences or other buildings within the actual ROW easement for a HVTL. In this case, the proposed ROW is to be 150 feet wide along the 345 kV sections of the transmission line, and 80 feet in the 161 kV sections. A displacement is defined by the applicant as any occupied structure (residence or business) located within the ROW of the proposed routes. Further information on route-specific displacement issues, narrow areas where buildings, structures or other sensitive features are present on both sides of the route, and potential route modifications, is provided in Sections 8.1.4.3, 8.2.4.3, and 8.3.4.3.

For the portions of this project where the proposed line has a voltage of 200 kilovolt (kV) or greater, landowners on the selected route may sell their property to the utility per Minnesota Statute Section 216E.12, Subdivision 4 (sometimes referred to as the "Buy the Farm" provision). This provision gives the owner of certain types of property the option of having the applicant purchase the entire property that the transmission line crosses for the fair market value of the land. Note that this option applies to the entire parcel, not just the portion crossed by the transmission line. The statute does not provide for the purchase of only the encumbered portion of the property. A parcel's eligibility under the statute depends on its classification under Minnesota Statutes Section 273.13. Only those parcels falling within the enumerated classifications are covered; unlisted classifications are excluded. The statute extends to the following types of property: agricultural or nonagricultural homestead, non-homestead agricultural land, rental residential property, and both commercial and noncommercial seasonal residential recreational property.

7.3.5 Tree Groves/Windbreaks

During public scoping meetings, residents identified the importance of trees for privacy, shade, and wind screen protection around rural residences and farmsteads. In areas where tree cover is more abundant, meeting participants identified the importance of trees for helping maintain the rural character of the region, providing a source of economic activity for some residents, and playing a role in recreational activities and the visual and aesthetic quality of the region. Additionally, trees often help to protect wildlife corridors, particularly near water and wetland features.

Mitigation

The primary means of mitigating impacts to windbreaks is to select routes that avoid them. Throughout the routing process, the applicant has indicated that they sought routes that would minimize the removal of trees. The applicant indicates that the P route alternatives and A route alternatives have been located to avoid the removal of trees to the greatest extent possible. In an effort to avoid agricultural impacts or impacts to wildlife corridors through the removal of tree canopy, the transmission line may share portions of the public road ROW. For the safe operation and maintenance of the transmission line, trees of a certain size or species within the transmission line ROW may need to be removed.

7.3.6 Existing Utilities

Construction of the project is not anticipated to affect any public utilities. The applicant has stated they would work with landowners and the rural utility providers to avoid direct or indirect impacts to public utilities. Where any impacts to utilities have the potential to occur, the applicant has stated that they can work with both landowners and local agencies to determine the most appropriate placement for pole structures. It may be necessary for the applicant to work with other public service utilities to relocate their facilities if they conflict with the location of the transmission line. At times, the route would cross over existing transmission lines, follow existing transmission line corridors, and likely pass over or cross small power distribution lines. Disruptions to public services during construction may occur; however, these would be temporary with service restored promptly. No direct long-term impacts to public buildings or infrastructure are expected, and as such, no mitigation of impacts to existing utilities would be required for the project.

7.3.7 Domestic Water Well Installation/ Maintenance

Outside of urban areas, landowners and rural residences are typically serviced by privately owned septic systems and wells or by rural water districts. The availability of data and information regarding the location of rural water services is limited and sometimes incomplete. The applicant can minimize any disruption of maintenance and service by working with local providers and landowners. Construction of the transmission line structures will not have an impact to area hydrogeology or groundwater quality. Section 5.0 of the draft EIS provides further detail on the construction of the transmission structures. Drilled installation of pier concrete foundations does not involve dewatering and therefore will not affect groundwater levels, groundwater availability, or the well capacity/yield of existing wells. Once installed, these foundations will have no affect on groundwater availability. Leaching of potentially hazardous constituents from concrete foundations and treated timbers is negligible. The types of materials used to treat timbers have a very low solubility and very low mobility in groundwater and therefore would not migrate more than a few feet from the foundation if leaching did take place.

7.4 Land Use

This section provides an overview of potential transmission line impacts on existing land use and regulated land use plans, such as county, city, and township zoning plans and ordinances. While local approvals are not required for the construction and operation of this project, knowledge of current zoning designations are valuable because they provide insight into the possible impacts on existing land uses and future development plans. New transmission line routes can sometimes conflict with existing land use and zoning plans in both rural and urban areas.

In rural and agricultural areas, the power poles can interfere with farming operations if the structures are not located carefully. Because agricultural impacts are a prominent economic issue as well as a land use issue, agricultural impacts are addressed separately in Section 7.5. Also, a number of route alternatives cross near one or more wildlife management areas (WMAs), Reinvest in Minnesota (RIM) and Conservation Reserve Program (CRP) lands, parks, trails, and scenic and natural areas. In these areas, removal of vegetation may disturb these areas in the immediate right-of-way (ROW).

In municipalities and developing suburban areas, transmission lines can conflict with recreational, residential, and other potential future development. For example, they can conflict directly with zoned development if new construction is planned within the ROW itself (which is not allowed). More commonly, a proposed route could more indirectly conflict with zoning or other land use plans in nearby areas due to visual impacts or other issues.

Transmission lines can also conflict with state and local transportation plans such as roadway construction or expansion. The issue of potential conflicts with transportation plans is summarized separately in Section 7.11.

7.4.1 Local Land Use Control Preempted

Zoning is a regulatory device used by local governments to geographically restrict or promote certain types of land uses. Minnesota statutes provide local governments with zoning authority so long as the restrictions promote the public health and general welfare.

The proposed project, however, is subject to Minnesota's Power Plant Siting Act (PPSA). Under this statute, the route permit issued for a high voltage transmission line (HVTL) "…shall be the sole site or route approval required to be obtained by the utility. Such permit shall supersede and preempt all zoning, building, or land use rules, regulations, or ordinances promulgated by regional, county, local, and special purpose government." (Minn. Stat. §216E.10).

Therefore, the applicant is not required to seek permits or variances from local governments to bring the proposed project into conformance with applicable zoning codes. The applicant, however, does need to acquire necessary approvals from the state-level ROW owners, such as the Minnesota Department of Transportation (DOT) for state highways. While local approvals are not required for construction and operation of the transmission line, potential conflicts of each route with local land use plans are summarized in Section 8.

7.4.2 Project Area Land Use

The proposed routes cross through Dakota, Goodhue, Olmsted, Rice, and Wabasha Counties. Information from the Minnesota Department of Natural Resources (DNR) Geographical Analysis Program (GAP) and the United States Geological Survey (USGS) Land Use/Land Cover database (LULC) were used to develop baseline land use along proposed route alternatives. The predominant land use is agricultural land (86.4%), primarily planted row crops such as corn and soybeans, but including substantial areas of open pasture and agricultural grassland. Other major land uses/land covers include woody vegetation areas (9.4%), consisting of maple, basswood, oak, and pine forests, lowland and upland shrub areas, and pine-deciduous mix forests; developed lands (2.8%), which could include cities and rural towns, roads and railroads, and commercial and industrial sites; and open water and wetland areas (1.4%) (see Map 2.5-01).

In general, residential development is denser near the Twin Cities metropolitan region and as the line approaches the Rochester area. Commercial and industrial land uses are also more concentrated in these areas. There is also industrial development outside of urban centers to support the growing renewable energy industry and for agricultural activities in the project area.

The predominant land use in the eastern portion of the project area is rural agricultural, including planted row crops, open pasture and grazing areas. Other land cover types the route crosses include natural land features — forested areas, wetlands, streams and standing water features.

Karst Features

Portions of the proposed project will be within areas of Southeastern Minnesota that have karst topography. These locations could have karst features such as sinkholes, stream sinks, or springs. Maps 8.1-21, 8.2-17, and 8.3-34 show known karst features along the proposed project corridors. These maps show two areas where karst features are most prevalent. Approximately five miles south of Cannon Falls the corridor is within a "sinkhole plain" which is characterized by over 20 sinkholes per square mile (Alexander et. al. 2003). The second area is east of Oronoco near the Zumbro River where the corridor is within an area with "moderate to high probability" of sinkholes or sinkhole formation which is characterized by sinkhole densities of 5 to 20 per square mile (Alexander and Maki 1988). Areas with active karst (less than 50 feet of sediment cover over bedrock) and mapped karst features will be evaluated by the applicant's geotechnical consultant during the design of the pole foundations. Karst features can be identified with the aid of:

- Aerial photography (identification of sinkholes and erratic drainage patterns)
- Topographical maps
- County soil surveys
- County geologic atlases
- Information from local landowners

The proposed project will result in minimal grading of the corridor and the pole foundations are relatively small. As a result the project will minimally change surface conditions and is not expected to impact surface or groundwater hydrology. The stationing between poles can be adjusted to position the poles a sufficient distance away from karst features so the construction does not disrupt drainage patterns or potentially unstable soils.

Soil investigations conducted by the applicant's geotechnical consultant at each pole location will identify depth to bedrock and soils overlying the bedrock to further delineate karst features. At locations where the foundation extends to bedrock, normal foundation design calls for excavation of the soil above the bedrock, which will uncover signs of sinkholes or cracks that would affect the foundation stability or the stability of adjacent grounds.

7.4.3 Mitigation

Any buildings and structures immediately within the ROW would be displaced; however, construction, operation, and maintenance of the line would not prohibit land use for development purposes adjacent to the line. More indirect impacts on nearby land uses can include visual impacts, general impacts on property value, and other issues. See Section 7.1 for a discussion of property value impacts and Section 7.2 for a discussion of displacement impacts. Impacts to recreation areas in the immediate vicinity of the line are not anticipated (see Section 7.12 for additional details).

The primary method used to reduce land use impacts is to follow existing ROW as much as possible. Throughout the route development process, the applicant has sought to identify areas to share ROW with existing infrastructure, including transmission lines, highways, and railroads.

Although land use would obviously be affected in some areas such as substations, in general, land use along the selected route is not expected to change as a result of construction and operation of the proposed transmission line. The majority of land under or adjacent to the transmission line could still be used for agricultural practices following construction. In some cases, the use of custom designed structures specific to the area could be considered to reduce the visual or other impacts. In addition, any vegetation that would be removed could be restored after the construction of the facilities, to the extent allowed by vegetation restrictions. For the substations, low-profile designs and architecturally designed walls could in some limited situations reduce the visual impacts.

Finally, local governments will have the opportunity during the route permitting process to provide the Public Utilities Commission (Commission) with feedback on whether the proposed transmission line could directly conflict with existing county and city land use plans and how these conflicts (if any) might be mitigated. Sections 8.1.4, 8.2.4, and 8.3.4 of this document discuss land use plans in the project area in greater detail and include an analysis of how the proposed routes may be congruent with or in conflict with specific land use plans.

During construction, all of the land uses crossed by the line would be temporarily impacted as a result of construction and for occasional maintenance purposes. Whether in agricultural or more suburban areas, during construction temporary impacts to farmland during construction include soil compaction and likely some crop damage within the ROW. Significant efforts have been made to avoid crossing or impacting center-pivot irrigation systems. The applicant will work with landowners to minimize impacts to farming operations along the entire route. As described in Section 5, landowners will be compensated where the transmission line crosses property. Landowners will also be compensated in the event of any crop damage or soil compaction during construction.

7.5 Land-Based Economies

Construction and operation of the proposed project could have impacts on economic activities in the project area; the majority of land-based economic impacts would be to agriculture. As stated in Section 7.4, approximately 86 percent of the project area consists of agricultural land, with approximately 53.2 percent of this agricultural land classified as prime farmland. This section summarizes the project's potential impact on agriculture as well as other land-based industries such as forestry and mining.

7.5.1 Agriculture

Agriculture is the primary land-based economic resource in the project area. The principal crops in the area are corn, soybeans, alfalfa, oats, and spring wheat. Farms in the area also raise livestock, primarily dairy cattle, beef cattle, and hogs.

Construction activities could result in impacts to agricultural lands, including soil erosion, interference with and damage to agricultural surface and subsurface drainage and irrigation systems, mixing or loss of topsoil and subsoil, and soil compaction. Reduced productivity of agricultural land or direct crop loss could also occur. Stray voltage could result in impacts to livestock if not properly mitigated.

In general, the applicant has attempted to mitigate impacts to agricultural lands by sharing existing road and highway rights-of-way (ROW) to the extent possible. The specifics of how the proposed transmission line would be designed to share roadway ROW are provided in Section 4.0. Potential impact to agricultural lands are also addressed by an agricultural impact mitigation plan (AIMP) – a plan developed in collaboration with the Minnesota Department of Agriculture (MDA) and included as a route permit condition (AIMP is available in Appendix E). This agreement identifies measures that the applicant would take to avoid, mitigate, or provide compensation for agricultural impacts that may result from construction and operation of the transmission line. The AIMP describes how the project will address, for example, repair of damaged drain tiles, removal of construction debris, and restoration of topsoil to pre-construction conditions in order to avoid loss of productivity post-construction.

Center pivot irrigation systems are present within the ROW of several route alternatives considered for this project. Discussions with landowners would take place to reduce impacts to irrigation systems and restore temporary roads to pre-construction conditions.

The project would result in permanent and temporary impacts to farmland. Permanent impacts would occur as a result of structure placement along the route centerline. It is estimated that the permanent impacts in agricultural fields would be 55 square feet per pole. During construction, temporary impacts such as soil compaction and crop damage within the ROW are likely to occur. Temporary impacts in agricultural fields are estimated to be one acre per pole for construction activities, five acres every 25 miles for equipment staging areas, and 1600-square-feet every two miles for spooling locations.

Prime Farmland

The majority of agricultural land in the project area is designated as "prime farmland," "prime farmland if drained or protected from flooding," or "farmland of statewide importance." Federal regulations define prime farmland as, "land that has the best combination of physical and chemical characteristics for producing food, feed, forage, fiber, and oilseed crops and is available for these uses" (7 CFR, 657.5 (a) (1)). Farmland of statewide importance includes land that is of statewide importance for the production of food, feed, fiber, forage, and oil seed crops. Areas of prime farmland and farmland of statewide importance within the ROW of each route alternative considered in this draft EIS are discussed in Section 8. Mitigation strategies for potential impacts to prime farmland are similar to those for all agricultural lands.

Organic Farms

In addition to traditional farms, the project study area includes several organic farms that could be crossed by a selected route alternative. The MDA was consulted to identify known organic farms within the project area. Because organic farms are not required to register with the MDA, organic farm registration does not give precise locations of organic fields, only the mailing address. Within the five counties comprising the project area, 30 organic farms are listed in the MDA's 2009 Directory of Minnesota Organic Farms.

Under current U.S. Department of Agriculture (USDA) requirements, high-voltage transmission lines (HVTLs) do not affect organic certification status. Similarly, there is no impact to certified Biodynamic® farms under Demeter USA rules. The Demeter USA certification is not accredited through the USDA NOP program and therefore cannot be termed "organic;" however, the principles of the Biodynamic® farming are similar to certified organic farming and thus Biodynamic® farm certification is included in this section.

While the presence of a HVTL near an organic agricultural area does not directly impact organic status, special procedures must be followed during the construction and maintenance activities associated with HVTLs to avoid impacts to organic farms. Substances prohibited under USDA NOP rules, e.g., herbicides, adnd pesticides, that may be used during construction or maintenance of the line, could impact organic farms. These substances, if applied to organic farms, could invalidate their certification.

As noted above, the AIMP for this project will identify measures that the applicant must take to avoid, mitigate, repair, and/or provide compensation for impacts that may result from transmission line construction (see Appendix E). All mitigation requirements addressed in the AIMP apply to organic farms. The applicant has stated in their application that they would avoid the application of prohibited substances on organic farms, including herbicides, pesticides, fertilizers and seeds. The applicant would follow the requirements outlined in the AIMP to control erosion, weeds, water from other fields, and to manage soils to continue the organic status of the farm.

7.5.1.1 Livestock

Livestock may be impacted temporarily during the construction phase of the project. There is potential for livestock to have reduced access to pasture lands and they may be subjected to construction noise. Measures to minimize impacts to livestock during construction may include erecting temporary fences, temporarily relocating livestock from construction areas, and restoring vegetative cover using landowner-approved seed mixes suitable for livestock grazing.

Impacts to livestock due to stray voltage may occur if this voltage is not properly mitigated. Stray voltage, including mitigation strategies, is addressed in more detail in Section 7.1.2

7.5.1.2 Aerial Crop Spraying/Dusting

Crop dusting may occur within agricultural fields along the route alternatives across the project area. Crop dusting within agricultural fields could be impacted if flying near the transmission line is necessary. Potential impacts to crop dusting and to agricultural crops could be mitigated by choosing routes that are consistent with current crop dusting patterns or by switching to land-based application of crop amendments.

7.5.2 Forestry

The route alternatives considered in this draft environmental impact statement (EIS) are located primarily in cultivated land and grassland with some forested areas adjacent to farmsteads, waterways, and within lands managed by the Department of Natural Resources (DNR). The DNR has several forest stands within Segment 3; however timber harvest plans are currently not available. While Minnesota's forestry industry is located primarily in the northeastern part of the state, there are two known private, small-scale, tree farms present within the project area. Impacts to DNR stands and these small-scale tree farms could be minimized by avoiding them. Impacts to other forested areas within the project area are discussed in Section 7.7.

7.5.3 Mining

The project area includes some commercial mining, primarily aggregate resources and some limestone quarries. There are no active mineral-based mining operations within the ROWs of the route alternatives considered for this project, although there are areas along these route alternatives that are not currently mined for natural resources that may be used in the future. In most cases, impacts to the existing or planned use of areas suitable for mining can be avoided by routing around mining operations and resources.

7.6 Rare and Unique Natural Resources

A variety of rare and unique natural resources have been documented within the proposed project area. Without careful planning, the proposed project could impact rare plants, animals, and habitats. A summary of the information used to evaluate rare and unique natural resources throughout the route alternatives considered for this project is provided below. Section 8 summarizes rare resources identified within the project area and compares the potential impacts presented by the various route alternatives.

7.6.1 State and Federally Listed Threatened and Endangered Species

As summarized in the Route Permit Application (RPA), the applicant queried the Minnesota Department of Natural Resources (DNR) Natural Heritage Information System (NHIS) database to obtain the locations of rare and unique natural resources across the project area. The NHIS database was again queried in November, 2010, for this draft environmental impact statement (EIS) (see Appendix F).

Rare and unique natural resources in the NHIS database have been listed on state and federally protected threatened and endangered species lists. The NHIS database also includes species that either do not have a status (referred to as "NON" in the tables in Appendix F) or are of

Figure 7.6.1-1 Loggerhead shrike

Source: Istockphoto

Figure 7.6.1-2 Dwarf trout lily

Source: Barr photo

special concern (referred to as "SPC" in the tables in Appendix F) status. Though these species ("NON" and "SPC") may be important to ecological functions, they are not, as compared with threatened and endangered species, afforded legal protection in Minnesota.

The rare species documented within the project area include a variety of birds, such as the state-threatened loggerhead shrike (*Lanius ludovicianus*) (Figure 7.6.1-1); reptiles, such as the state-threatened Blanding's turtle (*Emydoidea

Figure 7.6.1-3 Kitten tails

Source: John Hilty – Illinois Wildflowers

blandingii) and wood turtle (*Clemmys insculpta*); fish, such as the state-threatened paddlefish (*Polyodon spathula*); mammals, such as the state-special concern prairie vole (*Microtus ochrogaster*) and plains pocket mouse (*Perognathus flavescens*); mussels, such as the state-threatened ellipse (*Venustaconcha ellipsiformis*) and mucket (*Actinonaias ligamentina*); and plants, such as the state and federally-endangered dwarf trout lily (*Erythronium propullans*) (Figure 7.6.1-2), the state and federally-threatened prairie bush clover (*Lezpedeza leptostachya*), and state-threatened kitten tails (*Besseya bullii*) (Figure 7.6.1-3).

Bald eagles (*Haliaeetus leucocephalus*) and golden eagles (*Aquila chrysaetos*) also are considered unique resources within the project area. Bald eagles are known to nest and winter near surface water in the project area, and occasional reports of golden eagles in spring, fall and winter exist for all Minnesota counties in the project area. The 1940 Bald and Golden Eagle Protection Act (16 USC 668-668C) specifically prohibits the taking or possession of these eagles.

In addition to the rare species mentioned above, the NHIS database also documents locations where assemblages of rare species have been observed. Within the project area, the NHIS database documents a bat concentration area, a colonial waterbird nesting site, and four mussel concentration areas. The NHIS database also documents rare and unique plant communities; the communities identified within the project area are discussed below.

7.6.2 Threatened and Endangered Species Habitat

Threatened and endangered species are often found within high quality rare and unique habitats. The NHIS database was used to identify rare habitats, such as upland and wetland native plant communities, within one mile of each route alternative. Twenty-five different rare native plant communities were identified within one mile of the various route alternatives considered and include the following:

- Calcareous Fen (Southeastern)
- Dry Bedrock Bluff Prairie (Southern)
- Dry Limestone – Dolomite Cliff (Southern)
- Dry Sand – Gravel Prairie (Southern)
- Dry Sandstone Cliff (Southern)
- Elm – Ash – Basswood Terrace Forest
- Elm – Basswood – Black Ash (Hackberry) Forest
- Mesic Prairie (Southern)
- Mesic Sandstone Cliff (Southern)
- Red Oak – Sugar Maple – Basswood – (Bitternut Hickory) Forest
- Red Oak – White Oak – (Sugar Maple) Forest
- Red Oak – White Oak Forest
- Sedge Meadow
- Seepage Meadow/Carr, Tussock Sedge Subtype
- Silver Maple – (Virginia Creeper) Floodplain Forest
- Silver Maple – Green Ash – Cottonwood Terrace Forest
- Southern Dry Cliff
- Southern Seepage Meadow/Carr
- Spikerush – Bur Reed Marsh (Northern)
- Sugar Maple – Basswood – (Bitternut Hickory) Forest
- Sugar Maple – Basswood – Red Oak – (Blue Beech) Forest
- Swamp White Oak Terrace Forest
- White Pine – Oak – Sugar Maple Forest
- White Pine – Oak Woodland (Sand)
- Willow – Dogwood Shrub Swamp

DNR state-designated railroad prairie data were evaluated to determine whether there are recorded locations of remnant native prairie along railroads within one mile of each route alternative. Prairies, once abundant in Minnesota, are often found on railroad right-of-ways (ROWs) because these areas were typically not disturbed by cultivation and other human influences.

The DNR Minnesota County Biological Survey (MCBS) Sites of Biodiversity Significance (SBS) geographic information system (GIS) data were also reviewed to determine if there are areas with outstanding, high, or moderate biodiversity significance within the project area. Sites designated as "below" (below moderate biodiversity significance) are not included in the data presented in this draft EIS.

Complete lists of rare and unique natural resources obtained from the NHIS database query for each route alternative are available in Appendix F. Because there is no legal protection for species classified as SPC or NON, these species are not discussed in Section 8 but are shown in Appendix F. In order to protect rare resources from exploitation or destruction, the maps shown in Section 8 do not indicate the names of species or communities identified within the NHIS database.

7.6.3 Mitigation

Several of the documented rare species within the project area are associated with rivers, streams, and wetlands. In general, rivers and streams can be spanned by transmission lines and structures would not be placed within them. Because of this, direct impacts to aquatic species are not anticipated. Wetlands could also be spanned to the extent feasible, which would minimize impacts to rare wetland species and habitats. In addition, appropriate best management practices (BMPs) could be used throughout construction in order to protect topsoil and adjacent water resources by minimizing soil erosion and sedimentation.

Because MCBS and DNR-listed natural communities and animal assemblages are areas known to be capable of supporting rare and unique species, the placement of structures within these areas could be avoided or minimized by spanning them to the extent possible. Where structure placement cannot be avoided within areas of documented rare resources, a biological survey would likely need to be conducted to determine the presence of rare species or suitability of habitat for such species and coordination would occur with appropriate agencies to avoid or minimize impacts. If the resource is unavoidable, a takings permit from the DNR may be required along with other conditions. See Section 7.7 for a discussion of potential impacts to birds from the proposed project.

7.7 Flora and Fauna

7.7.1 Flora

7.7.1.1 Vegetation Communities

The project is located in southeast Minnesota, where the North American eastern deciduous forest begins to transition into the North American central prairie. The unique blufflands topography of much of the area also influences the types and distribution of vegetation communities in the project area. In order to describe vegetation community types in Minnesota, the Department of Natural Resources (DNR) and the U.S. Forest Service (USFS) developed the Ecological Classification System (ECS) for ecological mapping and landscape classification. ECS is a hierarchical classification system that identifies and describes areas with similar ecological features at progressively smaller scales. Based on the ECS classification, the project lies entirely within the Eastern Broadleaf Forest Province, one of four ecological provinces in the State. Within this ecological province, most of the project lies within the Paleozoic Plateau Section (Rochester Plateau Subsection and Blufflands Subsection) Portions of the route alternatives near the western end of the project are located within the Northeast Iowa Morainal Section (Oak Savanna Subsection) (DNR 2005). ECS subsection designations are used by DNR and U.S. Fish and Wildlife Service (USFWS) as the basis for management planning for certain wildlife species (discussed below in Section 7.7.2).

Historically, the Paleozoic Plateau Section was influenced by slope, aspect, flooding, and fire frequency, which influenced the distribution and condition of the dominant vegetation communities associated with the related subsection. The Rochester Plateau and the Oak Savanna Subsections historically contained tallgrass prairie and bur oak savanna communities (DNR 2005). Maple-basswood forests were also common in the Oak Savanna subsection. Most of this subsection is now farmed (DNR 2006). The Rochester Plateau subsection contains vegetation communities associated with the headwaters of the Root, Zumbro, Whitewater, and Cannon Rivers, as well as several trout streams. The Blufflands Subsection was historically characterized by several dominant forested communities including: red oak, white oak, shagbark hickory, basswood, and black walnut; as well as tallgrass prairie and bur oak savanna communities associated with the upper slopes and ridgelines. Areas protected from fire such as steeper slopes or dissected areas were typically dominated by oak forests with the exception of southwest facing bluffs and slopes which were typically dry prairie. Red oak-white oak-shagbark hickory-basswood forests were present on more moist slopes, and red oak-basswood-black walnut forests were present in protected valleys (DNR 2005).

Wetland habitats in the project area include floodplain forests, wet forests, lakeshores, wet meadows, and marshes. Floodplain forests are riparian hardwood forests located along the Mississippi River Valley and its tributaries and are typically dominated by green ash, American elm, cottonwood, and hackberry. Wet forests are in areas of groundwater seepage, often on level stream terraces and at the base of slopes. The canopy is often dominated by black ash, basswood, and American elm with an herbaceous layer containing various sedges, grasses, and forbs. Lakeshore systems are generally dominated by species of willow, rushes, sedges, and emergent aquatic plants near shore. Wet meadows are characterized by grasses, sedges, rushes, and various broad-leaved plants. Marshes are emergent herbaceous communities that are typically are heavily dominated by cattails, bulrushes, and sedges. General wetland issues are discussed in Section 7.8. Specific wetland presence and impacts within each route segment are discussed in detail in Sections 8.1.4.8, 8.2.4.8, and 8.3.4.8.

As a result of settlement and farming beginning in the 1800s, most of the historic prairie has been converted or fragmented to support agriculture and development. The dominant crop species in the project area include corn and soybeans; in grazed areas, dominant vegetation includes introduced grasses, such as smooth brome and sorghum. Similarly, many woodland trees were removed during the conversion to agriculture. Currently, the majority of the vegetative cover in the project area is dominated by agricultural cropland. Grasslands, including pastures and prairie remnants, are also commonly present along the various route alternatives. Forested cover is more prevalent in the eastern half of the project area. Details on general vegetation community types within the route segments are provided in Sections 8.1.4.7, 8.2.4.7, and 8.3.4.7.

Impacts to existing vegetation communities caused by construction and operation of the proposed project include direct and indirect, temporary and permanent impacts. Site preparation and installation of support poles may temporarily impact 20,000 square feet (less than 0.5 acre) of habitat at each structure location. Except for the final footprint of the installed structure, the majority of the disturbed area at each structure would be restored and allowed to re-vegetate naturally to pre-construction conditions.

Temporary impacts to existing vegetation communities include localized physical disturbance caused by the use of construction equipment during site preparation including grading, excavation, and soil stockpiling. The establishment and use of staging areas and stringing areas would also temporarily impact flora by concentrating surface disturbance and equipment use. Grading could occur at the staging areas if these areas are not located in previously disturbed sites. Clearing for access roads would be limited as much as practicable, to a maximum of 20 feet wide between pole locations. In forested areas, only trees or stands that interfere with safety and equipment operation would be removed.

Permanent vegetative changes would take place at each pole footprint (55 square feet) and within the right-of-way (ROW) that occurs in the forested communities. The transmission line ROW would be maintained to restrict the establishment and growth of trees and shrubs that have the potential to interfere with the operation and maintenance of the transmission line. Co-locating with existing corridors through wooded areas would reduce the impact to trees on the river valley bluffs. After the ROW is established, it is typical to control and manage vegetation using mechanical and herbicide treatments following a prescribed management plan. Vegetation that does not interfere with the safe operation of the transmission line would be allowed to establish within the ROW.

7.7.1.2 Noxious Weeds and Invasive Vegetation

Noxious weeds are regulated under Minnesota Statutes, Chapter 18. Noxious weeds can rapidly overtake native vegetation and degrade habitat quality. Cropland suffers losses in productivity following noxious weed infestations. Noxious weeds can be introduced to new areas through propagating material like roots or seeds transported by contaminated construction equipment. Disturbed soil surfaces allow noxious weeds to establish and out-compete existing vegetation.

Eleven species of primary noxious weeds are recognized by Minnesota Rules 1505.0730. The Minnesota Noxious Weed Law also defines and lists two restricted weed species and 52 secondary noxious weeds. A county may select a weed or weeds from the secondary list to be placed on its noxious weeds list. If a secondary noxious weed is placed on a county noxious weed list, that weed must be controlled in that county.

Dakota County regulates three noxious weeds from the state's secondary weed list. Goodhue, Olmsted and Wabasha Counties do not have secondary noxious weed lists.

7.7.1.3 Mitigation

Avoidance of native vegetation is the primary means of mitigating impacts to this vegetation. The majority of routes under consideration for this project utilize existing ROWs, including roads and agricultural field lines, most often adjacent to cultivated row crops. Accordingly, impacts to native vegetation are not anticipated to substantially disrupt vegetative community quality or function. Impacts to areas containing native vegetation communities could be mitigated by spanning these areas.

When native vegetation communities cannot feasibly be spanned, impacts could be minimized by using the fewest possible number of structures within these communities. All areas disturbed by construction of the transmission lines will be reseeded using a native seed mix appropriate to the site.

7.7.2 Fauna

7.7.2.1 Wildlife Overview

Topography, soils, and vegetation community types vary widely within the project area, resulting in a broad range of wildlife habitat types. Forage, shelter, nesting, and stopover habitat for both resident and migratory wildlife are all available in the project area, and support a diverse assemblage of birds, mammals, fish, reptiles, amphibians, mussels, and insects. Portions of the project area dominated by agricultural fields, pasture, or urban and suburban areas tend to support a less diverse wildlife community. Conversely, portions of the project with less-disturbed, unique and/or diverse vegetation communities tend to support more wildlife species, and can act as refuges or corridors of movement for wildlife as well.

Wildlife populations that occur within the project area include both game and non-game species. Game populations are managed and regulated by the DNR for hunting and fishing, and are an important part of Minnesota's recreation and rural economy. Non-game species contribute to Minnesota's biological diversity and are afforded protection or support at the state and federal levels under a variety of programs and laws. Lands managed and maintained for wildlife habitat, as well as habitat occurring naturally on the landscape, are also designated under several different state and federal organizations and programs (see text box "Laws and Programs That Protect Plants and Wildlife in Minnesota").

Species of Greatest Conservation Need (SGCN)

The U.S. Congress established the State Wildlife Grants (SWG) program in 2002 to help states identify and manage wildlife habitat needs. States participating in the SWG program were required to develop a comprehensive wildlife plan. Minnesota's plan, *Tomorrow's Habitat for the Wild and Rare: An Action Plan for Minnesota Wildlife* (DNR 2006), was completed in 2005 and was approved by USFWS. It is also referred to as the Comprehensive Wildlife Conservation Strategy (CWCS). Approval of the CWCS allows Minnesota to participate in the SWG program, which has provided approximately $1 million annually to implement the plan.

The CWCS is organized following the DNR ECS of native plant communities at the province and subsection levels. The project crosses three ECS subsections – Oak Savanna, Rochester Plateau, and The Blufflands. All three route segments pass through at least some portion of each of these subsections. Species of Greatest Conservation Need (SGCN) are identified within each ECS subsection. SGCN are those species whose populations are rare, declining or vulnerable in Minnesota. Of the approximately 1200 wildlife species evaluated by the CWCS, 292 (~25 percent) met the SGCN definition. Approximately half of the SGCN are state-listed species (DNR 2006).

Overall, the project area provides key habitat for 166 SGCN. Key habitats are defined as those habitats most important to the greatest number of SGCN in a subsection. The key habitats found in the project area are shown in Table 7.7.2.1-1, along with the subsections in which these habitats are found.

Table 7.7.2.1-1 SGCN Key habitats in the project area by ECS subsection

	Subsection		
Key Habitat	Blufflands	Oak Savanna	Rochester Plateau
Grassland		x	x
Prairie	x	x	x
River-Headwater to Large	x	x	x
River-Very Large	x		
Shoreline-dunes-cliff/talus	x		
Shrub/Woodland-Upland	x	x	x
Wetland-Nonforest	x	x	x

Source: DNR 2006

The Blufflands subsection has the most SGCN, not only in the project area, but statewide. It also has the most SGCN unique to any subsection statewide. Species unique to an ECS subsection are found nowhere in Minnesota except in that subsection. The Blufflands have 14 such SGCN. Table 7.7.2.1-2 summarizes the number of SGCN in each subsection, the number of SGCN unique to each subsection, the number of key habitats and the number and percentage of SGCN using at least one key habitat in each subsection.

The SGCN data demonstrate that the project area is important for providing wildlife habitat not only for common species, but for some of Minnesota's lesser-known wildlife species.

One of the largest and most important areas for wildlife habitat within the project area is the Upper Mississippi River National Wildlife and Fish Refuge (Refuge). The Refuge was established in 1924 "as a refuge and breeding place for migratory birds, other wild birds, game animals, fur-bearing animals, and for the conservation of wild flowers and aquatic plants" (USFWS 2011). The Refuge extends 261 miles, beginning at the confluence of the Mississippi and Chippewa Rivers near Wabasha, Minnesota, and ending near Rock Island, Illinois. It lies within four states – Minnesota, Wisconsin, Iowa and Illinois – and is the longest river refuge in the continental U.S. The Refuge covers over 240,000 acres.

An estimated 40 percent of the nation's waterfowl pass through the Refuge during annual migration, most using the North American Mississippi Migratory Flyway, which passes over the eastern end of the project and over the Refuge (see Figure 7.7.2.1-1). This migratory flyway is also utilized by numerous species of perching birds, larger birds of prey (e.g., raptors, eagles), and wading birds (herons, cranes, egrets) during biannual migrations between summer and winter grounds. Birdlife International has designated two Important Bird Areas (IBA) in the vicinity of the project (Audubon 2010). These are also shown on Figure 7.7.2.1-1. One is the Upper Mississippi River National Wildlife Refuge between the Minnesota-Iowa border north to Reads Landing, MN. The eastern terminus of the project lies within this IBA. The Audubon Society estimates that approximately 300 bird species utilize this IBA.

Laws and Programs that protect plants and wildlife in Minnesota

Plants and wildlife and their habitat in Minnesota are protected by a number of Federal and State programs and laws. These include:

- **Endangered Species Act (ESA):** 1973; protects critically imperiled species and their habitats
- **Bald and Golden Eagle Protection Act (BGEPA):** 1940; prohibits the taking or possession of bald eagles (*Haliaeetus leucocephalus*) and golden eagles (*Aquila chrysaetos*), their nests or eggs
- **Migratory Bird Treaty Act (MBTA):** 1918; regulates the taking of migratory birds. "Taking" refers to any act that would kill, harm harass, pursue, hunt, shoot, wound, kill, trap, capture, or collect a migratory bird
- **Fish and Wildlife Conservation Act (FWCA):** 1980; protects Birds of Conservation Concern (BCC), which are species regarded by USFWS as likely to be listed under the ESA
- **Minnesota Endangered Species Statute (MN Statutes 84.0895):** prohibits taking of State- or federally-listed species in Minnesota
- **Important Bird Areas (IBA):** IBAs are designated by BirdLife International and the Audubon Society to identify high-quality bird habitat
- **Grassland Bird Conservation Areas (GBCA):** GBCAs are developed by the USFWS to identify areas of unbroken grassland where migratory bird species make summer homes
- **Wildlife Management Areas (WMA):** managed by DNR to promote wildlife and game species
- **Wildlife Protection Areas (WPA):** managed to promote waterfowl populations and to conserve ecologically and recreationally valuable wetlands and lakes
- **U.S. Fish and Wildlife Service easements:** USFWS easements on private land protect the survival of wetlands and native grassland
- **National Wildlife Refuges (NWR):** NWRs are managed to conserve important natural resources. No sections in this project include NWR lands
- **Aquatic Management Areas (AMA) and Fish Management Areas (FMA):** These areas protect aquatic wildlife and fish species by conserving lakes and rivers and the surrounding land areas
- **Scientific and Natural Areas (SNA):** Lands set aside to preserve natural features and rare resources of exceptional scientific and educational value
- **Conservation Reserve Program (CRP):** CRP converts marginal farmland to grassland in 10-15 year easements providing valuable habitat for bird and terrestrial species
- **Conservation Reserve Enhancement Program (CREP):** CREP easements are often permanent and are in coordination with state grassland reserve programs
- **Re-invest in Minnesota Program (RIM):** RIM is a state-initiated program that has similar habitat goals as CRP and CREP
- **DNR designated areas with MCBS biodiversity significance:** The MCBS biodiversity areas, identified by the DNR, are good indicators of wildlife species habitat and quality
- **Designated trout streams:** Identified by Minnesota statute with special restrictions of recreation fishing activities to protect and enhance Minnesota's trout resources

Table 7.7.2.1-2 Summary of SGCN, key habitats and key habitat use by ECS subsection

ECS subsection	Number of SGCN	Number of SGCN Unique to Subsection	Number of Key Habitats	Number of SGCN Using at Least One Key Habitat	Percentage of SGCN Using at Least One Key Habitat
The Blufflands	156	14	6	139	89.1
Rochester Plateau	94	0	5	83	88.3
Oak Savanna	93	1	5	81	87.1

Source – DNR 2006

The second IBA identified by Birdlife International is Whitewater Valley at Whitewater State Park, approximately two miles south of the project area. The close proximity of the Mississippi River migration corridor to the Whitewater Valley IBA makes it a valuable stop-over region for migratory birds during both spring and fall. The Audubon Society estimates that approximately 250 bird species utilize this IBA (Audubon 2010).

Construction of the project would result in impacts to wildlife and wildlife habitat. These impacts may be either temporary or permanent, and would affect SGCN, non-avian species, and avian species.

SGCN

The CWCS identified habitat loss or degradation as the primary type of impact to SGCN (DNR 2006). Many SGCN have specific habitat needs, or require larger, unfragmented habitat areas to sustain viable populations. Figure 7.7.2.1-2 shows the percentage of SGCN that are affected by various wildlife impacts.

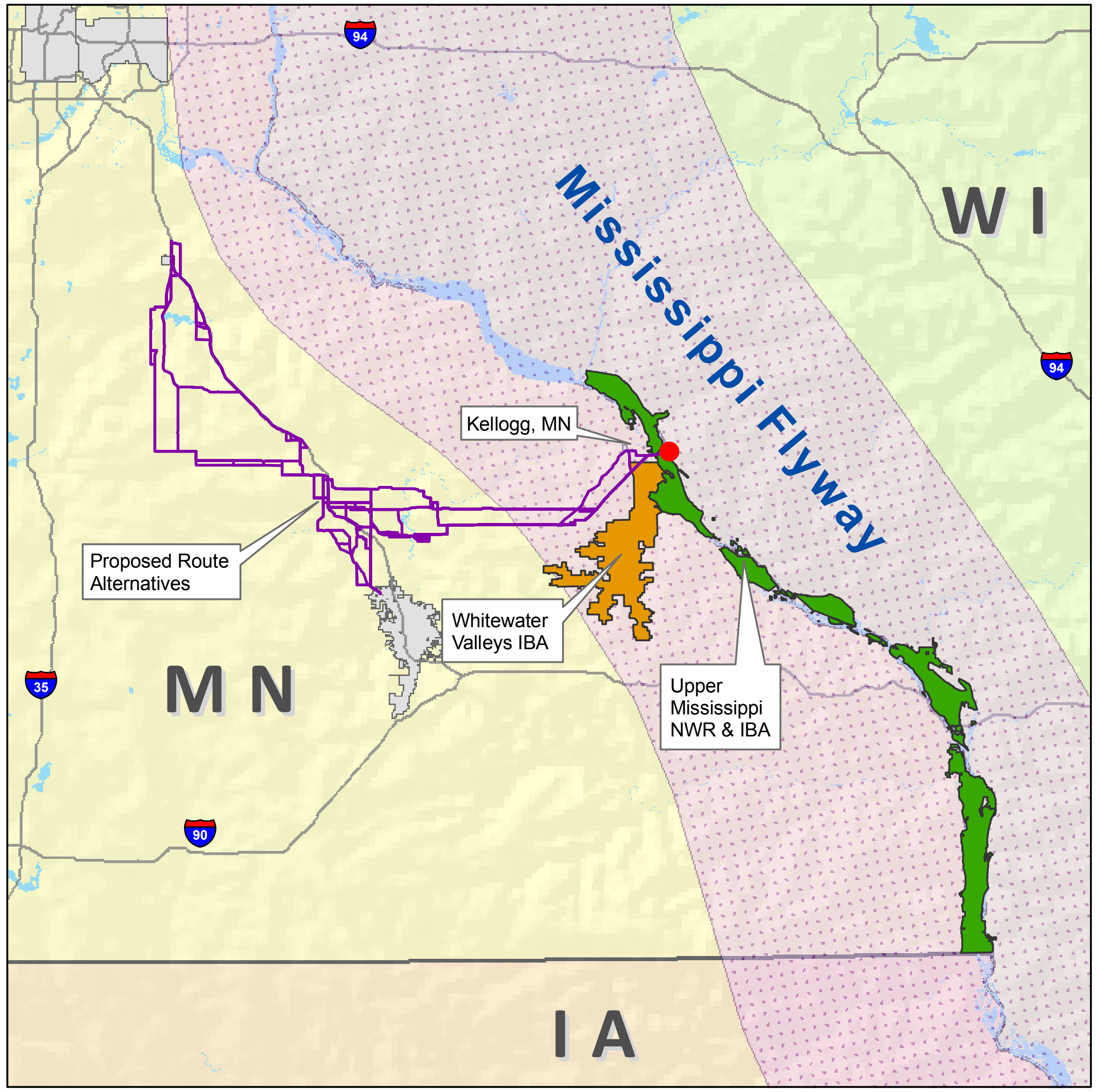
SGCN may also be affected by the temporary and permanent project impacts described below for non-avian and avian species.

Non-avian Species

Temporary impacts are associated with construction, and include short-term displacement and habitat alteration caused by activities such as clearing, grading, structure erection, and line stringing. The impacts can result from actual physical disturbance of wildlife or their habitat, or by noise associated with construction activities. Temporary impacts would be most intense at the proposed structure locations, where impacts to approximately 20,000 square feet (<0.5 acre) is anticipated at each new structure, or 1.0 acre of temporary impact per span. Staging and stringing areas also have the potential to temporarily impact fauna within the project construction area. Grading previously undisturbed sites for staging areas and clearing for access roads has the potential to temporarily impact wildlife by altering habitat. Clearing for access roads would be limited as much as practicable and should require a maximum width of 20 feet. Clearing and grading activities have the potential to impact small birds (e.g., eggs or nestlings) and small mammals that may be unable to avoid equipment. Many wildlife species would likely avoid the immediate area during construction. The distance that animals would be displaced is dependent on the species and the tolerance level of each individual. Based on the availability and suitability of other unaffected and similar habitat within and near the project area, the potential temporary impacts to wildlife are not expected to cause a change in listing status or a detectable permanent change in local populations.

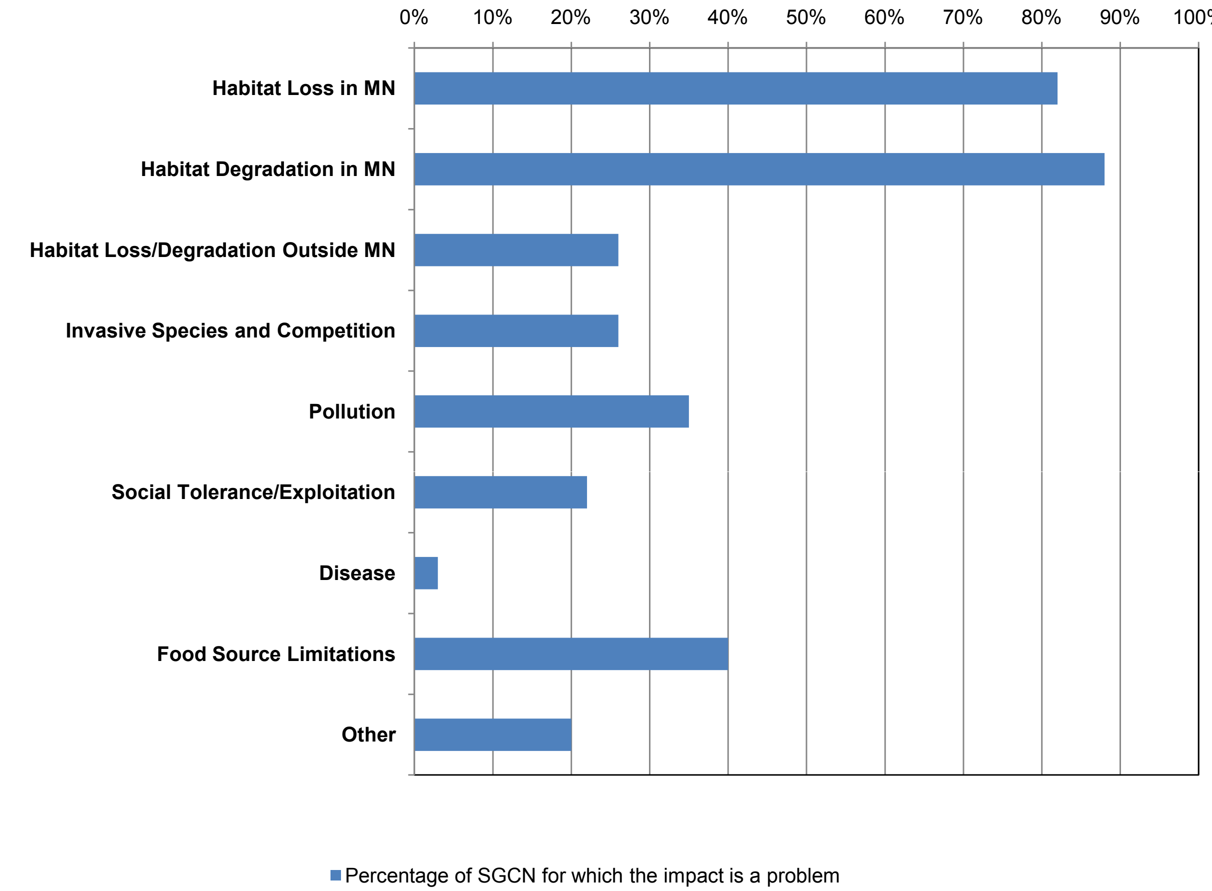
Permanent impacts to fauna that may result from the construction of a new transmission line include habitat loss and fragmentation. Habitat loss and fragmentation primarily occur when the new transmission line bisects large forest tracts that provide habitat for woodland species. Some species depend on large areas of undisturbed habitat, and their survivability decreases as fragmentation increases. Fragmentation affects

Figure 7.7.2.1-1 North American Mississippi Migratory Flyway, Upper Mississippi River National Wildlife and Fish Refuge, and Important Bird Areas in relation to project area



Source: Barr 2010 and Birdnature 1998

Figure 7.7.2.1-2 Impact categories and percentage of SGCN affected



Source: Barr 2006

some wildlife species by creating barriers to daily movement. In addition, predation rates may increase among animals that are forced out of cover as they search for food and as the distance predators need to travel to penetrate large habitat areas decreases. Routes that tend to follow existing corridors, such as roads, existing transmission lines, and field lines, reduce the potential for substantial habitat loss and fragmentation. If clearing in forested areas can be limited to only those trees necessary to permit the passage of equipment and to maintain the appropriate cleared ROW width, wildlife impacts would be reduced.

Chronic Wasting Disease

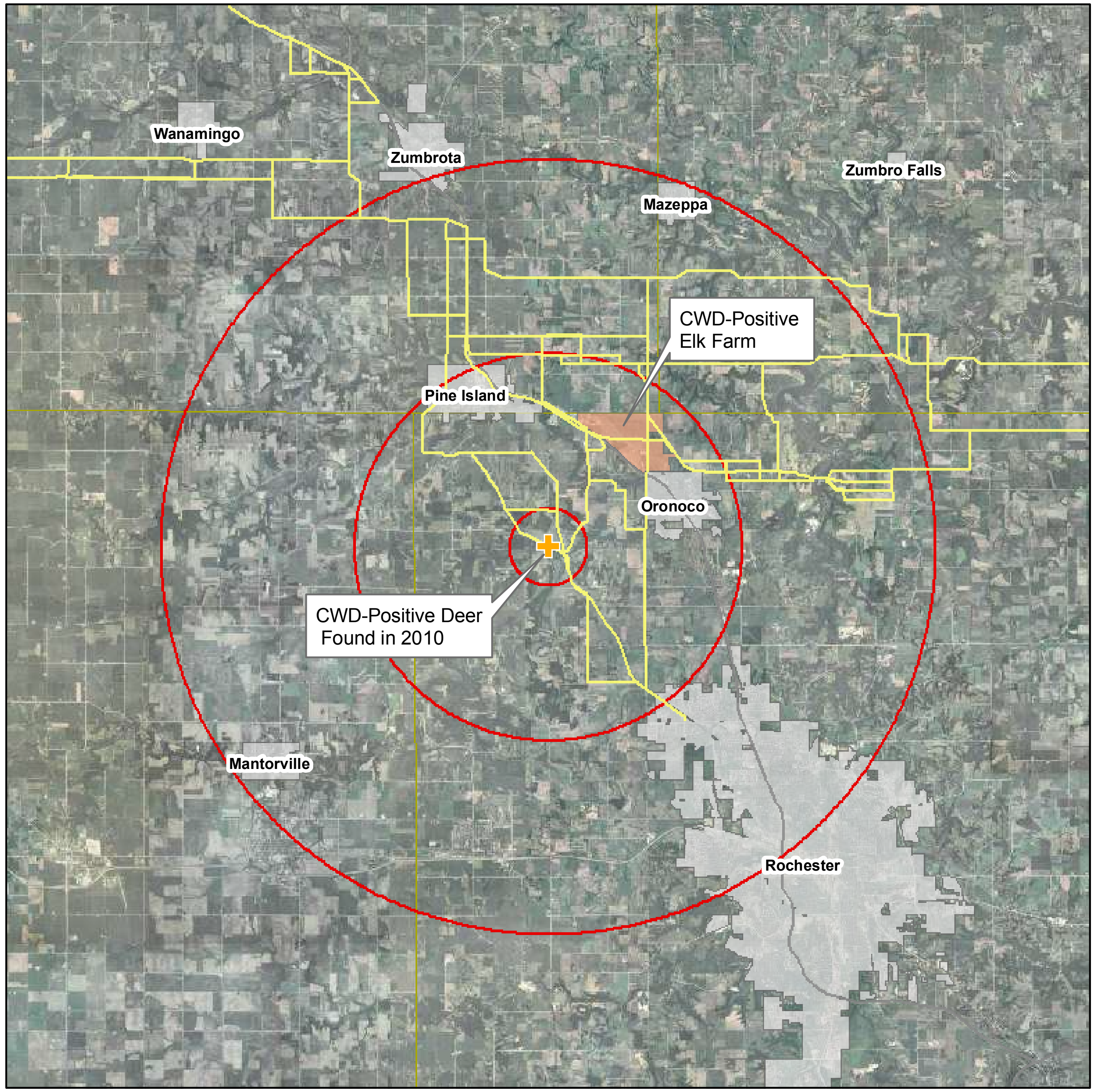
Several route alternatives in all segments of the 345 kV and 161 kV transmission lines pass through or near an area southeast of Pine Island where an adult female deer infected with Chronic Wasting Disease (CWD) was harvested in late 2010. The infected deer was taken approximately three miles southwest of a former elk farm that was depopulated in 2009 after a CWD-infected elk was discovered there. The DNR confirmed the diagnosis in the infected deer in January 2011, and implemented a CWD response plan. Figure 7.7.2.1-3 shows the location of the infected deer harvested in 2010 and the former elk farm in relation to the route alternatives in the area.

The first step of the DNR response plan was to identify the number and current distribution of deer in the Pine Island area. This was done using an aerial survey. DNR then initiated a limited harvest of up to 1200 deer in the area in order to collect additional lymph nodes for testing. Evidence of CWD can be found in the lymph nodes of infected deer. At least 500 of the sampled deer were taken within five miles of the location where the infected deer was harvested. DNR also implemented a deer feeding ban in a four-county area of southeastern Minnesota, and is restricting carcass movements out of the area (DNR 2011q).

CWD is spread by a disease agent called a prion. Prions are abnormal forms of cellular protein that are most commonly found in the central nervous system and in lymph nodes. The prion infects the host animal by promoting conversion of normal cellular protein to the abnormal form. It is not known exactly how CWD is transmitted. The prions may be passed in feces, urine, or saliva. Transmission is thought to be from animal to animal. Because CWD infectious agents are extremely resistant in the environment, transmission may be both direct and indirect. Concentrating deer and elk in captivity or by artificial feeding probably increases the likelihood of both direct and indirect transmission between individuals. The National Center for Disease Control (CDC) and the World Health Organization (WHO) have found no scientific evidence that CWD is transferrable from animals to humans (DNR 2011q).

Prions enter the environment when an infected animal dies, or through shedding of urine, feces, saliva, or blood by an infected animal onto the ground. Prions bound to soil particles remain

Figure 7.7.2.1-3 Location of CWD-infected deer harvested in late 2010



Source: Barr 2011, DNR 2011q

infectious to grazing deer, and may remain infectious for at least two years (Saunders et al 2008).

Grading and clearing for the transmission line corridors or excavation for new structure foundations may occur in areas where CWD-infected deer have shed CWD prions onto the upper soil surface. The actual presence or distribution of CWD prions in the project area cannot be determined, since the number of infected animals is not known. In any event, project activities are highly unlikely to increase the probability that an uninfected deer would come into contact with a CWD prion. As a result, there are no practical mitigation measures for reducing or preventing the potential transmission of CWD prions to uninfected deer.

Avian Species

Avian impacts potentially associated with the project include those described for non-avian species. In addition, avian species may be affected by collisions with lines and structures, electrocution, and loss or disturbance of nests during construction. The Avian Power Line Interaction Committee (APLIC) suggests that the effects of transmission lines on avian species are negligible beyond one mile (APLIC 1994). Therefore, all land areas designated for wildlife conservation and management were identified within one mile of all route alternatives. These included WMAs, WPAs, SNAs, conservation easements, state parks, state forests, wildlife refuges and Minnesota County Biological Survey (MCBS) areas. Details on the proximity of these resources to the various route alternatives are presented in Section 8.

Electrocutions occur when birds, especially those from larger species (raptors, eagles, large owls), perch on a structure and make contact with a conducting wire. The project proposes to use structures with long insulators carrying the wires, which are generally safer for large perching birds, since the insulators hold the wire out of reach of the bird perched on the structure.

Avian protection standards that minimize the risk of bird electrocution are well documented in the following resources: the APLIC's Suggested Practices for Avian Protection on Power Lines: The State of the Art in 2006 (APLIC 2006), APLIC's Mitigating Bird Collisions with Power Lines: The State of the Art in 1994 (APLIC 1994), and APLIC's and USFWS' Avian Protection Plan (APP) Guidelines (APLIC and USFWS 2005). The structure designs proposed for this project appear to be consistent with the recommendations of these resources in that they provide adequate clearance from energized conductors to grounded surfaces and to other conductors. As such, avian electrocution risk is anticipated to be minimal.

Independent of the risk of electrocution, birds are at risk of colliding with transmission lines and suffering injuries. The risk of collision is influenced by factors such as surrounding habitat, bird concentration and movement patterns, foraging areas, roost sites, and structure design. Potential collision risk is highest at spans or structures located in rural areas with native vegetation where the line crosses habitats typically used by area birds (e.g., rivers and wetlands) and human influence in the immediate vicinity is limited. Waterfowl typically are more susceptible to transmission line collision, especially larger waterfowl such as trumpeter swans, Canada geese, pelicans, cranes, and herons. Collision frequency increases when a transmission line is placed between agricultural fields that serve as feeding areas, and wetlands or open water, which serve as resting areas. In these areas, it is likely that waterfowl and other birds will be traveling between different habitats, potentially increasing the likelihood of avian conflicts with the transmission line.

The incidence of avian collisions with transmission lines is also influenced by the

Electrocution of birds by transmission lines

Large flocks of birds perched on transmission lines are a common sight. Why aren't they electrocuted? It's because a bird perched on a line has both feet on the conducting wire. It's not grounded, which would allow electricity to follow the ground and pass through the bird's body. Therefore, a bird perched entirely on the wire is not electrocuted. However, a bird sitting on a structure is grounded, since the structure is in touch with the earth. If the grounded bird extends its wing and contacts the conducting wire, it creates a circuit through which electricity will pass, electrocuting the bird. Structures can be designed to create distance and/or barriers between the conducting wire and the perching spots on structures, making it difficult or impossible for a bird to be electrocuted through incidental contact with a conducting wire.

number of horizontal planes in which the conductors are strung. Stringing the conductor wires in a single horizontal plane presents less of a vertical barrier to birds crossing the transmission line corridor. However, a single horizontal plane generally requires a wider configuration of structures. Conversely, stringing the conductor wires in two or more planes creates a taller barrier to birds attempting to fly not only across the lines, but over and potentially between them as well. However, stringing conductors in multiple planes generally requires less ROW.

7.7.2.2 Mitigation

Several mitigation strategies and measures could be used to minimize wildlife impacts of the project. Mitigation of wildlife impacts could be addressed in the design, construction, operation, and maintenance phases of the project. Avoidance of wildlife habitat and limiting impacts on habitat is the primary means of mitigating impacts to wildlife. To mitigate potential impacts to wildlife the transmission line could span designated habitat, conservation areas, or other sensitive habitats wherever practical. In areas where complete spanning is not possible, the number of structures placed in high quality wildlife habitat could be minimized.

Route alternatives that follow existing transmission line routes and/or roads and railroads would require less clearing of potential wildlife habitat than those that follow new alignments. Field and property lines can provide habitat to some wildlife species; however, these habitats tend to be narrow and of marginal quality. Therefore, route alternatives that follow field and property lines would also generate fewer wildlife habitat impacts than alternatives on new, cross-country routes. Route alternatives that require new transmission line corridors would create new collision hazards for birds.

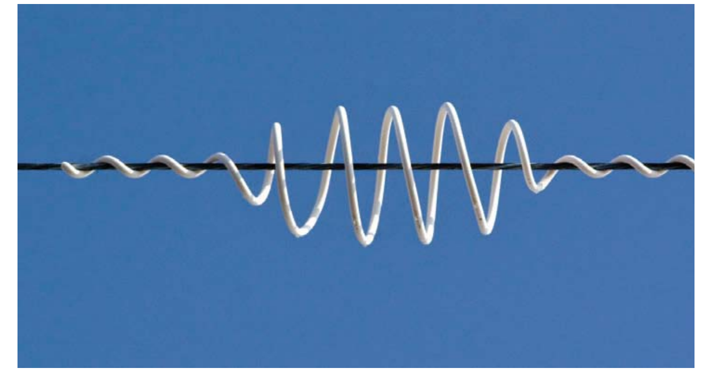
During construction, proper installation and maintenance of best management practices (BMPs) could reduce potential sediment runoff into aquatic habitats. With the exception of structure foundations, the areas cleared for construction could be reseeded using a native seed mix appropriate to the site. Existing native herbaceous and shrub vegetation communities could be allowed to re-vegetate cleared areas. Most native communities dominated by trees would not be allowed to re-establish under the completed transmission line. Maintenance of the transmission line corridor could be constrained to the minimum required for access to structures and passage beneath the conductors in native plant communities.

The applicant, in collaboration with the USFWS, Minnesota DNR, and Wisconsin DNR has proposed several potential structure configurations for crossing the Mississippi River to minimize avian and general wildlife habitat impacts. Details on the structure options for crossing the Mississippi River are found in Appendix D. In general, structure designs that minimize ROW width tend to be higher while lower structures require more ROW width. The applicant and agencies have arrived at an informal and general consensus that the preferable configuration is one that minimizes structure height and consolidates crossing wires in the fewest number of horizontal planes. It is anticipated that this configuration will minimize avian impacts. However, it may require additional ROW clearing in existing wildlife habitat. If necessary, field surveys to obtain more route-specific wildlife data would be completed once a route has been permitted in order to help minimize and mitigate potential impacts.

After the line is constructed, the transmission line can be marked at appropriate locations to increase visibility and decrease collisions. Marking devices include bird flight diverters and clamp-on markers. An example of these devices is shown in Figure 7.7.2.2-1.

Utilizing mitigation measures that are known and feasible, potential impacts from the project to non-avian wildlife are not anticipated to be signification at a population level. The potential for impacts to avian wildlife is relatively higher, due to the potential for collisions in areas of high natural resource availability and high avian use, e.g. Mississippi River Migratory Flyway. However, these impacts can be mitigated and are not anticipated to be significant at a population level.

Figure 7.7.2.2-1 Example of a bird flight diverter



Source: CapX 2020, 2009

7.8 Water Resources

The proposed project may impact lakes, watercourses (rivers, streams, and ditches), and wetlands. All lakes and watercourses could be spanned and transmission structures would not be placed within these resources. However, crossings of the Cannon, Zumbro, and Mississippi Rivers may impact views, birds, and other ecological resources in those areas. In addition, some wetlands would be directly impacted by the proposed project.

The potential impacts of the route alternatives under consideration on water resources are detailed in Section 8.

7.8.1 State and Federal Regulations

Some watercourses, lakes, and wetlands within the project area are designated Public Waters and listed in the Public Water Inventory (PWI) by the State of Minnesota. The statutory definition of a PWI can be found in Minn. Stat. § 103G.005, Subd. 15 and 15a. These water resources are under regulatory jurisdiction of the Minnesota Department of Natural Resources (DNR) and a permit would be required to cross any of these features.

Portions of the Cannon River within the vicinity of the project area are designated as Recreational and Scenic. Minnesota Rule 6105.0180 regulates utility transmission crossings within the Minnesota Wild, Scenic, and Recreational Rivers system. Utility transmission line crossing of these resources must follow existing corridors whenever possible and a permit would be required for any crossings.

What is a Wild, Scenic, and Recreational River?

According to Minn. R. 6105-0060, rivers eligible for inclusion are as follows:

- Wild rivers are those that "exist in a free-flowing state with excellent water quality and with adjacent lands that are essentially primitive";
- Scenic Rivers are those that "exist in a free-flowing state with adjacent lands that are largely undeveloped"; and
- Recreation rivers are those that "may have undergone some impoundment or diversion in the past and that may have adjacent lands which are considerably developed, but that are still capable of being managed" under the system.

Section 10 of the Rivers and Harbors Appropriation Act of 1899 is administered by the U.S. Army Corps of Engineers (USACE). Under Section 10, a permit is required in order to construct any structure that crosses in, over, or below any "navigable water of the U.S." Navigable waters of the U.S. are defined by the USACE as "those waters subject to the ebb and flow of the tide shoreward to the mean high water mark and/or are presently used, or have been used in the past, or may be susceptible for use to transport interstate or foreign commerce."

Within the project area, the Mississippi River is considered a "navigable water" that would be crossed by the project. A USACE Section 10 permit would be required for this river crossing.

Section 303(d) of the federal Clean Water Act (CWA) requires states to publish, every two years, a list of streams and lakes that are not meeting their designated uses because of excess pollutants (impaired waters). The list, known as the 303(d) list, is based on violations of water quality standards. In Minnesota, the Minnesota Pollution Control Agency (PCA) has jurisdiction over determining 303(d) waters, which are described as "impaired." This project would have the potential to increase turbidity through increased sedimentation from construction activities. Turbidity is the only pollutant on the PCA impairment list that could be generated by this project.

According to the federal CWA, a proposed project that requires a federal permit for any activity that may result in a discharge to navigable waters of the U.S. must first obtain a state Section 401 water quality certification to ensure the project would comply with state water quality standards. Federal permits include the USACE Section 10 and 404 permits. Section 401 of the federal CWA grants state agencies the authority to require certification of compliance with state and federal water quality regulations. In Minnesota, the PCA implements Section 401 compliance.

Wetlands, which perform many important hydrologic functions, are present throughout the project area. Pursuant to Section 404 of the CWA, the USACE defines wetlands in 33 CFR 328.3b as those areas that are "inundated or saturated by surface water or groundwater at a frequency and duration sufficient to support, and under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions." Jurisdictional wetlands must possess three essential characteristics: "(1) a dominance by hydrophytic vegetation, (2) hydric soils, and (3) wetland hydrology" (USACE 1987, 2008). For an area to be classified as a jurisdictional wetland under the federal guidelines, all of the above criteria must be met, and the wetland must have a hydrologic connection to a water of the U.S.

In Minnesota, both jurisdictional and non-jurisdictional wetlands are protected under Minn. Rules 8420, the Wetland Conservation Act (WCA). Although the Board of Water and Soil Resources (BWSR) administers the WCA on a statewide basis, local government units (LGUs) implement the WCA locally. Wetlands may also be regulated by the DNR if they are listed as PWI wetlands. The DNR requires a permit when an activity would cross or change or diminish the course, current, or cross section of public waters by any means, including filling, excavating, or placing of materials in or on the beds of public waters. Local governments may also have their own wetland ordinances.

Why are wetlands important?

Wetlands perform many important hydrologic functions such as flood abatement, maintaining stream flows, slowing and storing floodwaters, stabilizing stream banks, nutrient removal and uptake, groundwater drainage and recharge, sediment control, and water quality. Wetlands also serve as an important habitat for a variety of wildlife species.

7.8.2 Area Hydrology

The proposed project is located in the Upper Mississippi Region hydrologic unit (HU) (Seaber, et al. 1987). The project area is located within the Upper Mississippi-Black-Root Subregion. Annual precipitation across the project area averages about 32 inches per year (U.S. Department of Agriculture (USDA) – Natural Resources Conservation Service (NRCS) 2010).

7.8.3 Lakes

A few lakes are located within the project area; these include Lake Byllesby in Segment 1, Shady Lake in Segment 2, and Lake Zumbro in Segment 3 (see Maps 8.1-24, 8.2-20, 8.3-37, and maps in Appendix A). Each of these lakes is designated as a DNR Public Water. Both Lake Byllesby and Lake Zumbro are also on the PCA list of impaired waters due to excess nutrients/eutrophication. Lake crossings would be avoided to the extent possible; however, some of the route alternatives evaluated for this project may require spanning of lakes.

7.8.4 Surface Flows

Several rivers, streams, and ditches are located throughout the project area. The proposed project would require crossing several small rivers, streams, and ditches. Three of these crossings include the following larger rivers, all of which are listed on the PWI: the Cannon, Zumbro, and Mississippi Rivers (see Maps 8.1-24, 8.2-20, and 8.3-37).

All route alternatives within Segment 1 would cross the Cannon River. The P route alternatives would cross the Cannon River near Cannon Falls, while the A route alternatives would cross the Cannon River near Randolph (Map 8.1-24).

Both the Zumbro and Mississippi Rivers would be crossed by each route alternative in Segment 3 (Map 8.3-37). There are three options for crossing the Zumbro River. The P route alternatives would cross the Zumbro River north of White Bridge Road. The A route alternatives would cross the Zumbro River approximately 2.2 miles north of the Zumbro Dam. In addition to these two Zumbro River crossings, a third crossing option has been proposed. This option would cross the Zumbro River at the Zumbro River Dam.

The proposed crossing for the Mississippi River would be the same for all route alternatives evaluated in this draft environmental impact statement (EIS). The project would cross the Mississippi River near Kellogg, Minnesota (Figure 7.8.4-1, Map 8.3-37). See Section 6 for a description of the Kellogg crossing and Appendix D for details on the other Mississippi River crossings that were evaluated.

Many route alternatives would require crossing DNR-designated PWI streams and PCA-designated impaired water streams. In addition, several of the route alternatives in Segments 2 and 3 would require crossing DNR-designated trout streams. Designated trout streams are streams that have special restrictions of recreation fishing activities designed to protect and enhance Minnesota's trout resources.

7.8.5 Floodplains

The Federal Emergency Management Agency (FEMA) designates areas that are likely to experience flooding in a 100-year rainfall event. Permanent impacts to floodplains can reduce flood storage and may increase the flood elevation during a flood event. The small cross-section of transmission line structures are not expected to affect flood elevations over a large river floodplain. The proposed substation locations are not located in a 100-year floodplain and would not impact floodplains.

Figure 7.8.4-1 View of Mississippi River from Alma, Wisconsin

Source (Barr Photo 2010)

7.8.6 Wetlands

Wetlands are present at several points along the various route alternatives considered for this project. The U.S. Fish and Wildlife Service (USFWS) National Wetlands Inventory (NWI) was used to identify wetlands throughout the various transmission line routes evaluated. Starting in the 1970's, the USFWS produced maps of wetlands (NWIs) based on aerial photographs and Natural Resources Conservation Service (NRCS) soil survey maps. Because land use has changed since the 1970's, wetlands shown on the NWI maps are sometimes inconsistent with current wetland conditions; however, NWIs are the most accurate and readily available database of wetland resources within the proposed project area.

Wetland impacts that would occur due to construction of the project were estimated using

NWIs. Along each of the route alternatives reviewed for the proposed project, the acres of wetland located within the right-of-way (ROW) and route width were determined. This information is detailed for each route segment in Section 8.

7.8.7 Mitigation

It is anticipated that all lakes and watercourses would be spanned by the project. Thus, no structures would be placed within these features and no direct impacts to lakes and watercourses are anticipated. Placement of structures within 100-year floodplain zones would be avoided to the extent possible. Some counties and municipalities along the river have floodplain ordinances, which require that floodplain impacts be avoided when feasible, and permitted (usually through a floodplain permit) if unavoidable. Mitigation may be required as part of a floodplain permit. Each structure placed within a floodplain would displace less than 100 cubic feet of flood storage volume. Based on the low volume of potential floodwater displacement, the structures are not anticipated to have an effect on flooding. The number of structures in floodplains can be minimized by using taller (greater than 150 feet) and/or stronger (reinforced H-frame) structures that can span longer than-standard distances. Increased engineering and construction costs may be necessary in order to design and construct structures within the floodplain.

Construction activities may have the potential to indirectly impact lakes, watercourses, and wetlands by increasing the turbidity from sedimentation; however, best management practices (BMPs) could be used to minimize impacts during construction, as required in the State of Minnesota's National Pollutant Discharge Elimination System (NPDES) construction permit for the proposed project and as a condition of any route permit.

The construction stormwater general permit (MN R 100001) was re-issued by the PCA on August 1, 2008. Under the re-issued permit an NPDES/State Disposal permit is required for any construction activity disturbing:

- One or more acres of soil.
- Less than one acre of soil if that activity is part of a larger common plan of development or sale that is greater than one acre.
- Less than one acre of soil, but the PCA determines that the activity poses a risk to water resources.

Based on these requirements and previous interpretation of disturbance, transmission line projects that meet these criteria would be required to comply with the requirements found in this general construction stormwater permit. The types of activities associated with the construction of power lines which trigger the need for a stormwater construction permit include ROW clearing, staging areas, access roads, landings for storage of equipment and timber, and other types of activities which disturb soil.

The construction stormwater permit requires the preparation of a project specific pollution prevention plan that identifies controls and practices that would be implemented during construction to prevent erosion and sediment from impacting surface waters. In addition, when construction projects are located near (within one mile) certain protected waters, such as trout streams or waters that have been designated as impaired, additional precautions, erosion controls and sediment removal practices would be required.

Temporary impacts to wetlands may occur if they need to be crossed during construction of the transmission line. BMPs, such as scheduling construction when the ground is frozen and use of swamp mats, could be employed to minimize impacts to wetlands. Wetlands impacted during construction would be restored as required by the USACE and WCA.

The most effective means of minimizing impacts to wetlands is to locate structures in a manner that would span all wetlands with structures. However, when spanning wetlands is not possible, structures could be placed within wetland boundaries, causing permanent impacts to them. Wetland impacts due to permanent structure placement would result in approximately 55 square feet of permanent impacts per standard single-pole structure. Temporary impacts would total one acre per span of transmission line. Wetland vegetation would be restored following construction and all necessary Section 404 permits would be obtained from the USACE and would comply with the WCA.

Transmission lines cannot be safely or reliably operated with trees growing under and up into them. Therefore, existing trees must be removed throughout the entire ROW, including forested wetlands. Because of this, forested wetlands within the ROW may undergo a permanent vegetation type change to emergent or shrub/scrub vegetation. In addition, the USACE may require wetland mitigation for conversion of forested wetlands to non-forested wetlands. The required mitigation would be determined based on consultation with the USACE.

See Section 8 for a summary of impacts to water resources within each segment.

7.9 Electronic Device Interference

This section summarizes the potential impacts on electronic communication and similar devices, including radios, televisions, microwave communications, and Global Positioning System (GPS)-based agricultural navigation systems. Medical electronic devices are discussed in Section 7.1.

7.9.1 Radio Interference

Corona is the breakdown and ionization of air within a few centimeters of conductors and line hardware. Corona from transmission line conductors generates electromagnetic "noise." This noise may cause broadband interference at the same frequencies that many communication and media signals are transmitted. This noise can cause interference with the reception of these signals depending on the frequency and strength of the signal. The corona can affect both amplitude modulated (AM) and frequency modulated (FM) radio receivers. AM radio frequency interference typically occurs under a transmission line and dissipates rapidly to either side.

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

- Corona-generated radio frequency noise currents are quite small in the FM broadcast band (88-108 megahertz (MHz)).
- The excellent interference rejection properties inherent in FM radio systems make them virtually immune to amplitude type disturbances.

The steel towers of a transmission line could interfere, or cause signal blocking effects, on two-way mobile radio communication if the tower(s) were directly between the two mobile units. As a person moves away from the transmission line tower, the blocking would decrease as is the case with interference that might be encountered with AM radio communication.

7.9.2 Television

Both digital and satellite television (TV) are expected to have little interference from corona-generated noise. Digital TV broadcast frequencies are high enough that they are relatively immune to corona-generated noise. Satellite TV is transmitted in the Ku band of radio frequencies and is likewise immune to corona-generated noise.

Both digital and satellite TV reception can be impacted by tower placement. That is, the proximity of the towers themselves, rather than any electromagnetic phenomenon, can impact reception. Compared to previously-used analog broadcasts, digital TV reception is somewhat less resistant to multipath reflections. Multipath reflections (shadowing) might be generated from towers in proximity to the receiving antenna. An outdoor antenna may be necessary to solve issues with multipath reflections. Line of sight for satellite TV users could be obstructed by a transmission line structure. Line of sight can usually be restored by moving the consumer satellite dish to a slightly different location.

What are multipath reflections?

Multipath reflections are shadow effects that occur in a televised image when a structure is aligned between the TV receiver and a weak distant signal – sometimes called "ghosting."

7.9.3 Internet and Cellular Phones

Wireless internet and cellular phones use frequencies in the 900 MHz ultra-high frequency (UHF) range. The specific UHF frequency used by a cellular phone would depend on the technology (global system for mobile communications (GSM), 3G, etc.) of the provider. Radio frequencies used for both cellular phones and wireless internet are high enough that the adverse impacts on communications from corona-generated noise near the transmission line would be negligible. Line of sight for wireless internet and cellular phone users could be obstructed by a transmission line structure. However, interference should typically diminish if a person moved a little so that the tower would not be in the direct line of sight.

7.9.4 Microwave Communication

Electromagnetic noise from transmission lines is not an issue for microwave communication corridors; however, the large tower structures (over 130 feet tall) required for this transmission line could obstruct microwave communications.

- Microwave communication corridors can extend as close as 150 feet to the ground.
- Any structure over 100 feet is considered to be a structure of concern for the beam paths.
- Placement of the towers outside the microwave communication corridors eliminates any potential obstruction.

The location of microwave communication towers are provided on the detailed route maps in Appendix A. A microwave beam path analysis for the project cannot be completed until final design, which would be completed only after the route is selected.

7.9.5 GPS-Based Agricultural Navigation Systems

GPS is an electronic navigation system that collects and coordinates data from at least four satellites at any one time. As such, positioning of the four satellites, and signal strength are the key factors that determine accuracy of the GPS. In 2002, the Institute of Electronics and Electrical Engineers (IEEE) conducted a series of experiments to observe if overhead transmission lines interfere with the GPS function. One of the tests utilized a Trimble GPS receiver near a 345 kV line to determine if corona noise and gap discharge could affect the "lock" a receiver had on the satellite constellation above. The results from this experiment by IEEE are as follows:

- Generally, GPS function is very minimally affected by transmission line electromagnetic interference (EMI).
- Interference that is caused could be either due to corona noise or gap discharges.
- Rarely, transmission structures may cause a drop in accuracy due to blocking a view of at least one of the satellites from GPS. However, corona noise and gap discharges do not cause loss of a satellite signal "lock" (IEEE 2002 as cited in Minnkota Power Cooperative, Inc., n.d.).

Based on this research, GPS signals very rarely experience interference from overhead transmission lines. On rare occasions, a transmission line structure may cause a drop in accuracy within a GPS device due to blocking a view to one satellite, but this would only occur if the receiver, tower, and satellite are in a line, which is rare. Typically, if there is any EMI present, proper GPS function is usually restored in minutes (IEEE, 2002 as cited in Minnkota Power Cooperative, Inc., n.d.).

7.9.6 Mitigation

Potential impacts from transmission line corona could be mitigated by design and construction directed at minimizing insulation gaps and sparking that cause corona discharges. Minimizing corona minimizes impacts to radio signals.

If interference from transmission line corona occurs for an AM radio station that is within the station's primary coverage area and that had good reception before the project was built, satisfactory reception could be obtained by appropriate modification of the owner's receiving antenna.

If the steel towers of a transmission line interfere with, or cause signal blocking effects, on two-way mobile radio communication if the tower were directly between the two mobile units, moving either mobile unit so that the tower is not immediately between the two units should restore communications. This would generally require a movement of less than 50 feet by the mobile unit adjacent to a metallic tower.

Digital reception in most cases is more tolerant of noise and somewhat less resistant to multipath reflections (i.e., reflections from structures) than analog broadcasts. Although digital reception is more tolerant of radio frequency noise, it would impact digital television reception if the noise levels or reflections are great enough. In the rare occasion where the construction of the project may cause interference within a television station's primary coverage area, this problem could be corrected for affected viewers; this can usually be corrected with the addition of an outside antenna. If transmission line structures obstruct satellite dishes, the satellite dishes could be moved to a different location.

7.10 Cultural Resources

7.10.1 Overview of Cultural Resources

Cultural resources include archaeological and historic artifacts and features. These resources contribute to the record of human occupation and alteration of the landscape. Archaeological resources can be either historic or prehistoric structural ruins or artifacts, and are typically below ground. Historic resources include extant structures with local or regional cultural and/or architectural significance, such as bridges and buildings. An example is shown in Figure 7.10.1-1, a photo of a wall from the Oxford Mill, a historic mill located within one mile of one of the proposed routes.

This draft environmental impact statement (EIS) does not include discussion of places that have traditional cultural property (TCP) or cultural landscape significance, as no TCPs have been identified thus far, and there are no recognized cultural landscapes within the project area.

The State Historic Preservation Office (SHPO) maintains records of known cultural resources throughout the state. These records are typically generated by surveys tied to urban and rural development and infrastructure projects. Records of previous surveys are maintained by the SHPO and were reviewed during a Class I Literature Search to determine whether identified resources could be avoided. This evaluation was done in consideration with natural resources and existing conditions.

Review of the SHPO records indicates that there are 15 archaeological sites and over 110 historical sites within one mile of the route. There are 14 archaeological sites and over 115 historical sites within one mile of the route. Similar numbers of archaeological and historical sites are within one mile of the various route alternatives considered in this draft EIS. Details on the presence of archaeological and historical sites and their proximity to all route alternatives are provided in Sections 8.1.4.10, 8.2.4.10, and 8.3.4.10.

Cultural resources are typically categorized by type and level of eligibility for listing on the National Register of Historic Places (NRHP). Federal agencies apply a standard of significance

Figure 7.10.1-1 Oxford Mill

Source (Barr photo 2010)

for compliance with federal regulations, typically Section 106 of the National Historic Preservation Act (NHPA) of 1966 (as amended), and is useful when determining sites to avoid. Where sites have not been evaluated for significance or determination of eligibility for listing on the NRHP and may be physically impacted by the project, the applicant has stated that they will coordinate with the SHPO to develop a work plan to address the impact.

For areas under their jurisdiction and within their Area of Potential Effects (APE), U.S. Department of Agricultural Rural Utilities Service (RUS) has already initiated Section 106 consultation and other compliance activities in anticipation of the Section 404 and Section 10 permit application. Additional cultural resources may be identified in the APE as a result of U.S. Army Corps of Engineers (USACE) compliance activities. Any adverse effects to NRHP-eligible or listed properties in the defined APE would be treated through a federal consultation process.

All large-scale construction projects, including new transmission lines, have the potential to pass near or over cultural resources. In some instances, construction and/or operation of the transmission line can damage archaeological artifacts unless they are identified and carefully removed. Transmission lines can also alter the view or character of historic resources, resulting in impacts that, while not physical, can nonetheless diminish the significance and value of those resources.

See the Cultural Resources discussions for each route segment in Section 8. See Appendix G for a complete listing of cultural resources in the project area.

7.10.2 Mitigation

The primary means for mitigating impacts to cultural resources is to avoid them through prudent routing. However, as discussed above, some cultural resources are archaeological and may be located underground. It is difficult to know of these resources in advance and to route around them. Thus, a survey protocol is typically used to guide route engineering and construction, so that unknown cultural resources can be properly assessed and potential impacts mitigated.

The applicant has indicated in their route permit application (RPA), that a survey methodology would be developed in consultation with RUS, USACE, and the SHPO to document cultural resources within the project area. The survey would identify the extent of resources within the routes and, if applicable, provide recommendations regarding NRHP eligibility. During the project engineering phase, the applicant would seek to avoid the resources or minimize impacts by using best management practices (BMPs) developed in coordination with RUS, USACE, Office of Environmental Services (OES), and SHPO. RUS may also invite other parties (particularly Native American Tribes and other state and federal permitting or land management agencies) to assist in development of the avoidance, minimization, or treatment measures.

The applicant would integrate a training, monitoring, and discovery plan into construction bid documents, should previously unknown cultural resources or human remains be inadvertently encountered during construction of the transmission line. The plan would outline the framework for handling such discoveries in an efficient and legally compliant manner. The plan may include the following topics: construction contractor training, construction monitoring by a professional archaeologist in specific locations in the project area, procedures for identification and protection of resources in the field, contact information for parties to address a discovery, and procedures for avoidance and associated tasks in the event of work stoppage in a construction area. With regard to human remains, project-specific procedures would be outlined to ensure that the appropriate authorities are activated in accordance with federal laws, policies, guidelines, and state statutes (Minn. Stat. § 307.08).

7.11 Transportation and Public Services

This section summarizes the project's potential impacts on local roadways, highways, airports and railroads, and describes potential mitigation.

- Roadways: Paralleling roadways helps reduce the need for new right-of-way (ROW) and minimizes the proliferation of new infrastructure corridors. The proposed route alternatives would, in many places, run parallel to township roads, county roads and highways, state highways, and U.S. highways. Roadways can be subject to temporary impacts during construction activities. Roadways may also experience longer term effects where placement of the line affects maintenance, repair, and future expansion activities. The potential for impacts to roadways has been evaluated for three major categories of use:
  - *Traffic Use/Travel: Impacts to the zone associated with traffic traveling on roadways may occur during construction of the line. The placement of transmission poles will avoid any permanent impacts to safe and efficient use of roadways that the line parallels. Possible long term impacts to traffic use and travel are limited to potential impacts to travelers along scenic roadways.*
  - *Maintenance, Repair and Operational activities: If transmission line ROW overlaps with the maintenance, repair and operational activity zones along roadways that the line parallels, transmission poles will need to be placed appropriately to allow for the safe conduct of these activities.*
  - *Future construction activities: Future road expansion and/or realignment in areas where transmission lines parallel the roadway may result in additional costs to the public, as poles placed along the road ROW may need to be moved to allow a safe distance between power poles and the edge of the expanded roadway.*
- Rail corridors: Paralleling railroad corridors offers another opportunity to reduce the need for new ROW. Several route alternatives under consideration run parallel to or cross railroad corridors. If construction is carefully coordinated, the transmission line should not impact rail operations. Operation of the transmission line has the potential to induce electric currents on rails and to create electromagnetic interference with signals and switches. These potential impacts would require mitigation.
- Airports: There are both public and private airports and landing strips located in the project area. Tall high-voltage transmission lines (HVTLs) can conflict with the safe operation of public and private airports and air strips. The Federal Aviation Administration (FAA) and the Minnesota Department of Transportation (DOT) have each established development guidelines on the proximity of tall structures to public use airports. The FAA has also developed guidelines for the proximity of structures to Very-High-Frequency Omni-Directional Range (VOR) navigation systems.

7.11.1 Roadways

Traffic Use/Travel

Temporary Impacts to Transportation

There may be temporary traffic impacts associated with equipment and material delivery and worker transportation during construction and maintenance of the proposed project. In cities along the route, particularly in the constrained portions in downtown areas of certain cities, construction of the transmission line may temporarily impact use of streets. Impacts could result from construction vehicles and safety perimeters temporarily blocking public access to streets and businesses. Access to modify existing substations would be from existing roads and would only cause minor and temporary disruption to traffic. If the transmission line is buried beneath public roadways in certain areas, controlled lane closure would be used to allow continued use of the roadway.

Long Term Compatibility with Traffic Use

Transmission line infrastructure can be located such that its operation does not impede or present a safety hazard to personal travel and distribution of freight. Requirements for clear zones and roadside obstructions vary based on traffic volume, design speed, roadside geometry, radius of horizontal curve, presence of a curb, and presence of urban or rural roads, collectors, arterials, or freeways. Thus, this review provides a basic summary of requirements from state and federal manuals.

For very low-volume local roads, such as township roads, the American Association of State and Highway and Transportation Officials state that, "at locations where a clear recovery area (an area free of hazards along the edge of a road) of two meters (six feet) or more in width can be provided at low cost and with minimum social/environmental impacts, provision of such a clear recovery area should be considered." However, they also state that where constraints make these impractical, clear recovery areas of less than two meters may be used. They also suggest consideration of other factors such as the presence of vehicles wider than 2.6 meters (8.5 feet) such as farm equipment.

The DOT Road Design Manual Part I and Part II, Chapter 4 (4-6(6)-4-6(20)) provides charts to determine clear zone widths based on speeds and side slope type.

There are 11 different tables in the Minnesota manual for determining clear zone widths based on daily traffic, cut or fill slopes, and design speed. In addition, the State of Minnesota provides a formula for adjusting the clear zone on the outside of horizontal curves and a table for increasing clear zone widths when there are curbs greater than four inches. Given the complexity of roadway design, it is not appropriate to generalize about what is considered "safe" in regard to placing transmission line poles adjacent to roadways. The safe zone would have to be continuously evaluated and determined during the design phase.

Impacts to Emergency Services

Any required temporary lane closures on roadways would need to be coordinated with local jurisdictions, to provide for safe access of police, fire, and other rescue vehicles.

Occasionally there is a need for immediate medical transport via helicopter from roadside locations due to accidents and illness. In these situations, rescue helicopters may need to land in the roadside environment. DOT has indicated that an area with a minimum of a 90 foot diameter and two clear approaches separated by an arc of the least 90° is necessary for safe helicopter access to highways. While many helicopters operating in the roadside environment have cutters installed on the aircraft to cut power lines that they encounter, helicopter crashes can occur if power lines become entangled in the helicopter's rotor system or landing gear.

Impacts to Traveler Experience: Scenic Areas and Scenic Byways

Federal law prohibits new utility installations on "highway right-of-way or other lands which are acquired or improved with Federal-aid or direct Federal highway funds and are located within or adjacent to areas of scenic enhancement and natural beauty" with exceptions granted in limited circumstances (23 CFR §645.209). Areas of scenic enhancement, including park and recreation lands (Section 7.12, 8.1.4.12, 8.2.4.12, and 8.3.4.12), wildlife and waterfowl refuges, (Section 7.7, 8.1.4.7, 8.2.4.7, and 8.3.4.7), and historic sites (7.10, 8.1.4.10, 8.2.4.10, and 8.3.4.10) are discussed elsewhere in this document.

All routes cross the Great River Road National Route, US-61 Kellogg (about 2.4 miles south of the intersection on MN 42 and US-61).

In the project area US-61 is designated as the Great River Road National Scenic Byway. This scenic byway parallels the Mississippi River from its source at Lake Itasca in Minnesota to the Gulf of Mexico. All route alternatives in Segment 3 would cross the scenic byway where the route crosses US-61 (Map 8.3-39). One of the route alternatives in this segment would also parallel the scenic byway for approximately 1.3 miles (Map 8.3-39). The Great River Road National Scenic Byway provides opportunities to view scenery and wildlife, as well as providing access to recreational areas along the Mississippi River. Construction of the HVTL could affect the visual aesthetic of travel along the Great River Road National Scenic Byway. Visual simulations of the proposed transmission line structures as they would be seen from the perspective of a traveler along the Great River Road are being prepared and will be submitted for the record.

Maintenance, Repair and Operational Activities

In areas where power line infrastructure parallels roadways, modification of pole placement would be necessary to accommodate maintenance activities and equipment use associated with guardrail and fence installation, vegetation control, ditch cleaning, vehicular accident cleanup, and repair and bridge inspections and to ensure worker safety. The safe zone for these activities would have to be continuously evaluated and determined during the design phase.

In areas where power line ROW overlaps with road ROW, certain roadside structures may be displaced or need to be relocated. The placement of transmission line structures relative to large road signs, light posts, traffic control signals, traffic monitoring cameras, high mast light towers, noise walls, and snow fences would need to be evaluated during detailed design and mitigation strategies would need to be coordinated with DOT or local road authorities at that time.

Future Construction Activities

A variety of potential future construction activities may be impacted by the placement of transmission line infrastructure parallel to road ROW including:

- Widening a roadway by addition of travel lanes or turn lanes, installation of a roundabout or widening of a shoulder area,
- Rebuilding a highway in a way that changes the location or grade of a roadway,
- Addition of an overpass or interchange on a freeway or other highway, and
- Lengthening and/or widening of existing overpasses or other structures.

Two primary issues may arise during future construction activities. First, relocation of utilities may be necessary. When paralleling roadways, the applicant plans to install poles outside public ROW. This is partly for safety reasons, but also to avoid potential liability for the cost of moving the poles if the roadway is expanded in the future. That is, if a utility pole must be relocated to accommodate a roadway expansion and the pole is within the public ROW, the utility is liable for the relocation cost. But if the pole is outside of the public ROW, the public must pay for the relocation. Local governments and DOT have expressed concern about the potential for having to pay the high cost of relocating the poles, should they need to be moved in the future. Potential impacts to Hwy 52 corridor management plans are discussed relative to the proposed route alternatives in Section 8. The applicant identified future transportation facilities and plans in the vicinity of the P route alternative and the A route alternative through consultation with DOT and county public works or planning departments. For route alternatives suggested during scoping, available county roadway expansion plans have been reviewed (Rochester-Olmsted Council of Governments 2010; Goohue County 2004; Dakota County 2004).

Specific areas where road expansions and other road construction activities are planned, including and potential impacts of the proposed routes on future construction, potential impacts to Hwy 52 corridor management plans, are considered in Sections 8.1.4.11, 8.2.4.11, and 8.3.4.11.

Second, power line infrastructure may have implications for construction equipment used to expand, rebuild, or add roadway. Road construction projects often involve the use of large excavators and cranes and extra planning and safety procedures may be necessary to use such equipment near power lines along a road ROW. In addition, equipment used on construction projects would need to be re-fueled at the job site. Proper refueling techniques would need to be followed to mitigate potential fuel ignition caused by a spark discharge, induced by nearby transmission lines.

Mitigation

The primary means of mitigating potential impacts to roadway is through prudent routing and construction activities that take into account the need for safe operation and maintenance of the roadways. Coordination with roadway authorities is key to achieving this mitigation. As part of their route review for the project, the applicant has indicated that they have consulted with DOT and county public works or planning departments regarding new roadways, future expansion plans, and safety requirements. DOT permits would include specific routing and mitigation strategies that the applicant must undertake.

7.11.2 Railroads

Portions of the proposed route alternatives parallel existing railroad corridors and, in several areas, proposed route alternatives would require crossing railroad corridors. When a HVTL is located adjacent to a railroad, the tracks and signals may be subjected to electrical interference from electric and magnetic induction, conductive interference, and capacitive effects. The Minnesota Comprehensive Statewide Freight and Passenger Rail Plan Final Report was consulted in preparation of this draft environmental impact statement (EIS). Initial planning is underway for a possible high speed passenger rail line between the Twin Cities and Rochester. Highway ROWs may serve as a corridor for future electrified high speed passenger rail service. New rail alignments would share similar concerns to those of freight railroads related to electromagnetic interference with signals and switches.

Mitigation

Due to the relatively small number of railroad crossings and the relatively short distance of the proposed routes that would parallel railroads, few impacts are anticipated. Potential electrical interference impacts can be modeled. If this modeling suggests potential impacts, the applicant would need to work with the railroad to design and install mitigating equipment. Because transmission lines often parallel conductive infrastructure (railroads, pipelines), mitigating strategies and equipment are available and feasible.

7.11.3 Airports

Transmission line construction is limited near public airports due to FAA height restrictions, which prohibit transmission line structures above a certain height depending on the distance from the specific airport. Regulatory obstruction standards only apply to those airports that are available for public use and are listed in the FAA airport directory. Private airports are those that are not available to the general public without prior request and approval.

The DOT has established separate zoning areas around airports that restrict use, the most restrictive of which prohibit structures such as HVTLs. The most restrictive safety zones are A and B; Safety Zone A does not allow any buildings or temporary structures, places of public assembly or transmission lines; Safety Zone B does not allow places of public or semipublic assembly (i.e., churches, hospitals, or schools). Permitted land uses in both zones include agricultural uses, cemeteries, and parking lots (Minnesota Rules, Chapter 8800).

Different classes of airports have different characteristics in terms of the physical dimensions of the airport runways, the class size of aircraft capable of landing at an airport and the clearance required allowing safe airplane landing and proper operation of navigation and communication systems. These factors determine the take-off and landing glide slopes necessary for safe flight operation, which in turn determine the setback distance of transmission line structures.

There are two airports within one mile of at least one route alternative, Stanton Airfield and Lake Zumbro Seaplane Base. The Stanton Airfield is classified as a FAA non-primary commercial service, reliever, and general aviation airport. Lake Zumbro Seaplane Base is a private airport. Neither airport requires precision guidance systems for land approach. Guidelines around airports without precision instrument guidance systems for landing approach are generally less restrictive compared to airports with precision instrument guided landing capabilities. For example, airports without precision instrument guidance systems generally have smaller guide slope restrictions compared to larger airports with a high frequency of flight service.

Mitigation

Mitigation strategies to avoid impacts to airports include engineering strategies that would make it possible to use shorter structures in the vicinity of the airport. Alternately, impacts to airports and airstrips can be avoided by choosing a route that is not in close proximity to these types of facilities.

Once the route is selected, the applicant would file all necessary notice requirements with FAA and work with both FAA and DOT to identify final mitigation measures and to ensure compatibility between the transmission lines and air navigation stations and equipment along the selected route. The proximity of the proposed routes to existing public and privately owned / operated airfields has been evaluated in Section 8.

7.12 Recreation

A variety of outdoor recreational opportunities are present with the project area. Some of these opportunities include nature observation, hiking, canoeing, boating, fishing, swimming, biking, hunting, skiing, and snowmobiling. Recreational areas within the project area consist of rivers, lakes and streams, trails, public and private recreation areas, scenic byways, wildlife management areas (WMAs), and scientific natural areas (SNAs).

Section 8 provides an overview of the specific recreation resources located within proximity of each route alternative. The data for the recreational impact analysis was conducted primarily using geographic information system (GIS) data from local, state, and federal agencies.

Impacts on recreational resources may vary depending upon the proximity of the line to the recreational area, the placement of poles within the recreational area, and the sensitivity of the recreational area. Section 8 summarizes the types of impacts that may occur due to transmission line construction for each of the listed recreational resources.

7.12.1 Wildlife Management Areas

WMAs play a large role in Minnesota's outdoor recreation system, as they offer opportunities for hunting and may provide wetland, prairie, and forest wildlife viewing opportunities. WMAs within the project area may be impacted by the placement of poles where routes bisect or run immediately adjacent to these areas and where spanning the WMA is not possible. In these cases, temporary impacts up to one acre of land per pole are anticipated due to construction activities. For each pole placed within a WMA, permanent impacts of 55 square feet are expected. The applicant would need to acquire an easement from the DNR within a WMA if direct impacts are unavoidable. Other WMAs located outside the route may experience visual impacts in areas where the line is located within close enough proximity to the WMA to be seen by visitors. There are three WMAs within the project area, the Woodbury WMA and the Warsaw WMA; which are both located in Segment 1 (Map 8.1-27), and the McCarthy Lake WMA, which is located in Segment 3 (Map 8.3-40).

7.12.2 Scientific Natural Areas

SNAs provide an opportunity for the public to observe and learn about nature. SNAs located near the project area may become visually impacted in areas where the transmission line is close enough to be seen by nature observers. The only SNA located within the project area is the North Fork Zumbro Woods SNA, which is located in Segment 1 (Map 8.1-27).

7.12.3 Richard J. Dorer Memorial Hardwood State Forest

The Richard J. Dorer Memorial Hardwood State Forest (RJD Forest) is located along the majority of the North Rochester Substation to Mississippi River Segment (Map 8.3-40). The RJD Forest covers approximately two million acres of land across seven Minnesota counties. Only 45,000 acres of this land is owned by the State of Minnesota. The Minnesota Department of Natural Resources (DNR) has listed the RJD Forest as one of the best places in the state for birdwatching, motorized trail riding, horseback riding, and mountain biking (DNR 2010a); the RJD Forest is also used for camping, picnicking, hiking, and fishing. The Snake Creek Management Unit, which is part of the RJD Forest, has several miles of designated trails for hiking, cross country skiing, motorcycles, ATVs, and snowmobiles. The Snake Creek Management Unit also offers opportunities for camping and fishing.

7.12.4 Trails

The Douglas State Trail is a 12.5-mile, multiple use state trail that was developed on an abandoned railroad grade (Figure 7.12-1). One treadway is paved for bicyclists, hikers, in-line skaters, and skiers; the other is a natural surface for horseback riders and snowmobilers (DNR 2010b). The Douglas State Trail runs through Segment 2, between Pine Island and Rochester (Map 8.2-23).

In addition to the Douglas State Trail, Minnesota has a large network of state and county trails for hiking and cycling and a 20,000-mile snowmobile trail system across the state. At various points, route alternatives may run parallel to and in some cases may cross trails used for recreation including snowmobiling, cycling, hiking, and equestrian riding. Project impacts to trail systems may range from temporary construction impacts on trails immediately adjacent to the line to visual impacts for visitors where the line is visible from the trail.

7.12.5 Parks (City, County, State, and Federal)

Minnesota's park system provides recreational opportunities including fishing, boating, swimming, and camping. No state or federal parks are located in the project area. A few county and city parks are located within the vicinity of the project area. Lake Byllesby Regional Park and West Bllesby Park, which are managed by Dakota County and Lake Byllesby County Park, which is managed by Goodhue County, are all located within Segment 1 (Map 8.1-27). Parks located immediately adjacent to the selected route may experience impacts ranging from temporary construction impacts on parks immediately adjacent to the line to visual impacts for visitors in areas where the line is visible from the parks.

Figure 7.12-1 The Douglas Trail

Source (Barr Photo)

7.12.6 Water Bodies

Both the P and A route alternatives would cross the Cannon River in the northern portion of Segment 1. The Cannon River is designated by the DNR as a recreational river in this area (Map 8.1-24). Recreational rivers have bordering lands that have been developed for a variety of agricultural or other land uses but are also readily accessible by existing roads and railroads for recreational activities such as canoeing, boating, fishing, and swimming (DNR 2010c). Approximately 1.5 miles east of where the P route alternatives cross the Cannon River in Segment 1, the Cannon River is classified as a scenic river (Map 8.1-24).

Many of the route alternatives in Segment 3 would cross Lake Zumbro (Figure 7.12-2) and all of the route alternatives in this segment would cross the Zumbro River. Lake Zumbro and the Zumbro River provide a variety of recreational opportunities such as boating, fishing, and swimming. Lake Zumbro is one of the only lakes within the area that allows boats with gas engines (Rochester Angler 2010).

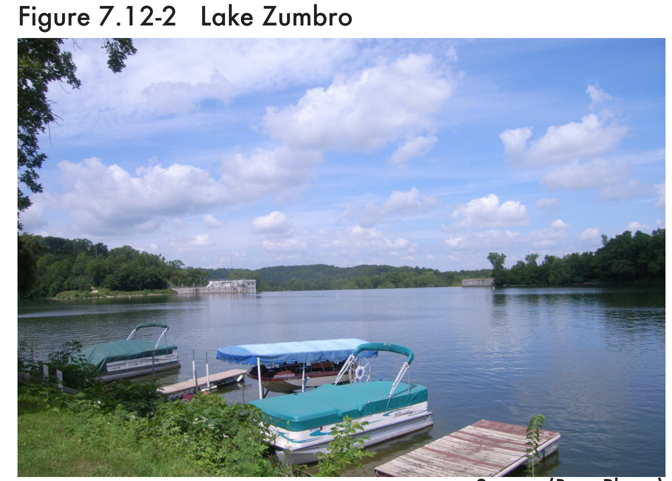
Many of the route alternatives in Segment 2 would cross branches of the Zumbro River. Recreational opportunities within these branches include canoeing and fishing.

Impacts to these water bodies would primarily consist of changes to the existing viewshed.

7.12.7 Scenic Byways

US-61 is designated as the Great River Road National Scenic Byway. This scenic byway parallels the Mississippi River from its source at Lake Itasca in Minnesota to the Gulf of Mexico. The Great River Road National Scenic Byway provides opportunities to view scenery and wildlife, as well as provide access to recreational areas along the Mississippi River. All route alternatives in Segment 3 would cross the scenic byway where the route crosses US-61 (Map 8.3-40). One of the route alternatives in this segment would also parallel the scenic byway for approximately 1.3 miles (Map 8.3-40). See Section 7.11 for information on potential impacts to Great River Road.

Figure 7.12-2 Lake Zumbro



Source (Barr Photo)

7.12.8 Mississippi River and Upper Mississippi River National Wildlife and Fish Refuge

All of the route alternatives lead to a crossing of the Mississippi River. Recreational opportunities in the Mississippi River include boating, fishing, and wildlife viewing. All of the route alternatives would cross the Upper Mississippi River National Wildlife and Fish Refuge (Map 8.3-36). Recreational opportunities within the wildlife refuge include boating, hunting, hiking, swimming, fishing, and wildlife viewing. No public access points or developed recreational facilities are located within one mile of the project area. Potential impacts to the Upper Mississippi River National Wildlife and Fish Refuge are discussed in Section 7.7.

7.12.9 Private Recreational Facilities

Some private recreational facilities are located within the vicinity of the project area; two of the larger private recreational facilities include the Cannon Golf Club and Steeplechase Ski and Snowboard Resort. The Cannon Golf Club is located in Segment 1, north of the Cannon River and west of the P route alternatives (Map 8.1-27). Steeplechase is located in Segment 3, west of the Zumbro River and just south of route alternative A1 (Map 8.3-40). Potential impacts to these resources are discussed in Section 8.

7.12.10 Mitigation

The primary means of mitigating impacts to recreational resources is to avoid these resources through prudent routing. Impacts could be minimized by spanning resources that cannot be avoided. Indirect impacts may result from changing the viewshed of recreational areas. These impacts can be minimized by choosing route alternatives that intersect the resource(s) at an angle, as opposed to paralleling the resource. See Section 8 for a summary of impacts to recreational resources within each segment.

7.13 Air Quality

The air quality in Minnesota is generally good. Minnesota and the Minnesota Pollution Control Agency (PCA) have had success in decreasing the emissions and concentrations of many traditional air pollutants since the Clean Air Act was enacted in 1970. Emissions from large facilities have decreased dramatically, resulting in lower concentrations of many pollutants including fine particles, ozone and air toxics. According to the 2009 legislative report, Air Quality in Minnesota: Emerging Trends (PCA 2009) air quality in Minnesota has been improving for most pollutants since 2002.

All of Minnesota is currently in attainment for one-hour and eight-hour CO National Ambient Air Quality Standards (NAAQS), annual N_2O NAAQS, ozone NAAQS, PM_{10} and $PM_{2.5}$ NAAQS, and annual and 24-hour SO2 NAAQS (PCA 2010).

Currently the only area designated as a non-attainment area in Minnesota is the area around Gopher Resources in Eagan, Minnesota (Dakota County) which currently exceeds the October, 2008 standard for lead (0.15 µm/m3). A State Implementation Plan (SIP) demonstrating attainment will be due to EPA in June 2013 and new ambient monitors will be required around certain sources of lead emissions, in order to determine if those areas are in attainment.

Attainment status in Minnesota will be re-evaluated relative to new standards recently promulgated for N_2O (one-hour standard of 100 parts per billion (ppb)) and SO2 (1-hour standard of 75 ppb) and upcoming revisions to standards including the 8-hour ozone standard, the 24-hour $PM_{2.5}$ standard.

Air emissions associated with the operation of a high-voltage transmission line (HVTL) are limited. Emissions directly linked to the operation of the line are caused by the "corona effect" which results in the production of a small amount of ozone and oxides of nitrogen. One other potential source of air emissions associated with operation is the release of sulfur hexafluoride (SF_6), an inorganic, colorless, odorless, non-toxic, and non-flammable gas that is used in substation transformers and other electrical equipment. Operation and maintenance of the line will require periodic aerial and ground inspections. Vehicles used to conduct the inspections would generate exhaust emissions resulting in minor, short term effects on air quality.

Short term air emissions will also be generated during the construction phase of the project. Operation of heavy duty construction equipment will generate exhaust emissions from fuel combustion as well as potential fugitive dust emissions due to travel on unpaved roads and excavation for transmission structure foundations.

7.13.1 Ozone and Nitrogen Oxides

Corona consists of the breakdown or ionization of air within a few centimeters or less immediately surrounding conductors and can produce ozone and oxides of nitrogen in the air surrounding the conductor.

Studies designed to monitor the production of ozone under transmission lines have generally been unable to detect any increase due to the transmission line facility. The operation of the proposed transmission lines would not create any potential for the concentrations of these pollutants to exceed the nearby (ambient) air standards. Modeled worst-case concentrations of ozone within the zone immediately surrounding the conductor are compared to state and national ambient air quality standards in Table 7.13.1-1. Modeled concentrations for NO2 are not available, as the available Electric Power Research Institute (EPRI) models do not include a module for NO_2.

Table 7.13.1-1 Ozone: comparison of modeled concentrations to state and national air quality standards

	Ozone	Averaging Period
National	0.075 ppm	8-hour
State	0.08 ppm	8-hour
Foul weather 345 kV/345 kV (both circuits in service) transmission line	0.0007*	N/A
Foul weather 161 kV transmission line	0.0002*	N/A

*Calculations obtained from the Software Applications for the EPRI AC Transmission Line Reference Book, 200kV and Above, Third Edition

What causes corona?

Corona is caused when there is some imperfection on a conductor such as a sharp edge, a protrusion on hardware, a scratch on the conductor, or if moisture collects on the line. This causes breakdown or ionization of air within a few centimeters or less immediately surrounding conductors and can produce ozone and oxides of nitrogen in the air surrounding the conductor.

What is ozone?

Ozone is a very reactive form of oxygen molecules and combines readily with other elements and compounds in the atmosphere. Because of its reactivity, ozone is relatively short-lived.

7.13.2 SF_6 and PFC use in Electricity Transmission and Distribution

The proposed project includes the construction of one new substation (North Rochester Substation), the expansion of one existing substation (Northern Hills Substation), and modifications to a substation constructed as part of the CapX 2020 Brookings to Hampton 345 kilovolt (kV) project (Hampton Substation) under all route alternatives considered.

SF_6 is used in the electrical industry as an insulator for high-voltage equipment that transmits and distributes electricity. The gas has been employed by the electric power industry in the United States since the 1950s because of its effectiveness in managing the high voltages carried between generating stations and customer load centers.

SF_6 Emissions and Management

The applicant would contain SF_6 within a closed system. However, fugitive emissions of SF_6 can escape from gas-insulated substations and switch gear through seals, particularly in older equipment. Current technologies require less SF_6 at lower pressures than older technologies, resulting in a more secure system. The gas can also be released during equipment manufacturing, installation, servicing, and disposal.

Several methods can be used to minimize SF_6 emissions from electric power systems, including improvements in the leak rate of new equipment, refurbishing of older equipment, and the use of more efficient operation and maintenance techniques. The U.S. Environmental Protection Agency's (USEPA) SF_6 Emission Reduction Partnership for Electric Power Systems focuses on reducing the nation's SF_6 emissions through cost-effective operational improvements and equipment upgrades.

What is SF_6?

SF_6 is used in the electrical industry as an insulator for high-voltage equipment that trans¬mits and distributes electricity. It has been used by the electric power industry in the United States since the 1950s because it is effective in managing the high volt¬ages carried between generating stations and customer load centers.

What is the potential global warming impact of SF_6?

SF_6 has a heat-trapping capability 23,900 times greater than CO_2. SF_6 emissions can stay in the atmosphere, trapping heat for 3,200 years. Because of its strong heat-trapping potential and long lifetime, one pound of SF_6 has the same global warming impact as 11 tons of CO_2.

Potential Mitigation

For the proposed project, potential impacts from SF_6 emissions are expected to be limited and are not expected to vary by route. The substation equipment that would be installed as part of the project includes state of the art circuit breakers designed to minimize the risk of SF_6. The applicant currently participates in USEPA SF_6 Emission Reduction Partnership for Electric Power Systems. Program participants are active partners in applying strategies to minimize SF_6 emissions, including:

- **Leak detection and repair.** The USEPA estimates that if consistently and aggressively implemented in the United States, SF_6 emissions could be reduced by 20 percent.
- **Use of recycling equipment.** The USEPA estimates that SF_6 recycling could eliminate 10 percent of total related emissions from the U.S. electric industry.
- **Employee education/training**

7.13.3 Construction Emissions

As noted above, construction of the transmission line would result in minor short-term air quality impacts from the operation of construction equipment and from fugitive dust created during construction activities. Exhaust emissions from construction equipment including greenhouse gases, oxides of nitrogen, volatile organic compounds, CO and PM10 are expected to be limited and temporary. As a result local impacts on air quality are expected to be minor and construction is not expected to have any long-term or regionally significant impacts on air quality.

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